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Carorita limnaea (Araneae: Linyphiidae) and other Araneae at Wybunbury Moss, Cheshire — a unique refuge for two relict species of spider in Britain

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Summary

The distribution of the endangered, British Red Data Book status 1, linyphiid spider, *Carorita limnaea* (Crosby & Bishop) is described at Wybunbury Moss, Cheshire. *C. limnaea* was not recorded during a survey of ten other schwingmoors in Cheshire, Shropshire, Staffordshire and Clwyd. Both it and *Gnaphosa nigerrima* L. Koch are relict species, apparently restricted in Britain to Wybunbury Moss. One hundred and thirty-three spider species are recorded from the site. Eleven species of harvestmen and one pseudoscorpion are also recorded.

Introduction

In 1994 English Nature funded a Liverpool Museum survey to determine the status and conservation requirements of *Carorita limnaea*, a minute linyphiid spider known in Britain only from Wybunbury Moss, Cheshire (Grid ref. SJ 697503). It was first recorded there in 1962 (Duffey & Merrett, 1963) and subsequently by J. R. Parker in 1970 and C. Fulton in 1982 (English Nature, 1991), and S. Dobson and J. D. Stanney in 1993 (Scott, 1993). The possible threats to its survival at this site were briefly summarised by Merrett (1991).

Little is known about the biology of this species. It is rare throughout its extensive Holarctic range and is recorded from the United States, Belgium, Germany, Sweden and Finland (Duffey & Merrett, 1963) and recently, from a number of river basin sites in north-east Asia (Marusik, Eskov & Kim, 1992), and Canada and throughout northern Asia (see Eskov, 1994).

The site

Wybunbury Moss is a National Nature Reserve (NNR) and a Site of Special Scientific Interest which is given Grade 1 Status in the British Nature Conservation Review (Ratcliffe, 1977). It is positioned almost centrally in the recently designated Midlands Meres and Mosses Ramsar Site and is one of the two best examples of schwingmoor in the British Isles (English Nature, 1991). Chartley Moss NNR, Staffordshire (Grid ref. SK02-28-) and Wybunbury Moss are “subsidence raised mires” and are structurally unique in Britain. They are of great scientific importance within a national and a European context (English Nature, 1991).

The Reserve is small (11.43 ha), very compact, with different habitats compressed together, and is surrounded by 3.8 ha of wet pasture, which is also managed by English Nature. It is not contiguous with any areas of known ecological importance, being isolated in an agricultural and urban landscape.

Four major plant communities occur in the Reserve — *Sphagnum* lawn; pine woodland; fen woodland; and mixed birch, oak, and rowan woodland (Poore & Walker, 1958; Green & Pearson, 1968). These, together with the surrounding wet grassland were most recently mapped in the site management plan (English Nature, 1991). The post-glacial history of the site was discussed by Green & Pearson (1977).

Its small size and isolation make the site vulnerable, particularly to run-off water containing fertiliser from surrounding agricultural land and until recently, to eutrophic water from adjacent houses. This pollution extends across nearly two-thirds of the site and has led to the deterioration of the surface-floating peat raft and in several places to its collapse and also to the spread of rheophilous mire communities (Rieley & Page, 1990). This is a potential threat to *C. limnaea* and other spiders.

Recent management at the site has included the reversal of the successional advancement of pine/birch woodland on the *Sphagnum* lawn and the successful instalment of a pumped drainage system to stop household pollution.

Wybunbury Moss is treacherous and access is strictly controlled by English Nature.

Methods

Field collecting skills were balanced by repeatable fixed-point trapping, sieving and sweep-netting which maximised the recording of spiders and reduced the risk of failure due to over-reliance on one technique. The repeatable samples were collected at 14-day intervals between 30 June and 8 September 1994. Hand-searching began on 23 June 1994. Voucher specimens are stored at Liverpool Museum.

The *Sphagnum recurvum*-dominated lawn was intensively surveyed because all previous site records for *C. limnaea* were from *Sphagnum*. Areas where the lawn grades into tall pine woodland were surveyed and the marginal wet grassland was also investigated because the closely related *C. paludosa* Duffey occurs in open fens. The fen woodland was only briefly visited and the mixed woodland was ignored.

