No. 12

The reintroduction of
the white-tailed sea eagle
to Scotland: 1975-1987

Prepared by John A Love
for
Nature Conservancy Council,
Royal Society for the Protection of Birds,
Institute of Terrestrial Ecology
and
Scottish Wildlife Trust

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Four-year-old male sea eagle on Rhum in January 1979 (J A Love)
Preface

The reintroduction of the sea eagle to Britain is one of the success stories of conservation in recent years - and one which has excited public imagination. The project has a long history, inevitably with birds which take several years to reach maturity. Introductions started in 1975. In 1985, the NCC published (with sponsorship from Britoil) an illustrated leaflet describing the project up to 1984, the year before the first sea eagle for about 70 years was reared in the wild in Britain.

There has been a continual demand for further information on the project, both to update the story and to give more details of the work that was undertaken. The purpose of this volume in the NCC's "Research & survey in nature conservation" series is to meet this demand by a blow-by-blow account of the project's work and the results of it. John Love, who has been more involved with the project than anyone else, has put together this account on behalf of the Project Team (which includes personnel from the Nature Conservancy Council, the Royal Society for the Protection of Birds, the Scottish Wildlife Trust and the Institute of Terrestrial Ecology). I should also like to thank Lissie Wright for her work in editing the text.

The project has involved a very great number of people and organisations in Britain and other countries. Thus this report gives us the chance to thank them for their efforts by demonstrating what these efforts have achieved.

What of the future? The project has achieved its first two targets: first, the reintroduced young sea eagles have survived and established themselves in the former range; and secondly, these are now reaching maturity and breeding successfully. The third and major aim is for the population to breed sufficiently successfully for it to maintain itself and spread throughout the sea eagle's former haunts. In the next few years we shall be monitoring the numbers, distribution, survival and productivity of the birds and investigating any problems which arise.

We hope to update this volume by brief annual reports of progress on the project. Whilst I regret that resource limitations generally prevent individual responses to enquiries about progress, we would be pleased to add the names and addresses of interested persons to our mailing lists for these short reports. Anyone who wishes to receive these should write to me at Nature Conservancy Council, Northminster House, Peterborough PE1 1UA, Great Britain.

Mike Pienkowski
Senior Ornithologist
NCC Chief Scientist Directorate
Ten- to twelve-week-old sea eagle on tethers on the Isle of Rhum (J A Love)
1 Introduction

Early last century the white-tailed sea eagle Haliaeetus albicilla was widely distributed along the north and west coasts of Scotland and Ireland, with an estimated 200 or more pairs nesting. Love (1983) has detailed the persecution which ultimately led to the species' extermination in Britain. Only a handful of pairs lingered in Scotland into the early years of this century, and the last nesting attempt is said to have taken place on the Isle of Skye in 1916 (Baxter & Rintoul 1953).

Few sea eagles were recorded in Britain thereafter. Only seven records unconnected with the current reintroductions are known for the period 1957 to 1981, and no natural recolonisation of Britain has taken place. This was because the species had also suffered in Europe, from persecution, habitat loss and, latterly, from pesticides. A slight recovery in parts of Europe has been detected in recent years and has resulted in about seven more sea eagles being recorded in Britain since 1982, all in the south and east of England. One shot in north Norfolk in May 1985 bore an East German leg ring. These recent immigrants have all been immature and, even if any were to survive to maturity and succeed in finding a mate, the only suitable habitat lies far to the north. Natural recolonisation is therefore unlikely.

Only northern Norway retains a healthy population of sea eagles; this is now estimated to exceed 600 pairs (H Misund pers. comm.). Ringing studies have shown that these birds exhibit little inclination to disperse from their natural area. Thus conservationists concluded that, if the sea eagle was to become re-established in Britain, active help by man would be necessary. Two small reintroduction schemes were undertaken some years ago - the first in 1959 in Argyll and the other in 1968 on Fair Isle in the Shetlands (Sandeman 1965; Dennis 1968, 1969). These involved a total of only seven eagles, of which only a few may have survived. However, they were important pioneering moves. The current scheme was initiated in 1975 by the Nature Conservancy Council (NCC).
2 Justification for the reintroduction of the sea eagle

In its wide-ranging review of animal introductions, the UK Committee for International Nature Conservation (1979) defined a reintroduction as:

"The deliberate or accidental release of a species or race into an area in which it was indigenous in historic times."

This distinction from an introduction of an alien species is important. The sea eagle is an ideal candidate for reintroduction. Love (1983) reviewed the justification for its premeditated reintroduction and his conclusions were as follows.

1 The extinction of the sea eagle in Britain was brought about by persecution (shooting, trapping, egg-collecting and especially poisoning).

2 The environment in north and west Scotland has changed little in ways that would adversely affect the sea eagle. Indeed, the major changes have been advantageous and include the widespread reduction of persecution and the increase in some of the sea eagle's seabird prey, such as eider and gulls.

3 There have been too few reports of sea eagles in Britain this century to suggest that they could ever recolonise on their own.

4 In recent times populations throughout the species' range, except those in Norway, have been much reduced by habitat loss and, especially, by pesticides. The relatively unpolluted waters of north-west Britain could easily support a viable population of sea eagles, which would be a valuable contribution to the species' survival on an international scale.

5 On purely ethical grounds, man is justified in aiding the sea eagle's return to Britain since he brought about its extinction in the first place.

6 A reintroduction attempt with such a large and spectacular avian predator, together with the media attention it would attract, would serve to highlight the ideals of conservation in the eyes of the public. Witness the recent success of the RSPB's Operation Osprey in winning public sympathy for birds of prey.

7 With the NCC's commitment to 'constructive conservation', the project would develop unique expertise pertinent to reintroductions of other species both at home and abroad.

8 Besides the aesthetic appeal of seeing sea eagles back in their traditional haunts, a varied environment is a healthier one. Predators have proved a sensitive barometer to the health of our environment. The sea eagle has already served to highlight the dangers of pollution in the Baltic Sea and many inland lakes and rivers on the continent.

The sea eagle fulfils all the criteria for reintroductions laid down by the UK Committee (1979).
3 History of the proposal

Although the earlier attempts had only involved a few birds, they had demonstrated the viability of techniques for releasing birds into the wild. The idea of a large follow-up project had been considered within the Nature Conservancy for some time and, after its division into the Institute of Terrestrial Ecology (ITE) and the NCC, discussions continued between Dr David Jenkins of the ITE and Dr Derek Ratcliffe of the NCC. By the end of 1973 Dr Ratcliffe was pursuing the project with his colleagues in Scotland, advocating Rhum as a possible release site. In the light of discussions and advice on technical feasibility from Dr Ian Newton (ITE) a project proposal was devised. Dr Newton consulted experts on captive breeding of large raptors, and the initial procedures adopted owed much to his advice. The proposal fitted well with an NCC review of the future of Rhum made in 1974, and a recommendation to reintroduce the sea eagle was approved by the NCC's Council early in 1975.

The 'pros' and possible 'cons' of reintroduction were examined in detail by the NCC and its advisers before this latest reintroduction attempt was launched.

The 'pros' are reviewed above in Section 2. The 'cons' included several points. First, there were fears that, because of marine pollutants, especially polychlorinated biphenols (PCBs), any tendency for sea eagles released on Rhum to feed on seabirds might result in low breeding performance. Against this were considerations of the role of carrion in the diet, as well as the relatively unpolluted nature of north-western Scotland compared with other areas (see Section 2). Secondly, the possibility of competition between sea eagles and established golden eagles was noted. However, the two species had lived alongside each other until human extermination of one early in the century. Thirdly, there were fears among sheep farmers about possible predation of lambs. The ecology of the eagles suggested that serious damage was unlikely even in the long term if the experiment was successful. Fourthly, there were worries over the possibility of eventual failure.

After prolonged consideration, the NCC decided that the very considerable potential benefits justified the experiment and outweighed the possible 'cons'. This commitment by the NCC to a reintroduction project was a bold move at the time, as such projects had been subject to relatively little public debate.

First-year sea eagle on Rhum (J A Love)
4 Methods

Using the experience gained in the earlier reintroductions, this latest project imported nearly-fledged eaglets which had been taken under licence from nests in northern Norway. The number taken annually varied from four to ten. Whenever possible, single chicks were taken from broods of two. Furthermore, such is the density of breeding pairs in the area that few were ever deprived of a chick in more than one season. Thus the genetic diversity of the founder population was maximised.

The eaglets were collected and cared for each year by a local ornithologist, Harald Misund. They then travelled to Scotland in a Nimrod reconnaissance aircraft of the Royal Air Force, which in mid-June was engaged locally in a routine training flight. The Royal Norwegian Air Force base at Bodø was conveniently placed as a departure point for the two-hour flight to Kinloss in north-east Scotland. From there the birds were taken by truck and boat to the Isle of Rhum, a National Nature Reserve in the Inner Hebrides owned by the NCC. The complete journey from Norway was achieved in under ten hours, thus minimising any trauma to the eaglets.

