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a review of the literature and historical evidence

J W H Conroy<sup>1</sup> & A C Kitchener<sup>2</sup>

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## **THE EURASIAN BEAVER (*Castor fiber*) IN SCOTLAND**

### **A review of the literature and historical evidence**

**J.W.H Conroy & A.C. Kitchener**

#### **Summary**

The Eurasian beaver (*Castor fiber*) was once widespread throughout Britain and Europe, but demands for its pelt and castoreum, as well as habitat destruction in many areas led to its decline and, by the nineteenth century disappearance from large tracts of its range.

The historical evidence suggests the species was once widely distributed throughout mainland Scotland.

It was once probably fairly common, but by the sixteenth century the species had become extinct.

The main cause of the decline was most likely hunting. Habitat destruction was possibly important in the loss of small isolated beaver populations.

Possible threats to the reintroduction of the beaver to Scotland include those likely to affect the actual reintroduction as well as potential threats associated with successful reintroductions.

Should no suitable habitat be found to permit reintroductions, then serious consideration should be given to creating area which would be suitable for the species.

#### **1 INTRODUCTION**

The Eurasian beaver (*Castor fiber*), Europe's largest indigenous rodent, was once widespread throughout much of Europe and Asia, but because of demands for its pelt, and, to a lesser extent, food and the medicinal properties of the castoreum, the species was heavily persecuted throughout much of its range. This, accompanied in many areas by a loss of suitable habitat, meant that by the end of the nineteenth century it had disappeared from large parts of the continent (Corbet 1974; Yalden 1986; Zurowski 1983). Corbet (1978), in his taxonomic review of the mammals of the Palearctic region, lists the distribution as throughout the wooded parts of the region except for the Mediterranean zone and Japan. Indigenous populations survive on the Rhine and Elbe, in southern Norway, parts of European Russia and north west Siberia. In recent years, beavers, both Eurasian and Canadian (*C. canadensis*) have been extensively reintroduced/introduced into western Siberia,

European Russia, Finland, Sweden, Switzerland, Germany, Poland, Austria and the Netherlands (Corbet 1978; Lavsund 1983; Nolet 1994; Macdonald, Brown & Tattersall in press).

The species, once present in Scotland, has been described by Ritchie (1920) as the rarest and most interesting of all Scotland's fur-bearers. This paper examines the historical, palaeontological and archaeological evidence from Scotland, with a view to:

- \* identifying where beaver remains have been found;
- \* determining its distribution in the country;
- \* estimate when it became, and possible causes for this;
- \* identify factors which might affect any programme to reintroduce the beaver.

## Data Sources

### Written Record

An examination of historical documents has revealed few sources of information about the beaver in Scotland. All were published over 400 years ago.

These are:

Assisa Regis David de Tolloneis

Itinerarium Cambriae: Sylvester Giraldus de Barri (1188):

The Ayr Manuscript.

Bishop Hector Boece (1527): Scotorum Historiae: (Translated by Belleden in 1536).

Sir Robert Sibbald (1684): Scotia Illustrata.

Acts of the Scottish Parliament.

These original texts have not been examined by the authors, rather they restricted their review to more recent publications, and commented on their interpretation of these original texts. These include Neill (1819, 1821), Wilson (1858) and Ritchie (1920).

## Palaeontological and Archaeological Remains

The main sources of information on the discovery of beaver bones in Scotland are Neill (1919, 1921), Gordon (1844), Wilson (1858), Ritchie (1920) and J. Dent (pers. comm.).

In addition, the original records from archaeological digs where beaver bones were found and various vertebrate faunas of Scotland were examined.

Many authors have repeated these original accounts, e.g. Owen (1846) Harting (1880), Lydekker (1896), Alston (1912), Barrett-Hamilton & Hinton (1921) etc.

## **THE BEAVER IN SCOTLAND**

### **Arrival in Scotland.**

The beaver probably arrived in Scotland after the end of Loch Lomond Readvance, at the end of the last glaciation (10,500 years ago), when the appropriate habitat had been established. Recolonisation occurred from continental Europe, via England, before the land bridge was inundated by rising sea levels, possibly 9,500 years ago (Yalden 1991), but because of the lack of evidence of the species on the outer and northern isles (Alston 1880).

### **Palaeontological Remains**

There are very few palaeontological remains from Scotland. These are:

- i. An adult skull, mandible and left innominate bone of the pelvic girdle. These remains, found during drainage operations, were under 5-6 feet of peat moss, at the interface between the marl and peat, in the Loch of Marlee (now also known as Drumellie Loch), Kinloch Parish in Perthshire (GR NO141445). The bones were donated to the Society of Antiquaries of Scotland by Dr. William Farquharson of Invercauld on 16 December 1788. Originally a complete skeleton was found, but only the bones described above survived excavation - the remainder disintegrated. Thought to be a mature animal (Wilson 1858).