Pitfall trapping: Eleven, 10 m square pitfall grids with nine 80 mm diameter catering cups in a 3 × 3 matrix, containing 10% formalin/ethylene glycol solution, were set — seven on the schwingmoor along two transects laid out at right angles across the axes of the mire, one in pine woodland and three in marginal wet grassland (Fig. 1). Wire mesh domes prevented the capture of small mammals and a “double cup system” minimised disturbance when the traps were emptied. Pitfalls were found unsuitable for use in wet fen and unstable parts of the schwingmoor.

Sieving: A two-gallon (9 l) bucket was filled with *Sphagnum*/fen/carr litter from nine points within a 3 m square, at eight sampling stations on the schwingmoor and four in the peripheral wet grassland (Fig. 1). Samples were sieved twice, for 10 minutes, using a 35 cm

diameter sieve with 7 mm square mesh. The concentrated samples were placed in plastic bags and sorted by heat extraction at the Museum, over a 10-day period, using Burkard Tullgren funnels.

Sweep-netting: Fifty sweeps were made along two transects on the schwingmoor and four in the marginal wet meadows (Fig. 1).

Hand-searching: Three person days, spread over six visits, were spent searching 22 “promising” areas chosen at the discretion of the surveyor.

Other sites: Five person days were spent searching ten other schwingmoors: Abbots and Shemmy Moss, Cheshire (SJ59-68-), 19 July 1994; Black Lake, Cheshire (SJ 538709), 19 July 1994; Flaxmere, Cheshire (SJ 555724), 19 July 1994; Little Budworth Country Park, Cheshire (SJ 587657), 19 July 1994; Brown Moss, Shropshire (SJ56-39), 26 July 1994; Clarepool Moss, Shropshire (SJ43-34), 26 July 1994; Chartley Moss, Staffordshire (SK02-28-), 29 July 1994; Cranberry Bog, Staffordshire (SJ74-50-), 20 July 1994; Llay Bog, Clwyd (SJ 322554), 12 July 1994; Vicarage Moss, Clwyd (SJ 360540), 12 July 1994.

Results

C. limnaea: Ninety-three specimens were collected from 16 June–8 September from 29 sampling stations (Fig. 1). Thirteen (11♂ 2♀) were from pitfalls, 37 (8♂ 29♀) from concentrated sievings, and 43 (13♂ 30♀) from hand-searching, but none was sweep-netted. It was found to be widely distributed in the schwingmoor, where it occurs in low numbers, always in *Sphagnum*. “Hot spots” were along the south-facing northern margin of the schwingmoor (14 specimens), in a recently cleared area to the north of the schwingmoor (17 specimens) and on the extreme eastern end of the lawn, where there is some stunted pine (15 specimens). One

