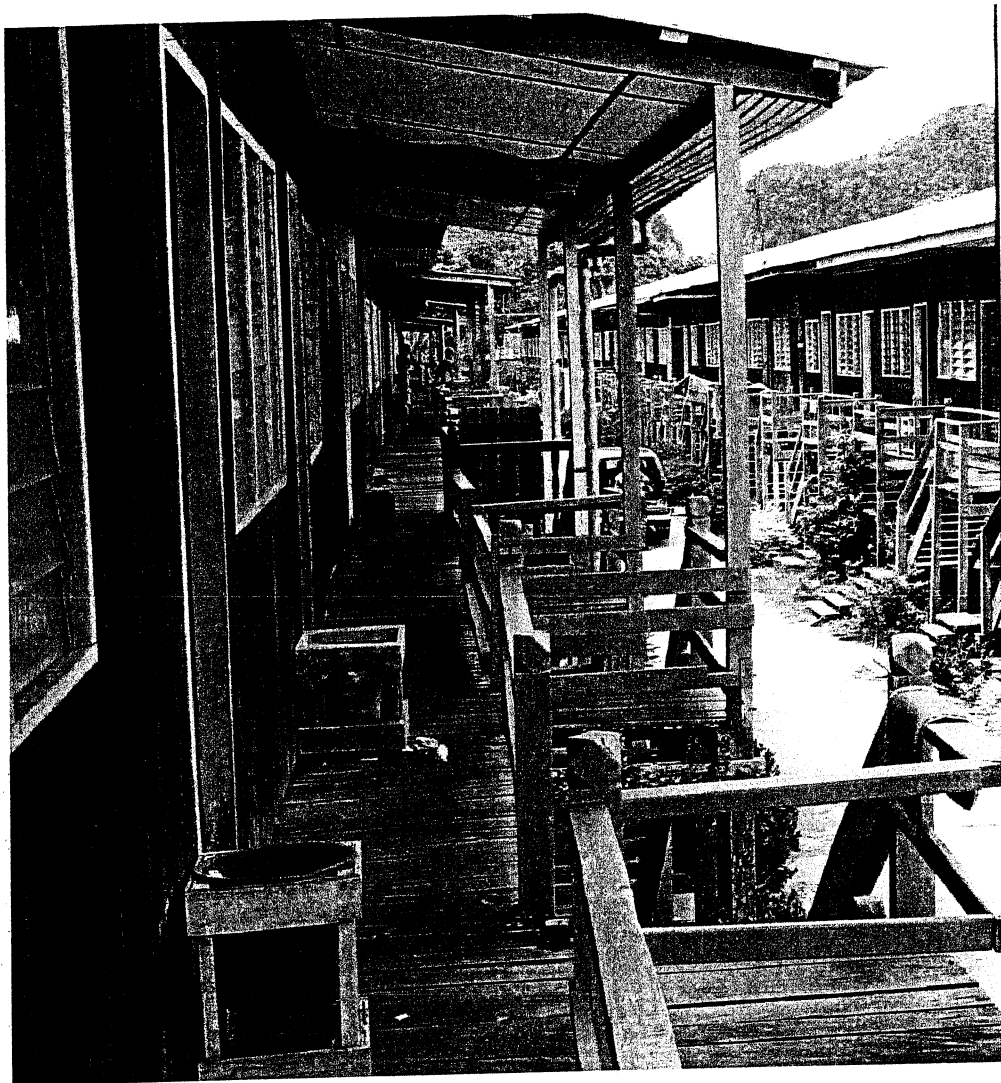


## Bird's Nest Collection in Niah Cave



By:

Stud. Comm. Anna Agger

Stud. Polit Majken Hansen

Stud. Scient Nicolas Beyer

# BIRD'S NEST COLLECTION IN THE NIAH CAVE

BY

Stud. Comm. Anna Agger  
Stud. Polit. Majken Hansen  
Stud. Scient. Nicolas Beyer

SLUSE Interdisciplinary Joint Basic Course 2000-2001.

Niah River Catchment,  
Sarawak, Malaysia

SUBMISSION: 18 DECEMBER 2000

SUPERVISORS: OLE MERTZ & QUENTIN GAUSSET

THIS REPORT IS DEDICATED TO CHUI PING SWEE, MAY YOU REST IN PEACE

ACKNOWLEDGEMENTS

WE WISH TO THANK THE FOLLOWING PEOPLE FOR THEIR HELP IN DOING THIS REPORT:

OLE MERTZ

QUENTIN GAUSSET

WELYNE GAUSSET

CORINA YONG SIAW PING

LEE KOK KWANG

ROSALIND WONG TAI MING

SHIRLEY LYN AK MICHAEL GIAS

HASMAWATI BTE SAPAWI

WEE BOON SIONG

JONA KARENI

MISTER CHEW

RUMAH CHANG

TANJUNG BELIPAT

NIAH NATIONAL PARK STAFF

## TABLE OF CONTENTS

|  |    |
|--|----|
| ABSTRACT .....   | 4  |
| 1. INTRODUCTION .....                                  | 4  |
| 1.1 Study area.....                                    | 5  |
| 2. METHODS .....                                       | 6  |
| 2.1 Methods used and selection of informants.....      | 6  |
| 2.2 Limitations and ethical considerations.....        | 7  |
| 2.3 Verification.....                                  | 7  |
| 2.4 Degree of achieved information.....                | 8  |
| 3. SWIFTLETS IN NIAH .....                             | 9  |
| 3.1 Taxonomy.....                                      | 9  |
| 3.2 Echolocation .....                                 | 11 |
| 3.3 Feeding.....                                       | 12 |
| 3.4 Breeding.....                                      | 12 |
| 3.5 Counting the birds.....                            | 13 |
| 3.2 Limiting factors.....                              | 15 |
| 4. THE BIRD'S NEST COLLECTION .....                    | 18 |
| 4.1 The interest groups.....                           | 18 |
| 4.1.1 The Penan .....                                  | 18 |
| 4.1.2 The Iban.....                                    | 18 |
| 4.1.3 The middlemen.....                               | 19 |
| 4.1.4 The Bird's Nest Association.....                 | 19 |
| 4.1.5 The authorities .....                            | 20 |
| 4.2 The history of the bird's nest extraction .....    | 21 |
| 4.2.1 The closures.....                                | 21 |
| 4.2.2 The local management.....                        | 23 |
| 4.3 The harvest.....                                   | 23 |
| 4.3.1 Harvest technique .....                          | 23 |
| 4.3.2 Terms of payment .....                           | 24 |
| 4.3.3 Quantity of harvest.....                         | 25 |
| 4.4 Overexploitation of the resource.....              | 25 |
| 4.4.1 Tragedy of the Commons and the Clark Model ..... | 25 |
| 4.5 Open access and the price/cost-ratio .....         | 26 |
| 5. DISCUSSION AND CONCLUSION .....                     | 28 |
| 5.1 Deforestation.....                                 | 28 |
| 5.2 Declining yield from sustained population .....    | 28 |
| 5.3 Conclusion.....                                    | 29 |
| REFERENCES.....  | 30 |

## ***Abstract***

*The population of Black-nest Swiftlets in the Niah area has decreased from 1.7 million in 1935 to only a little more than 200,000 in 1997. This report analyses the causes of this decrease. A multitude of factors are affecting the Black-nest Swiftlets negatively, as the conversion of forest to agricultural land and oil palm plantations in the 70's and 80's and an intensification of the bird's nest collection. Since 1985 a lot of different interests groups have been involved in the bird's nests industry, which have made it very difficult for the original Penan owners to regulate the harvesting of nests, in the 90's the intensification of birds nest extraction reached a level where no nestlings were allowed to fledge if their nests were within reach of the collectors.*

## **1. Introduction**

On Borneo lies a large system of caves known as the Niah Cave. The cave is a part of the Subis limestone formation in Miri, consisting of many caves, of which Niah Cave is the largest with approximately 600 crevices (lubangs) in the cave ceiling<sup>1</sup>. The Cave is the home for several species of bats, insects and different ground animals, and most important of all, the Black-nest Swiftlet, who builds its nests here. The bat and Swiftlet dropping cover the cave floor and have through centuries developed into a thick layer of guano that is collected and sold as fertiliser.

