Guardian of the Swifts in the Tower of the Oxford University Museum of Natural History

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Background

After many meetings of Convocation, the Oxford Museum Committee was formed in 1847 with the aim of establishing a university museum to bring together the scientific collections which were scattered across the University. The initial attempt failed due to opposition from William Buckland, Professor of Mineralogy, who thought Natural History not to be part of the “proper business of the University”. The Museum Committee prepared another memorandum in 1850, prompting Hebdomadal Board (The chief executive body for the University of Oxford from 1854 until its replacement, in 2000, by the new University Council) to establish a committee to consider the issue. This committee resolved that it was “desirable that a new museum be built for a collection in illustration of Physical Science and of Natural History”. Finally, in December 1853, four acres of land at the south-west end of the University Parks were purchased from Merton College for the museum site. The Museum Building Delegacy was established in 1853 to oversee the construction of the building. From 32 submitted designs for the new museum two were selected to be voted on by Convocation. The neo-Gothic design of Deane and Woodward was chosen in preference to the classical design of E.M. Barry. Henry Acland and John Ruskin, who intended the Museum to be a cathedral for science to inspire an appreciation of God’s creation, supported the neo-Gothic design. The foundation stone was laid on 20 June 1855 but three years later a setback occurred when the faulty wrought iron supports for the roof collapsed. The roof supports were then replaced by cast iron beams which are still in place today with their original painting. The building was officially opened in 1860 and has remained open until this year, 2013, when replacement and waterproofing of the glass roof necessitated temporary closure.

The neo-Gothic tower held no bells and bore no clock but it was an integral part of the elaborate ventilation system of the building because of the ventilation flues which project from the structure. There were gaps under all the internal walls and the wind was meant to sweep the air through the building (A. Lack pers. comm.). However these ventilation openings were to prove important not only for air circulation but also for the access they provided for Swifts. I can find no evidence that the top two floors of the tower were ever used by anyone from the Museum. The Tower had not been built with any intended purpose for internal use and when David Lack first visited in 1947 the tower was inhabited by pigeons, jackdaws, starlings, sparrows and swifts. These species had gained access through the ventilators in the roof. He decided that it would make an ideal study site for Swifts; little was known about these birds at the time. The following winter the installation of a system of floors and nest boxes meant that access for all but Swifts was denied. The guano was removed and the study of Swifts began the following year. One nest box was built behind each of the forty ventilator openings and the study of the lives of the visiting Swifts, *Apus apus*, by Dr David Lack, together with his future wife Elizabeth, began, resulting in *Swifts in a Tower* published in 1956.

Introduction

David Lack was the Director of the Edward Grey Institute of Ornithology from 1945, when the early studies on the swifts began, to 1961. During the period 1957 to 1961, the care and ringing of the Swifts was undertaken by Chris Perrins and other members of the Institute. My involvement with Swifts began in the early 1960s as a recently qualified ringer in the Oxford Ornithological Society (OOS). I was keen to develop my skills with a wide variety of birds. I joined with other ringers in the Society at the local reed beds at Wolvercote, the trap in Christ Church Meadows and the sewage farms at Abingdon and Sandford-on-Thames. Amongst the OOS members was Chris Perrins, who introduced me to the tower of the Oxford University Museum of Natural

History, and its occupants. My first visit was in 1962 when we climbed stone staircases and then came to a 30-foot wooden ladder leading to the 40 nest boxes and their tenants, made famous by Dr David Lack. Having managed the hair-raising ladder and ringed some swifts, Chris asked me if I would ring the remaining younger swifts in the following weeks as he was going to West Wales to ring Puffins (*Fratercula arctica)* and Manx Shearwaters (*Puffinus puffinus)* and would not be able to ring the remaining young swifts. The following year I was again asked to ring and monitor the Swifts. He must have realised at this stage that I was hooked. Before long, ten years had flown by, then another ten, then twenty. This labour of love lasted for a total of forty-nine years. During this time I have listed the significant events in the Swift's short (three and half months) life in Oxford, with date of arrival, nest building, egg laying, hatching, ringing and fledging all contributing to the records of the birds in this now world famous study.

Life in the Tower

The season starts in April well before the Swifts return. April is the housekeeping time when visits to the tower involve checking fixings of the nest boxes, cleaning the glass observation windows and removing debris from the box. The tower is also home to spiders and as I have a mild arachnophobia, the prospect of coming into close proximity with some very large spiders did not exactly inspire me, being almost as alarming as climbing the long unsupported wooden ladder. The ladder has subsequently been replaced by a safer, albeit noisy metal spiral staircase. Smaller spiders often build their webs across the entrance hole of the nest box. I do not like cobwebs on my face and Swifts will not enter a box with webs across the entrance hole. During the winter of 1965 a roof repair made it possible to increase the number of glass-backed boxes in the tower from 40 to 80. At the same time a further 67 boxes were installed beneath the eaves. This made a total of 147 nest boxes and quadrupled my work. Visits to the tower were made twice a week from April to September with extra visits for visitors.

