Atlas of Ferns of the British Isles

Botanical Society of the British Isles
British Pteridological Society · 1978

ERRATA

In a re-drafting of the Introduction an explanation of the significance of the open circle was inadvertantly omitted. Unless otherwise explained, such open circles are those squares in which the species has been recorded only PRIOR TO 1950 (nineteen hundred and fifty).

On page 95 the spelling of "Dryopteris x ambrosiae" should be "Dryopteris x ambroseae". It is similarly mispelt in the Index, (p. 100).

May 1978.

ATLAS OF FERNS
OF THE BRITISH ISLES

edited by

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Introduction

It is now 16 years since the publication of the *Atlas of the British Flora* (Perring & Walters, 1962). Though it has proved valuable it was inevitably an imperfect work. Conditions of the grants under which the work was carried out meant that the first maps had to go to printers within six years of the start of the scheme and the maps of the Pteridophyta were the first to be sent. Some of these maps e.g. *Dryopteris carthusiana* (as *D.lanceolatocristata*), *D.oreades* (as *D.abbreviata*), *D.pseudomas* (as *D.borreri*), were very unsatisfactory because of difficulties of identification and the map of the first mentioned species was accordingly marked P, indicating it was only provisional. Furthermore, taxonomic revisions in *Asplenium, Dryopteris* and *Equisetum* were producing data on the distribution of new taxa worthy of mapping. A recent reprint of the *Atlas* (1976) gave the opportunity to revise maps of about 300 of our rarest species including only five ferns but production costs ruled out a complete revision, and this is a situation likely to continue.

The British Pteridological Society had, from 1962, taken a considerable interest in collecting further data on ferns for the Map Scheme and these had over the years been passed to the Biological Records Centre to be added to the mass of data coming in from the Botanical Society of the British Isles. The B.P.S. felt that an interim publication showing the state of our knowledge of the distribution of British ferns, horsetails and club-mosses, would, apart from removing the anomalies mentioned above, give a guide-line for further concentrated field work. Therefore when the B.P.S. investigated the possibility of B.R.C. revising the maps for publication it was very pleased to find the idea already under consideration as part of a scheme to revise the *Atlas* in parts.

Discussions were held to see how the two Societies could best be involved in drawing together all available data that was not already in the data bank. A proforma (the 'Green Book') containing the species to be mapped was circulated to B.S.B.I. Recorders and to other interested workers studying regional or vice-county Floras. This data was transcribed by A.J.Worland (B.P.S. Recorder) to single species cards to facilitate their transfer to the data-bank and to manuscript maps from which we could query any outstanding or anomalous record. A.C.Jermy arranged for the loan of critical material from the following university or municipal herbaria: Aberdeen (ABD), Aberystwyth (ABS), Bangor (UCNW), Belfast (BEL), Cambridge (CGE), Cardiff (NMW), Carlisle (CLE), Dublin (DBN), Edinburgh (E), Glasgow (GL), Kew (K), Liverpool (LIV), Maidstone (MNE), Manchester (MANCH), Newcastle upon Tyne (HAMU), Oxford (OXF), Perth (PTH) and the South London Botanical Institute (SLBI), and, with the help of the following specialists, many new records were added to the data bank: H.V.Corley (*Dryopteris*), J.A.Crabbe (*Polypodium*), C.R.Fraser-Jenkins (*Dryopteris*), M.Gibby (*Dryopteris*), J.D.Lovis (*Asplenium*), C.N.Page (*Equisetum*), R.H.Roberts (*Polypodium*) and A.Sleep (*Polystichum*). Particular attention has been given to the determination of hybrids although it is appreciated that the maps of these can only be regarded as preliminary; for detailed information on the distribution of hybrids the reader should consult C.A.Stace (ed.), *Hybridization and the Flora of the British Isles,* London, 1975. As the data were marshalled the B.R.C. staff, under the direction of F.H.Perring, set to work to produce the maps and it was Lynne Farrell on whom fell the major task of checking the maps against the data cards.

Nomenclature and arrangement of the maps

The nomenclature follows that used in *Flora Europaea* (ed. Tutin et al., Cambridge, 1964) with a few later changes. These together with the arrangement are to be found in a *List of British pteridophytes* shortly to be published (J.E.Dandy & A.C.Jermy, in prep.). The arrangement of the genera is based on that proposed by J.A.Crabbe, A.C.Jermy & J.T.Mickel (*Fern Gaz., 11;* 141-162; 1975).