The island lies in the heart of the sea eagle's former range and is only a dozen miles from the last recorded nest site on Skye. Rhum formerly held two or three pairs, the last of them nesting as late as 1909 (Love 1983). The coastal cliffs support considerable colonies of seabirds, while a population of 1,500 red deer *Cervus elaphus* and some 200 feral goats *Capra hircus* are available as a source of carrion for the eagles. The island has no domestic livestock, other than a handful of cattle and ponies. The entire human population of the island is employed by the NCC, and visitor access is controlled.

On Rhum the eaglets were installed in four roomy wire-mesh cages, sited on a remote section of coastline. Here the birds had to spend a statutory 35 days in quarantine before a final veterinary examination. Release usually began in August, although in the early years this was sometimes delayed until October or November. After contact with captive-breeding facilities in both Germany and Israel, it was realised that captive-breeding could either enhance the number of releases or preclude the need for further importations from Norway. Four birds imported in 1976 were kept on Rhum as potential captive-breeding stock, and work commenced on clearing a site in the walled garden of Kinloch Castle for the breeding cages. One male escaped in May 1977, and its place was taken by one of the 1977 imports. A female died in 1978, highlighting the remoteness of Rhum from immediate veterinary help. The remaining three eagles (two males and a female) were released (after three and a half years in captivity) in the spring of 1979 (see Sections 4.4 and 4.5). The potentially lengthy and expensive commitment to captive breeding on Rhum was abandoned when the Norwegians proved willing to provide further wild-bred stock for release. Whilst in captivity the eaglets were provided with a 'natural' diet - mainly fish, with some seabirds, venison and goat meat - all obtained locally at minimal expense. Love (1979) investigated the daily food intake of the captive eaglets. Human contact was limited to brief daily visits to provide food, no attempt being made to screen the eagles from human approach at these times.

The long-term captives were retained out in the open on jesses and a running leash, which permitted flight between a perching block and a tent-like wooden shelter/perch some 5 m apart. The eagles were tethered within sight of one another in a small, secluded, fenced enclosure. In later years most of the other
eagles also spent a short time on tethers immediately prior to their release. Such a system minimised feather damage and allowed the birds to exercise freely. Indeed two tethered eagles even succeeded in catching prey - a crow and a gull - which had strayed within reach whilst seeking food scraps.

A leather falconer's hood subdued each eagle while it was weighed and measured before release. This aided the initial assessment of sex based on appearance, behaviour and voice: males tended to be smaller, darker and more nervous and possessed a higher-pitched call. There was however some overlap in the measurements of males and females. Although it now seems likely that three of the earlier imports were incorrectly sexed, ringing recoveries and post-mortem examinations have otherwise confirmed the sexing technique.

Initially the eagles were released singly or in pairs, but latterly as many as six were freed simultaneously. These birds tended to remain together in the vicinity, often attracted back to a food supply by other eagles awaiting release. The feeding stations near the cages were replenished regularly for several months until the young eagles had dispersed or proved able to fend for themselves. Three birds were liberated with tail-mounted radios, but the remote mountainous and coastal habitat proved unsuitable for telemetry. All eagles bore a metal leg ring with a serial number and a return address: the other leg bore a pair of coloured plastic rings to identify each individual. In 1982 patagial wing tags were also fitted, and in 1984 and 1985 they replaced colour bands altogether. The tag colour denoted the year of release, while a single large digit identified each individual. These tags greatly facilitated observations and monitoring in the field. In 1984 the BTO redesigned their standard 26 mm rings, when it was realised that the sea eagles were losing or removing the metal rings. The new rings were made from stainless steel.

All these procedures and methods are described at greater length by Love & Ball (1979) and Love (1983). Costs were kept to a minimum. The major item was the employment of John Love as a full-time Project Manager on Rhum. The cost of initial materials and maintenance were met by the NCC. H Misund’s travel expenses during collection of the eaglets were covered by the World Wildlife Fund. Thus the total outlay is estimated to have been approximately £700 for each bird imported. Survey and nest protection were undertaken partly by the NCC, but mostly by the Royal Society for the Protection of Birds (RSPB) with financial support from the Eagle Star Insurance Group.
5.1 **1975** Plans were set in motion early in 1975 by Martin Ball and Roy Dennis. In late May John Love was recruited on a short-term contract to work with Peter Corkhill, then Chief Warden on the Isle of Rhum. Suitable sites were chosen near Harris in SW Rhum, and two cages, designed by John Love and based on those used in Fair Isle in 1968, were built by NCC estate staff on the island.

Each cage was 24 ft long by 12 ft wide and 6 ft high. It was divided into two separate compartments, each containing a shelter 3 ft square and open to the front and a perching block. Martin Ball went to Norway to assist Dr Johan Willgoths with his coastal sea eagle survey and was replaced a few weeks later by John Love. Four eaglets were collected from two nests in the Bodd area on 25 June, and the following day a Nimrod from Kinloss flew the birds, each in a large cardboard box, back to Scotland.

Food consumption of the four eaglets was monitored from the outset. The only male, Odin, was smaller and more nervous than the three females and was erratic in his food intake, especially after 15 July. He began to get weaker and despite medical advice died on 8 August. A post-mortem by DAFS Lasswade diagnosed kidney failure, but failed to detect what had brought about the condition in the first place. In retrospect perhaps lead-poisoning was involved. The eaglets were fed gulls shot with a rifle rather than a shotgun, but there is the possibility that the male may have ingested a bullet fragment in goat meat or venison scraps.

Juvenile sea eagles, about nine weeks of age, sheltering within one of the large cages: Rhum, July 1980 (J A Love)
The three females thrived and were released on 26 September, 24 October and 1 November. Only the second female did not utilise the food provided near the cages. The first eagle, Loki, was positively identified on Rhum on 31 October but found dead in late November in Morvern, Argyll, 40 miles to the south-east. She was said to have flown into overhead power cables but it is now suspected that she could have been shot.

5.2 1976 Johan Willgoths transferred the responsibility for collecting the eaglets to Captain Harald Misund, a local ornithologist, who is stationed at the Norwegian Air Force base at Bodø. Peter Corkhill accompanied the RAF to collect the 10 eaglets. Meanwhile two additional and improved cages had been constructed on Rhum, and one of the original cages upgraded. One eagle was placed in each of the eight compartments and, once fledged, the final two (and youngest) eaglets were fitted with jesses and placed on a running line.

The arrival of the eaglets at Kinloss was filmed for ITN 'News at Ten'. It was proposed to transport all 10 eaglets by helicopter, but in the end so many TV crew came that there was only room for one eaglet in its box. The rest followed on by the Mallaig charter boat Western Isles.

By this time the project team (consisting of Dr J M Boyd, R H Dennis, Dr I Newton, M E Ball and J A Love) had agreed to retain two males and two females, with a view to establishing a captive-breeding facility on Rhum. The sea eagle takes at least five years to reach maturity, but eventually any captive-bred eaglets would be released, thus removing the need for further importations from Norway. The four eagles were retained on jesses and running lines and provided with troughs of water for bathing and drinking. All this created an increased and full-time requirement for food, so that fish had to be obtained in bulk from Mallaig fish market. Locally caught mackerel were available only from July to September. Gull chicks, goat meat and venison were important additions to the diet.

Dr Johan Willgoths presented a paper on behalf of the project team at a WWF Sea Eagle Symposium in Norway in September. An informal project team meeting was held on Rhum in the summer.

Release of the six eaglets took place from November 1976 to May 1977. Two tethered birds had escaped over the winter but were almost immediately netted and recaptured after being dazzled at night with a powerful torch beam. Tethering materials were then improved and strengthened, but on 4 May 1977 a male, Beccan, escaped again. Because of the bright, moonlit nights he defied all attempts to recapture him. The length of jess attached to his legs provided a valuable marker, however, so that his movements could be followed closely thereafter. He readily adapted to the wild.

A female, Isla, released in May 1977 was found dead on the beach on the Isle of Sanday, near Canna, one month later: she had failed to utilise the food dump. Her release had been filmed by a BBC TV crew for Tony Soper's 'Animal Magic'.
5.3 1977 The project team met in Edinburgh on 31 January, when Douglas Weir of the Highland Wildlife Park, Kincraig, was temporarily co-opted because of his interest in captive-breeding. In March 1977 John Love and Martin Ball spent a week in West Germany at the invitation of Claus Fentzloff. They visited his captive-breeding facility and were able to view several wild pairs of sea eagles in Schleswig-Holstein.

Four eaglets were collected and transported by the RAF Nimrod on 22 June. Additional measurements were made on food consumption of the captive eaglets, which, together with the more extensive series made in 1975, were published in *Bird Study*.

Two of the new sea eagles were released on 18 October. A third was fitted with a tail-mounted radio transmitter (provided by Dr M Marquiss of ITE) and was released on 4 November. It was kept under continuous surveillance for four days until it began to wander further afield and the nature of the terrain, together with bad weather, made further tracking difficult. However, some useful information was gained. The fourth eagle, Cathal, a male, was retained on tethers to replace the male which had escaped in May. Sea eagles, including the escapee with its conspicuous tether, were now being seen regularly on Canna, where they fed on rabbits, seabirds and sheep carrion.