There are six 3 ft fluorescent lights in the tower, but throughout the Swift breeding season these white lights are locked off to prevent workmen or others switching them on inadvertently and disturbing the swifts. The tower is then only lit by 6 red lights, which do not seem to upset the birds and also means that I am less likely to see the spiders. In 2009, as a result of Health & Safety legislation, white emergency floodlights (six of them) were installed in the tower. On enquiry I was told that in an emergency power failure or testing the generators these lights would come on. I then suggested that under the provisions of the Wildlife Protection Act 1981, whoever had authorised the setting up of these lights could face imprisonment or a large fine as nesting colonies of Swifts have the same legal protection as bats. The next day the lights were removed and at my suggestion replaced with light bulbs with red plastic covers. I have never seen bats in the tower in either summer or winter although in theory it could provide a suitable roost or breeding place. At the top of the 30 ft wooden ladder is an open space, which originally David Lack had covered with wartime barrage balloon fabric to prevent light from the top tower window disturbing the nesting swifts above. Over this area there were more heavy wooden ladders, which it was necessary to move to enable one to reach the higher boxes under the slope of the tower. This meant that I was working above the fabric which would have been no help had I fallen. The fabric was replaced by 8 x 4 ft sheets of hardboard, not much safer had I stood on them. The hardboard was later replaced with wooden floorboards and an extra floor was fitted in the tower together with short steps to individual nest boxes. In the 1980s the awesome wooden ladder, which was quite off-putting to some visitors, was replaced with a spiral metal staircase (see Figure 1).

Figure 1. The new spiral staircase, which replaced the old wooden ladder

As I had my own set of keys I could visit the tower at my convenience to fit in with my full time employment in the National Health Service. Occasionally I encountered other members of the museum staff, although not at night, but they never asked me what I was doing in the Museum. My most frequent contact was with the porters who would relay my wishes to the museum administrators.

The Life of the Swift

The Common European Swift (*Apus apus*) belongs to a large group of species of swift with a worldwide distribution. David Lack recorded 69 species in his book, *Swifts in a tower* (1956), today the number has increased to 96 (Chantler and Driessens 1995). The Common Swift is the only swift breeding in the British Isles although two other species (Alpine Swift, *Apus melba* and Pallid Swift, *Apus pallidus*) have been recorded in Britain. They are classed as vagrants with only a very few sightings in Britain per year. The breeding range of the Common Swift extends from the West of Ireland throughout Europe and Asia as far as China and north to the Arctic Circle and south to the Mediterranean coast of Africa (Chantler and Driessens 1995).

Overwintering occurs across the southern half of the African continent. The Swift shares a close relationship with Hummingbirds and both have the unusual feature that they can lower their body temperature. The Hummingbirds lower their temperature at night to conserve heat and young Swifts (pulli) lower their temperature when food is scarce, going into a torpid state until the parent bird returns with food. Even in this state the young respond to sound or the returning adult with wide-open mouths to accept the food bolus. To some people Swifts are grouped with Swallows and Martins but, though they share a similar lifestyle, they are not closely related. All overwinter in the southern hemisphere, breed in the British Isles and feed on insects but here the similarity ends. Streamlined for a life on the wing, with very short legs, Swifts lack the ability to perch and only cling briefly to vertical surfaces. Their scientific name comes from the Ancient Greek words α "without", and πούς, "feet". ἄπους (apous) meaning "without feet". (The German name Mauersegler, literally translates as "wall-glider"). They never settle voluntarily on the ground, where they would be vulnerable to accidents and predation. Together with Hummingbirds and Tree Swifts they form the order *Apodiformes*. The passerine or perching Swallows and Martins in the family Hirudinidae form part of the order *Passiferiformes*. Another characteristic of Swifts, both adult and young, is the large gape extending back to under the eye. This allows the young Swift to swallow a bolus of up to half an inch in diameter (see Figure 2).

Figure 2. Adult Swift transferring a food bolus to newly hatched young

Picture courtesy of Erich Kaiser

Swifts spends most of their life in the air. They gather food, nest material, sleep and even sometimes mate on the wing. Some sleeping and mating has been observed in the nest box. Mutual preening of both birds in the nest box is frequently observed. This is, of course, only for three months of the year. For the remainder of the year whilst migrating and over wintering how do they keep their feathers in good condition? I have yet to find any mention of the need to maintain feathers in optimum condition during the rest of the year in the published literature. I can only surmise that preening and feather maintenance is carried out, with difficulty, whilst flying. Adult male and female Swifts are virtually indistinguishable; only in the nest can one predict the female bird when egg laying, but both adults share incubation and feeding. Although the female has a slightly larger brood patch than the male during the breeding season, this is of little use for identification as no handling of the birds takes place during the nesting period.