Edible nests from swiftlets have been a part of the Chinese pharmacy since the T'ang Dynasty (618-907)<sup>2</sup>; it is the main ingredient in the famous and very expensive Bird's Nest Soup, which is believed to be healthy for the skin and give one a good long life. Since the 1930's, where the first bird count was made, there has been a tremendous decrease in the population of Black-nest Swiftlets in the Niah area. In 1935 the estimated number of birds was 1.7 millions falling to an estimated number of only a little more than 200,000 in 1997<sup>3</sup>.

The decrease in the population of swiftlets has been so drastic that it can be questioned, whether there is a future for the collection of bird's nests in the Niah Cave. The collection is regulated by two official harvest periods, but there is a strong indication that the nests are harvested throughout the year. The nestlings are not allowed to fledge from the nest, and as a consequence the birds are not able to reproduce. We find it important to

---

<sup>1</sup> Sim, 1997.

<sup>2</sup> Lim, 1999.

<sup>3</sup> Sim, 1997.

investigate what has caused this decrease in order to understand what can be done to make the harvesting of bird's nests sustainable. Therefore our research question is:

*What has caused the decrease in the population of Black-nest Swiftlets in The Niah Cave?*

## **1.1 Study area**

The cave and the surrounding forest were made into a national park after Tom Harrison's archaeological discovery the oldest Asian prehistoric human remains 1974<sup>4</sup>. Huge tracts of oil palm plantations of which a large part was established around 1975 dominate the area<sup>5</sup>. Close to the Niah Cave, about 30 minutes walk through the national park is the Iban<sup>6</sup> village of Rumah Chang located. This was our base-camp during the field course and where we did most of our research.

Rumah Chang consists of 105 households distributed between two longhouses. The road leading to Rumah Chang is very poor and thus the village is very isolated with approximately one hour by four-wheel drive to the nearest town, Batu Niah. The Penan<sup>7</sup> village of Tanjung Belipat, the main city of Batu Niah, and the old Niah, now called Sepupok, are also important habitations in the bird's nest business and we conducted interviews there as well.

The report is arranged in the following way: In chapter 2 the methodology used will be presented together with limitations, hypothesis and biases. Chapter 3 will give an overview and introduction to the swiftlets. Chapter 4 gives a presentation of the various interest groups, a history of the bird's nest collection together with a description of various aspects of the harvest, such as techniques, terms of payment and quantity. Furthermore the theory Tragedy of the Commons and an elaboration of it, the Clark Model, is presented. Chapter 5 consists of a discussion and conclusion.

---

<sup>4</sup> Sim, 1997.

<sup>5</sup> Leh et. al., 1995.

<sup>6</sup> Iban is one of the indigenous groups in Borneo.

<sup>7</sup> Penan is another indigenous group.

## **2. Methods**

### **2.1 Methods used and selection of informants**

The largest part of our data is collected through semi-structured interviews. Semi-structured means that we, as a starting point, ask open-ended questions, which allows the informant to choose what he finds relevant to talk about within a wide subject area. After an open-ended question we typically asked the informants to elaborate on a part of the asked. We have tried to conduct the interviews as close to a conversation as possible despite the interpretation, because we believe that it is the easiest way to the information.

We have tried to interview people from all the different interest groups. We have interviewed: Iban and Penan bird's nest collectors (climbers), guards, team leaders, Chinese middlemen, Penan and Chinese owners, Penan and Chinese members of the Bird's Nest Committee, Park Warden and Penan rangers from the Niah National Park, a bird's nest processor, guano collectors, a guano guard, and tourists visited the cave and Rumah Chang and Bird Count Researcher Mrs. Sim from Sarawak Museum.

During the field trip we have made several observations, which has provided us with information about the standard of living in Rumah Chang and Tanjung Belipat (in combination with interviews), daily life and farming. We have made several forest walks with informants as guides, spend one night in the cave together with informants and experienced the life in the cave night and day. It was interesting to see how they guarded and harvested the nests at night, how much noise the human activities made and how it affected the birds. We tried to test the method used by the bird counters, and we observed the guano collection and guarding. In the village of Rumah Chang we saw them make handicraft and observed the tourism in the caves.

Furthermore we made a participatory mapping of the ownership and use of the cave with one of the informants. We have made guano samples together with our Malaysian counterparts in order to estimate the amount of guano produced. In the same way we helped the Malaysian group to estimate the quantity of garbage in the caves. Through group-interviews we made a wildlife inventory in the past and present. The result of this was that the biodiversity has been decimated substantially due to deforestation and hunting pressure.

## 2.2 Limitations and ethical considerations

The guano collection is an important part of the exploitation of the cave and is a large part of our Malaysian counterparts project. Furthermore there is a tourist programme in Rumah Chang, the home-stay programme, which is also studied by our Malaysian counterparts. In the beginning we considered all three aspects but as well, but as we proceeded, we found it too big a task to cover all three at an equal level and at the same time get an in-depth understanding of the problems at hand. We found that there was a very weak link between the three subgroups and that it would be difficult to write a coherent report. So, in this report we will only discuss these subjects when relevant for the discussion on swiftlets.

During our interviews we found that much of the problems surrounding the birds nest collection, is characterised by illegal activities, such as illegal harvesting and illegal subcontracts. This has caused us some concern analysing the interviews because it could cause our informants problems if published in a report. We do not want to use information that can cause our informants any harm, and therefore we have excluded some information from the text. We have covered the origin of the information, wherever possible, and have in that way been able to use it.

## 2.3 Verification

A large part of the SLUSE-program is aimed at training collaboration between disciplines, universities (methods and traditions) and cultural boundaries. This naturally leads to communication problems in all parts of the process of preparing and making the field study. We have tried to see this as a learning experience.

Another challenge was the language. We had one interpreter of Iban and Bahasa Malaysia<sup>8</sup> with whom we spoke English. One of the Malaysian students that spoke Iban and Mandarin translated for us as well<sup>9</sup> but not all the time, because we split up in order to make more than one interview at the time. Many of our informants spoke a little English, but most of them preferred to answer in their own language. In other words, we conducted all our interviews in a language that was, if not the informants mother tongue, then a language very well known by the informant. On one hand it was an advantage that we did not have to worry about misunderstandings caused by a weak common language, but we did, on the other hand, have misunderstandings between the interpreter and us. Some times he misunderstood our questions and gave a wrong interpretation, and some times the informant misunderstood his interpretation, and this, of course, went the other way around as well. We know this because

---

<sup>8</sup> Bahasa Malaysia is the primary language in Malaysia and is taught in the schools.

<sup>9</sup> Almost all informants spoke Bahasa Malaysia and this meant that the Malaysian group could manage without the use of interpreters.



the Malaysian student who spoke Iban, sometimes attended our interviews, and afterwards informed us of the misunderstandings. By comparing our notes with hers, we often found discrepancies. We tried to do this as much as possible, but due to the time constraint it was not possible for the whole group to be present at all interviews.

Many of the interviews were conducted in a public area in the villages and there were often five to ten people sitting around listening in on the interviews. Sometimes they remarked on the informant's answers and this probably affected the interviews, but it is our impression that it has not had a major significance.

All these aspects are biases to our research, but it is difficult to measure them and exactly say what or how much has been affected. To verify our data we can to some extent say that all information that has been confirmed by more than one person must have some truth in it, even though the interpreter can have misunderstood the question every time, or the informants from the same villages could have co-ordinated their answers.