Juvenile sea eagle on a shelter in the fenced enclosure on Rhum. The tether consists of a jesse attached to each leg and meeting at a swivel mounted on a long running line. The bird is thereby able to fly along six metres of cable to a perching block at the other end. (J A Love)
5.4 1978 The project team met at Aviemore on 6 March to discuss captive-breeding, and the captive pairs held at the Kincraig Wildlife Park were inspected. Plans for importation later that year were in hand, but beyond that future importations were in doubt; hence the importance of breeding in captivity and liaising with both Kincraig and Claus Fentzloff. John Love presented a discussion paper on alternative release points, since Rhum's golden eagle were known to have poor breeding success, perhaps owing to pesticides. Shetland and the west of Ireland stood out as the two most suitable alternatives. However, as the infrastructure required for releases was not readily available in either place and there was a possibility of diluting the still small pioneer stock, it was decided to continue on Rhum.

The team were host to Dr Willgoths in early June and he was able to view the captive eagles on Rhum. By this time John Love and Bob Sutton were already clearing a site in the walled garden at Kinloch Castle, which would be used as a large cage for captive stock.

Dr Morton Boyd and Roy Dennis travelled to Norway in June and met various authorities involved in the project, returning on 21 June with eight eaglets. Two were a donation from World Wildlife Fund (Norway).

By now it was apparent that Harald Misund was against the captive-breeding scheme and he expressed willingness to provide further eaglets in the future. In early October one of the tethered females, Colla, took ill suddenly and, despite veterinary advice, died a week later. This highlighted the isolation of Rhum as a long-term captive facility, far from skilled veterinary assistance. Since further importations were assured, it was decided, in accordance with the wishes of Harald Misund, to abandon the captive-breeding scheme. This was done early in 1979.

On 6 July one young female, Shona, apparently suffering from some mineral deficiency, injured both legs against the sides of her cage. This structure was inferior in design to the other three, having a horizontal wooden beam along each wall, and has not been used again. The bird was successfully treated by Glasgow Veterinary College and convalesced with Mrs C Scott and Mr G Watt in Eaglesham. She was returned on 19 October but was imprinted on man and was unable to fly properly. It was decided to retain her as possible captive-breeding stock for Kincraig Wildlife Park, but she died in September 1979.

Two of the 1978 eaglets were released with tail-mounted radios in mid-September, but a period of extremely wet and stormy weather followed (during which the 1976 female Colla took ill - see above) and both radios ceased to function. On 29 September one of the 'radio' eagles was recaptured in the enclosure of the tethered birds. Its plumage was waterlogged but after a few days in captivity it was fit for release again.

The remaining 1978 imports were released on 15-16 October, 15 November and 24 November. The presence of the escaped Beccan around the food dump encouraged the new releases to associate with him, and he was occasionally seen to provide them with food. Doubtless this enhanced their survival and underlined the importance of continuing releases on a long-term basis.
5.5 1979 The presence of the tethered eagles awaiting imminent release and of Beccan flying free in the vicinity encouraged the young eagles to remain together during the early part of the year. Since the captive-breeding scheme had been abandoned, three of the tethered eagles were released (8 February, 6 March and 24 April). The injured 1978 import, Shona, was still captive and served as a useful decoy at the food dump until she died in September.

One long-term captive, Cathal, was found long dead on the Isle of Sanday in mid-August, curiously on the same beach as Isla, found dead in 1976 - perhaps by a quirk of tides and currents. The cause of his death was unknown, but again this bird had rarely utilised the food dump after his release. This was the third recorded death from among 23 birds thus far released.

Six eaglets were imported in June. The vet who was to clear them after the statutory 35-day quarantine period was delayed for three weeks by bad weather, so the first two releases were not until 24 August. The remainder were freed during September. They provided some useful observations over the next few months and were often in the company of the older birds released earlier in the year. A female released in 1977 was also in the vicinity. However, sightings were becoming commoner away from Rhum. With the death of the injured Shona in September, there were now no captives to act as decoys.

5.6 1980 The early part of the year provided many interesting interactions between the released eagles (see Love 1983).

John Love and Martin Ball travelled to Bodd with the RAF on 20 June and were involved in filming with a BBC TV crew. Three days later eight eaglets were flown to Rhum. They included the runt of a brood of three, a bird which would almost certainly have died had it not been removed by H Misund and cared for. It and the other seven eaglets all fledged successfully, and the first two were released on 27 August. Hugh Miles of the BBC came to Rhum to film further releases in early September. The still-caged eaglets attracted some of those previously released, two of which were also filmed. The final programme featured on BBC TV's 'Wildlife on One' series on 8 September 1981 and was well received.

The remaining four eaglets were freed on 16 September and 2 October.

A project team meeting was held on 21 July in Edinburgh, the team now being expanded to include Dr Derek Langslow of the NCC's Chief Scientist Team and Dr Jeff Watson, Development Officer of the Scottish Wildlife Trust (SWT). Roy Dennis now officially represented the Royal Society for the Protection of Birds.

The NCC's funding of the project temporarily ceased on 31 March 1980, but a grant from the World Wildlife Fund was being administered through the SWT. This employed John Love for three months until he was taken on by the RSPB, which funded the project for the remainder of the year.
5.7 1981 At a team meeting in Edinburgh on 28 January, Derek Langslow announced that the NCC would take over the employment of the Project Officer again, on an annual contract. In addition the RSPB received finance from Eagle Star Insurance Group for a temporary warden, Colin Crooke.

Courtship displays, copulation and stick-carrying were becoming more frequent amongst the older birds and at least two adults had paired up (both 1976 releases). Their behaviour in May indicated that they might have a nest in the area.* One likely ledge was located, but it was inaccessible.

Meanwhile, in late April, a 1980 released male, Erin, was found poisoned beside a bait in Caithness. Analysis of both bird and bait revealed Phosdrin: otherwise the bird was in good condition. This was the fourth recorded death out of 37 released, but numerous scattered observations indicated that at least 25 distinct individuals were accountable (66%) - a very encouraging survival rate. One or two other pairs seemed to have formed and were holding territory.

The poor breeding season in Norway meant that it was not possible to take as many eaglets as the licence allowed. Five eaglets were taken to Rhum on 19 June and all fledged successfully. They were freed on 18 September, 29 September, 16 October and 19 October in the presence of up to three older birds.

On 29 October a female sea eagle which had been released in October 1977 was found, long dead, near Dunvegan, Isle of Skye, 47 km north of Rhum. This bird, almost sexually mature, was the fifth recorded death and the second this year found killed by poisoning.

In the annual report the successes to date were summarised as follows.

1 The viability of the technique for the reintroduction of a species hitherto exterminated was established.

2 It was confirmed that the west of Scotland is indeed still suitable to support a population of sea eagles.

3 The birds successfully adapted to the wild, remained in the vicinity of the release site (up to 95% within 50 miles of Rhum) and showed a high survival rate (estimated between 50 and 80%).

4 The eagles identified suitable habitat where they could congregate, allowing pair formation and permitting potential breeding territories to be taken up.

An average of six eagles had been released each year since the project began in 1975. Their survival had been high enough to permit a continued increase in the pioneer population. On the basis of breeding success data from Norway this meant that, for the wild population to provide six recruits each year, at least seven breeding pairs would have to become established. Forty-two had so far been released, of which a maximum of 38 had survived. Only 10 (the 1975 and 1976 imports) could be approaching sexual maturity.

*This was where pair 6 established themselves in a later year. Established pairs are numbered 1-10 and their nest sites lettered, A for the first site, B for a second site, etc.
5.8 **1982** At the project team meeting on 12 February, Derek Langslow became the Chairman. The team assessed the situation thus far and projected that it would be at least 1985 before the wild population could produce enough young to replace Norwegian imports. Harald Misund had intimated that he was willing to step up the effort from now on so that 10 eagles could be imported annually.

No breeding attempts were confirmed, although in 1983 a substantial nest was found at site 2A which had perhaps been constructed in 1982. The long-dead carcass of the 1980 female, Hynba, was found on Canna; she had been unusually dependent upon the food dump even in her second summer and had died some time during the previous winter.

For the first time the RAF had to withdraw from its commitment to transport the eaglets, because of the invasion of the Falkland Islands by Argentina. Fortunately, however, the Norwegian Air Force stepped in and 10 eaglets arrived at Kinloss in an Oriel aircraft on 22 June. Veterinary clearance was not obtained, because bad weather delayed the boat to bring the vet, until mid-September, by which time John Love had been able to attend and address a Bald Eagle Conference (13-15 August) in Rochester, NY, in USA. There he was able to compare notes with several delegates involved in similar restocking or reintroduction projects with bald eagles. The first and most ambitious was begun in New York State in 1976, a year after our own project began.
Eight of the 10 sea eaglets released during late September/early October were fitted with patagial wing tags of brightly-coloured plastic, which greatly facilitated identification of individual eagles in the field. For instance, one of the eagles, Gregor, released on 1 October, remained on Rhum until 9 October, was seen on the nearby island of Muck four days later, and eventually turned up near Stornoway, Lewis, on 19 October, aided in his passage no doubt by the south-easterly gales. (This is the bird pictured opposite.) He remained there until the following spring. Tagging also demonstrated just how many different eagles returned to utilise the food, a feature that had tended to be underestimated when identification relied upon the poorly visible coloured leg rings alone.