When examined by Wilson (1858), the left mandible was damaged.

The bones are in the Perth Museum and Art Gallery (Register no. 1981.925)(M. Taylor pers. comm.).

- ii. Left mandible, part of the zygomatic arch. Found in the same locality on the same date as the bones listed above, and from a second individual. This bone, however, has not previously been reported in the literature. (Held in the Department of Natural History of the National Museums of Scotland in 1994: Register no. Z1994.160.5).

- iii. Berwickshire, 1818. Skull and mandible of a young adult. (Collected October 1818). Found under seven feet of peat moss on marl while draining Middlestot's Bog, 'Estate (GR NT815515) in the parish of Edrom, Berwickshire. Many bones were found, but only the skull and mandible were robust enough to survive excavation (Neill 1921).

Of the teeth, Wilson (1858) comments ....

with all the incisors perfect, their cutting edges sharp, and the peculiar colour enamel, found alike in the recent beaver still subsisting on the outer convexity, though deepened to an almost jet black.

When Wilson (1858) examined the skull it had been damaged, the right zygomatic arch missing. This specimen was believed lost until re-discovered in 1994. During the intervening period it was damaged - the mandible, incisors and most of the molars are now missing. (Edinburgh University no. 1818.30).

On page 267 of the Statistical Account of Scotland for Berwickshire 1841, there is reference to several other beaver heads being found, in the vicinity of Middlestot's Bog. These were less well preserved, and Wilson (1858) concluded that this was approximate evidence of a colony there. The reference to skulls only, and no mention of other articulated parts of the skeleton, suggests that it is more likely these remains were from water borne carcasses which collected in the bog over hundreds, if not thousands, of years.

- iv. Roxburghshire, 1843. At a meeting of the Berwickshire Naturalist's Club in 1843, the discovery of another skull in perfect condition was announced (Johnston 1943; Wilson 1858). This was collected from under eight feet of peat, on the surface of the marl about 20 yards from Linton Loch in Roxburghshire (GR Linton Village: NT776263). The skull was found among archaeological material including horse-shoes and arrow heads, prompting Wilson to conclude that it might date from the Anglo-Saxon period but with a wide margin of error.

The skull is still in excellent preservation, but the incisors have been broken and repaired (Register no. 1930.33.1).

- v. Dumfriesshire. Ritchie (1920) records beaver remains in Dumfriesshire. This was found during the draining of a bog on Sir William Jardine's estate at Jardine Hall, Lockerbie (GR NT135815) (A. Truckle, pers. comm.). The authors have been unable to trace the original reference to this find.

It is interesting to note that the first three named specimens were all recorded under a deep layer of peat, lying on top of, or in, marl, showing that

conditions in the latter are much better for preserving bone than in the more acidic peat moss.

At these sites, remains of large antlered deer were also found alongside those of the beaver (Wilson 1858).

- vi. Morayshire. Gordon (1844) tells of a number bones, including the remains of this ancient denizen of Scotland - the beaver, found by Admiral Duff of Drummuir in a small cave in a sandstone quarry on his estate near Hopeman (GR NJ145699).
- vii. Caithness, Sutherland and West Cromarty. Buckley & Harvie-Brown (1884) and Harvie-Brown & Buckley (1887) report beaver bones being found along with those of reindeer (*Rangifer tarandus*) in different parts of Caithness and Sutherland, but give no further details of locations. Pennie (1982) makes no reference to beaver in his account of the mammals from Sutherland.
- viii. Morayshire. At Sculptor's Cave, Covesea (GR NJ 176709), Benton (1930) found a beaver's right upper incisor. (Department of Archaeology, NMS: Ref. no. HM163-7).
- ix. Berwickshire. While digging a pond during August 1992, Mr. Hamish Morrison found four pieces of tree trunk (two willow {*Salix* sp.}; two birch {*Betula* sp.}) in peat moss 1.5m below the surface of West Morrison Bog, Berwickshire (GR NT604404). By comparing them with reference material in the NMS it is evident that they had been gnawed by beavers. The new material is currently being conserved by the Department of Conservation and Analytical Research (NMS).

### **Archaeological Remains**

Beaver remains have been found at only three archaeological sites in Scotland

These are at

- i. Ardrossan, Ayrshire. Beaver bones were recorded in a shell-mound at Ardrossan (Smith 1894; Ritchie 1920). Shell-mounds are thought to date from Neolithic times and are middens containing mostly molluscan shells, but also bones and human artefacts. The Ardrossan shell-mound was situated on the south west side of Cannon hill close to Ardrossan railway station (GR NS239422). The beavers bones were described as being rare in the shell-mound (Smith 1894). It has not been possible to trace the beaver bones from this site.
- ii. Cleaves Cove, Dalry. In the middle deposit of a cave in Cleaves Cove (GR NS290495) a fragment of the left mandible was discovered (Smith 1889;

Ritchie 1920). (Registered in the Department of Natural History: Ref. no. Z1995 041)

- iii. Edinburgh Castle (GR NT251736). During a recent excavation at the castle a beaver incisor was found in the Dark Ages level (F1382) (F. McCormick, pers. comm.; J. Driscoll, pers. comm.).