The informal interviews or conversations in the host families gave us a lot of good background knowledge. This was the main source of information on their children's occupation and insight in their daily livelihood. In these situations we often got information on the local gossip, which sometimes provided us with background knowledge on our informants. This was mostly done by the Malaysian students and, not to mention, our interpreter, who was good at socialising and had a good understanding of our project.

## **2.4 Degree of achieved information**

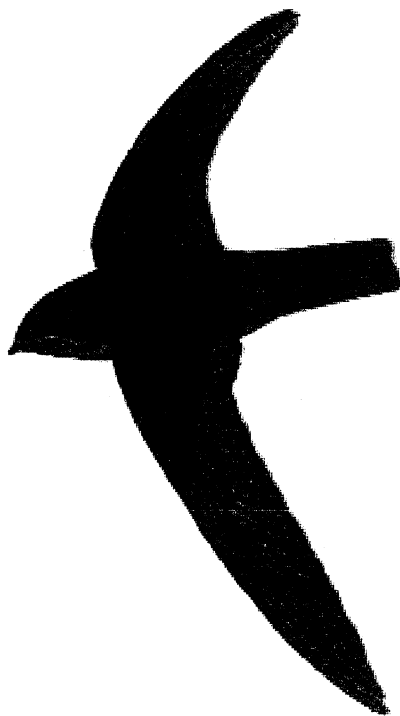
Before going to Borneo it was our expectation that the data collection would be made difficult due to the sensitivity of the information concerning the illegal activities our informants were involved in. But the informants were surprisingly un-candid; apparently the only information they did not want to share with us was the exact quantity they were harvesting. When asked about this they made absolutely sure by lots of laughs that we knew they were not telling the truth.

Unfortunately we did not have the ability to interview any officials from a higher level during our stay in Kuching. This could have been relevant as well as there were some questions we did not ask, which we can see now could have been beneficial. But in the broad lines we have achieved what we wanted.

### 3. Swiftlets in Niah<sup>10</sup>

#### 3.1 Taxonomy.<sup>11</sup>

Swiftlets (tribe *Collocalini*) are any of 26-30 species of cave dwelling birds belonging to the swift family, Apodidae, found from Southeast Asia and Malaysia through the Philippines, and eastward to the South Pacific. Swiftlets are 9 to 15 cm long and pale brown or grey above (sometimes with blue or green shine) and lighter on the rump and underparts.<sup>12</sup>



**Figure 1**

**Picture of Black-nest Swiftlet.<sup>13</sup>**

---

<sup>10</sup> Del Hoyo et. al., 1999. Unless otherwise stated.

<sup>11</sup> A way of grouping organisms to reflect evolutionary relationships, it is a hierarchal system where each member of a group is closer related to the other members of the group than it is to any species outside the group, if we take the wolf as an example it will be: species *lupus*, genus *Canis* with dogs, family Canidae with dogs and foxes, order Carnivora with all carnivores e.g. tigers, class Mammalia with all mammals e.g. zebras, phylum Chordata with all vertebrates e.g. blackbirds and kingdom Animalia with all animals e.g. honeybees. Mayr et Ashlock 1991.

<sup>12</sup> <http://www.britannica.com>

There are five kinds of swiftlets in Borneo:

- Waterfall Swift (*Hydrchous gigas*)
- Glossy Swiftlet (*Collocalia esculenta*)
- Mossy-nest Swiftlet (*Aerodramus salangana*)
- Black-nest Swiftlet (*Aerodramus maximus*)
- Edible-nest Swiftlet (*Aerodramus fuciphagus*)

The first two do not produce edible nests, and it is all but the first species that live in the Niah cave. The Edible-nest Swiftlets have only recently turned up in Niah and there are only a few pairs. All members in the genus *Aerodramus* produce edible nests, but only Black-nest swiftlets are commercially important in the Niah area so this is the species we will concentrate on. The genus *Aerodramus* is often merged into *Collocalia*, but recent studies of cytochrome b sequences strongly suggest that they should be kept apart, even though analysis of ectoparasitic lice points in a different direction. The closest relatives to the Swifts are hummingbirds (Trochilidae).

Class AVES (birds)

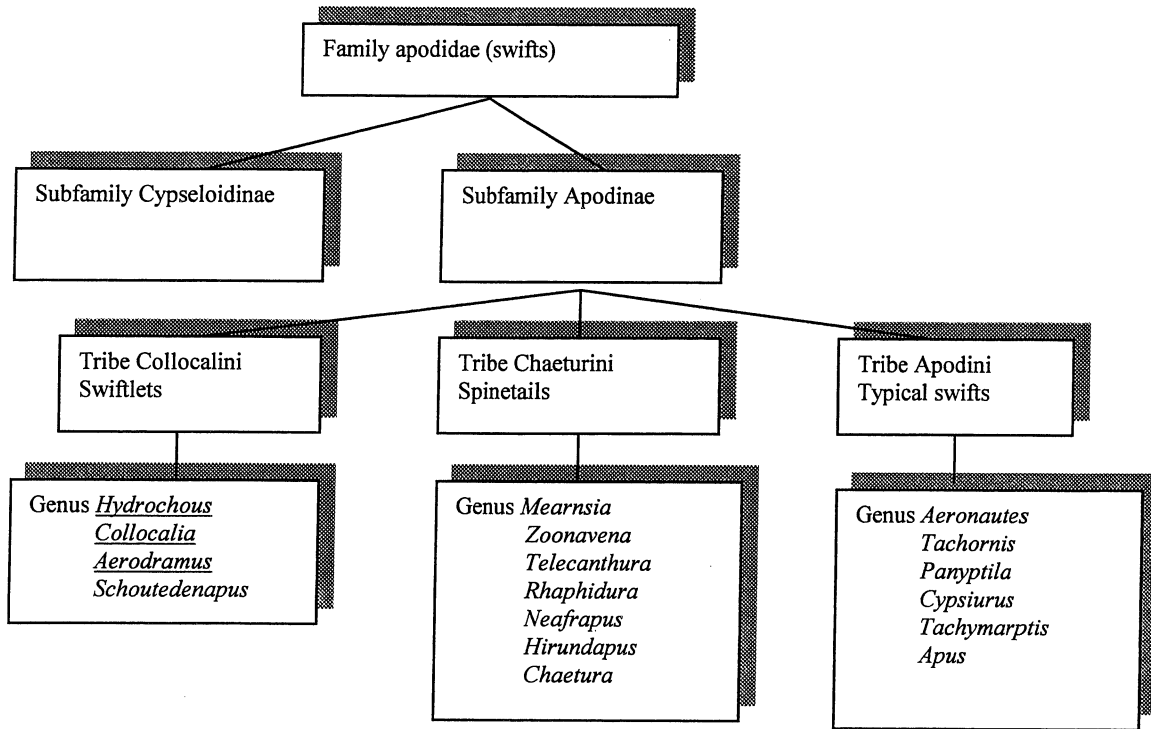
Order APODIFORMES (hummingbirds and swifts)

Suborder APODI (swifts and tree swifts)

---

<sup>13</sup> MacKinnon et Phillips, 1993.

Figure 2 Subdivision of the Apodidae



The three *Aerodramus* species are practically indistinguishable unless you have the specimen in your hand, and thus we will not go into the physical differences. Swifts are equipped with very small legs, and all but one species of swifts are incapable of perching due to their short legs. If a swift lands on flat ground it is unable to get airborne again as it is not possible for it to make the jump other birds use to break free of the ground. Apus is derived from the Greek a-pous and means without foot. Their former name Machrochires means “with large hands” refers to their comparatively large wings. Their wings are specialized for high-speed flight, and swifts have been measured at speeds above 100 km/h for horizontal flight. They have a large gape, that makes it easy for them to catch prey in the air; the beak is comparatively small as it is mainly used for preening and making the nest. Insect capture is facilitated by an acute sense of sight in all Swiftlets.