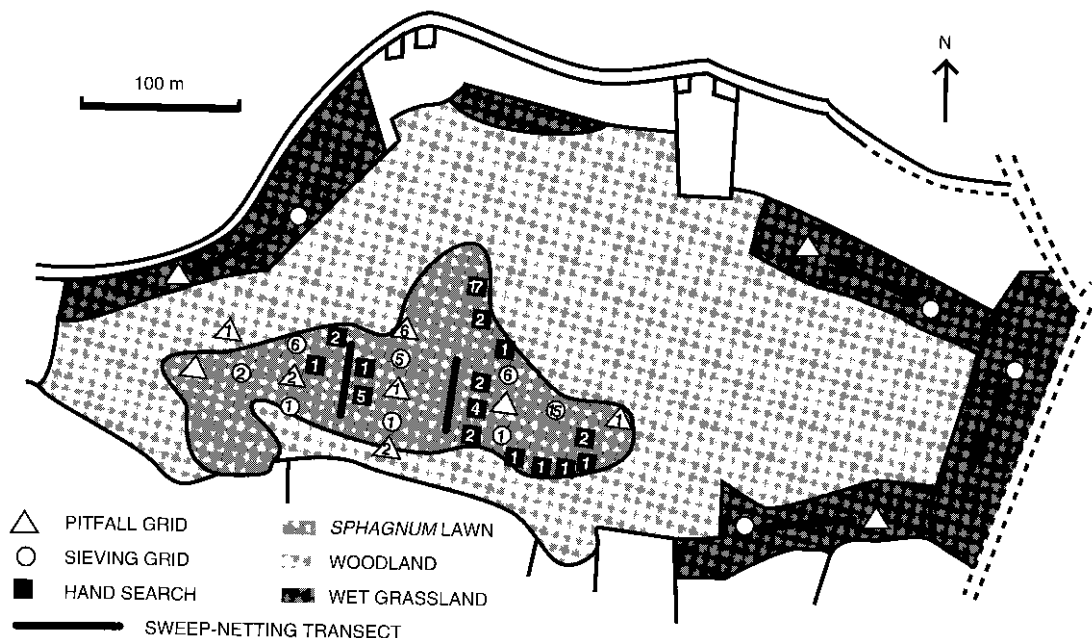


Fig. 1: Location and number of *Carorita limnaea* specimens collected at Wybunbury Moss. All fixed-point sampling and successful hand-search areas are indicated.

specimen was recorded from *Sphagnum* in the pine woodland, but none was recorded from the fen woodland or wet grassland, nor was it recorded at any of the other ten sites visited.

Females were recorded in all sampling periods from 16 June to 8 September, and males from 16 June to 25 August. There was some indication that peak numbers of males occurred in June and early July, and females in late July and August, but the numbers were small.

Other species: One hundred and thirty-three spider species were recorded from the site, of which forty-seven are new site records and are printed in bold type in Table 1. A further seven species previously recorded from the site, but which were not found during this survey, are: *Gnaphosa leporina* (L. Koch), *Clubiona corticalis* (Walckenaer), *Xysticus erraticus* (Blackwall), *Tegenaria silvestris* L. Koch, *Theridion melanurum* Hahn, *Hypselistes jacksoni* (O. P.-Cambridge) and *Agyneta subtilis* (O. P.-Cambridge). The record of *Agyneta cauta* (O. P.-Cambridge) in Duffey & Merrett (1963) is *A. olivacea* (Emerton) (P. Merrett, pers. comm.).

It must be emphasised that recording at the site was greatly biased towards the *Sphagnum* lawn and limited to a short time period. The lower number of species given for the other habitats in Table 1 does not reflect their likely fauna.

The first British specimens of *Gnaphosa nigerrima* were discovered in two pitfall grids in the south-east corner of the schwingmoor at Wybunbury Moss on 30 June 1994. This species also appears to be restricted, in Britain, to this site (Felton, 1997).

The schwingmoor at Wybunbury supports a unique and nationally important assemblage of Red Data Book spiders. Two species, *C. limnaea* and *G. nigerrima*, are recorded from nowhere else in Britain and a third, the RDB 3 jumping spider, *Sitticus floricola* (C. L. Koch) is very restricted (Merrett, 1991; Wallace & Wallace, 1991) (at least four other Red Data Book invertebrate species are also recorded from the Reserve).

The only other notable British spider species recorded, that is associated with *Sphagnum* bogs, was the linyphiid *Notioscopus sarcinatus* (O. P.-Cambridge). Paradoxically, the remaining species are all local or common in distribution throughout Britain. Many species on the *Sphagnum* lawn, such as *Salticus cingulatus* (Panzer), *Theridion mystaceum* L. Koch and *Nuctenea umbratica* (Clerck) were associated with dead and dying pine and birch. Others, such as *Episinus angulatus* (Blackwall) and *Crustulina guttata* (Wider), were on and under heather.

Interestingly, although *Pirata piraticus* (Clerck) and *Trochosa terricola* Thorell were present, their respective congeners *P. tenuitarsus* Simon and *T. spinipalpis* (F.O.P.-Cambridge), which are also associated with *Sphagnum*, were not recorded.

The harvestmen *Nemastoma bimaculatum* (Fabricius), *Oligolophus tridens* (C. L. Koch), *Paroligolophus agrestis* (Meade), *Lacinius ephippiatus* (C. L. Koch), *Mitopus morio* (Fabricius), *Phalangium opilio* Linnaeus, *Opilio parietinus* (Degeer), *Rilaena triangularis* (Herbst),

Lophopilio palpinalis (Herbst), *Leiobunum rotundum* (Latreille) and *L. blackwalli* Meade, and the pseudoscorpion *Neobisium muscorum* (Leach) were also recorded.