The use of the wing tags had finally been agreed at a project team meeting in Inverness on 16 September, and the materials were immediately made available by Dr M Marquiss of the ITE. With a commitment from Norway to continue the provision of eaglets, Derek Langslow was able to confirm that the NCC had agreed to fund the Project Officer until September 1985. Through Eagle Star, the RSPB again employed seasonal wardens in the Hebrides, and their efforts, combined with those of the NCC, were able to confirm that at least two and possibly four pairs had now become established.

5.9 1983 Early in the year there were several sightings of sea eagles in southern England, but these were probably genuine immigrants from the Baltic.

Two nests were located in April. The first (site 2B) was used by two adult females mated to a single adult male; although each laid eggs in this cliff nest, both clutches were damaged in disputes between the females and the nest was abandoned early in May. Nearby a second pair were located in a tree nest (site 1A). It is thought that one bird was only three years of age and its mate four. Their single egg was abandoned in mid-May, during a spell of bad weather. Two or three other pairs were found this spring but as far as is known none attempted to breed. Again using money donated to the RSPB by Eagle Star, it was possible to employ several seasonal wardens who mounted a round-the-clock guard at nest 2B, obtaining much useful data on its unique trio and their incubation rhythms.

This year 10 eaglets were again imported from Norway in June. One of the adults of pair 4 often frequented the cages and once brought in a dead fulmar to the eaglets. All 10 birds were released during August, having again been tagged and colour-ringed. Most returned for several months to utilise the food provided, except number four, which was found dead in the north of Rhum on 21 October.

At the end of the season John Love moved from Rhum to live near Inverness, returning to check up on the situation on Rhum from time to time. Roger Broad (hitherto Assistant Highland Officer of the RSPB) moved to Strathclyde and at a meeting held in Inverness on 16 August he was invited to join the project team. John Love (for the NCC) and Roy Dennis (RSPB) were nominated to handle press enquiries at a personal level, with the Press Officers of the two organisations agreeing to produce joint press statements in future. John Love's book The return of the sea eagle was published by Cambridge University Press in October and received favourable reviews.
At least two more juvenile sea eagles were seen in south-east England during the early part of the year. One was later found dead, in May, in Norfolk and bore a German ring, confirming that these birds (which attracted a great deal of excitement amongst local birdwatchers) were genuine immigrants from the Baltic, where the populations are showing some signs of recovery.

Two breeding attempts were discovered amongst the released eagles. The trio did not breed this year, but the young pair (1) laid a single egg in a new nest (1B). This they incubated for seven weeks before giving up; the egg was collected for analysis and showed no embryo development but neither did it contain unduly high levels of pesticides (see Table 4). The second breeding attempt was made by a new pair (3) which had been located the previous year: they were incubating eggs by late March but abandoned the nest in late April. Although the male was an adult, the female was later determined to be only five years old.

A new nest was located in a spruce tree (5A) but again this pair (5) were immature and laid no eggs. A fourth (adult) pair were frequenting a cliff nest but did not breed. Several other possible pairs had become established.

John Love and Martin Ball travelled to Norway with the RAF. They spent much time with the Norwegian press, two of whom came to Rhum later in the summer to follow up the story. All 10 imported eaglets settled down well on Rhum and were filmed by a TV news crew on 14 August. This event together with an interview with John Love was screened on both ITN and Channel 4 on 20 August.

Releases were begun in early August, when six eagles were set free at once. They remained together in a flock, but the adults of pair 4 were much less in evidence at the cages this year. The remaining four juveniles were freed on 14 and 16 August, and by the end of October most were independent and beginning to move further afield.

There was no formal team meeting during the year. Eagle Star again financed survey and protection at two nests and Britoil agreed to finance a coloured information brochure, written by John Love and to be published by the NCC. Jeff Watson presented a useful analysis of pellets collected to date.
5.11 1985 The year began with a project team meeting in Edinburgh on 30 January 1985. Surveying was begun earlier this year and resulted in the location of several pairs and no less than four nests with eggs. Pair 5 had moved to a cliff site nearby but did not lay. The trio built a new nest in a tree (2C) but also did not lay. Pair 6 consisted of an adult female and a three-year-old male, but they abandoned incubation in late April. The adult pair (4) seemed to have hatched one egg but gave up soon afterwards. Neither nest was accessible to permit a check of the contents. Both these pairs were breeding for the first time. Pair 3, which had laid the previous year, were watched round-the-clock by a seasonal warden, Mike Cook. They were incubating by mid-March and the eggs hatched at the end of April. Unfortunately there then followed a severe snowstorm, in which the two chicks succumbed. Both this and the 6A nest faced due north and received the full brunt of the blizzard.

Only pair 1 remained, this year back on the original A1 (1983) nest, watched continuously by RSPB wardens. They hatched two young in early May, but one died about a month later. Additional food supplies were provided near the nest and the surviving chick fledged in late July. It remained in the vicinity with its parents until the end of the year. This was the first wild sea eagle fledged in Britain for 70 years.

In the mean time, Colin Crooke and John Love had returned from Norway with a final batch of 10 eaglets, all of which fledged successfully. In mid-June, Dr Johan Willgohs and his wife had visited and were shown the successful nest, but it was especially pleasing that Harald Misund and his daughter were able to visit Rhum in mid-August to witness the release of the first six eaglets. The remainder were released on 16 and 18 August. Two Norwegian journalists visited Rhum a few days later to report on the eagles. It was an extremely wet summer, so post-release observations were not as comprehensive as previously.

A press release was issued by the project team about the hatch at the time the eaglets arrived from Norway, and a second statement was issued about the successful fledging six weeks later. The NCC's colour brochure (sponsored by Britoil) was published in June, and the RSPB issued a smaller leaflet (with Eagle Star) later in the summer. A project team meeting was held in Edinburgh on 21 November. John Love, Martin Ball and Jeff Watson were all taking up new posts within the NCC but the team remained intact and Jeff Watson continued to represent the SWT.
Now that importations were to cease and that the first successful hatching had been achieved, the team identified two further aims of the project -

1. to establish sufficient pairs in the wild, with a recruitment sufficient to replace the annual releases of Norwegian eaglets;

2. to establish the species in suitable habitat throughout Britain.

The team remained together to assist further in these aims and to supervise both RSPB and NCC seasonal staff in survey and nest protection.

5.12 1986

For the first time since the project began, no importations from Norway were made.

Pairs 3 and 4 laid clutches in new nests, but neither hatched. An egg from pair 3 was collected for analysis (see Table 4). Pair 6 also made an unsuccessful breeding attempt, while pair 2 (two of the trio) produced a single egg in the tree nest they had built up late in the previous season as a frustration eyrie (2C). The chick died attempting to emerge from the egg. Fortunately pair 1 repeated the success they had shown the previous year. Two young hatched and this time both fledged. Two other pairs established territories but did not lay. Thus five breeding attempts from seven pairs produced two chicks in a single successful nest.

A project team meeting was held in Edinburgh on 27 November. Dr D R Langslow resigned as Chairman owing to a change of duties, and his place was taken by Dr M W Pienkowski of the NCC's Chief Scientist Directorate.

5.13 1987

No less than nine pairs were located holding territories. Three of the newly located individuals bore wing tags.

Pair 7 produced its first egg, but it did not hatch. Pairs 3, 4 and 6 again laid - in new eyries - but none hatched any eggs. For some reason the male of pair 2 reverted to the other female of the 1983 trio, and they had commenced incubation by 9 March! A single chick fledged. Pair 1 again successfully incubated, hatched and reared two chicks, bringing their total to five young in three successive seasons. 1987 was a notable year because two pairs bred successfully. Altogether six pairs laid eggs this year out of nine holding territories.

Two deaths were reported during the year. A 1984-released female was found dead in Torridon in February - the eighth recorded death from 82 releases. One of the young fledged by pair 1 in 1986 was found dead on Skye in May.