Swifts usually arrive in Oxford about the first week in May and the museum porters are quick to tell me when they first hear or see the Swifts. The call is a high pitched ‘swee-ree’ which is made by the pair calling in unison as they sweep around the outside of the tower. Later in the season the calling is more pronounced as juveniles join with adults. Occasionally fights break over ownership of nest boxes. Face to face the birds peck at each other but the claws do the most damage as the birds become locked together and difficult to separate. They may even leave the nest in this condition only separating as they fall downwards. A stranger will usually only enter a nest if the resident birds are absent, beating wings against the nest entrance will elicit a response from an occupant which will normally deter entry of a stranger. All nest material is gathered on the wing, mainly feathers, dry leaves and grass cuttings as well as other aerial rubbish, confetti, tissue paper, cellophane and rubber from burst balloons; in fact anything carried on the wind. Interestingly before the appearance of Dutch Elm Disease, many of the nests were constructed with a large amount of Elm seeds. It is likely that these came from the row of Elm trees on Parks Road in front of the Museum, now replaced by Plane trees. This material is cemented together with saliva. In this country they can produce up to three plain white eggs, which are incubated by either parent over 19 days, at least a week longer than songbirds of a comparable size.

Recording

This began the first week in May each year and regular visits to the tower were made every Saturday/Sunday morning. Afternoons were kept for visitors who wished to see the Swifts at close hand. At the tower I recorded the weather for the day of the visit: cold / windy / wet or warm / light winds / dry. A summary of the previous week's weather was also noted. Starting from the top of the tower in a clockwise direction, I recorded the number of birds per box, any activity such as nest building, brooding or fighting between adult birds. The number of eggs laid, young hatched and fledged was also recorded for each nest box. David Lack had identified the boxes by referring to the side of the tower: North, South, East and West and numbering the boxes from the top downwards. Later when the tower and Museum were reroofed and each original nest box replaced by two boxes, the box number was retained and subdivided into A and B. This enabled me to continue to compare occupancy of the boxes from year to year. I was able to observe activity within the nest boxes by lifting a piece of blackout fabric fitted over the glass panel at the back of each nest box, at the opposite end to the entrance hole. In 1982 I found two adult birds trapped in a nest box where the nest had become loose and blocked the opening. In subsequent years I always removed any loose nests and cleaned out the nest boxes in April each year before the birds returned. The first two video cameras were set up in 1996. The birds almost always built their nest as far from the entrance and daylight as possible and therefore near the glass back. Since the adults spread saliva whilst nest building, because of the habit of nesting next to the glass and the young defaecating against the glass, this necessitated frequent changing of the glass panels in these nest boxes so that clear pictures could be seen on screen. In 2004 the first two cameras were replaced by four improved cameras which transmitted to a monitor downstairs in the Museum and could be accessed via the web. A portable monitor allowed me to adjust the pictures from each box for transmission.

Figure 3. The author adjusting the video cameras on one of the swift nest boxes

Other inhabitants of the nest boxes

Swifts are hosts to several parasites, the principal and largest being the Flat Fly, *Crataerina pallida.* These are interesting creatures in their own right. Although they are classed as flies in the order Diptera, their wings have atrophied. They are not required to fly themselves as they rely on the Swift to provide transport. Hooks on their feet enable them hold on firmly to their host when in flight. They have flattened bodies which allow them to run rapidly between the swift's feathers. The Flat Fly has an unusual life cycle. The adult, like other Hippoboscid flies, does not lay eggs but lays a single larva, which instead of feeding, immediately pupates. The small, oval, brown pupa is approximately 6 mm in size. The pupa remains in the nest throughout the winter and it is only with the arrival of warm weather in spring and the hatching of the young swifts that the Flat fly emerges and commences feeding by sucking the blood of the young naked Swifts. Although the presence of these parasites was noted each year, no attempt was made to record or manipulate numbers other than cleaning the nest boxes each year.

Figure 4. Young Swift, 32 days, with Flat Fly, *Crataerina pallida*, circled

Figure 5. Flat Fly, *Crataerina pallida*, gorged with blood

However from 1990s I decided to clean the nest boxes at the beginning of each breeding season in part to reduce the number of overwintering *C. pallida*. Despite this the parasite always reappeared at hatching every season and therefore pupae must have survived within the corners and crannies of the nest boxes. Another explanation would be that the parasite returns with the adult bird but this has not been confirmed to date. *Crataerina pallida* parasites remove considerable amounts of blood from the young Swifts on a regular basis (see Figures 4 and 5). When they occur in high numbers the impact of their presence might be expected to have a detrimental effect on the growing Swifts. In fact no adverse effects have been reported although David Lack (1956 p204) states that Swifts found dying on the ground had up to 20 *Crataerina pallida* on them and it seems likely that the parasites contributed to the weakness of the birds. I have never found such large numbers of *Crataerina* on Swifts in the tower. Squeezing a Flat Fly between finger and thumb does it little damage; it simply gets up and runs away. Seed eating birds with their powerful beaks and head muscles could easily crush these parasites but in adult Swifts the small beak and associated smaller head muscles mean that they are unable to do this and must therefore co-exist with the parasite. It has been suggested that parental compensation through increased effort may balance the negative effects of the parasitism. However in nests where *C. pallida* numbers had been manipulated, Walker and Rotherham (2011) could find no difference in parental provisioning of nests with the same number of young, differing only in the numbers of the parasite present. Parents did spend longer at the nests with increased parasitism but it is not known if this relates to the quantity and or quality of the food provided. It is possible that differences in parental provisioning become more pronounced in bad weather periods when the effects of parasitism by *C. pallida* may be more pronounced.