We have adopted the four genera in Lycopodiaceae as in *Flora Europaea* but we agree with Holub (*Preslia, Praha, 47:* 97-110; 1975) that *Diphasium* should be restricted to a few South American species and that *Diphasiastrum* should be used for the European species. Within *Dryopteris* two major changes on purely nomenclatural grounds have been made. There has been confusion over the past 150 years with regard to the identity of *Polystichum abbreviatum* DC., the basionym of *D.abbreviata* (DC.) Newm.; *D.oreades* Fomin should now be taken as the correct name (see C.R.Fraser-Jenkins & A.C.Jermy, *Taxon, 25:* 659-665; 1976). It is also inevitable that we have to change the recent name *D.assimilis* S.Walker; the plant described by Presl from British Columbia as *Nephrodium expansum* has been shown to be conspecific with the European plant and that epithet must be taken up. Furthermore our British *D.villarii* is tetraploid and sufficiently distinct from the diploid alpine material described by Bellardi to warrant subspecific separation (see C.R.Fraser-Jenkins & A.C.Jermy, *Fern Gaz., 11:* 338-340; 1977). Lastly,European *Thelypteris palustris* Schott has been shown to differ from American plants, originally called *T. thelypteroides* Michx, solely in the absence of hairs on the lamina and rachis, a character which we agree warrants its separation at subspecific level only. Unfortunately Michaux's epithet has priority over that of Schott thus removing a well-known name from the British list.

Comments by A.C.Jermy on the distribution of species are given beneath the maps. The phytogeographical elements referred to relate to the species distribution in Europe as a whole; the concepts as applied to the Atlantic seaboard are those of D.A.Ratcliffe (*New Phytol., 67:* 365-371; 1968). The distribution of pteridophytes in Europe is to be found in the *Atlas Florae Europaeae 1, Pteridophyta (Psilotaceae to Azollaceae)*, ed. J.Jalas & J.Suominen; Helsinki, 1972. For a discussion on the distribution of European pteridophytes using numerical analyses of those data see H.J.B.Birks (*New Phytol., 77:* 257-287; 1976).

Species omitted

Only three aliens have been mapped: *Azolla filiculoides* Lam. a species so well established that its status is often forgotten; *Selaginella kraussiana* A.Br., a native of southern Africa, introduced into conservatories from which it has spread considerably; and *Equisetum ramosissimum* Desf., a single population, of interest because it is the putative parent of *E. moorei* Newm. In addition to these there are four species grown as ornamentals which have escaped and established themselves in our natural vegetation; none have spread further other than by vegetative means. They are *Onoclea sensibilis* L., *Matteuccia struthiopteris* (L.) Tod., *Blechnum chilense* (Klf.) Mett. and *B.penna-marina* (Poir.) Kuhn; *Dicksonia antarctica* Labill. may also be included in this category. Three house ferns have spread to warm locations on walls in various parts of south and west Britain namely, *Cyrtomium falcatum* (L.f.) C.Presl, *Pteris cretica* L. and *P.vittata* L. The latter is also established on a warm slag-heap in the Forest of Dean, v.c. 34 (see S. Holland, *Jl. N. Glouc. Nat. Soc., 19:* 318; 1968).Although these produce spores their presence is usually ephemeral.

Acknowledgements

We should like to thank all those, too numerous to mention individually, who have over the years sent in records to B.R.C. Similarly we thank also those many people who will no doubt find gaps in our maps and rectify the situation by sending in further records. We are especially grateful to A.J.Worland, for transcribing all incoming data from the 'Green books' to single-species cards and to manuscript maps. J.W.Dyce, as Secretary of the B.P.S., was alone responsible for collating the records made on the meetings of that Society. Liaison with the vice-county Recorders of the B.S.B.I.. was initially through the Records Committee (secretary, F.H.Perring). The following botanists, either as B.S.B.I. Recorders or as members of B.S.B.I. or B.P.S., have made a special effort to cooperate with this revision:

D.E.Allen, G.H.Ballantyne, M.Barron, E.P.Beattie, P.M.Benoit, J.Bevan, J.H.Bevis, H.J.B.Birks, T.L.Blockeel, I.R.Bonner, H.W.Boon, E.H.Booth, R.P.Bowman, M.Briggs, A.B.M.Brewis, J.M.Brummitt, K.E.Bull, E.R.Bullard, A.R.Busby, J.K.Butler, M.S.Campbell, J.F.M.Cannon, J.M.Castle-Smith, E.Chicken, E.R.T. Conacher, P.Copson, H.V.Corley, R.W.M.Corner, F.E.Crackles, G.Crompton, T.A.W.Davis, J.G.Dony, D.A.Doogue, U.K.Duncan, E.S.Edees, P.J. Edwards, T.Edmondson, E.A.Ellis, G.Ellis, T.G.Evans, I.K.Ferguson, F.Fincher, B.E.M.Garratt, G.M.Gent, E.J.Gibbons, M.Gibby, V.Gordon, G.G.Graham, I.F.Gravestock, E.F.Greenwood, J.M.Gunn, P.Hackney, P.C.Hall, A.D.Hallam, G.Halliday, S.G.Harrison, C.C.Haworth, J.G.Hodgson, S.C.Holland, K.M.Hollick, R.C.L.Howitt, †S.T.Jermyn, Q.O.N.Kay, D.L.Kelly, A.G.Kenneth, D.H.Kent, M.P.H.Kertland, J.E.D.Lamb, P.J.Lambley, H.Lefévre, F.LeSueur, A.G.Long, †J.E.Lousley, J.D. Lovis, R.McBeath, D.McClintock, D.J.McCosh, B.M. Mack, R.Mackecknie, †V.J.Macnair, L.J.Margetts, M.E.Martin, T.F.Medd, K.G.Messenger, †H.Milne-Redhead, R.J.Murphy, A.Newton, A.M.O'Sullivan, C.N.Page, R.C.Palmer, R.J.Pankhurst, C.P.Petch, E.G.Philp, M.Porter, A.C.Powell, A.L.Primavesi, M.C.F.Proctor, A.W.Punter, D.A.Ratcliffe, J.E. Raven, B.W.Ribbons, M.H.Rickard, R.H.Roberts, C.A.Robinson, R.G.B.Roe, J.Rogerson, F.Rose, A.Rutherford, C.D.Sayers, M.J.P.Scannell, M.R.D. Seaward, B.Seddon, S.Segal, B.Shepard, F.W.Simpson, A.A.Slack, W.A.Sledge, A.Sleep, J.E.Smith, A.H.Sommerville, O.M.Stewart, A.McG.Stirling, K.M.Stevens, R.Stokoe, G.A.Swan, E.L.Swann, D.M. Synnott, M.A.Turner, I.M.Vaughan, †W.E.Warren, M.McC.Webster, T.C.E.Wells, D.J.B.White, L.E. Whitehead, A.J.Willis, A.Willmot, S.R.J.Woodell, P.Yule.