### 3.2 Echolocation

Three of the four species of Swiftlets that lives in the Niah caves (Black-nest Swiftlets, Mossy Swiftlets and Edible-nest Swiftlets) are capable of echolocation making them able to navigate in total darkness, and thus inhabiting inner cave areas. The last species the Glossy Swiftlet nests in the entrance areas where there is a bit of natural light. The sound the Swiftlets use for echolocation is within the human range of hearing, and is

likened to the sound made when you run your fingers across the teeth of a comb. The echolocation ability is not used to locate and catch insects.

### 3.3 Feeding

Swifts feed solely on insects and spiders, but stinging insects are generally avoided. The Glossy Swiftlets are capable of feeding very close to the forest canopy and takes prey that are not available to the other species, like the Black-nest Swiftlets which generally feed well above the canopy.

When feeding in mixed flocks the swiftlets tend to divide the air column between them in the way that the larger species stay in the higher strata, thus avoiding inter-specific competition. As swiftlets are incapable of taking off from a horizontal surface they have to drink from lakes or rivers while flying.

### 3.4 Breeding

Swifts are monogamous, and pair for extended periods. They are sexually mature at one year of age and have a life expectancy of 15 years. Most of the members of the subfamily Apodinae use saliva as a binding material when they construct their nests. The Edible-nest Swiftlets have taken this to extremes by building their nests solely of salivary glue. The salivary glue, which largely is composed of glycoproteins, is produced in two sublingual<sup>14</sup> glands that are greatly enlarged in the nest-building season.

All swiftlets breed in caves, they build their nest on walls and ceilings to avoid predators, and they preferably return to the hole where they were born to build their own nest. The nest of the Black-nest Swiftlet is six to seven centimetres in basal width bracket-shaped and made of saliva mixed with feathers from any part of the plumage, the concentration of which depends on the season (moulting).

**Table 1 Incubation and fledging data for three species of swiftlets<sup>15</sup>.**

| Species              | Clutch size | Incubation Period | Fledging Period |
|----------------------|-------------|-------------------|-----------------|
| Black-nest Swiftlets | 1           | 25 ± 1 days       | 46 ± 1 days     |
| White-nest Swiftlets | 2           | 24 ± 1 days       | 45 ± 1 days     |
| Glossy Swiftlets     | 2           | 22 ± 2 days       | 41 ± 3 days     |

<sup>14</sup> Placed below the tongue.

<sup>15</sup> Lim, 2000 p. 86.

Black-nest swiftlets usually lay one egg, and it takes approximately four months from nest-building starts to the fledgling leaves the nest (see table 1).<sup>16</sup> The Black-nest Swiftlets can breed all year, but three times a year the majority of the birds breed<sup>17</sup>. During night pairs of adult Black-nest Swiftlets have been seen sharing the nest. In Niah Cave the nests are build in one of the crevices of which today 20% has been abandoned.<sup>18</sup>

### 3.5 Counting the birds

To asses the sustainable harvesting rate it is important to know how many birds there are in the cave, but counting the birds is very difficult. They nest in the darkest places and move about all day and when entering and leaving the caves they use any of the more than 300 openings. Officials from the Forest Department count birds entering and leaving the main entrances. We tried to make a count following the methods used by the authorities to judge how reliable the official counts are. The evaluation showed us that the official figures must be uncertain as they are based on a number of assumptions:

- On average the swiftlets make two flights a day, no investigation of the accuracy of this assumption has been made.
- The brooding birds are not taken into consideration. The brooding bird stays in the nest all day.
- They only count at the five busiest entrance holes.
- They only count for one day at each entrance, not taking fluctuations into account (some days a lot of birds stay in the cave for no apparent reason).
- The birds leaving the caves before sunrise are not counted.
- The weather is not taken into consideration (the birds do not fly out in bad weather).
- Some birds hunt in the entrances, and may therefore be counted multiple times.
- When there are to many birds leaving the cave, a one second count is made, this number is then multiplied with 60 to get the number of birds leaving per minute, we tried this and found it too be very inaccurate, we ask ourselves how you can count for one second.
- They assume that 70% of the birds leaving are Black-nest Swiftlets.

But since the counts are made in the same way every time, they should give a relatively good impression of the fluctuations in the populations. Since the four species using the cave cannot be distinguished in the air, it requires that the fluctuations in the populations are synchronized; according to the nest-collectors this is not the case. The people in charge of the bird counts has in all counts since 1987 assumed that 70% of the observed

---

<sup>16</sup> Leh, 1995.

<sup>17</sup> Tompkins, 1999.

<sup>18</sup> Sim, 1997.

birds are Black-nest Swiftlets<sup>19</sup> and that is in our opinion very optimistic and highly unlikely since the Black-nest Swiftlets are the only ones almost without progeny.

| <b>Year of study</b> | <b>Researcher</b>                      | <b>Estimated population of Black-nest Swiftlets</b> | <b>Percentage change</b> |
|----------------------|--|---|--------------------------|
| 1935                 | E. Banks                               | 1.7 million   | -                        |
| 1958                 | Lord Medway                            | 1.5 million   | -12%                     |
| 1962                 | Lord Medway                            | 1.5 million   | 0%                       |
| 1974                 | Hunting Technical Services Consultants | 1.3 million   | -13%                     |
| 1987                 | Leh et. al                             | 0.45-0.61 million                                   | -65%                     |
| 1993                 | Leh et al                              | 0.14-0.18 million                                   | -68%                     |
| 1995 April           | Leh et al                              | 0.232-0.235 million                                 | +66%                     |
| 1995 November        | Leh et al                              | 0.200-0.215 million                                 | -9-14%                   |
| 1997 May             | Sim et al.                             | 0.202-0.331   | +1-54%                   |
| 1997 October         | Sim et al.                             | 0.202-0.321   | -0-3%                    |

**Table 2** Estimated population of Black-nest Swiftlets in Niah Cave<sup>20</sup>.

<sup>19</sup> Sim, 1997.

<sup>20</sup> Sim, 1997, p. 90.

Since 1935 several estimates of the number of Black-nest Swiftlet in Niah Cave have been made and an overview of these are listed in table 2. It is worth noting the rapid decrease after 1974, which is the same year large-scale oil palm plantations, began operation in the area surrounding Niah National Park<sup>21</sup>. Unfortunately the figures for the latest bird-count, done by Sim while we were in Sarawak, is not available yet, but according to our informants there has been a decrease in yield between 1997 and today of at least 30%.

### 3.2 Limiting factors

There are several possible explanations why the number of Black-nest Swiftlets has decreased. In the following we will try to give a brief outline of the probable causes. Brown/green algae is spreading on the cave walls from the mouth inwards and thus making them unsuitable for nest building. The algae reach as far in as 200 meters (a third of the cave). Brown/green algae need light to grow so there is a natural limit to how far it can spread. It has not been possible to find out what causes the algae to spread or when it first appeared.

- The number of Glossy and Mossy Swiftlets is increasing and they are taking over areas previously occupied by Black-nest Swiftlets. It is difficult to judge whether the Glossy and Mossy swiftlets are actively displacing the Black-nest Swiftlets or if they are colonizing areas no longer used by the Black-nest Swiftlets due to their decreasing numbers.<sup>22</sup>
- During the last 50 years there has been a very large conversion of natural forest to oil-palm plantations and farming, which also must have affected the amount of food available to the birds.<sup>23</sup>
- The birds might also be threatened by the use of pesticides in the surrounding area, DDT residues have been found in chicks. The use of pesticides might also limit the amount of prey available to the birds.<sup>24</sup>
- Predators are, due to the swiftlets high speed and manoeuvrability limited to <sup>Man</sup>falcons, hawks and eagles that catch them in the air, but this has probably only a limited effect on the swiftlet populations. Inter-

---

<sup>21</sup> Leh et. al., 1995.