### **Historical Evidence.**

Here the authors examine the historical reports and discuss the subsequent interpretation of these observations by later naturalists.

Assisa Regis David de Tolloneis. - written in the mid-twelfth century, during the reign of King David I (1124-1153). This lists the duties paid on the export of a timmer (40) of pelts. Among the many fur bearers mentioned is the beveris (beaver). There is no additional information on the distribution or status of the animals, but, according to Wilson (1858).....

we can scarcely conclude otherwise than that the beaver was then met with in the country, and apparently even in considerable numbers, so that its fur was an ordinarily recognised article of commerce, of native produce.

Sylvester Giraldus de Barri (1188): *Itinerarium Cambriae*. This is an account of the travels of Sylvester Giraldus de Barri of a journey through Wales in 1188. The narrative contains extensive information on the habitat of beavers, their dam construction etc. He also mentions its importance in medicine. The animals were, however, restricted to only one river - the Teivi in Cardiganshire (Owen 1846). Within the text, there is one reference to the beaver in Scotland, where it was allegedly found on only one river.

The Ayr Manuscript. Ritchie (1920) refers to The Ayr Manuscript, written at the time of King Robert the Bruce (1306-1329), probably at a parliament there. In a chapter entitled Pelours or Peltry mention is made of not only the commoner animal skins such as todd, whitret, mertrick and cat but also of beaver and sable. These, however, according to Ritchie (1920), could have referred to skins which had been imported to Scotland and were being re-exported - sable never having been indigenous to Scotland.

Bishop Hector Boece (1527): *Scotorum Historiae*. This account of the history of Scotland, written by Bishop Hector Boece, the first Principal of the University of Aberdeen, was published in 1527

In it he describes the beaver being found in the environs of Loch Ness.....

ad haec Marterilae, Fovinae ut vulgo, Vulpes, Mustellae, Fibri, Lutraeque in

incomparabili numero, quorum tergoraa gentes ad luxum immenso  
precio coemunt.

It is also listed as a source of fur for export (Neill 1821).

Such was the importance of this document that Belleden was instructed by royal decree from King James V, to translate it. The translation (1536), Cronikils of Scotland, however, was not totally accurate. While mentioning the existence of the beaver as one of the fur bearers living on Loch Ness, he failed to translate the references to many of the commoner species listed in Boece's document.

Sir Robert Sibbald (1684): Scotia Illustrata. Sibbald refers to Boece's statement, and without rejecting it, professes his ignorance as to whether or not the species was still indigenous in the country.

Other sources.

- a. In 1424, at the first parliament of King James I (1406-1437), there was a list of tolls on fur bearing animals similar to that produced at the time of King David I (Assisa Regis David de Tolloneis.). While many of the species listed in the twelfth century document appear in the later act, mention of the beaver is conspicuously absent (Laws and Acts of Parliament of Scotland 1682).
- b. The beaver is not included in the list of fur bearing animals upon which export duty had to be paid for shipping through the port of Leith in 1482 (Ritchie 1920).

### **The Disappearance of the Beaver from Scotland**

From the fragmentary evidence available, only one, Boece, contains original information on beaver distribution in Scotland. Giraldus' reference to the species being found on only one river of Scotland should be treated with caution, because his account is second hand, there being no record of him ever visiting Scotland.

There has been much discussion about when the species actually disappeared from this country.

Neill (1919, 1921) is skeptical of Boece's account that it was extant in numbers around Loch Ness in the early sixteenth century. His arguments for this are:

- a. Belleden's translation must be treated with caution because of its carelessness and looseness, referring to the imprecise translation about the wildlife of the Loch Ness area ;
- b. At the time Neill wrote his articles, there was no known published record about the beaver surviving in Scotland to support Boece's claim;
- c. No remains of beavers were found in the vicinity of Loch Ness during the extensive excavation of the Caledonian Canal, at the beginning of the eighteenth century, although the contractors had been instructed to preserve any organic remains, in particular bones, they uncovered. (It should also be pointed out, however, that no bones from any quadruped were discovered during this work.)

Neill (1919) concludes .....

that in the 12th century, the beaver probably still existed in Scotland, but was then a scarce animal.

In contrast, Wilson (1858) accepts that the beaver probably existed in Scotland until the sixteenth century, but in low numbers and in restricted locations.

He argues:

- a. That because the species was included in a list of different animals for which export duty was payable in the twelfth century, it was then relatively common, and not rare as suggested by Neill;
- b. Contrary to Neill (1919, 1921), because Belleden highlighted the animals' existence in his translation of Boece, while failing to include the more commoner species, supports the case for its continued existence at that time.