Ringing

There were two ringing schemes in Britain until 1937 when they were amalgamated and came under the control of the British Trust for Ornithology (BTO). The BTO, via an elected Committee of 'A' Ringers, supervises the training, standards, issue of permits and maintains records of all birds ringed in the United Kingdom as well as liaising with other ringing schemes throughout the world. The ringers must conform to guidelines and rules as set out in *The Ringer's Manual*. Catching and ringing birds gives the opportunity for qualified ringers to record data including age, sex, plumage variations and weight. Subsequent re-trapping, controlling and recovery of dead birds enables the BTO to inform the original ringer and the finder of the information thus obtained.

The rings used for Swifts differ from those used for most other species in that they are made from soft, flexible aluminium. Each one bears the name 'Brit Museum Nat Hist London' and an individual number. Rings are only issued to qualified ringers and during my years in the tower I have used over 4,700 rings, provided by the Edward Grey Institute (EGI). I have never asked about the cost. The ring known as SO, Special Overlap, is placed on the Swift's tarsus (leg). As the rings are made of soft aluminium, they can be rolled between finger and thumb to overlap the ends. Final tightening is achieved by using special pliers (see picture 5). The ring must be free to rotate on the tarsus but not loose enough either to lock on the ankle joint or to ride down over the lower joint where the toes insert into the tarsus. In the tower pulli were ringed on a regular basis once they were ready to leave the nest. Adult birds were not disturbed while on the nest and were only ringed near the end of the breeding season.

Figure 6. Top: Pliers for closing Swift rings. Lower left: Swift rings as supplied by BTO. Lower right: Rings opened & closed.

The Study

Swifts are usually first recorded at Farmoor reservoir, Oxfordshire, during April each year, but do not make an appearance at the museum tower until the beginning of May. Insects can be found at Farmoor allowing the birds to feed up after their long flight north from southern Africa.

Occupancy of the nest boxes

Between 1962 and 1964 almost all the available nest boxes were in use. By 1966 the total number of boxes available was 147, 80 in the main part of the tower and a further 67 under the eaves. Although there was an increase in the numbers of pairs nesting in 1966, there was a decrease in the following years falling to a low of 29 in 1972 and not exceeding 40 again until 1974. Numbers continued to increase until 1981 when 72 pairs were recorded. After this time numbers fluctuated between 49 and 75, averaging 63 pairs per year. Since 2008 numbers have fallen steadily and decreased even further in 2011 and 2012 (see below). During the period 1962 - 2010, nest boxes were checked on a weekly, often twice weekly basis but the nest contents under the sitting birds were not checked so as to minimise disturbance. Swifts sometimes lay eggs and lose them quite rapidly. Hence after 1962 some nests in which eggs were laid and quickly lost may have been missed. The number of pairs using the row of boxes beneath the slates has always been low. However, in 2008 young were recorded in nine of the 67 boxes.

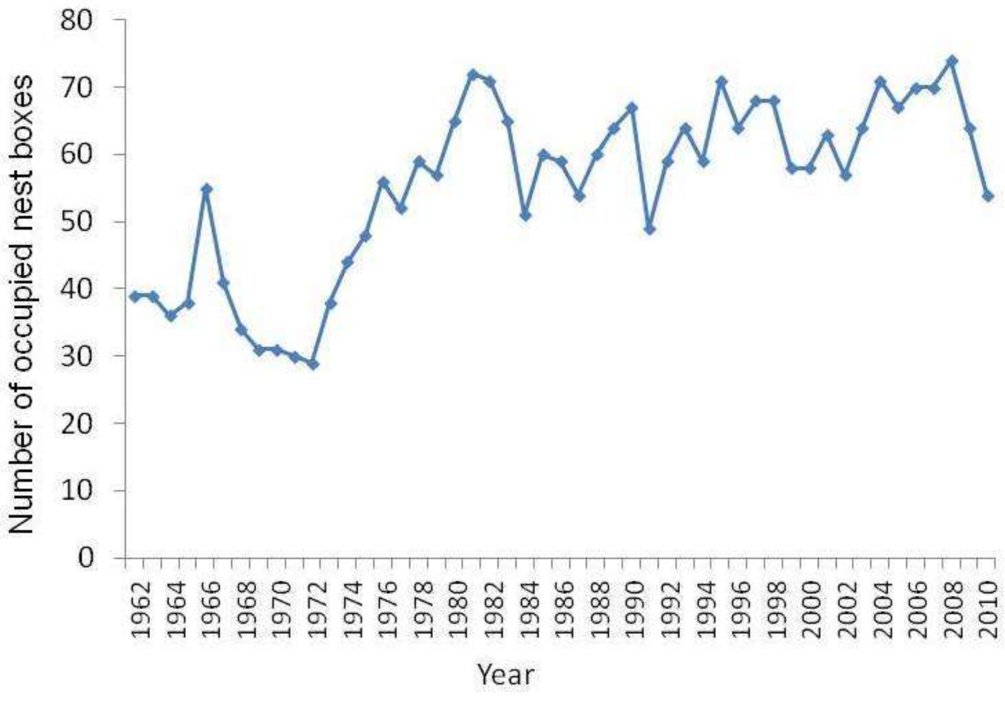

Figure 7. The number of nest boxes occupied by pairs of swifts in the tower from 1962 to 2010