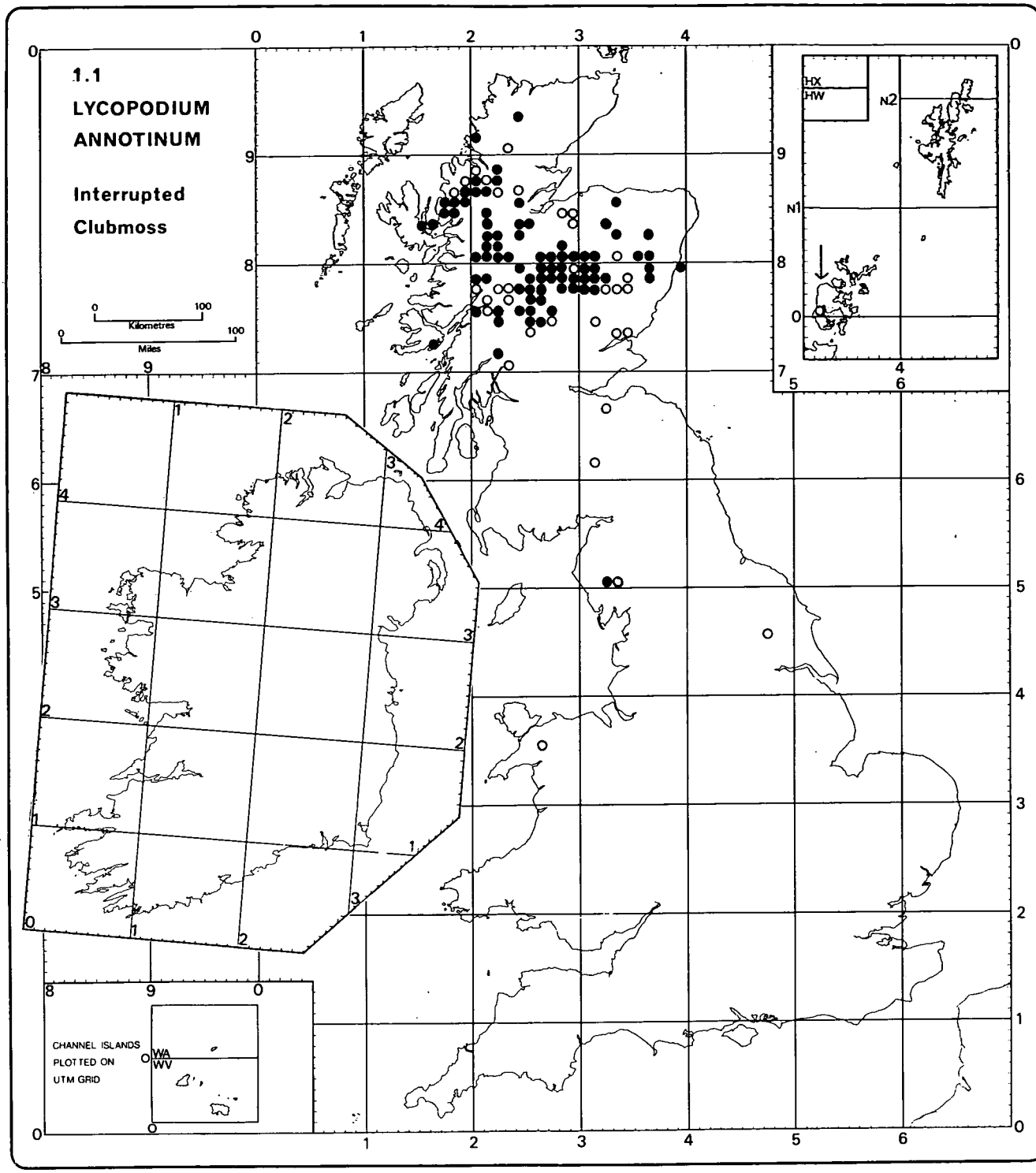
A considerable amount of general but often difficult material, sent in by recorders, was identified by J.A.Crabbe and J.M.Mullin, who also handled some thousands of specimens sent on loan from other British Herbaria, filling in 'pink cards' and searching for grid references when new records were found; such routine work, so often boring, is gratefully acknowledged.

We also thank those curators and staff of Herbaria who have cooperated by sending their material of critical groups to the British Museum (Natural History) or to Leeds University for checking. Of these we would like to mention the following whose knowledge of their own region, both floristically and geographically was placed continually at our disposal: S.G.Harrison, and colleagues at the National Museum of Wales, and M.J.P.Scannell and D.M.Synnott at the National Herbarium, Glasnevin, Ireland. Funds to enable students to make out 'pink cards' of critical groups at Oxford University herbarium were provided by the Druce Fund.

Last and by no means least, we thank the staff at B.R.C. especially D.W.Scott, and R.A.Cooke, a voluntary worker, who prepared the maps on which the final production of this Atlas was based.