<sup>22</sup> Leh, 1995.

<sup>23</sup> Leh, 1996.

<sup>24</sup> Sim, 1997.



specific competition is supposedly of minor importance as they are con-specific throughout much of their distribution range.<sup>25</sup>

- All the human activities in the cave might influence the livelihood of the birds. They are constantly disturbed, which stress them and force them to spend energy otherwise conserved. Considering the cave's remote situation half an hours walk from the nearest road, it is remarkably busy, there is tourists, people collecting guano (Penan everyday and Iban's from Rumah Chang on Tuesdays), nest collectors a couple of days a month often at night and a lot of 24 hours watchmen to guard the nests. So there is a constant noise (the guards purposely makes a lot of noise to show thieves they are awake) that might disturb the birds. From the time we spent in the cave it is our impression that the use of powerful flashlights also had an unsettling effect on the birds, the birds kept vocalizing all night, and the guard we stayed with, when we stayed in the cave over night, told us that years ago the birds fell silent a few hours after sunset. The people using the cave thought that the smoke from cooking done by the guards was disturbing the swiftlets.

Of course harvesting of nests also have a disturbing effect especially if this is done more often than every fourth month. This is the time it takes from the onset of nest-building, to the nestling is ready to leave the nest. In Niah harvesting is performed about once a month, hence none of the birds who have made the nests have viable offspring. If all the nests in the cave are harvested this way, the birds will go extinct within the lifetime of a bird (15 years). Not all nests are harvested though; some of them are situated in inaccessible places.<sup>26</sup>

On our stay in Niah National Park we encountered stranded swiftlets on four different occasions, we tried to help them get airborne and feed them, but they were all too weak and died within a short time. It might have been a coincidence, but the number of birds found in this way indicates that something is wrong.

In Indonesia farming of Edible-nest Swiftlets is practised in large scale and this might be an alternative to the exploitation in Niah. Farming of swiftlets is done in pretty much the same way as bee keeping just with a regular house, renovated to suit the birds needs, functioning as a hive. The birds has an urge to return to where they were reared, so if they are brought up in the house, by Glossy Swiftlet foster parents they will return to

---

<sup>25</sup> Sim, 1997.

<sup>26</sup> Sim, 1997.

breed with a member of their own species and produce their valuable nests. It has not been successfully done with Black-nest Swiftlets, but the nests of Edible-nest Swiftlets fetch a higher price so why bother.<sup>27</sup>

---

<sup>27</sup> Leh et al., 1995.

## **4. The Bird's Nest Collection**

In this chapter the various interest groups who are involved in the bird's nest collection will be presented, the history of the extraction shows the interest groups interact and finally it will be analysed how this interaction leads to an overexploitation of the natural resource.

### **4.1 The interest groups**

The interest groups involved are the Penan, the Iban, the middlemen, the Bird's Nest Association and the authorities. There are other groups as well, as for example the Bugis<sup>28</sup>, but these are not relevant for the understanding of the scenario as they are minor actors, only acting as guards and collectors.

#### **4.1.1 The Penan**

The Penan mainly live in the village of Tanjung Belipat, or in the nearby town of Batu Niah, and are the sole holders of The Native Customary Rights to the Niah Caves. The Penan has converted to Islam, and live in detached houses, considered as Malays. The village of Tanjung Belipat consists of 176 households characterised by an unequal income distribution. Not everyone in the Tanjung Belipat is involved in bird's nest collection, and these people are mainly dependent on the low-yielding guano collection, as a source of income. Most of the households have paddy subsistence farming, but some also have a few cash crops, mainly fruits.

Individual Penan own the right to the holes in the Niah Cave. There are 106 registered owners with a grant to one or more holes in the cave. This means that they own an area on the cave ceiling where there are (or were) a reasonable potential for bird's nests, a good hole. There are areas in the caves, which are not owned by anyone because there are almost no nests. Furthermore there are about 20 unregistered owners<sup>29</sup>. The Penan used to be the only bird's nest collectors in the Niah caves, but now most of them lease the right to harvest their holes to Chinese middlemen or to Iban. A few have sold their grants to the Chinese in Batu Niah in order to get "easy" money to, among other things, pay debt, even though this is illegal.

#### **4.1.2 The Iban**

Another indigenous group is the Iban from Rumah Chang. Most of the Iban are Christian, but a few are still retaining their traditional religion. 75% of the men are engaged in bird's nest collection as harvesters and

---

<sup>28</sup> Group of Indonesian Immigrants.

guards. They supply their income with paddy subsistence farming, and cash crops, such as pepper, oil palms, fruits, rubber, and coconut. 22 of the 105 households also participate in a home-stay programme, but it is still too new to be considered as a reliable source of income for the village. One gets the impression that the Iban are very open for new income opportunities. They are not as poor as we had expected; the sons, and sometimes also the daughters, are sent to universities. Every household we visited had one or more stereos (several even had three), television and a four-wheel drive or a motorcycle. They generally had savings account, but they did not want to disclose the balance. Migrant work is very common, both in the oil palm industry and off shore on oil platforms.

#### **4.1.3 The middlemen**

The group of middlemen mainly consists of Chinese. A few of these have, as mentioned, bought grants to the holes from the Penan and the rest of them are leasing the rights. The middlemen usually hire Iban, Bugis or Penan workers as harvesters and guards or sub-lease the right to them.

There are about ten middlemen, who are in total control of the market<sup>30</sup>. Furthermore there are middlemen without a license, illegal middlemen, who buy and sell nests. It is difficult to get an accurate figure of the size of the illegal market, but several respondents stated that it is the same size or even bigger than, the legal market. The middlemen are powerful business men, who, besides being involved in the buying and selling of bird's nests, typically are engaged in other income generating activities, such as oil palm plantations, bird's nest processing, and are owners of shops and restaurant.

#### **4.1.4 The Bird's Nest Association**

The Bird's Nest Association dates back to the British colonial time, but it was not formally registered until 9<sup>th</sup> of September 1997. The Association is responsible for the administration of the cave and is managing the harvest. It consists of owners (the Chinese owners can be a member) or Penan who is going to inherit an ownership, but they invite people from all the different interest groups to join their meetings. The Association decides when and how long the harvesting season is and has in the past stopped or prolonged the season, like in 1972 when the season was extended from two to two and a half months due to the lack of workforce among the collectors<sup>31</sup>. According to the Association the official harvest time is every May and November, which means that it is only

---

<sup>29</sup> In 1908 when the registration was made, the owners had to travel to Baram to do the registration. Some did not had the ability to travel, but are still considered as legally owners. The Bird's Nest Association is now working to get these people a grant to their property.

<sup>30</sup> From interviews with one Iban respondent and a Chinese middleman.

<sup>31</sup> Cranbrook, 1984.

legal to harvest in these two months<sup>32</sup> and the role of the committee is then to issue licenses to the harvesters. The Association is in co-operation with an official from Forest Department responsible for the harvest being weighted and registered. 2% of the harvest is then paid to the Bird's Nest Association as a tax on each harvest.

An elected committee, which consists of 15 members with representatives from the members, heirs and the government, runs the Association, and a chairman and a secretary, manage it. The committee is working closely together with the government, who is represented by officials from the Forest Department, scientists from Sarawak Museum and a protector, who is a minister at state level, in managing the harvesting of bird's nests. The committee is having one annual meeting at the end of the year. Furthermore there are four meetings during the year without the presence of the government officials, and in case of problems or discrepancies the committee can have ad-hoc meetings also. This could be because of conflicts about borderlines, license contracts or theft, where the committee acts as a mediator.