Discussion

Carorita limnaea: The Red Data Book 1 (Endangered) status, given to this species in Bratton (1991), is fully justified. The invertebrates of British lowland peat mosses have been surveyed intensively during the last ten years, e.g. at Thorne Moors, Yorkshire (Skidmore *et al.*, 1985), Welsh sites (Holmes *et al.*, 1991), five Cumbrian sites (Drake *et al.*, 1989), Chartley Moss NNR, Staffordshire (Procter, 1987), Fenn's, Whixall and Bettisfield Mosses NNR (Liverpool Museum, 1994). There were, however, no additional records for *C. limnaea* and the species is still only known from Wybunbury Moss in Britain.

The results suggest that *C. limnaea* is not in immediate danger at Wybunbury Moss. It is restricted to the *Sphagnum* lawn where it is widely distributed, but uncommon. It was caught in pitfalls and must, therefore, sometimes occur on the surface of the lawn. However, the small numbers trapped compared with those found in the concentrated sieving samples suggest that it is more abundant within *Sphagnum*.

It was most frequently collected in three warm, south-facing, sheltered areas, where there is a transition between open *Sphagnum* lawn and pine. This habitat is being actively created by felling pine and "opening-up" the margins of the *Sphagnum* lawn or by allowing pine to invade the *Sphagnum* lawn and remain in isolated pockets. Post-1985 management work aimed at reversing the successional advancement of pine/birch woodland on the *Sphagnum* appears to have been successful. Continued management of this pine/*Sphagnum* ecotone will be essential for the future conservation of this spider at the site.

C. limnaea is unlikely to suffer from human disturbance, as the site is a restricted access Reserve and its use for educational purposes has been generally discouraged. Aerial pollution and global warming are potential long-term threats to the sensitive *Sphagnum* communities which support *C. limnaea*.

Collecting techniques: The pitfall trapping was not particularly effective in relation to the collection of *C. limnaea*, but it was very successful for other spider species. It was difficult to set pitfalls flush to the surface of the *Sphagnum* and the lip of the cup may have prevented capture of *C. limnaea*. Sieving and hand-searching in the field provided distributional records and were slightly more productive than the concentrated sampling/Tullgren funnel method.

The sampling programme has enabled an assessment of the distribution and abundance of *C. limnaea* at Wybunbury. It does not explain the precise microhabitat requirements, which might, for instance, be the raised, drier areas around pine stumps. The absence of *C. limnaea* from *Sphagnum* elsewhere in Britain suggests that there may be something special about Wybunbury.