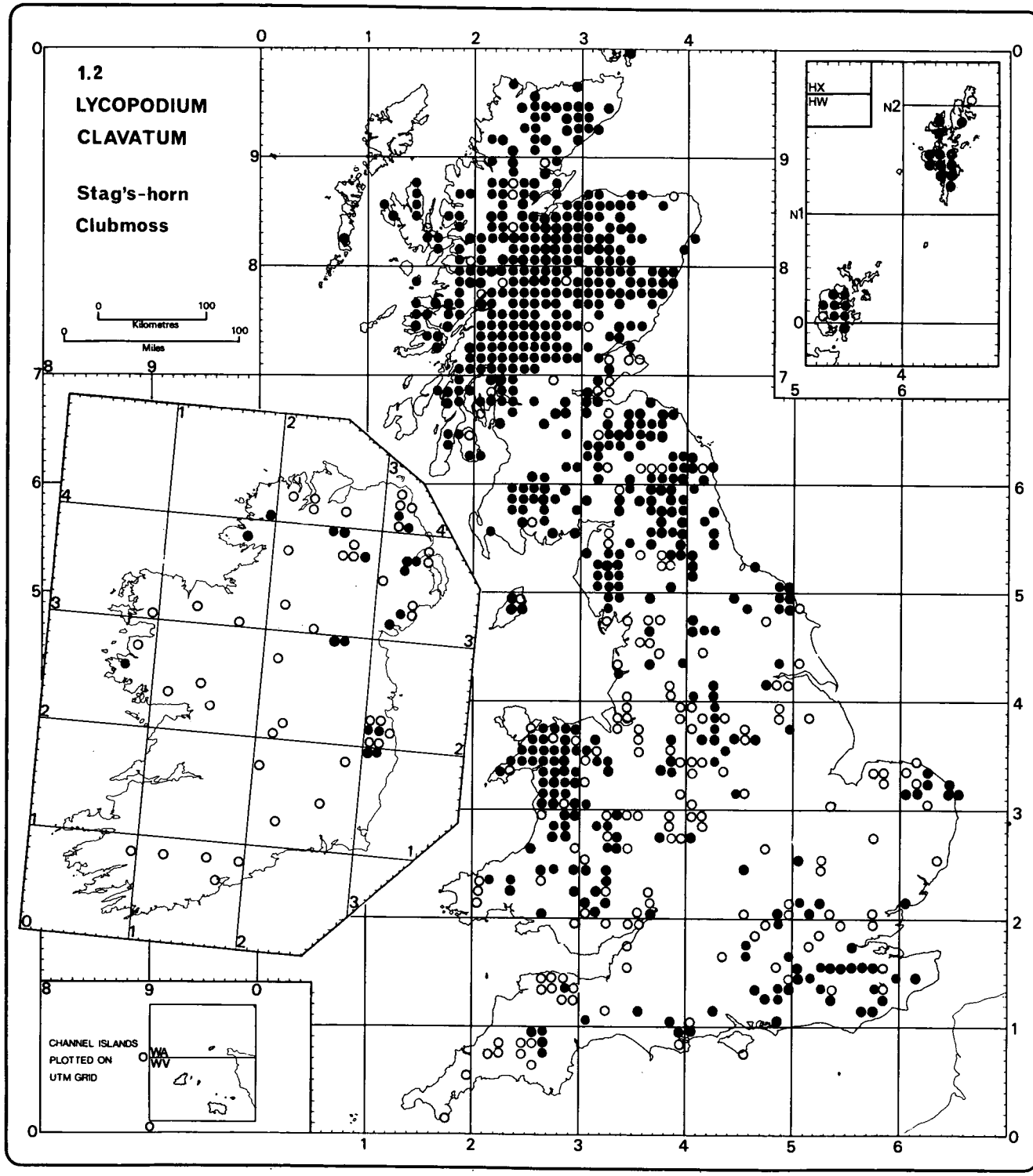
Further recording

The British Pteridological Society Recorder will continue to monitor additions or amendments to these maps. All such records will be passed to the Biological Records Centre at I.T.E., Monk's Wood Experimental Station, on the appropriate record card, and the relevant B.S.B.I. Recorder will be notified. New records may be sent to the B.P.S. Recorder, c/o Botany Department, British Museum (Natural History), Cromwell Road, London SW7 5BD.