A meeting of the project team was held in Inverness on 23 November, attended also by Graham Elliott of the RSPB. In autumn 1987, John Love returned to western Scotland and was contracted by the NCC to co-ordinate work on the sea eagles. This will involve, among other aspects, monitoring and liaison work as the population becomes established.
<table>
<thead>
<tr>
<th>Year</th>
<th>No. of eagles</th>
<th>Colour code</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Imported M F</td>
<td>Released M F</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>3 3</td>
<td>3 3</td>
<td>RED ring left leg</td>
</tr>
<tr>
<td>1982</td>
<td>3 7</td>
<td>3 7</td>
<td>BLUE ring left leg (one with BLUE right): RED/ORANGE wing tags</td>
</tr>
<tr>
<td>1983</td>
<td>3 7</td>
<td>3 7</td>
<td>Large WHITE ring left leg (one right leg): YELLOW tag</td>
</tr>
<tr>
<td>1985</td>
<td>5 5</td>
<td>5 5</td>
<td>No colour rings: PALE BLUE tags</td>
</tr>
</tbody>
</table>
1986 No importation

Five breeding attempts: two chicks fledged at one nest: one later found dead Skye May 1987. Seven pairs holding territory.

1987 No importation

Five (possibly six) breeding attempts: two chicks fledged at one nest and one at another. Nine pairs holding territory.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. Importation</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>No</td>
<td>Five breeding attempts: two chicks fledged at one nest: one later found dead Skye May 1987. Seven pairs holding territory.</td>
</tr>
<tr>
<td>1987</td>
<td>No</td>
<td>Five (possibly six) breeding attempts: two chicks fledged at one nest and one at another. Nine pairs holding territory.</td>
</tr>
</tbody>
</table>

**Totals**

<table>
<thead>
<tr>
<th>Year</th>
<th>1986</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Pairs</td>
<td>39</td>
<td>43</td>
</tr>
</tbody>
</table>

82 released: 5FF and 3MM found dead; otherwise survival high. Six young bred in the wild so far (probably two M and four F) and one found dead.

Isle of Rhum from the mainland at Arisaig (J A Love)
6 Results

6.1 Number imported

From 1975 until 1985 a total of 85 sea eagle chicks were imported. The numbers varied annually, but in each of the last four years 10 eaglets were released (Table 2). Of the 85, three died in captivity during the early stages of the project, one from complications arising from injury and the others apparently from illness and/or disease. Thus a total of 82 sea eagles were successfully reared and released on Rhum, 39 males and 43 females.

6.2 Post-release observations

As the project continued over a number of years, older birds were attracted by the presence of still-captive youngsters. Indeed, one adult made regular appearances over two or three seasons and once even brought a fulmar it had killed to present to the caged eaglets.

Once freed, the youngsters tended to remain together whilst utilising the feeding station. They also freely associated with the older birds, which effectively acted as foster parents. If an adult was seen carrying food (which it might have caught itself or lifted from the feeding station), the juveniles would harry it relentlessly, screaming hungrily. They would swoop up from below, trying to snatch the prey until the adult was forced to yield. The juveniles also pursued each other or other species such as crows and ravens, with apparent disregard for the easier pickings available at the feeding station. Doubtless this behaviour greatly enhanced the survival of the new releases, but even without any foster-parental example they quickly learnt to locate food for themselves. Often they would be attracted to carrion by the presence of other eagles or by squabbling congregations of corvids. Deer-stalking took place on the island from August to December, and the discarded entrails of shot deer provided a convenient additional food source; they also encouraged the young eagles to quarter the island seeking out carrion.

Some young eagles were able to hunt and kill seabirds within a month or so of freedom. By September or October most of the new releases were independent and gradually dispersed out from the release point on Rhum.

6.3 Mortality

Only eight introduced sea eagles have been reported dead - 10% of the 82 birds released. Four of these died in the first year and another, which had been retained on tethers for two and a half years, died within six months of being freed.

A four-year-old female and a first-year male were victims of illegal poisoning. The only other reported cause of death was that of a first-year female which apparently killed herself against overhead power cables, although it is possible that she too was a victim of persecution. Sea eagles, being partly carrion-feeders, are especially vulnerable to poison baits, and indeed this indiscriminate and irresponsible activity doubtless contributed greatly to the species' demise in Britain (Love 1983).
Table 2

Sea eagles imported to and released on the Isle of Rhum (1975-1985)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number imported</th>
<th>Captive deaths</th>
<th>Males</th>
<th>Released Females</th>
<th>Total</th>
<th>Known/ reported wild deaths</th>
<th>Cumulative total</th>
</tr>
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<tr>
<td>1975</td>
<td>4</td>
<td>1M</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1F</td>
<td>2</td>
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<td>1976</td>
<td>10</td>
<td>1F</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td></td>
<td>11</td>
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<td>1977</td>
<td>4</td>
<td></td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>1F</td>
<td>14</td>
</tr>
<tr>
<td>1978</td>
<td>8</td>
<td>1F</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>1979</td>
<td>6</td>
<td></td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>1M</td>
<td>26</td>
</tr>
<tr>
<td>1980</td>
<td>8</td>
<td></td>
<td>5</td>
<td>3</td>
<td>8</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>1981</td>
<td>5</td>
<td></td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1F, 1M</td>
<td>37</td>
</tr>
<tr>
<td>1982</td>
<td>10</td>
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<td>3</td>
<td>7</td>
<td>10</td>
<td>1F</td>
<td>46</td>
</tr>
<tr>
<td>1983</td>
<td>10</td>
<td></td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>1M</td>
<td>55</td>
</tr>
<tr>
<td>1984</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1F</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>3</td>
<td>39</td>
<td>43</td>
<td>82</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Sea eagles bred in the wild (1985–1987)

<table>
<thead>
<tr>
<th>Year</th>
<th>Fledged Male</th>
<th>Fledged Female</th>
<th>Total</th>
<th>Known deaths</th>
<th>Cumulative total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1986</td>
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<td>2</td>
<td></td>
<td>3</td>
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<tr>
<td>1987</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1F</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
The five remaining deaths occurred in unknown circumstances. The birds may have been unable to adapt to the wild; two of them had failed to utilise the feeding stations upon release and a third was seen there only once. All but one of the eight dead birds were between 1 and 14% below average weight. The time of release may also be implicated in failure to survive. Eight sea eagles were released during the spring months and two (25%) of these were later reported dead, contrasting with only six deaths amongst the 74 autumn releases (8%). Perhaps the lengthening summer days encouraged the spring releases to quit the vicinity of the feeding station prematurely, at a time when alternative food supplies, in the form of carrion, were scarce.

It is likely, of course, that other deaths have occurred undetected, but estimates of survival (see later) suggest that these have been few.

6.4 Dispersal

In 1981 surveying beyond Rhum was increased. Before this 969 sightings had been reported - locally, on neighbouring islands or on the adjacent mainland. Not surprisingly about 75% were made on Rhum itself, mostly in the autumn and winter. However, these did not only involve the new releases, as several sub-adult birds returned to the island, albeit temporarily, in autumn and winter. By spring 1982 sea eagles were tending to be recorded 30-60 miles away, largely as a result of increased surveying but also because of particularly stormy weather the previous autumn, and the most distant sightings occurred in the summer. Up to 1981 some 97% of sea eagle sightings were made within 60 miles of Rhum.

This pattern has changed little in recent years as birds attaining breeding age have established permanent territories. It is perhaps interesting to note that the eagles which were wing-tagged in 1982 tended to disperse further afield than any released subsequently. Not only were the 1982 releases made one or two months later, but, as in the previous year, it was also a very stormy autumn. One individual was recorded on Rhum on 13 October but turned up over a hundred miles to the north only six days later, after a period of prolonged south-easterly gales.

6.5 Survival

The distribution and timing of these early reports provided several opportunities to estimate survival. Although colour rings were rarely identified, plumage features, especially moult patterns, facilitated the recognition of individuals in widely scattered localities. By January 1982, for example, at least 20 separate individuals out of 42 then released could be accounted for. Similar estimates were made early in 1984 (62 released) and early in 1985 (72 released). These estimates suggest a minimum survival of about 60%. Since only eight eagles have been found dead, survival could, theoretically at least, be as high as 89%.

Sightings of wing-tagged birds (of known age if not individually recognisable) provided the best estimates of survival. Eight or nine of the 10 released in 1982 were still alive over two years later. Amongst a further 10 released in 1983 seven or eight survived at least until the following spring, as did at least eight of the 10 1984 releases. It is difficult to give similar information for the final 10, tagged in 1985, as no captive birds were then present on Rhum; previously these had served to attract young eagles back, allowing
sightings of tags. However, of the 30 tagged eagles for which adequate figures are available, as many as 80% lived through at least their first year, the difficult period of learning to survive. As more and more eagles were released they tended to congregate at favoured feeding locations or at roosts, whilst older birds became available to assume the role of foster parents.

6.6 Diet

The high survival rates of the sea eagles is firm proof that they have found their habitat perfectly suitable, with adequate, perhaps even abundant, prey. Casual observations accumulated over the years have confirmed the importance of carrion in their diet, especially in winter. Alan Leitch and Jeff Watson analysed 127 pellets from winter roosts of young sea eagles; 166 prey items were recognised, 40% of which comprised carrion in the form of deer, sheep or goats. There was a surprising preponderance of small mammal prey (48%), mostly rabbits and hares, the remaining 12% being bird prey including two grouse, two gulls, three ducks and eight seabirds. These roosts lay some two miles inland and much of the area over which the sea eagles hunted was of course deficient in seabird prey. Furthermore, mammal fur can be over-represented in pellets at the expense of bird and fish remains.