Owen (1846), commenting on the surviving legislation relating to export duty on animal pelts, argued that just because the beaver was not included in the later fifteenth century document, it did not mean that it was extinct, rather the population could have become so small and the animals so rare, that they no longer warranted legislative action re the export of their skins.

In the most recent review of the beaver in Scotland, Ritchie (1920) concludes that the species could still be found in the sixteenth century, but probably did not survive much longer. Of Boece's observations, he comments that these could have been based on vague tradition, but also argues that at that time, many persecuted

animals in Scotland found refuge in the remoter Highlands, and it is likely that the beaver was one of them .

Darling (1947), in his account of the natural history of the Highlands and Islands of Scotland also mentions Boece, and concludes that the species existed in the Highlands until the fifteenth/sixteenth century, and was hunted for its skin. More recently Smout (1993) puts the date of the disappearance of the beaver to around 1550, but also says that it was already rare in the late Middle Ages.

### **Distribution of the Beaver in Scotland**

The archaeological record shows that beavers were found in Dumfriesshire, Ayrshire and the Scottish Borders in the south and Perthshire, Morayshire and the northern counties (Neill 1991, 1921; Wilson 1858; Buckley & Harvie-Brown 1884; Harvie-Brown & Buckley 1895; Watt, 1907; Ritchie 1920). The narrative of Boece confirms the species was also found in the wild land around Loch Ness.

In addition, Neill (1921) refers to beavers being found in the western regions of Aberdeenshire, but does not identify the source of his reference.

The species, too, was found in Lochaber, Neill (1919) quoting Dr. Stuart of Luss.

It is also highly likely that the beaver was relatively common elsewhere in the west of Scotland. According to Stuart (quoted in Neill (1991) and subsequently in other publications) the highlanders referred to the beaver as either Losleathan (meaning broad tail) or Dobhran losleathan ( the broad-tailed otter), a name which survived in the Highlands until the nineteenth century.

In summary, the beaver once lived in Scotland, and was fairly widely distributed throughout the mainland. There are no records of it from the Outer or Northern Islands of Scotland.

The species was still present in Scotland in the twelfth century, and there is strong indication that it survived longer, possibly until the early sixteenth century, although the evidence for this has been challenged.

## **CAUSES FOR THE BEAVER'S DISAPPEARANCE FROM SCOTLAND**

Wilson (1858) is probably the best historical account of the decline and disappearance of the beaver from not only Scotland, but also from Europe.

### **Hunting for its Pelt.**

Since earliest records, the pelt of the beaver has been much sought after. For example, one of the earliest written reports (940AD) from Wales, details the prices paid for various pelts - the otter, 12 pence; the marten, 24 pence and the beaver, 120 pence (Laws of Howel the Good). This, according to Neill (1819), showed that by the ninth century, the beaver in Wales was being hunted for its pelt, which was held in high esteem, and by the end of that century was becoming rare.

In Scotland, the fact that pelts were collected in such numbers as to warrant an excise duty on their export in the twelfth century, suggests fairly extensive hunting. Also Boece records that foreign merchants came to Scotland to purchase skins.

Ritchie (1920) is in no doubt that man was responsible for the extermination of the beaver in Scotland.

Macan & Worthington (1951) suggested that the species' large size, its thick soft fur and living in colonies, all led to its eventual extinction in Britain.

### **Medicinal Properties**

Beaver castoreum contains salicylic acid (aspirin), and has long been associated with medicine, with records of its potency and use going back over 2,000 years. Sylvester Giraldus de Barri commented the skin is coveted in the west, and the medicinal part of its body, which is coveted in the east. Wilson (1858) detailed the varied medical cures associated with the beaver, and commented that they were still used by physicians on the continent in his day.

We can find no reference to the beaver being hunted solely for its castoreum in Scotland, but feel that the medical prowess of the beaver also played a part in its disappearance from this country.

### **Other Possible Causes**

- i. As food. Beaver was also eaten although there is some discussion as to how palatable it was. Wilson (1858) quotes Streso, a Dutch writer, that beavers were part of the diet in Holland during the Crusades. The tail and paws could be eaten as fish. Beaver bones have been found associated with middens in Scandinavia, but not such remains have been found in Scotland, where they have, however, been associated with shell-mounds.

While beaver may well have been eaten, it is unlikely that this was a serious cause of their demise in Scotland.

- ii. **Habitat destruction.** Habitat destruction in many areas might have had serious implications for the survival of beavers (Zurowski 1983; Yalden 1986). Macdonald et al. (in press) quoting Rackman (1986) include habitat loss as being potentially important for the disappearance of the beaver in Britain. This, however, is unlikely to have been important throughout Scotland, because the species had disappeared from the whole country before there were any large scale changes in land practice. It could, however, have had serious local effects, eg the clearing of a wood and drainage of an area which contained a vulnerable beaver population.