	A	B	C		A	B	C
<i>Amaurobius fenestralis</i> (Stroem)	+	+	-	<i>W. nodosa</i> (O. P.-Cambridge)	+	-	-
<i>Dictyna arundinacea</i> (Linnaeus)	+	-	+	<i>W. atrotibialis</i> (O. P.-Cambridge)	+	-	-
<i>Segestria senoculata</i> (Linnaeus)	+	-	-	<i>W. nudipalpis</i> (Westring)	+	-	-
<i>Drassodes cupreus</i> (Blackwall)	+	-	-	<i>W. furcillata</i> (Menge)	+	-	-
<i>Haplodrassus signifer</i> (C. L. Koch)	+	-	-	<i>W. vigilax</i> (Blackwall)	+	-	-
<i>Zelotes latreillei</i> (Simon)	+	-	-	<i>Dicymbium nigrum</i> (Blackwall)	+	-	-
<i>Gnaphosa nigerrima</i> L. Koch	+	-	-	<i>D. tibiale</i> (Blackwall)	+	-	-
<i>Clubiona reclusa</i> O. P.-Cambridge	+	+	-	<i>Hylyphantes graminicola</i> (Sundevall)	-	+	-
<i>C. lutescens</i> Westring	+	-	-	<i>Gnathonarium dentatum</i> (Wider)	+	-	-
<i>C. brevipes</i> Blackwall	-	+	-	<i>Gongylidium rufipes</i> (Linnaeus)	-	+	-
<i>C. diversa</i> O. P.-Cambridge	-	+	-	<i>Hypomma bituberculatum</i> (Wider)	+	-	-
<i>Scotina gracilipes</i> (Blackwall)	+	-	-	<i>Maso sundevalli</i> (Westring)	+	-	-
<i>Phrurolithus festivus</i> (C. L. Koch)	+	-	-	<i>Peponocranium ludicrum</i> (O. P.-Cambridge)	+	-	-
<i>Zora spinimana</i> (Sundevall)	+	+	+	<i>Pocadicnemis pumila</i> (Blackwall)	+	-	-
<i>Xysticus cristatus</i> (Clerck)	+	+	+	<i>P. juncea</i> Locket & Millidge	+	-	-
<i>X. ulmi</i> (Hahn)	+	-	-	<i>Oedothorax gibbosus</i> (Blackwall)	+	-	-
<i>Ozyptila trux</i> (Blackwall)	+	-	-	<i>O. fuscus</i> (Blackwall)	+	-	-
<i>Philodromus dispar</i> Walckenaer	-	-	+	<i>O. retusus</i> (Westring)	+	-	-
<i>P. cespitum</i> (Walckenaer)	-	+	-	<i>Cnephalocotes obscurus</i> (Blackwall)	+	-	-
<i>Tibellus oblongus</i> (Walckenaer)	+	-	-	<i>Tapinocyba pallens</i> (O. P.-Cambridge)	+	-	-
<i>T. maritimus</i> (Menge)	+	-	-	<i>Lophomma punctatum</i> (Blackwall)	+	-	-
<i>Salticus cingulatus</i> (Panzer)	+	-	-	<i>Gongylidiellum vivum</i> (O. P.-Cambridge)	+	-	-
<i>Heliophanus flavipes</i> (Hahn)	+	-	-	<i>Micragus herbigradus</i> (Blackwall)	+	-	-
<i>Neon reticulatus</i> (Blackwall)	+	-	-	<i>Notioscopus sarcinatus</i> (O. P.-Cambridge)	+	-	-
<i>Euophrys frontalis</i> (Walckenaer)	+	+	-	<i>Diplocephalus permixtus</i> (O. P.-Cambridge)	-	+	-
<i>Sitticus floricola</i> (C. L. Koch)	+	-	-	<i>D. latifrons</i> (O. P.-Cambridge)	+	-	-
<i>Pardosa palustris</i> (Linnaeus)	+	-	-	<i>D. picinus</i> (Blackwall)	+	-	-
<i>P. pullata</i> (Clerck)	+	+	+	<i>Araeoncus crassiceps</i> (Westring)	+	-	-
<i>P. amentata</i> (Clerck)	+	-	+	<i>Erigone dentipalpis</i> (Wider)	+	-	-
<i>P. nigriceps</i> (Thorell)	+	-	+	<i>E. atra</i> Blackwall	+	-	-
<i>Alopecosa pulverulenta</i> (Clerck)	+	-	+	<i>Leptorhoptrum robustum</i> (Westring)	+	-	-
<i>Trochosa terricola</i> Thorell	+	-	-	<i>Carorita limnaea</i> (Crosby & Bishop)	+	-	-
<i>Pirata piraticus</i> (Clerck)	+	-	-	<i>Aphileta misera</i> (O. P.-Cambridge)	+	-	-
<i>P. hygrophilus</i> Thorell	+	-	+	<i>A. olivacea</i> (Emerton)	+	-	-
<i>P. uliginosus</i> (Thorell)	+	-	-	<i>A. ramosa</i> Jackson	+	-	-
<i>P. latitans</i> (Blackwall)	+	-	-	<i>Meioneta saxatilis</i> (Blackwall)	+	-	-
<i>P. piscatorius</i> (Clerck)	+	-	+	<i>Microneta viaria</i> (Blackwall)	+	-	-
<i>Pisaura mirabilis</i> (Clerck)	+	-	+	<i>Centromerus arcanus</i> (O. P.-Cambridge)	+	-	-
<i>Hahnia pusilla</i> C. L. Koch	+	-	-	<i>C. dilutus</i> (O. P.-Cambridge)	+	-	-
<i>Episinus angulatus</i> (Blackwall)	+	-	-	<i>Saaristoa abnormis</i> (Blackwall)	+	-	-