Moreover the Association is working on getting a grant to the owners who does not have one. Secondly, the Committee wants to be the distributor of nests in order to control the price. Thirdly the has Committee made a foundation based on the taxes, with the purpose of buying back the holes, which has been sold. It has as a purpose to protect the Penan rights though gaining control of the whole chain of harvest and sale, of bird's nests.

#### **4.1.5 The authorities**

The authorities responsible for the enforcement of the regulation of the bird's nest collection is the Forest Department and their law instrument is The Wild Life Protection Ordinance of 1998. The part of the ordinance, regarding bird's nest collection, consists of 16 paragraphs and contains information mainly on licensing procedures. The Ordinance is formulated in broad terms and does not specify anything about quantity and frequency of the harvest. It is generally very weakly formulated, because the administration of the cave is the responsibility of the holders of the Native Customary Rights, through the Bird's Nest Association. Who is trying, through a lawyer, to address the problem of weak and ineffective laws.

The various different interest groups in the bird's nests business draws a complex picture that has its roots in the history of the extraction.

---

<sup>32</sup> In the following harvest outside May and November is referred to as illegal harvesting, while harvest without a license or a grant is referred to as stealing of nests (stealing can of course take place both in the legal and in the illegal harvest period).

## 4.2 The history of the bird's nest extraction

The Penan has presumably been bird nest collectors' since the early 1800, but archaeological findings suggests that there have been harvesting activity as far back as the T'ang dynasty from 618 - 907<sup>33</sup>. In the beginning, up till the 1960's, only the Penan harvested the nests and shipped them to Singapore and other harbours. There were not many people involved in the collection. In the late 1970's the Earl of Cranbrook recorded that there were only seven men harvesting of which one was ill and no longer active<sup>34</sup>. This was probably the reason why the Iban became involved in the bird's nest collection in the late 1970's. Back then, the bird nest was not as valuable as today and there were no serious problems with thefts. When it was harvesting season the climbers and collectors stayed in the Traders Cave, a smaller cave on the way to the main entrance to the Niah Caves, in order not to disturb the birds. The buyers came here to weigh and by nests from the collectors.

In 1978 the harvest period was 60 days twice a year, the Birds Nest Committee monitored this<sup>35</sup>. Today the harvest period is 30-days, in May and November, in order to stop the decline in the population, which had been going downwards for at least two-five decades<sup>36</sup>.

The value of the nests increased in the 1980's, and the Chinese saw the profit in working as middlemen overbidding the present buyers. The price had maybe been to low, because it drastically soared during the last part of the 1980's, when the Chinese opened the marked. After the increase in value, the Chinese buyers employed workers among the local people and Indonesian immigrants, the Bugis. During this time the thefts of nests increased following the increase in value. But the caves are very difficult to protect from thefts, because it is impossible to lock all entrances to the caves, there are too many, and the collectors are often the ones stealing. So, the solution was that the harvesters and guards moved from the Traders Cave into the harvesting areas in the Niah Caves, to enable the guards to watch the nests 24 hours a day.

### 4.2.1 The closures

The cave was closed in 1989-1991 and in 1993-1996 due to the rapid decline in the population of Swiftlets<sup>37</sup>. During the closures the government stationed guards from Police Field Force and Forestry Enforcement Officials in the caves main entrances. Many of the informants claimed that, despite this enforcement, there were

---

<sup>33</sup> Lim, 2000.

<sup>34</sup> Cranbrook, 1984.

<sup>35</sup> Cranbrook, 1984.

<sup>36</sup> Lim, 2000.

<sup>37</sup> Lim, 2000.

a lot of people running around in the caves harvesting. The guards tried to catch the intruders, but the caves have three levels with a web of small tunnels connecting the many different holes, that made it easy to escape. The many entrances to the caves, forced the authorities to station guards on top of the caves, but as one of our informants said, “*we could always get inside*”. Furthermore the guards would only go into the caves if they heard noise from inside.

The two closures of the caves was in a way an opening for a more intense and profit based rationale. The government needed approval of the closure from the Penan because of the Native Customary Right. The Penan owners agreed on the closure and did, according to our interviews with the Birds Nest Committee, not harvest during those periods, even though this took away their income for first two and later three years. They agreed on the closure, according to the same source, because they could see that the birds where drastically declining and that there was an incentive for them, in getting the bird population up to a higher level. Whether they harvested or not can be subject to discussion, because other informants stated that the Penan was as active during the closure as any of the other interest groups.

So, when the closure supposedly stopped the harvest, the people from outside *and* inside began stealing nests, even their own nests, otherwise somebody else would steal them, they argued. The guards captured some of the intruders but they were not convicted, because they were stealing from their own holes or holes they had leased the right to, and was only convicted for trespassing. In other words they were stealing from themselves. The result of the closure was, when they opened the caves in 1991, that there were no nests left and the population of birds had decreased even further, according to our informants.

The Chinese middlemen became more powerful as more Penan owners began to lease their holes to them. But the Chinese middlemen neither owns the natural resource, nor do they feel responsible for it, as the Penan did to some extent, a Chinese middleman said: “*If the birds are really threatened by the harvest the authorities will do something about it*”. The Bird’s Nest Committee had, and still has, rules that say that you are not allowed to harvest nests with eggs or nestlings or small nests, but these rules are not followed. So, the Committee does not have the ability or will to enforce their rules, maybe because the people sitting in the Committee profits from the illegal harvest.

#### **4.2.2 The local management**

The Bird's Nest Committee used to enforce the rules by, for example, prohibiting a collector, who had stolen nests from another, to harvest the next season or fined him. Now they do not have the same power, partly because the value of the nests enhances the motivation to steal, and partly, because there are many non-locals working in the business, who do not have any attachment to the community. As one informant said: "*The old ways of the Committee can not deal with new things*". But whether the Bird's Nest Association really made the collectors follow the rules in the past can be subject to discussion, while for example Lord Medway reports that in 1950 the bird nest collector's harvested nests where almost all of them had eggs or nestlings in them<sup>38</sup>. So, in a sense the Bird's Nest Association are the only interests group, besides the government, which has some sort of rules that regulates the harvest, incorporated in their thinking.

#### **4.3 The harvest**

Iban or Penan workers, who is sub-leasing the right from Chinese middlemen, who lease the right from a Penan owner, typically conduct the harvest as shown in Figure 1. This is the general picture, but there are other constellations, for example the Penan harvesting them selves, lease to Iban, Bugis etc. In this part it will be described how the harvest is performed, the terms of payment to the middlemen and the quantity of the harvest.

##### **4.3.1 Harvest technique**

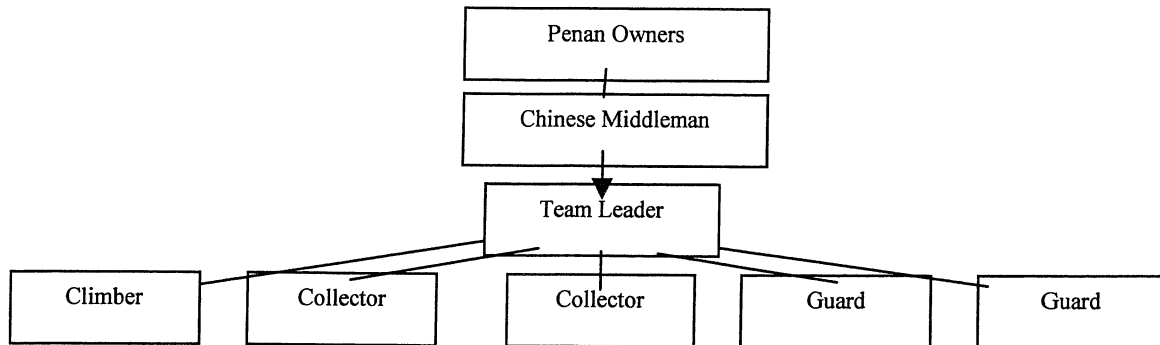
The Iban workers usually work in teams of four to nine men. There is a division of the labour, so that some are climbing, some are collecting from the ground, and some are hired as guards. Furthermore every team has a team leader, who monitors the team and who is responsible for the connection to the middleman. This team leader often leads several teams. The man with the greatest number of teams in Rh. Chang has 13 teams.