On the other hand, when prey remains are examined at nests, birds tend to be overestimated (Wille 1979). A preliminary analysis was made of 114 such remains from Scotland, together with sight observations of eagles with food, mostly in the summer months. This revealed 51% to comprise bird prey, mostly fulmar Fulmarus glacialis, gulls Larus spp., and duck (Anatidae) but including auks (Alcidae), grouse (Tetraonidae), shag Phalacrocorax aristotelis and hooded crow Corvus corone. The mammal prey made up 27% of the prey items, again mostly rabbits and hares, and carrion a further 16%. The remaining 6% were fish. There are a few reports of fish being caught. One sea eagle became something of a local celebrity by subsisting for several months on fish baits thrown out for it by lobster fishermen. Several other eagles have been seen taking offal discarded from fishing boats. Once a sea eagle was observed appropriating a fish from a heron Ardea cinerea. Another young eagle showed a close interest in an otter Lutra lutra with cubs; these sea-going mammals provide an important source of freshly caught or half-eaten fish for sea eagles in Norway. It is suspected that fish have been greatly underestimated in these studies of sea eagle diet, and indeed the use of automatic cameras at eyries in Greenland has revealed that about 90% of prey items brought to feed eaglets were fish, though collection of prey remains at the same nests suggested that fish made up only a third of the diet (Wille 1979).

6.7 Pre-breeding behaviour

Almost from the outset the young eagles engaged in display flights and mutual calling or even attempted talon-grappling. Such behaviour may have been social interaction rather than actual courtship, and it was only the older birds which were adept at interlocking talons and cartwheeling, an exciting display which is accompanied by frenzied, high-pitched screaming. In their fourth year of life, the eagles began to abandon their nomadic existence and instead took up residence at potential breeding sites. These sub-adults would often indulge in talon-grappling and stick-carrying, some even building crude nest structures.
### Table 3

**Summary of sea eagle nesting attempts (1982-1987)**

Clutch (C) and brood (B) sizes are indicated.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>nest 1A C1</td>
<td>-</td>
<td>nest 1A C1</td>
<td>-</td>
<td>nest 1A C2-B1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>nest 2A C2+2 (trio)</td>
<td>trio</td>
<td>-</td>
<td>nest 3A C2</td>
<td>-</td>
<td>nest 3B C2</td>
<td>nest 2C C1-B1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 3A C2</td>
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<td>nest 3B C2</td>
<td>nest 3C C</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 4A C2-B1 (died)</td>
<td>-</td>
<td>nest 4B C</td>
<td>nest 4C C</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 5A</td>
<td>-</td>
<td>nest 5B</td>
<td>seen in early spring</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 6A C</td>
<td>-</td>
<td>nest 6A C?</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 7A C1</td>
<td>nest 7A C1</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
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<td>-</td>
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<td>9</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?nest 9A</td>
</tr>
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<td>10</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nest 10A</td>
</tr>
</tbody>
</table>

![Adult female incubating in tree-eyrie (J A Love)](image-url)
6.8 Nesting

A summary of nesting attempts (1982-1987) is presented in Table 3.

1981/1982 The first serious attempts at nest-building occurred in 1981 and by 1982 perhaps three pairs had become established. Although copulatory behaviour was observed, no breeding attempt was made. A large tree nest (2A) was found later, which may have been built that spring, but no eggs were laid.

1983 It may well have been the pair that built the 1982 nest which was discovered the following spring on a cliff ledge, only a mile or two distant from it. Two eggs were laid in the 1983 eyrie (2B), but by this time the male was beginning to show a lively interest in a second adult female. She was allowed to share incubation and in fact succeeded in laying her own clutch in the nest, breaking the original clutch in the process. This uneasy triangle of the male with his two females persisted until his original mate was ousted completely. However, in the mean time the second clutch had also been damaged and by mid-May the eyrie was deserted.

A second pair of sub-adults (pair 1) were located a couple of miles away in another tree eyrie, where they incubated a single egg. They too abandoned the nest in mid-May, during a prolonged period of heavy rain and storms. Thus in 1983 two eyries contained eggs but none of the three clutches hatched.

1984 The trio made no attempt to breed. The sub-adult pair moved to a new site (1B) about 1 1/2 miles away. Here they assiduously brooded another single egg for no less than 50 days, but in vain. The egg was collected by the RSPB under licence and analysed by the Institute of Terrestrial Ecology, Monks Wood. Organochlorine levels were insignificant, although the PCBs were slightly high (Table 4). A new pair (3) also laid eggs in the spring of 1984, but unfortunately the eggs were abandoned in mid-May and disappeared, perhaps taken by crows. At least one other adult pair (4) had become established in the mean time. Thus, although two clutches were laid in 1984, again none hatched.

Table 4

Pesticide levels in sea eagle eggs from Scotland (1984-1986)

<table>
<thead>
<tr>
<th>Sample units</th>
<th>1984</th>
<th>In lipid</th>
<th>1986</th>
<th>1986 unhatched</th>
<th>1984</th>
<th>Wet weight</th>
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BHC                 | 1.27 |
Heptachlor epoxide  | 1.59 |
HEOD (from aldrin and dieldrin) | 6.37 |
DDE (from DDT)      | 29.30 |
Polychlorinated biphenyls | 115.61 |
Mercury             | 0.56 |
1985 This year proved much more successful. A new pair (4) produced eggs for the first time; one clutch hatched, but the chicks died almost immediately. Although the female resumed incubating, her second egg proved infertile. Pair 3 also laid again, but the very day the eggs hatched an unexpectedly severe snowstorm occurred and the two young succumbed. This eyrie, in common with a new eyrie (6A) which also contained eggs, faced north and both received the full brunt of the storm. Although pair 6 were still incubating at the time, they abandoned this their first nesting attempt.

In the mean time the trio had finally split up. The male moved to a new site (2C) with his second female and together they built a substantial tree nest. This was completed too late in the season for any eggs to be laid.

Pair 1, now both fully adult, had returned to their first eyrie (1A), where they were diligently sitting on a clutch of two eggs. These hatched in early May, and, although one youngster died at an early stage, the other was reared successfully. It fledged in late July to become the first sea eagle bred in Britain for 70 years. However, the team's elation was tempered slightly by the knowledge that, were it not for the notoriously bad summer of 1985, two other broods might also have fledged, out of no less than four clutches laid that season.

1986 Although the trio were sometimes seen in the vicinity of the 2B nest ledge, the male consistently courted only one female. The other tended to remain near the nest ledge, while the pair regularly frequented the 2C site. Substantial additions were made to this nest during late February and early March with much courtship and copulation attempts. On 18 March one of the pair was found to be incubating. Incubation proceeded uneventfully and hatching was expected towards the end of April. However, on 24 April it was obvious that something was wrong and the nest was abandoned altogether the next day (at least 39 days after incubation had commenced). Although both adults were perched nearby, neither visited the nest that day. Near the edge of the eyrie an almost intact membrane was found, with adhering shell fragments, surrounding a well-developed embryo: this was collected for analysis (see Table 4). Other fragments were insufficient to account for more than a single egg. Thereafter, until mid-July, the adults visited the nest only sporadically. Instead several cliff ledges in the vicinity were used as roosts.
The 2A site continued to he ignored and to fall into disrepair. It appears that this had been built initially by the male and one female of the trio, probably as a frustration eyrie in 1983.

Pair 3 was located in April on a new site (3B), some distance away from their first nest. A clutch of two was laid, but on 14 May the site was abandoned: one intact egg was collected for analysis (see Table 4). Microscopic analysis of fragments of a second egg showed that it had contained a half-grown embryo. Pair 4 also moved to a new site (4B) and incubated during April. From the birds' behaviour a hatch seemed imminent on 11 May, but soon afterwards the site was abandoned. On 25 May the nest was found to contain a single empty egg, apparently holed by a crow.

The eyrie of pair 6 was also used this season, and it is likely that they incubated a clutch, but the site (which is inaccessible) had been abandoned by late May. Pair 5 continued to frequent their cliff site but apparently made no attempt to breed. Another pair (7) were located a short distance away.

Pair 1 (successful in 1985) remained in the area over the winter and by late February were roosting side by side on the eyrie. As in previous years (but unlike pair 2) they maintained a low profile and were rarely seen in courtship display. Mating was observed on the eyrie on 17 March and was repeated shortly afterwards on a hillside nearby. One adult was confirmed incubating on 21 March (seven days earlier than in 1985). Two eggs hatched, one on 28 April (after 38 days' incubation) and the other by 1 May. Both chicks fledged successfully 12 weeks later.

Thus seven pairs were located in 1986: four (possibly five) laid eggs but only one (the successful pair in 1985) hatched and reared two chicks.

1987 No less than nine pairs were located holding territories this year. Three of the newly-located individuals were wing-tagged birds. At least five and probably six pairs produced clutches.