Occupancy in relation to orientation of the nest boxes

The occupancy of the nest boxes varied with the orientation of the boxes around the tower. East was the preferred location with the mean number of boxes occupied per year between 1962 and 2010 being significantly higher than in north, south or west (see Table 1).

Table 1. Nest box occupancy per year from 1962 – 2010 in relation to orientation

Data was analysed by Student's t-test (paired)

Orientation	Occupancy per year (mean ± standard error of the mean)	n (Total number of nests occupied in each group)	
North	13.1 ± 0.5	644	a
South	13.0 ± 0.4	638	a
East	15.2 ± 0.5	743	b
West	14.1 ± 0.6	692	c

a indicates that the mean occupancies for north and south were not significantly different.

b and c indicate that there were significant differences in the mean occupancy:

- **North was significantly different from East ($p<0.001$)**
- **South was significantly different from East ($p<0.001$)**
- **West was significantly different from East ($p<0.02$).**

Numbers of eggs laid, hatched and young fledged (Figure 8)

The numbers of eggs in each nest were recorded each week. I frequently found eggs out of the nest. At first I thought it a mistake and marked the eggs and replaced them but they were mostly out again by the next week, although some were missing altogether. Three eggs are the maximum number of eggs that I have seen in a single nest. The most marked differences occur between the numbers of eggs laid and the numbers hatched. A closer relationship exists between numbers of young hatched and numbers fledged. Possible reasons for this are discussed later. The average number of young fledged per year between 1966 (when the number of boxes was increased) and 2010 was 86. Half this number were fledged in 2010 (42), numbers went down to 14 in 2011 but recovered slightly in 2013 to 24. 2011 was the poorest year for decades due to the wettest June on record. Although 32 nests were started, only 28 were completed, some birds failed to lay, others deserted at the egg stage and yet others left hatched chicks.

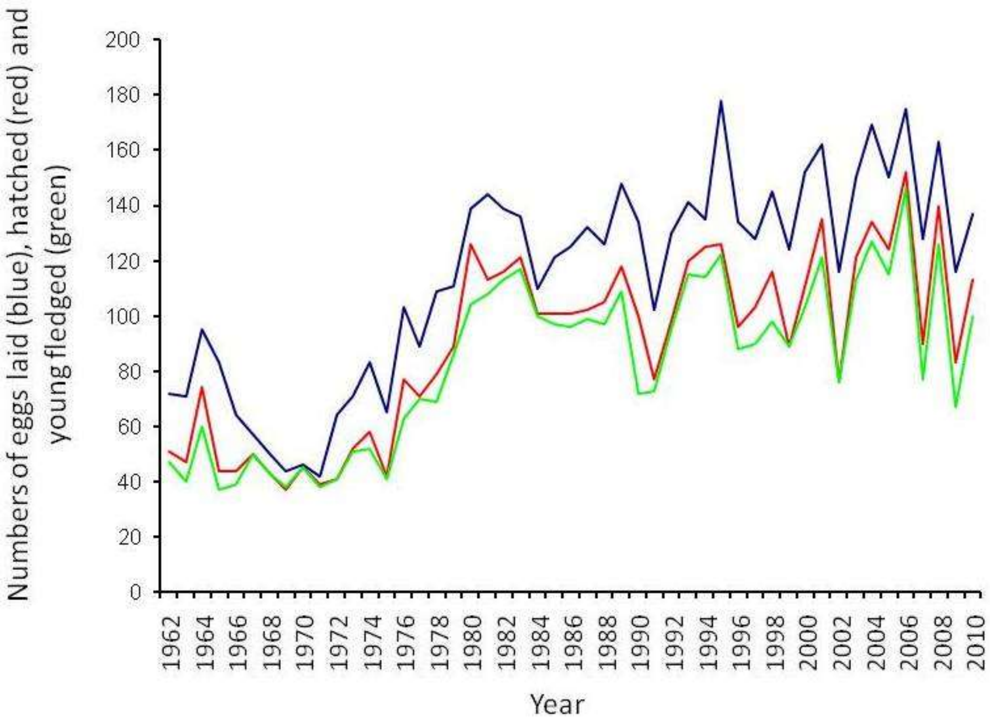

Figure 8. The number of eggs laid, hatched and young fledged between 1962 and 2010