---

<sup>38</sup> Meadway,



**Figur 1** An example of the relationship between owner, middleman and workers.



This is simplification, the Chinese middlemen normally leases from several owners and has typically many teams, The team leader is sometimes the climber and the climbers and collectors sometimes work as guards as well.

The most common way of harvesting is to use scaffolding made of bamboo to reach the nests in the ceiling of the caves, which are up to 100 metres above the ground. Inside the Caves it is necessary at all times to use flashlights in order to see the nests. A stick or a line is then used to chuck the nests down, where they are collected. Bird's nest collection is a dangerous job; the nests are as mentioned placed high above the ground, the darkness makes it difficult to move around the very slippery ground due to the guano. There is approximately one person every year that dies from a fall in the Caves and it is becoming more normal to use safety lines where it is possible<sup>39</sup>.

#### **4.3.2 Terms of payment**

The Chinese middleman pays the Penan owners an annual rental for the right to the hole. The license fee to The Bird's Nest Association is 100 RM for leasing and 50 RM for sub-leasing paid once a year. One middleman paid RM 100.000-150.000 for the lease of 80 holes, RM 1.250-1.875 a hole/year. The middleman then hires workers who pay him two amounts after each harvest, a fixed as well as a variable amount. The workers pay a fixed rental, around RM 600+ depending on the hole, for the rights to one hole. This is deducted from the harvest, the variable amount, and then the harvest is divided into 1/3 to the middleman and 2/3 to the workers. This is shared between the men in the team, but with the constraint that they are committed to sell it all to the middleman, who then pays a price around 10% lower than the marked price. Some of our informants stated that they always hid some of the harvest from the middleman and sold it on the black market. It cannot be a large

amount because the middleman usually knows approximately how big the harvest is. Some of our informants, who are former collectors, stopped because the harvest in recent years has been too small to pay the costs of the rental and guards.

### **4.3.3 Quantity of harvest**

According to Sim (1997), a scientist from Sarawak Museum, the quantity of the harvest in November 1997 was 324 kg. The year after, the Bird's Nest Association's records of the harvest, say that the quantity was 263,2 kilogram. According to an official from the Niah National Park, who is weighting the nests in collaboration with the Bird's Nest Association, the quantity in November 1999 was 137,85 kilogram. These are the official numbers, which, compared to the information we got from the harvesters and officials, is much too low. According to our information, it is only about 1/3 of the total harvest that is weighted. Furthermore it is our clear understanding that most of the collectors are harvesting every month or nearly every month, which as mentioned is illegal. This means, in order to get the total harvest per month, that we need to multiply the official harvest by three, this number can then be multiplied by 10, which is the average number of harvests a year if we do not count every month, to get the total quantity. This gives us a total harvest of more than 4 tonnes in 1999. This is of course a rough estimate, but it gives us an idea of the total harvest.

Due to the great demand for nests, most of the collector's harvest all nests every month, which is the so-called cave cleaning, even though this is illegal. The illegal nests obtain a higher price than the legal ones, often up to 30% higher. Since there is nearly no control of the caves, it is easy, and without any particular risk for the harvesters, to take the nests outside the official harvesting season.

## **4.4 Overexploitation of the resource**

In the following section we will present the theory of Tragedy of the Commons and the Clark Model and relate it to how the bird's nest is subject to overexploitation.

### **4.4.1 Tragedy of the Commons and the Clark Model**

Tragedy of the Commons refers to a very common phenomenon, described by Hardin in 1968<sup>40</sup>. The commons are the resource itself, which everybody have open access to, either because it is publicly owned or because there are no well-defined property rights. Overexploitation of the commons arises because the private cost of

---

<sup>39</sup> Interview with the Bird's Nest Committee.

<sup>40</sup> Hardin, 1968 p. 1243 - 8.

using the resource being less than its social cost<sup>41</sup>. That means that when there is free access to the resource, and the consumption of the resource is rivalling<sup>42</sup>, everybody has incentive to maximise the benefits from the resource before any other person does; that is to reap as much profit out of it as possible, which will lead to overexploitation of the resource<sup>43</sup>. The lack of management institutions to meet the resource scarcity and ensure a sustainable extraction is the main cause of the degradation<sup>44</sup>. A good example of such an open-access resource is a common fishing ground. Tragedy of the Commons has been criticized from various sites, because it is not universal. But since it suites our situation very well, we have chosen to use it anyhow, as it works.

The Clark model is an elaboration of Tragedy of the Commons and it sets up the causes leading to human-coursed degradation and extinction of wild life. The Clark model explains the degradation and extinction from the following three factors<sup>45</sup>:

- Open access to the resource
- High relative price to cost of harvested resource
- Slow relative growth rate of resource

A combination of these three factors is sufficient to create a degradation of the resource. The open access case, with the absence of management institutions to restrict and supervise the aggregate exploitation, is as mentioned, a very important explanation of degradation, but it is not the only one. The price of the resource being high relatively to the cost of exploiting it, and a relatively slow growth rate of the resource, leads to a prospect that the resource will be degraded. The latter two conditions are closely related; that is as long as the price of the resource is high and the cost of harvesting it is low, it creates incentives for continued harvesting. Continued harvesting leads to a slower growth rate of the resource, which makes the resource even scarcer. This in turn makes the price of the resource soar even more. The result is a vicious circle of resource degradation.

#### **4.5 Open access and the price/cost-ratio**

We mentioned above that the factors leading to resource degradation was open access to the resource and a high price/cost-ratio. One could state that the open-access case is not applicable here, because there are well-defined

---

<sup>41</sup> Bardhan et. Al., 1999, s. 170.

<sup>42</sup> Rivalling means that A's consumption of the resource diminishes B's ability to consume it.

<sup>43</sup> Hanley et. al., 1997, s. 37.

<sup>44</sup> UNEP, 1996, s. 11.

<sup>45</sup> UNEP, 1996, s. 56.

property rights owned by the Penan. That is to some extent right, but since most of the Penan have leased their rights, and hence a lot of different actors are involved in this industry now, the property rights are not that well defined or enforced anymore. The local customary management of the Penan have been weakened, because it is no longer possible to exclude “non-members” from benefiting of harvesting nests in the caves, and thereby control the resource. Moreover the Bird’s Nest Association is weak as an institution, due to the Chinese middlemen’s power and the Association does not have the capacity to regain the control. Furthermore is the Committee not functioning effectively because it is not capable of adjusting to the many different actors that has come into the business and does not take action towards enforcing its own rules. When we asked the question: *“Why do you harvest every month, when it is illegal and there is a possibility that the birds will become extinct as a cause of it?”* the most common answer (or actually the only answer) we received was: *“Because everybody else does and everybody steals”* indicating that the situation is very much like Tragedy of the Commons with *de facto* open access to the resource.

The price incentive for overexploitation is indeed in place in the Niah case of bird’s nest collection. During the 1980s the purchasing price of nests from the point of view of the middlemen soared from around 23 RM per kilo to the present value ranging from 800 RM to 1700 RM per kilo depending on the quality<sup>46</sup>. At the same time the costs of harvesting remains very low, as mentioned above. The chances of being arrested because of illegal harvesting or stealing of nests are also very low, which means that the price of risk since there are nearly no enforcement of the regulation, the opportunity costs covering being away from the farm on harvesting days and the danger risk of climbing the high bamboo staging are also low compared to the yield. Furthermore the harvesters have minor expenditures on harvesting tools. There are no transportation costs, because the middlemen come to the village to pick up the nests. Furthermore the price rises about four times once the nests are processed<sup>47</sup>. With such a large profit potential it is no wonder that the resource is being overexploited.