For the first time pair 7 laid producing a single egg which did not hatch. Pairs 4 and 6 used new eyries (4C and 6B) and laid eggs, but none hatched. Pair 3 laid in a new nest (3C) but deserted the site by mid-May.

The male of pair 2 reverted to the original female of the 1983 trio, and together they built up eyrie 2A (a tree nest not used since its discovery in 1983). Incubation had begun as early as 9 March, and a single chick fledged in mid-July.

Although the female of pair 1 had not been in evidence over the winter, both birds returned to eyrie 1A in the spring. Incubation began on 27 March (six days later than in 1986). Two chicks hatched and successfully fledged at the end of July.

Both successful nests had been rigorously protected by the RSPB, and all three chicks were wing-tagged before fledging.
6.9 Nest sites

Of the 20 nests located up to the end of 1987, five were built in trees - four in oaks *Quercus robur* and one in a spruce *Picea sitchensis*. The other 15 eyries were located on largely inaccessible cliff ledges. One of them (2B), the very first one found, was on a rather wet and poorly drained ledge. Such cliff eyries tend to lack much nest material, so the 2B site was built up and improved by the [RSPB](https://www.rspb.org.uk) wardens. Another rather crude eyrie (5A) in the spruce tree was largely reconstructed and consolidated. However, neither artificial nest has yet been used.

Six of the 10 pairs are known to have alternative eyries. Pair 1 has both its eyries in trees while another 'pair' (in fact the trio) possess both a cliff site and two tree sites. A young pair first built a crude tree nest (in the spruce) but now frequent a cliff site: they have not yet laid eggs. The remaining pairs have chosen only cliff sites.

6.10 Age at first breeding

Sea eagles are assumed to reach sexual maturity at five years of age. However, pair 1 made their first breeding attempt when the male was only three years old and the female four. The male of pair 6 was also only three

![Adult sea eagle: Rhum, August 1983. Fully adult birds have pale eyes and a yellow beak. (J A Love)](image-url)
years of age when he first bred, although his mate may have been as old as nine. In pair 3 it was the male who was the elder, breeding at eight years of age whilst his mate was only five. The 1983 trio are thought to have been six or seven years old, while the fourth egg-laying pair (4) were both nine before they bred.

This wide age span at first breeding may be linked to the period spent in captivity. One nine-year-old (of pair 4) and the eight-year-old (of pair 3) had been retained on tethers for three and a half years before they were finally released. Another nine-year-old (also of pair 4) was intended as another long-term captive but escaped after a year. Nearly all of the other sea eagles were released after only two to four months in captivity. Whilst an extended period in captivity may have delayed first breeding for some reason, it is worth noting that it also deterred these birds from moving very far from the release point on Rhum. Hence, also, their nests have been easily located.

Otherwise, in a suitable and vacant habitat, there seems little reason why the sea eagle cannot begin breeding at four or even three years of age. The very young pair (1) may have been stimulated prematurely by the presence of the three adults breeding at the 2A site nearby.

6.11 Egg-laying

Most of the nests were carefully observed and closely guarded. It was not deemed wise to examine the eyrie to determine laying dates, so instead this was deduced from behaviour.

In 1983 the trio (all full adults) laid their first egg between 4 and 6 April. Their next breeding attempt, involving the male and one of the females, took place in 1986. Incubation had commenced by 18 March. The male paired with the other female in 1987 and they laid as early as 9 March. In 1984 pair 1 are thought to have laid around 4 April. In 1985 they laid on 28 or 29 March and the following year a week or so earlier, on 21 March, but in 1987 they laid six days later, on 27 March. In 1987 the male had found a new mate, the spare female from the trio. Pair 4, again adults breeding for the first time, laid as early as 25 March in 1985. Pair 3 were even earlier: in 1984 they were already incubating by 23 March, but they could not have laid much before that date. The following year their second attempt commenced on 17 March.

Age and experience both obviously influence egg-laying, which becomes progressively earlier with each breeding attempt.

6.12 Clutch size

The normal clutch is two, but there are sometimes three eggs and, more rarely, only one (Willgoth 1961). Banzhaf (1937) considered that young females breeding for the first time tended to lay a single egg. This was certainly borne out by the young pair 1, which produced only one egg in each of its first two breeding attempts but two eggs in subsequent attempts. When both females of the trio recommenced breeding in 1986 and 1987 respectively, it appeared that only one egg was laid. The only other clutch
sizes known, the two from the trio's second clutch and probably pair 4's first clutch, both consisted of two eggs.

6.13 Incubation

Sea eagle eggs hatch after an incubation period of 38-40 days (see Loye 1983). The duties are undertaken by both sexes. Detailed watches were made by the RSPB on the 1983 trio (from dawn to dusk), on pair 2 in 1986 (32 hrs) and 1987 (52 hrs), and on pair 1 (throughout incubation in 1984 onwards, for about 9 hours' daylight each day). NCC watchers studied pair 3 (from dawn to dusk throughout incubation in 1985).

It could not always be ascertained which sex incubated overnight: it seemed usual, however, for the female to incubate during the hours of darkness. Thus she took the larger share of incubation (about 75% in pair 1 in 1985). The female tended to incubate for slightly longer in the daylight hours (50-60% in the case of pairs 1 and 3).

Recently the male of pair 2 has taken a much smaller share of incubation (perhaps only 25%). In 1983, with two females, he exhibited a unique incubation regime. For the first week the male and both his partners undertook brooding stints with little aggression between them. However, on 9 April it seems that the first clutch was broken when the second female pushed past her rival on the rim of the nest before 'jumping' onto the eggs to begin her bout of incubation. That day the male had been seen to copulate with the second female while the first was incubating. The following day he attempted copulation with the second female twice, but she resisted each time. On 12 April both females were seen standing side by side on the nest rim while the male was incubating. However, within two more days the first female had been ousted completely; she rarely visited the eyrie, although the male occasionally displayed to her. On 14 April the eyrie was found to contain an intact clutch of two eggs, with the fragments of the earlier clutch scattered around the nest cup. After 8 May the male showed less interest in sitting. The first female was then beginning to reappear at the eyrie, and the second clutch probably became damaged during this time. Within a week the eyrie was abandoned altogether.

Change-overs generally took place on the nest, the eggs being uncovered for only a few minutes. Pair 2 were unusual in that in 1986 the sitting bird often left the nest prematurely to greet the incoming bird with raucous calling. Change-overs with the other female in 1987 were again noisy but tended to take place on the nest.

The longest recorded incubation stints were made by the female of pair 3 - two lasting 4½ hours and one 7 hours, 10 minutes. Only once did the male sit as long as 4 hours, 32 minutes. Nest-lining might be brought to the nest several times during incubation, mostly by the male. Fourteen prey items were brought in by pair 3 during incubation in 1985, compared with 16 by pair 1 that same year. These were usually carried in by the male and this activity seemed to help to initiate a change-over. On only four occasions did the female of pair 3 actually consume the prey on the nest - all during the first three weeks of incubation. Two of the three instances where the female brought prey to the eyrie were immediately prior to the hatch.
Towards the end of incubation males showed less interest in incubation, or else females were increasingly reluctant to let males incubate. In 1985, for instance, during the week preceding the hatch, the male of pair 1 sat for only 19% of the time. The female spent shorter periods off duty and on returning might coax her partner off by gently pecking at his neck. Both parents tended to become more agitated during hatching and would stand repeatedly to look into the nest cup and sometimes to prod the eggs gently with the bill. Thereafter the duty bird would settle with an exaggerated rocking motion and then sit noticeably higher in the nest. In 1987 the male of pair 1 often remained nearby in attendance and was the first to be seen to feed the chick.

6.14 Fledging period

At first the male brought in one or two prey items each day, which either he or the female would tear up to feed to the eaglets. On occasions both adults presented food simultaneously and they were sometimes seen to masticate the food in their bills first. The eaglets were fed regularly and often and without discrimination. The female of pair 2 was, however, much more reluctant to let the male feed the chicks. It was actually two weeks before he was seen to do so, but observations had been intermittent.

Almost at once the female took her turn in hunting, but constant adult attendance at the nest continued into the second week. The parents were noticeably intolerant of crows near the nest and sometimes left the nest unattended for short periods to see off any intruders.

By the third week the chicks were left on their own for longer periods. Thereafter daytime visits by the adults were only to bring food and to feed the eaglets, even in spells of poor weather.

Sibling aggression was at first infrequent and brief, but during the fourth week in the 1985 season pair 1 were experiencing difficulty in catching sufficient prey, perhaps owing to the persistent wet weather. Sibling rivalry became more obvious, and by 5 June (about a month after hatching) only one chick remained alive: the other was never found. Thereafter the RSPB wardens began to leave dead rabbits and hares in the vicinity of the nest, and this extra food was readily accepted by the adult eagles.

As a precautionary measure food was again made available during this period in 1986. The adults were again prepared to accept this, but owing to a poor, wet lambing season there was no shortage of carrion and the chicks were well fed.