From the information available, we conclude that the main cause of the disappearance of the beaver in Scotland was hunting for its skin. This appears to have been a major activity in Scotland, at least during Mediaeval times, supporting both a local and an export trade.

## **REINTRODUCTIONS OF BEAVER IN SCOTLAND**

### **Isle of Bute**

In 1874, the Marquis of Bute introduced four Canadian beavers into a three to four acre pine wood enclosure, near Rothesay on the Isle of Bute. These were apparently unsuccessful, and a further seven were introduced on 6 January 1875. These settled into the enclosure and soon built dams etc on the stream which flowed through the wood.

Accounts of the initial success of the venture can be found in Brown (1880) (in Harting 1880) and Harting (1880), the latter quoting extensively from Charles Hockins. There is some differences in the two accounts. According to Brown, there were sixteen beaver alive in 1878. Harting, however, states that in December 1877 there were only 12, and these had more than doubled within a year to 26 or 27 in 1878.

Despite this early success, by 1890, the population on Bute had died out (Ritchie 1920).

### **Brodie, near Nairn.**

D. Weir (pers. comm.) has told us of an introduction of beaver at Brodie, near Nairn, but, at present, we have no additional information.

### **Releases in England**

There have also been Canadian beaver introductions in England (Hills 1991).

- a. Sotterley Park, near Beckles, Suffolk. A small colony founded in 1870. Animals, however, quickly escaped from confinement and became established in the park for a couple of years, during which time they successfully bred. The young tried to establish themselves in Benacre Broad (ca. 7 km. from the park), from which all were either killed or captured (Harting 1880).
- b. Leonardslea, Horsham, Sussex. Founded in 1890, this colony thrived for nearly 50 years, with the addition of only two further individuals (in 1917) (Loder 1898; Barrett-Hamilton & Hinton 1921; Hills 1991)

J.S. Baker (in Hills 1991) reports that escaped beavers have recently been recorded in Essex and Somerset, the latter animal surviving in the wild for at least eight years.

### **Releases in Europe**

There have been many releases of beaver, both Eurasian and Canadian, in Europe, these have been comprehensively reviewed by Macdonald et al. (in press).

## **THREATS TO BEAVER REINTRODUCTIONS IN SCOTLAND**

### **Introduction**

There have been several successful reintroductions/introductions of both beaver species across Europe (see Danilov & Kan'shiev 1983; Lahti & Helminen 1974; Zurowski 1992a; Macdonald et al. in press). From these it should be possible to examine the practicalities of reintroducing the species to Scotland, and to see whether or not there are suitable sites in the country to achieve this. We examine what risks and threats there are in any proposed reintroduction.

According to Lever (1985), there are five points which need to be considered when a species is to be reintroduced into an area. These are

- \* the individuals used in the reintroduction are from a tax on as close as possible to that of the original stock;
- \* the removal does not endanger the survival of the donor population;
- \* the causes of the extinction are known and no longer exist, and the reason was not that the species was a pest or dangerous;
- \* suitable food and habitation must be available;

- \* the species is unlikely to become a pest in the existing demographic conditions.

Threats to the success of any beaver reintroduction programme are two fold - first the threats involved in establishing the population-establishment threats and second threat which develop as a result of the species becoming successfully established - established threats.

### **Establishment Threats**

As Lever (1985) pointed out before we reintroduce a species to an area it is important to establish what caused the decline, and that these causes no longer exist. In Scotland, the main cause of the beaver's decline was clearly hunting. If a reintroduction programme is proposed for Scotland, the assumption is that the species will be fully protected, at least during the initial years of the programme. This threat, we can safely assume will be non existent.

It is important to ensure that the proper sites are selected, with the correct tree species composition and that modern day threats, such as pollution are minimal. For example in the reintroduction programme in Netherlands, there was concern about the amount of cadmium in the ecosystem, and it was thought that this might be responsible for the low breeding success of the introduced populations in this area (Nolet 1994). Research from the Netherlands release programme has also showed that after about a year in the area, the levels of cadmium being recorded in the beaver were in excess of 100 ppm dry weight, the level above which kidney damage has been demonstrated in other species (Nolet 1992). See also Hillis & Parker (1993) for the implications of cadmium pollution on Canadian beavers. The quality of the water must be checked to ensure that it is not poor, or polluted, and the soil tested to determine the levels of contamination, particularly heavy metals. For example, on the rivers Rhine and Meuse, where during the 1960s the water quality was very poor, and the level of contamination in the sediments was 27 times higher than in sixteenth century sediments. Also because flooding no longer occurred regularly, due to dam operations further up the rivers, there was clear evidence of decalcification in the soils, which in turn may enhance the uptake of cadmium in the plants and thence to the beavers (Nolet 1994; Otte 1991)

There is the potential threat of a conflict with other conservation interests. For example, beavers have a preference for tree species such as willow, areas of which, large enough to support a reintroduction programme, might also be protected because they are willow.