Numbers of Swifts Recovered

One of the main reasons for following the Swift colony in the museum tower over many years was the opportunity it offered for ringing the birds, particularly the newly fledged birds with the hope of learning more about their lives as they moved between the UK and Africa each year. The young swifts remain in the nest for at least six weeks from hatching, sometimes longer if there is a food shortage. For the first four weeks the legs of the young swift are not sufficiently developed for the ring to be placed on the leg without it falling off. At the age of five weeks the young swift is sufficiently developed for the ring to be placed on its leg. At six weeks old it is liable to erupt from the nest prematurely and may not be able to fly very well. This probably explains why the legs and rings from four young swifts were found in a nearby Hobby's (*Falco subbuteo)* nest (see below). Adult birds were not handled while on the nest so as to minimise disturbance during breeding and were only handled and ringed once the young had fledged or if single birds were found in a box. Therefore the number of adult birds ringed was low compared with that of young ringed (Table 2). Records of birds ringed in the tower are shown in Table 3.

Table 2. Swifts ringed and re-trapped in the tower of the Oxford University Museum of Natural History 1962 – 2010

Adult Swifts ringed	Adult Swifts re-trapped	Pulli ringed	Pulli re-trapped
674	291 (43%)	4064	52 (1%)

Table 3. Records of Swifts ringed as an adult or pullus in the tower of the Oxford University Museum of Natural History from 1948 to 2010

“Controlled” refers to a bird wearing a ring put on at a different site, i.e. other than the tower in this context. The important factor is the distance the bird has moved, not who handled it at either end (Redfern and Clark 2001).

D 3082	Ringed as adult 29.6.48 found dead in tower 22.5.64	Age at least 16 years old
K 53088	Ringed (age not recorded) 28.7.58 found dead 2.6.72	Age at least 16 years old
SA 33739	Ringed as adult 17.8.77 controlled on Port Meadow, Oxford , 28.5.79	Age 2 years 9 months
SA 56873	Ringed as pullus 8.8.78 found dead at Stow on the Wold, Gloucestershire, 21.5.85	Age 7 years 9 months
SB 05614	Ringed as adult 10.7.82 found dead in Aoulouz, Taroudant, Morocco, 7.6.93	Age 10 years 11 months
SB 05676	Ringed as pullus 24.7.82 controlled at Tring, Hertfordshire, 12.7.86	Age 4 years
SB 29827	Ringed as adult 6.8.86 found dead in tower, Oxford 1.6.96	Age 9 years 10 months
SB 47989	Ringed as adult 24.7.89, re-trapped 21.7.90 and 19.8.95, found dead in the tower 24.5.97	Age 8 years 9 months
SB 74127	Ringed as pullus 6.8.94, found dead at Duxford, Cambridgeshire, 23.6.97	Age 2 years 10 months
SB 80543	Ringed as pullus 31.7.96, re-trapped in tower at least seven times, the latest being 21.7.07	Age at least 11 years
SB 88565	Ringed as adult 7.7.01, returned in 2003, 2005, 2006, 2007, the latest record being 2010	Age at least 9 years
SE 07078	Ringed as pullus 13.7.67, controlled Headington Hill, Oxfordshire, 21.5.77	Age at least 10 years
SE 82052	Ringed 1969 (age/date not recorded) controlled in Holywell, Oxford, 21.5.77	Age at least 8 years
SE 82113	Ringed as pullus 14.7.73. found killed by wires at Sandy, Bedfordshire, 18.7.75	Age 2 years

Rings from four recently fledged pulli were recovered from a Hobby (*Falco subbuteo*) nest at Wood Eaton on 15. 8. 2008: SE 24723, SE 24744, ringed 5.7.08, SE 24798, ringed 19.7.08 and SB 43708, ringed 26.7.08. The survival times of the last three were 41, 27 and 20 days respectively.

Whilst waiting for a colleague outside the Museum at 9am on 13th July 2008, I noticed a Sparrowhawk *(Accipiter nisus)* sitting on a pinnacle just below the lower ventilators on the north side of the tower. Almost immediately an adult swift was seen flying up to enter Box North 10A. The Sparrowhawk sprang into the air caught the Swift and flew rapidly away over the roof of the Museum. The contents of Box 10A were as follows. Three eggs were hatched by 14.6.08, the pulli were ringed on 5.7.08. The Sparrowhawk took the adult Swift on 13.7.08. The pulli were still doing well on 19.7.08 and had flown by the 26th July, six weeks after hatching. Several of the museum staff reported seeing a Sparrowhawk on numerous occasions during that summer. I noticed that the feral and wood pigeons usually present on the museum lawn feeding on tourist food scraps were not present that summer.

Summary

The installation of the nest boxes in the tower of the Oxford University Museum of Natural History in 1947 was the beginning of a long and ongoing study of the lives of Common Swifts (*Apus apus)* during their brief visits to Britain between April and

August each year to breed and raise the next generation. The initial study by David and Elizabeth Lack required nerve to climb the perilous wooden ladders to the tower and patience and perseverance to observe and record the occupied nest boxes on a daily basis. Having followed in their footsteps on those wooden ladders for a number of years I can appreciate the dedication required for these early studies.