By the fifth week the chicks became more active, wing-flapping, preening and picking up small morsels on the nest platform. In 1987 the two chicks of pair 1 were wing-tagged when nearly five weeks old, enabling reliable individual recognition. Eight days later it became apparent that the older chick (a female) dominated the smaller male. The female greedily snatched food from the parents while her sibling cowered to one side. The little male was, however, able to tear up and swallow the remnants when his sister was satiated. Extra food was provided by the wardens just in case, but the male did not suffer much deprivation. Love has noticed similar behaviour in captive chicks, where the smaller was actually more precocious while the larger continued to rely on being fed.
By the end of the seventh week visits by the parents had become infrequent, and they spent less than 10% of their time at the eyrie. During the ninth week the chicks were indulging in vigorous wing exercises, and in 1986 one eaglet wandered along a stout branch, some 2 metres from the nest. Such tentative expeditions by the single 1985 chick had not been noted for a further two weeks.

All chicks fledged at 11 or 12 weeks. The two 1986 eaglets fledged two days apart, while the two chicks of pair 1 in 1987 left the nest only one day apart. They all periodically returned to the nest for a further few days, and indeed pair 2's eaglet in 1987 returned for a period of at least three weeks. Initial flights were short and tentative, and the landings distinctly clumsy and awkward.

One of the 1986 juveniles disappeared a month after fledging and was found dead on Skye, having died in about April or May of the following year. One or two other juveniles remained in the vicinity of the nest for several months.

Both 1986 juveniles were clearly larger than the single 1985 youngster, so were probably two females. The single 1987 eaglet was apparently also a female, making a total of four females and two males fledged. The juvenile later found dead was a female.

6.15 Breeding success

It seems that initial breeding attempts were foiled by the inexperience and/or the immaturity of one or both parents. Inclement weather caused at least two failures, while another resulted from the presence of two breeding females at the same eyrie. The two successful pairs to date nest close to one another, one pair a short distance inland, where they prey to a large extent on rabbits, hares and sheep carrion. All other pairs are coastal, preying more on seabirds.

DDE and PCBs have been detected in all three eggs analysed (Table 41, but especially so in the 1986 egg of pair 3. The overall levels may not be high enough to cause infertility, and indeed the embryo of pair 3's broken egg had undergone partial development (Dr M Marquiss pers. comm.). Furthermore, none of the seven eggshells measured (again by M Marquiss) have been unduly thin, showing a mean thickness of 535 ± 38 μm (range 472-591). Thus there is little at this stage to suggest that organochlorines or PCBs are implicated in egg failure.

Although breeding success to date has been slow, at least 10 pairs have now established territories. Three of the individuals in the recently-formed pairs were the first to be wing-tagged in 1982. From 1982 to 1985 no less than 40 young eagles were released. Thus half of the total sample are only now attaining or have yet to attain sexual maturity. Survival has been high, so the team is optimistic that the white-tailed sea eagle will become firmly re-established in its traditional British and Irish haunts. Although importations ceased in 1985, six wild-bred young have so far fledged in Scotland, and the option remains open for further importations from Norway if they are deemed necessary.
7 Conclusions

The white-tailed sea eagle was one of many raptors to suffer at the hands of man during the 19th century. It was one of several species to be exterminated completely. The marsh harrier *Circus aeruginosus*, honey buzzard *Pernis apivorus* and osprey *Pandion haliaetus* have now become re-established by natural means, while the goshawk *Accipiter gentilis* has built up a small population from falconry escapes (Newton 1979). However, the sea eagle has required intervention by man to initiate recolonisation. The current reintroduction scheme is the third in recent decades and is by far the largest and longest running. Only one other bird, the capercaillie, has been successfully reintroduced to Britain to date, after a number of release programmes undertaken last century in the Central Highlands (Pennie 1950, 1951).

The procedure employed in the current sea eagle reintroduction has proved quite successful. The young eagles adjusted well to the wild. As the project has continued through its 11 years, the presence of some of the earliest releases has tended to enhance the survival prospects of the newly released juveniles. Latterly up to 10 eaglets have been freed each season within a matter of weeks only, encouraging them to remain together in foraging groups. Often these contain one or two older eagles acting as a cohesive presence. Subsequent dispersal has varied, but recent tagging experiments have shown that only after the exceedingly stormy autumn of 1982 did the juveniles tend to scatter further afield.

Only eight of the sea eagles have been reported dead. Nearly all died during their first winter of freedom. One four-year-old and a first-year male were victims of illegal poisoning. The estimated survival rate is high, somewhere between 60% and 90%, indicating that the habitat has remained suitable. Persecution is still a worry but is much reduced compared with last century.

The sea eagle takes some five years to attain sexual maturity, which has resulted in a delay in the first breeding attempts. The earlier imports were retained in captivity for longer. Indeed in the case of the prospective captive-breeding stock (which were held for three and a half years) breeding did not occur until an age of eight or nine years. On the other hand, these birds did show a stronger attachment to the release point, they returned regularly to foster the new releases and ultimately they chose to breed in the immediate vicinity.

In 1985 the first chick was successfully reared to fledging and in 1986 the successful pair again reared two chicks. Up to the end of 1987 17 clutches have been discovered. Initial breeding attempts were foiled by the inexperience and/or immaturity of one or both of a pair, by unfavourable weather or by the presence of two breeding females at one of the eyries. Organochlorine levels in eggs were detected and, like PCB levels, were rather high, though perhaps not high enough to cause concern at this stage (Dr I Newton pers. comm.). Dr R W Furness of Glasgow University has monitored organomercury levels in feathers of the sea eagles. On arrival from Norway, chicks contained from 1 to 6 ppm. The successful breeding pair had only 1 to 8 ppm in feathers; other pairs (feeding to a larger extent on seabirds) had up to 25 ppm. However, at this stage there is nothing to suggest that their failure to breed successfully can be attributed to anything other than immaturity, inexperience and other natural factors.
The build-up in breeding pairs may seem slow, but this may not be unexpected where a species is striving to re-establish itself in long-vacated haunts. An interesting parallel can be found in the natural situation in southern Norway. There the sea eagle is extending south into areas where it was exterminated earlier this century. Dr J F Willgohs (pers. comm.) has discovered that it is a year or two before the new breeding pairs begin to nest successfully.

Furthermore, the rate of success in Scotland has been achieved by only 42 of the 82 eagles released. In the last four years of the project, another 40 have been freed and have yet to attain maturity. Importations ceased in 1985 (with the offer of more eaglets from Norway should it be deemed necessary to top up the stock).

Since 1976 a similar project has been undertaken with bald eagles in New York State, where a once thriving wild population had been reduced to a single breeding pair (Nye 1983). Strictly speaking this is 'restocking' rather than a reintroduction, though several other North American states have now initiated reintroduction programmes.

The first two eagles reintroduced into New York State returned to breed, at an early age of four years. This somewhat unusual circumstance may well have been influenced by the presence of the original wild pair. There is some evidence of the same pattern in the sea eagles, where a three- and four-year-old pair made an early breeding attempt in close proximity to an incubating trio of adults. It was this young pair which finally reared the first chick (at their third attempt). In 1984 and 1985 at least three other pairs were observed becoming established. They included at least one sub-adult.

Thus, after an initially slow start, the number of breeding pairs is likely to increase over the next few years, as the last 40 imports come 'on stream'. In Norway about 50% of nesting attempts are successful, with about 1.6 chicks being fledged per nest. If such an output is maintained in what seems an equally favourable habitat in Scotland, eight to 12 breeding pairs will be required to equal the recruitment which was achieved by the importation programme; six to 10 young imported per annum, together with their high survival subsequently, proved adequate to permit a continuing increase in the pioneer population.
References


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The project team (on whose behalf this paper has been written by John Love) includes Dr M W Pienkowski (Chairman; NCC), M E Ball and J A Love (both NCC), Dr I Newton (ITE), R H Dennis and R A Broad (RSPB) and Dr A J Watson.
(representing the Scottish Wildlife Trust). Past Chairmen of the team have been Dr J M Boyd and Dr D R Langslow (both NCC). The project was initiated also by Dr D A Ratcliffe (NCC).

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Summary

Eighty-two young sea eagles from Norway were released on the Isle of Rhum in the west of Scotland during the period 1975 to 1985. Eight have since been recovered dead, but amongst the remainder survival has been encouragingly high (estimated at 60-89%). The first breeding attempts took place in 1983 and the first young eagle fledged in 1985. Seven pairs were located in 1986, five of them attempting to breed. The successful pair of the previous year succeeded in hatching and rearing two chicks in 1986. Nine pairs held territories in 1987. Six of them laid eggs and two pairs fledged three chicks. One of the 1986 juveniles has since been recovered dead, about nine months after fledging.
11 Bibliography

A list of all the major articles and papers about sea eagles in Britain with a selection of the major press reports


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Appendix

Details of sea eagles released on Rhum (1975–1985)

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39 males (average weight 4.9 kg) 43 females (average weight 6.0 kg)

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