The threat of predation should be examined, but, at least in Scotland, this is unlikely to be a serious problem. Included in any list of beaver predators in Europe are the wolf (*Canis lupus*), lynx (*Felis lynx*), wolverine (*Gulo gulo*), brown bear (*Ursus arctos*) and fox (*Vulpes vulpes*) (Tyurnin 1984). With the exception of the last named, the other species either were never found in Scotland, or were, by the time beaver numbers were low, themselves extinct or under threat of extinction.

In recent years, the main cause of accidental death throughout Europe has been man-induced - poaching, road accidents and entanglement in nets (Tyurnin 1984; Esteve 1988).

Habitat destruction, urbanisation, industrialisation, modern agronomy and unsympathetic changes in land use are all potential threats to successful reintroductions (Zurowski 1983; Lavsund 1983).

The introduction of *C. canadensis* into an area occupied by *C. fiber* pose a real threat to the survival of the latter. In Finland and Russia, the Canadian beaver is expanding at the expense of the Eurasian species (Lahti & Helminen 1974; Danilov 1992). *C. canadensis* was introduced to France, and there is now concern as the species is expanding and growing from a population of three in 1975 to 50 by 1985. This problem is exacerbated by the development of a group who are very vociferous in their support of the Canadian beaver (Richard 1985). In Poland, however, Zurowski (1983) reported that a small colony of Canadian beavers became extinct following the appearance of the Eurasian species.

Should reintroductions of *C. fiber* be considered in Scotland, it will be important that it is properly supervised and that the necessary legislation is in place to ensure that alien species, such as the Canadian beaver cannot be introduced. Zoos and Wildlife Parks which currently have Canadian beavers in their collections should be made responsible for capturing, or killing, any animals which escape.

Other threats which need to be addressed are the possibility that introduced beavers might be exposed to diseases/illnesses which are alien to them and could have disastrous results for the new population. Macdonald et al. (in press) mention that four animals introduced into the Netherlands died of pseudotuberculosis, which is stress induced. There is, therefore, a need to ensure that the release site is suitable for beavers and that the dangers of stress are minimal.

Periodic pollution episodes on rivers or water courses and modifications of the river bed - eg straightening of banks, dredging etc, all offer potential threats.

### **Established Threats**

Beavers are one of the few mammals which can cut down trees and play a keystone role in riparian forests and modify their environment (Barnes & Dibble 1988; Johnston & Naiman 1990; Zurowski 1992b).

Once a population has become successfully established, it can be subject to a new series of threats which develop because of the success of the reintroduction. For example, Lizarralde (1993) examined the effects of an introduced population of Canadian beavers in Tierra del Fuego - these included

- \* expansion of wetlands;
- \* elevation of water tables;

- \* accumulation of organic material;
- \* modification of the biochemical composition of the water, sediment and soil of the riparian areas;
- \* changes to the nutrient cycles in the boreal forest;
- \* changes to the riparian system of the southern beech forest.

Similar effects have been described for other introductions eg Lavsund (1983) discussing reintroductions of *C. fiber* in Scandinavia, lists felling valuable trees, flooding and destruction or irrigation channels. In Finland, the damage to forest land caused by flooding in areas of beaver varies between 17 and 44 km<sup>2</sup> (Lahti 1981; Rajala 1977), while in Sweden, the beaver was reported to have had a major impact on the current bog, marshes and associated woods (Curry-Lindahl 1967).

Where beaver population populations have expanded into urban area, they have become a nuisance felling valuable trees and damaging river embankments (Lavsund 1983).

Naiman & Melillo( 1984) and Naiman Melillo & Hobbie (1986) described the changes Canadian beavers made to both subarctic and boreal forests.

It is clear that once established, beavers can expand and cause economic damage (eg Sieber & Bratter 1992). They may then be perceived as a threat and demands be made to control the problem. Such demands could then become a serious threat to the introduced beaver population. Monitoring the introduced populations and their effects will need to be an integral part of any reintroduction programme.

## DISCUSSION

The archaeological and written evidence clearly show beavers were was once widely distributed throughout the mainland of Scotland. It is, however, more difficult to get an indication of animal numbers. This is partially because the numbers of bones uncovered are few, when compared with some other places in the UK, such as the Fens (Matthews 1982). In part this is because any Pleistocene remains would have been destroyed during the last glaciation, when Scotland was completely covered in ice. Also, the mainly acid soils of Scotland, with lack of limestone areas, offer limited opportunities for the preservation of bone. Only the most robust elements survive, the skull and mandible. It is noticeable that the palaeontological finds are at the interfaces between the acidic peat moss and the calcified marl, the area best suited to the preservation. Another reason for the lack of palaeontological material is the lack of excavations in Scotland.