---

<sup>46</sup> Sim, 1997 and interview with harvesters and middlemen.

<sup>47</sup> Lim, 1999.

## **5. Discussion and Conclusion**

### **5.1 Deforestation**

In the 20 years between 1974 and 1993 something happened that made the swiftlet population crash. According to table 2, 89% percent of the population disappeared in the period and the decrease started before the intensification of bird's nest harvesting around 1985. The causes of the decline is probably to be found in the limiting factors outlined in chapter 3, of these the conversion of forest to other uses stands out as the prime suspect. Since the oil palms do not belong to the natural Borneo flora, the native fauna, and especially the insects, cannot utilize the resource. When a foreign organism is introduced like the oil palm in Borneo, there are two possible scenarios more likely than any other: either the oil palm does not have any defence against the local fauna or the local fauna has no way of penetrating the oil palms defences. In the first case the oil palm will perish unless the insects are combated with pesticides. In the second case the insects will not be able to live by/from the oil palm. In both cases the oil palm would not be home to very many insects. But even if the crop in question was native, a monoculture will never support as many insects as the same area in a mixed dipterocarp rain forest can. The beginning of large-scale oil palm plantation operations in the area happened at about the same time as the swiftlet population started to decrease, it seems very unlikely that the synchronicity of these two events is purely coincidental. The pesticides used in the agriculture and plantations might also have been a contributing factor in the decimation number of swiftlets.

### **5.2 Declining yield from sustained population**

When the prices of bird's nests soared in 1985 the collection was rejuvenated and from that time on all accessible nests have been harvested as often as possible, and as a consequence no birds are fledged in the accessible areas. Therefore we were quite puzzled by the apparent stabilization of the population of swiftlets between 1993 and 1997 at the same time as the collectors were complaining about continuous declining yields of up to 70%. Under the assumption that the figures are fairly accurate, we have reached the conclusion that the explanation for the discrepancy between them, must be due to an increase in the number of birds breeding in inaccessible places at the same time as there is a decrease in the birds breeding where their nests can be reached. This explanation is in absolute accord with the fact that the birds try to return to where they were hatched when they are going to breed.

The management of the natural resource by the Penan has not succeeded in preventing the decline in bird population, and it can be questioned whether they are able to turn this development. The Bird's Nest Association is not well functioning

### **5.3 Conclusion**

It has been the objective of this report to answer the question:

*What has caused the decrease in the population of Black-nest Swiftlets in The Niah Cave?*

We conclude that the two main causes for the decline in swiftlet population are:

- Forest conversion to farmland and oil palm plantations in the 70's and 80's has decimated the amount of insects available to the swiftlets.
- Over-harvesting caused by de facto open access to the resource, which the people with legal rights to harvest feel forced to reap before anyone else. As long as the law is not enforced it is very unlikely that the present situation will change before the birds has been decimated to a degree where harvesting is no longer profitable.

## References

References marked with a \* is background literature and is not referred to in the text.

- Bardhan, P. & Udry, C. (1999): "Development Microeconomics", Oxford University press, New York, USA.
- \*Brookfield, H., Potter, L. & Byron, Y. (1995): "In Place of the Forest. Environmental and Socio-economic Transformation in Borneo and the Eastern Malay Peninsula". United Nations University Press, 1995.
- \*Cleary, M. & Shaw, B. (1994): "Ethnicity, Development and the New Economic Policy: The Experience Malaysia". Pacific Viewpoint 35(1) p. 83 - 106, 1994.
- Cranbrook, Earl of. (1984): "Report on the Birds' Nest Industri in the Baram District and at Niah, Sarawak". Sarawak Museum Journal XXXIII (54) p. 145-170, 1984.
- \*Compendium to the SLUSE Interdisciplinary Joint Basic Course on Natural Resource Management 2000-01.
- Del Hoyo, J. Elliot, A. Sargatal, J. (1999): Handbook of the birds of the world. Vol. 5 Lynx Edicions Barcelona, 1999.
- Hanley, N., Shogren, J. F. & White, B. (1997): "Environmental Economics in Theory and Practice", TJ Press Ltd, Bristol, England
- \*Keng, N., Hails, C. J. & Sigurdsson, J. B. (1991): "Nest Construction and Egg-Laying in Edible Nest-Swiftlets *Aerodramus SPP* and the Implications for Harvesting". Ibis, British Ornithologists Union, Tring, 133: (2) p. 170 – 177, Apr. 1991.
- \*King, V. C. (1993): "Politik Pembangunan: the Political Ecology of Rainforest Exploitation and Development in Sarawak, East Malaysia". Global Ecology and Biogeography Letters, 3: p. 235 – 244, 1993.
- "Laws of Sarawak". Chapter 27, National Parks and Nature Reserves Ordinance, 1998.
- Leh, C. 1996: "Edible birds' nests towards the year 2000 – the Sarawak scenario".
- Leh, C. Gombek, F. Nawi, E.Y. Megang, E.M. Muhidden, E.A. Jainuddin, E.T. Tiam, P.S. bin Haji Mahli, E.J. Yapik, R.J. Othman, E.A. (1995): "The Swiftlet population of Niah caves". National Parks and Wildlife office Forest Department and the Sarawak Museum, November 1995.
- Lim, C. K. (1999): "Sustainable Management and Conservation of the White-Nest Swiftlet of Sarawak". Paper presented at the Borneo 2000 research conference, Malaysia 2000.
- Lim, C. K. (2000): "Humans and Swiftlets – Centuries of Affiliation". Paper presented at the Borneo 2000 research conference, Malaysia 2000.
- Mackinnon, J. Phillipps, K. (1993): "A field guide to the Birds of Borneo, Sumatra, Java and Bali". Oxford University Press, 1993.

Mayr, E. Ashlock, P. D. (1991): "Principles of systematic zoology". McGraw Hill Inc. Singapore 1995.

Medway, Lord, (1957): "Birds' Nest Collecting". Sarawak Museum Journal (New Series), 8 (10) p. 222-252, 1957.

\*Oda, M., Ohta, S., Suga, T., Aoki, T. (1998): "Study on Food Components: The Structure Linked Asialo Carbohydrate from the Edible Bird's Nest Built by *Collocalia fuciphagus*". Journal of Agricultural and Food Chemistry, volume 46, issue 8, p. 3047 – 3053, 1998.

\*Phach, N. Q. & Voisin, J.-F. (1998): "Influence of Cave Structure, Microclimate and Nest Harvesting on the Breeding of Nest Swiftlet *Collocalia fuciphanga germani* in Vietnam". Ibis, Journal of the British Ornithologists Union, Volume 140, Issue 2, p. 257 - 264, 1998.

"Sarawak Government Gazette". Part II, Published by Authority, Kuching Friday 22<sup>nd</sup> March 1963.

Sim, L.K. (1997): "Population census of edible nest swiftlets (*Collocalia maxima*) in the Niah caves". Forest Department, Sarawak. Proceedings of a workshop on Sarawak's national parks and wildlife, 1997.

Tompkins, D .N. (1999): "Impact of nest-harvesting on the reproductive success of black-nest swiftlets *Aerodramus maximus*". Wildlife Biology 5:1, 1999.

United Nations Environment Programme (UNEP) (1996): "The Economics of Environmental Degradation" edited by T.M. Swanson, Edward Elgar Publishing Ltd, Cheltenham, UK

\*Yates, S. (1992): "The Nature of Borneo". Library of Congress Cataloging-in-Publication Data, 1992.

<http://ecol.upm.edu.my/~jayum/publish/Ibantoday/Ibantoday.html>

<http://www.britannica.com>