<i>Crustulina guttata</i> (Wider)	+	-	-	<i>Bathyphantes approximatus</i> (O. P.-Cambridge)	+	-	-
<i>Steatoda bipunctata</i> (Linnaeus)	+	-	-	<i>B. gracilis</i> (Blackwall)	+	-	-
<i>Theridion sisyphium</i> (Clerck)	+	+	-	<i>B. nigrinus</i> (Westring)	+	-	-
<i>T. impressum</i> L. Koch	+	-	-	<i>B. parvulus</i> (Westring)	+	-	-
<i>T. pictum</i> (Walckenaer)	+	-	-	<i>Kaestneria pullata</i> (O. P.-Cambridge)	+	-	-
<i>T. mystaceum</i> L. Koch	+	-	-	<i>Poecilonea variegata</i> (Blackwall)	+	-	-
<i>T. pallens</i> Blackwall	+	+	-	<i>Drapetisca socialis</i> (Sundevall)	-	+	-
<i>Enoplognatha ovata</i> (Clerck)	+	-	-	<i>Tapinopa longidens</i> (Wider)	-	+	-
<i>Robertus lividus</i> (Blackwall)	+	-	-	<i>Floronia bucculenta</i> (Clerck)	+	-	-
<i>R. arundineti</i> (O. P.-Cambridge)	+	-	-	<i>Stemonyphantes lineatus</i> (Linnaeus)	+	-	-
<i>Tetragnatha extensa</i> (Linnaeus)	+	+	+	<i>Lepthyphantes minutus</i> (Blackwall)	+	+	-
<i>T. montana</i> Simon	+	-	-	<i>L. alacris</i> (Blackwall)	-	+	-
<i>Pachygnatha clercki</i> Sundevall	+	-	-	<i>L. tenuis</i> (Blackwall)	+	-	-
<i>P. degeeri</i> Sundevall	+	-	-	<i>L. zimmermanni</i> Bertkau	+	-	-
<i>Metellina segmentata</i> (Clerck)	+	+	+	<i>L. cristatus</i> (Menge)	+	-	-
<i>M. mengei</i> (Blackwall)	-	+	-	<i>L. mengei</i> Kulczynski	+	-	-
<i>M. merianae</i> (Scopoli)	-	+	-	<i>L. ericaeus</i> (Blackwall)	+	-	-
<i>Zygiella x-notata</i> (Clerck)	+	-	-	<i>L. pallidus</i> (O. P.-Cambridge)	+	-	-
<i>Z. atrica</i> (C. L. Koch)	+	+	-	<i>Helophora insignis</i> (Blackwall)	-	+	-
<i>Araneus diadematus</i> Clerck	+	+	-	<i>Linyphia triangularis</i> (Clerck)	-	+	-
<i>A. quadratus</i> Clerck	+	-	+	<i>L. hortensis</i> Sundevall	-	+	-
<i>Larinioides cornutus</i> (Clerck)	+	-	+	<i>L. montana</i> (Clerck)	+	+	-
<i>Nuctenea umbratica</i> (Clerck)	+	-	-	<i>L. clathrata</i> Sundevall	+	+	-
<i>Araniella sp.</i>	-	+	-	<i>L. peltata</i> Wider	-	-	+
<i>Ceratinella brevipes</i> (Westring)	+	-	-	<i>Microlinyphia pusilla</i> (Sundevall)	+	-	-
<i>C. brevis</i> (Wider)	+	-	-	<i>Allomengea vidua</i> (L. Koch)	+	-	-
<i>Walckenaeria acuminata</i> Blackwall	+	-	-	TOTALS	116	30	16

Table 1: Wybunbury Moss spiders. Names in bold=new site record. A=*Sphagnum* lawn, B=Pine and fen woodland, C=Wet grassland.

Historical perspective: It is important to interpret the distribution of *C. limnaea* and *G. nigerrima* in geographical space and time. The apparent restriction of these species, in Britain, to Wybunbury Moss, is a biogeographical puzzle. Both species must have been present in Britain, but not necessarily at Wybunbury, during the Boreal period, before the severance of the land connection with continental Europe (c. 8,300BP). It is most unlikely that they are more recent immigrants. They could possibly have been widely distributed throughout Britain during the extension of ombrogenous mires in the Atlantic Period (c. 6,000BP), with their distributions contracting due to subsequent destruction and fragmentation of this habitat, until they became restricted to Wybunbury Moss, which has been relatively undamaged by peat-cutting, drainage, fire, etc.

Relict populations, restricted to one, or a few, locations in the British Isles, are likely to have been isolated from continental populations for at least 10,000 years and represent important biological capital in the context of conservation (Hammond, 1974).

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