The reference in the Statistical Account from Berwickshire referring to the remains of several beavers in the marl at Edrom in Berwickshire, and the fact that in the early

part of this millennium beaver skins were being exported, and a duty being levied on that export, suggests that at one time they were fairly numerous.

When the species became extinct in Scotland is more difficult to determine. In England the species probably disappeared during Saxon times (Fitter 1945), in Wales, if the account by Giraldus de Barris is accurate, towards the end of the twelfth, or beginning of the thirteenth century. In Scotland, the evidence suggests that isolated populations existed until the 15/16th century, but this is a question for discussion (Neill 1819, 1821; Wilson 1858).

The most important cause of the decline was probably hunting, but in the latter years, particularly in the southern part of the country, the destruction key habitat might have hastened the disappearance of small isolated populations. Predation by animals, other than man, was unlikely to have played a significant role in the beaver's disappearance. Most of the species known to predate beavers had either disappeared from Scotland by the eleventh century or were themselves under threat.

Both types of threats likely to affect a successful reintroduction programme should be examined critically. The quality of the habitat must be suitable, including the best combination of tree species, most suitable water regime, water quality, size of release area etc. Much can be learnt from reintroduction programmes in Europe. It is also important at the planning stage to consider the threats imposed by a successful programme and the implications for further reintroductions. Problems can occur as populations grow and expand, and while these may not be on a large national scale, they might, none the less, be locally important, eg damage to a nature reserve, excavation of river banks etc. A regime to combat and compensate for such events needs to be established before any reintroductions take place.

## **BEAVER REINTRODUCTION TO SCOTLAND THE NEXT STAGES**

It is highly likely that the beaver can be successfully reintroduced into Scotland, should suitable habitat be found. The experiences in Europe will serve as a useful baseline.

Before considering any release we need to:

- \* identify suitable sites
- \* develop a release programme
- \* produce standard protocols to control beaver numbers and to compensate for damage.

Should no suitable be found, and there is a desire to reintroduce the species, then the possibility of creating suitable habitat should be considered.

### Identification of Suitable Sites.

- a. Firstly examine beaver introductions elsewhere in Europe and identify the key habitat feature required for a successful reintroduction programme.
- b. Once the key habitat has been determined using existing databases, including GIS, such as the ITE Countryside Information System and Land classification (see Bunce, Barr & Whittaker 1981; Barr, Bunce, Clarke, Fuller, Furse, Gillespie, Groom, Hallam, Hornung, Howard, & Ness 1993), identify potential areas which might be suitable for beaver reintroductions. Refine these potential areas by use of other databases, such as tree surveys and an examination of SSSI designations etc.
- c. Having identified an area, carry out a detailed survey, and should it prove suitable for reintroduction, produce a management plan for the site to maintain and enhance its suitability for beaver.

### Development of a Release Programme

Any release programme should be under licence, only in areas agreed as suitable for beaver release, and contain details of how the released population is to be monitored.

It is important to learn the lessons from the introductions of other high profile species in the UK, where their success, methodology and value have often been questioned, eg the otter (*Lutra lutra*) reintroductions in East Anglia (Mason 1991).

### Protocols to Deal with Problems.

Agreed protocols should be produced to deal with potential problems of reintroductions, including methods for controlling the population and how the release programme will be ended should it prove to be impractical. Some of these could be used in subsequent discussions with people (eg neighbouring farmers) and agencies regarding the reintroduction programme.

### Creation of Suitable Habitat

If, for example, the species diversity of the countryside would be enhanced by the introduction of beaver, but that, at present, no suitable habitat exists, consideration should be given to the creation of such habitat.

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- Mr. M. Taylor, Perth Museum and Art Gallery, Perth.
- Mr. A Truckle
- Dr. S. Tunnicliffe, British Geological Survey, Edinburgh.

Figure 1. Approximate position of the records of beaver in Scotland

Key

- \* Site where bones were found
- [ ] Area where bones were found - no definite sites located
- { } Area mentioned in literature

- |     |                                       |          |
|-----|---------------------------------------|----------|
| 1.  | Berwickshire: Middlestot's Bog, Edrom | NT815515 |
| 2.  | Roxburghshire: Linton Loch            | NT776263 |
| 3.  | Berwickshire: West Morrison Bog       | NT604404 |
| 4.  | Edinburgh: The Castle                 | NT251736 |
| 5.  | Dumfriesshire; Lockerbie              | NT135815 |
| 6.  | Ayrshire: Dalry, Cleaves Cove         | NS290495 |
| 7.  | Ayrshire: Adrossan                    | NS239422 |
| 8.  | Perthshire: Loch of Marlee, Kinloch   | NO141445 |
| 9.  | Morayshire: Hopeman, Drummuir         | NJ145699 |
| 10. | Morayshire: Covesea; Sculptor's Cave  | NJ176709 |
| 11. | Caithness/Sutherland/Rossshire        |          |
| 12. | Loch Ness Area                        |          |
| 13. | Lochaber Area                         |          |
| 14. | West Aberdeenshire                    |          |