By 1965, occupancy of the nest boxes was reaching capacity, so the opportunity to increase the number of potential nesting areas during the reroofing of the Museum was welcomed. It is likely that the scaffolding around the lower parts of the tower during 1965 and 1966 disturbed the Swifts resulting in the low numbers of nesting pairs over the next few years. It took eight years before the numbers of nesting pairs reached 40 once more, suggesting that the birds may have found new locations during this time. Although there has been an overall increase in the numbers nesting between 1974 and 2010, there is considerable variation in numbers from year to year which is likely to be related to the prevailing weather conditions and the amount of food available to the adult birds. Swifts capture insect food on the wing and aerial feeding is much better during sunny summers than in cloudy ones, allowing more pairs to nest and breed. The total number of young fledged in any one year did not relate to the number of breeding pairs, suggesting that the prevailing weather conditions may have been the major factor determining the number of surviving young. In the years that I recorded the Swifts, the lowest ratio of young fledged to number of breeding pairs was seen in 2009 when only two good weeks were recorded out of 10 during the breeding period. The reason for the small but significant preference for nest boxes on the east and west sides of the tower over the 40 years of study is not clear but may reflect the temperature difference across the tower with the Swifts avoiding boxes with the more extreme temperature differences across the day.

A large variety of live insects are caught while on the wing by the adult birds. Young spiders drifting in air currents also contribute to the bolus of food which is loosely bound together with saliva within the throat pouch which expands to accommodate it. On occasions when food is abundant the young may become satiated and the food ball is simply deposited into the nest area. I have watched insects moving around in these saliva balls and eventually freeing themselves from the saliva. Therefore insects can survive within the saliva ball when collection times are short. The young of most passerines (perching birds) cannot fly when they leave the nest and depend on their parents for food and protection for about two weeks. Swifts, on the other hand, remain in the nest for at least six weeks prior to leaving. Being independent when they leave the nest, they must have the inherent knowledge to enable them to fly, catch food and navigate without the help of their parents. One correspondent in Spain, who had spent days watching the Swifts on the Museum website camera contacted the Administration Staff and demanded that someone go up and feed the young Swifts as she had not seen the parents entering the box for at least three days. Young Swifts must achieve certain milestones in their life prior to fledging to enable them to migrate. If the weather is fine and there are plenty of insects they will probably weigh more than the parent by the sixth week. However, they will not leave the nest until the correct feather length is reached. If conditions are ideal, the young swifts will reach 50 – 60 gm weight by 25 – 30 days. The parents will then stop feeding them, as the Spanish lady observed, (does the urge to migrate in the parents become dominant at this time?) and their weight will fall to 40 – 45 gm, the ideal fledging weight, but the wing and tail feathers will continue to grow throughout this period of weight loss (see Figure 9).

Figure 9. Age and average weight of the common Swift (Apus apus) from 6 days of age to fledging

Courtesy of Gillian Westray

During this time they spend a lot of time in the nest doing 'press-ups' and exercising their flight muscles. In the museum nest boxes they must do this at right angles to the length of the nest because of the dimensions of the box (see Figure 10).

Figure 10. Young Swifts, 42 days old, exercising in nest box

The clutch size of the Common Swift varies from one to three; only rarely are four eggs laid. In the tower colony the average number of eggs laid per pair per year over the study period was 2.1. However the clutch can be reduced by the parent birds removing one or more of the eggs; occasionally all eggs are ejected. Although the beak of a Swift would not be strong enough to move the egg, the large gape allows the adult to pick up an egg and remove it from the nest (Pers. comm. A. J. Greatorex). The eggs are presumably removed from the nest for a reason. Can the parent detect if an egg is infertile? Disturbance such as fighting between adult birds when a stranger enters a nest box, has been seen to result in egg ejection from the nest. Should it become necessary to reject all eggs for any reason such as cold weather, lack of food or fights in the nest, then the Swifts will lay again, but the second clutch is usually smaller than the first.

Once hatching has occurred, parents can still regulate brood size and again this is dependent on the prevailing weather conditions which determine the amount of food available. The tower colony of Swifts has enabled a number of research projects to be carried out by members of the EGI, for example the manipulation of brood size by Martins and Wright (1993) where they concluded that brood reduction by the parent birds in times of food shortage was a strategy that could have adaptive consequences for both parents and young in the long term, Swifts being a relatively long lived species. Pianka (1976) reported that most chicks from clutches of two leave the nest in sunny years, but only one survives in cloudy years, and the optimal clutch size shifts from 3 to 2.