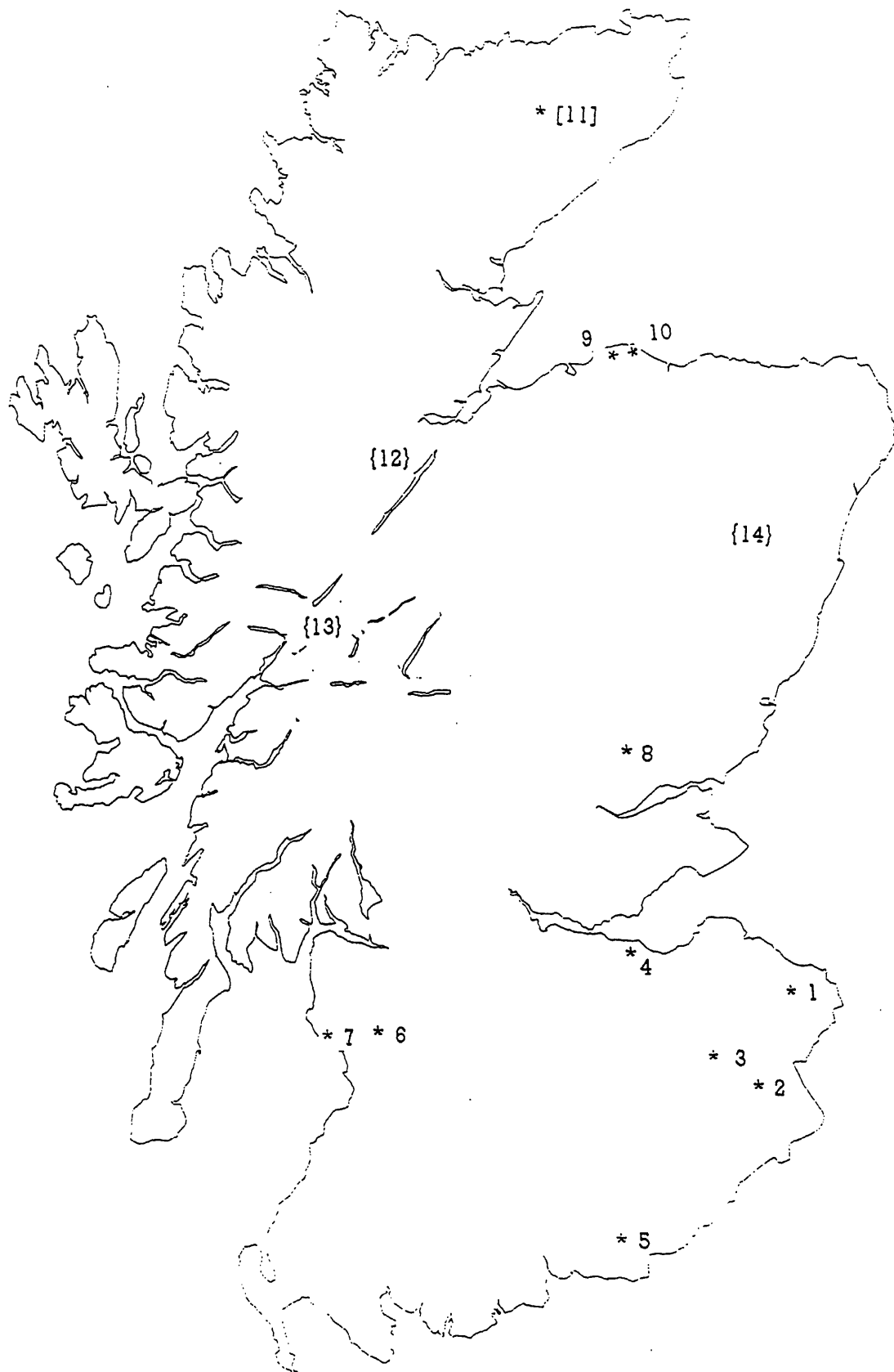


Figure 1. Approximate position of the records of beaver in Scotland

## SCOTTISH NATURAL HERITAGE

Scottish Natural Heritage is an independent body established by Parliament in 1992, responsible to the Secretary of State for Scotland.

Our task is to secure the conservation and enhancement of Scotland's unique and precious natural heritage - the wildlife, the habitats, the landscapes and the seascapes - which has evolved through the long partnership between people and nature.

We advise on policies and promote projects that aim to improve the natural heritage and support its sustainable use.

Our aim is to help people to enjoy Scotland's natural heritage responsibly, understand it more fully and use it wisely so that it can be sustained for future generations.