Most nesting birds remove the faecal sacs produced by their young after hatching. Dell'omo *et al* (1998) observed Swift parents swallowing faecal sacs during the first three weeks after hatching, actively searching the nest and surrounding area. Females ate significantly more sacs than males. Consumption decreased as the nestlings grew because the begging behaviour of the young birds restricted access of the parents to the nest. The authors concluded that the Swift parents ingested their nestlings' faeces to recycle water and nutrients during periods of high energetic requirements. Another possibility may be to replace calcium lost in egg laying. Although the nest is kept clean by this behaviour during the initial nesting period, accumulation of faecal material accumulates as fledging approaches. In bad weather years it would seem that the amount of nutrients obtained from consuming the faecal sacs did little to assist survival. In the tower I found that if the nests were left untouched at the end of the breeding season, the amount of residual material decreased over time due to the activity of moth larvae and other overwintering inhabitants of the nest boxes.

The main object of my work over the years was to ring the fledgling Swifts. There is no doubt of the value of ringing in increasing knowledge of the life of birds in general. The grand total of rings used for all species between 1909 and 2011 recorded by the BTO is 39,350,770. Swift ringing since 1909 has contributed a total of 185,643 (0.5%). Although there are approximately 2,500 qualified ringers in the UK, not many attempt to catch flying swifts and only 3,294 have been recovered or controlled; this represents a recovery rate of 1.8% (*Ringing & Migration* 2012). David Lack talks of the adverse effect of handling adult birds either when nest building, egg laying, incubating or feeding (Lack 1956). For all the years I have monitored the Swifts in the tower I have followed David's policy of not handling adult Swifts when they are present as a pair nor when brooding for fear of disturbing them. Handling adult females could also result in damage to eggs within the bird. Adults have been handled, and either ringed or checked for rings if found singly sheltering in a nest box or post breeding when the young have left the nest. Even this limited recovery has shown that many of the birds return to the same location year after year. This means that the numbers of adults recorded are an underestimate of the number of birds returning to the tower each year. Despite this 43% of adult birds ringed were recovered in the tower over the 40 years of study, far higher than the overall figures from the BTO. The numbers reflect the nature of the birds to return to the same nesting place each year and that few ringers have access to such a large established colony of nesting swifts to study. Far fewer birds ringed as pulli have been recovered compared with birds ringed as adults. There are a number of possible reasons for this; they take some years before they are ready to breed and therefore return to this country, many must die on migration due to adverse weather conditions, others are killed on their wintering grounds by predators, and others may be discouraged from returning to the tower by their parents and seek alternative nesting sites.

Although over 5,000 swifts have been ringed in the tower since the study began, the most significant event for me was when I found number D 3082 dying in the tower. It had been ringed by David Lack on 29th June 1948 and recorded as an adult. I found it on 22nd May 1964, 16 years later when it must have been at least 18 years old. A further finding was of a recently dead swift in the tower, K 53088, on 2nd June 1972; it was ringed as an adult on 29th July 1958 so was over 14 years old. I know that another ringer has re-trapped a bird ringed by him as a nestling some twenty years earlier. He then released the bird, which one hopes is still undertaking that breath-taking migration to and from Southern Africa.

With the advent of micro-methods of marking a new chapter is unfolding in the study of birds. There are at least 12 different marking methods (*Ringing & Migration* 2012), but this is beyond my study of the Swifts in the tower of Oxford University Museum of Natural History. Despite the low numbers of Swifts successfully breeding in the tower in the last few years, it is likely that this colony of Swifts will continue to provide an important source of study for researchers in the future, albeit no longer in my care.

Additional Information

Observing the Swifts in the Tower

There are four black and white infra–red cameras in the tower and during the summer months it is possible to track the progress of the Swifts on the museum website, www.oxford.university.museum.co.uk/swifts. They can also be seen on a television monitor downstairs in the Museum to the left of the entrance.

Devil Birds

Information and data on the Swifts nesting in the tower were provided to Derek Bromhall during the filming of the Swifts for his film Devil Birds produced in 1976 and shown on Anglia Television in the Survival series and the book of the same name in 1980.

The first International Conference on Swifts

This was held in Berlin in 2010. Thirty people attended. The second conference in 2012 attracted 70 delegates representing most European countries, also Russia and China.

Caring for injured Swifts

From time to time I have been brought starving or injured adult and nestling Swifts. The lack of knowledge and facilities meant that most of the injured birds died. I have had some success with placing the homeless and starving nestlings with birds of a similar age in the tower, no more than one per nest and where possible with slightly younger companions so that the older introduced nestlings might stand a better chance of obtaining food from the foster parents. More recently I have come across Gillian Westray who has been running a sanctuary/hospital for Swallow, Martins and Swifts. She has had amazing success with rehabilitating and releasing birds in her care.

Birds brought to her need rehydration followed by food. Suitable food is Silent or Brown Crickets, Wax Moth larvae and Bluebottles (maggots are indigestible due to their thick skins). Vitamin and mineral supplements are also given (Westray 2011). Starving pulli removed from the tower and taken to Gillian Westray have survived and been released, emphasising the importance of Gillian's work to provide the correct diet and care environment.

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In 2012 Roy Overall was awarded the Unsung Museum Hero Award for his work on Swifts in the Tower of the Oxford University Museum of Natural History.

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