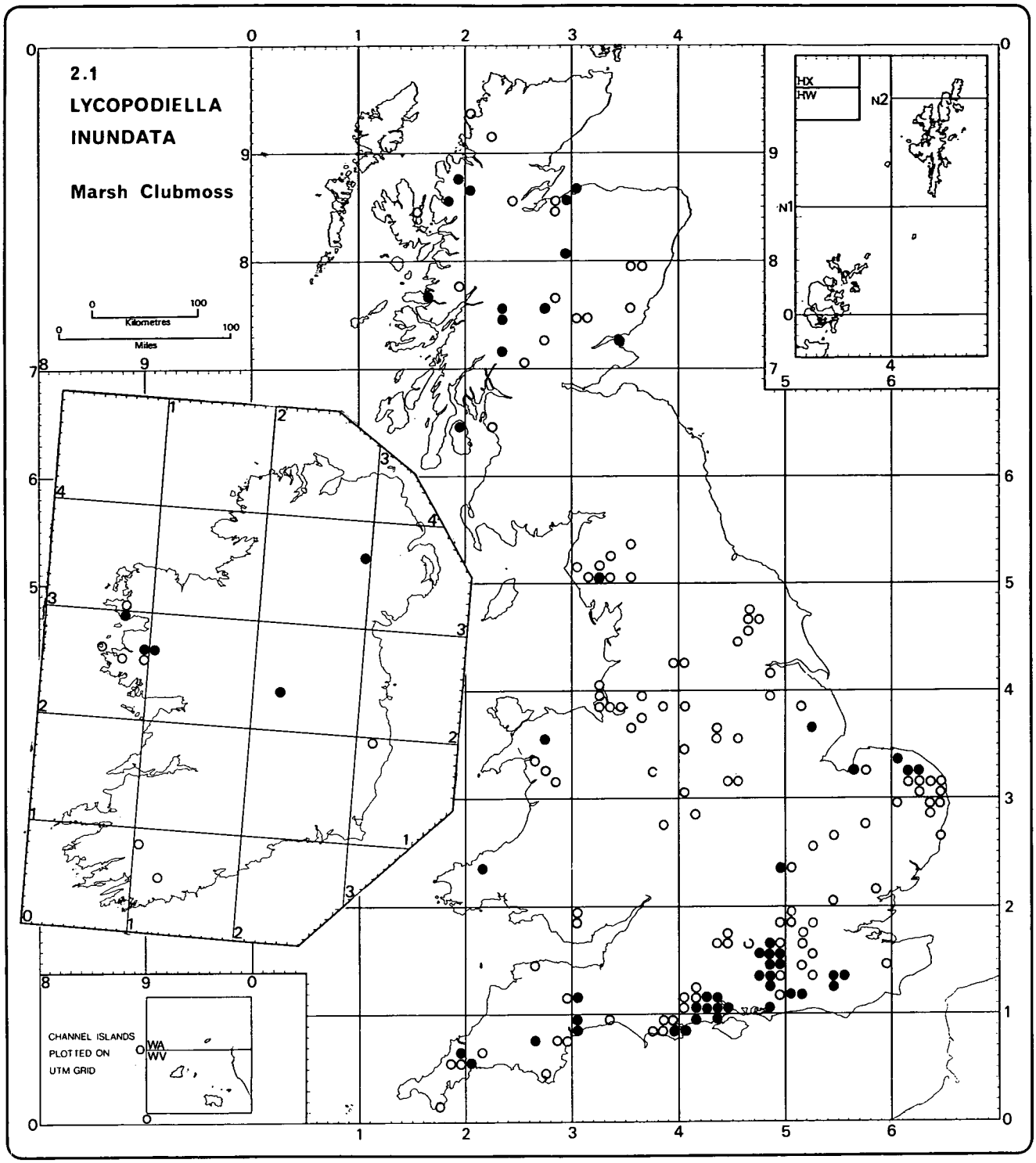
1.1 Lycopodium annotinum L.

A northern montane species confined now to one locality in v.c. 70, north-west Scotland and the Grampian Highlands, associated with dwarf shrub communities. Land-use changes and the ravages of collectors are probably the reason for its disappearance from the Moffat Hills (v.c. 72). The species was last recorded for v.c. 49 (Llynn y Cwm) by J.E.Griffith (*Fl. Anglesey and Caernarvonshire:* 17) who (in 1895) had not seen it "for (some) years". The Yorkshire locality has long since changed in character; there is a specimem from Buttercombe Wood in LIV collected 1928. *L.annotinum* may still be on Orkney (last recorded 1883) and may yet be found on Shetland.



1.2 **Lycopodium clavatum** L.

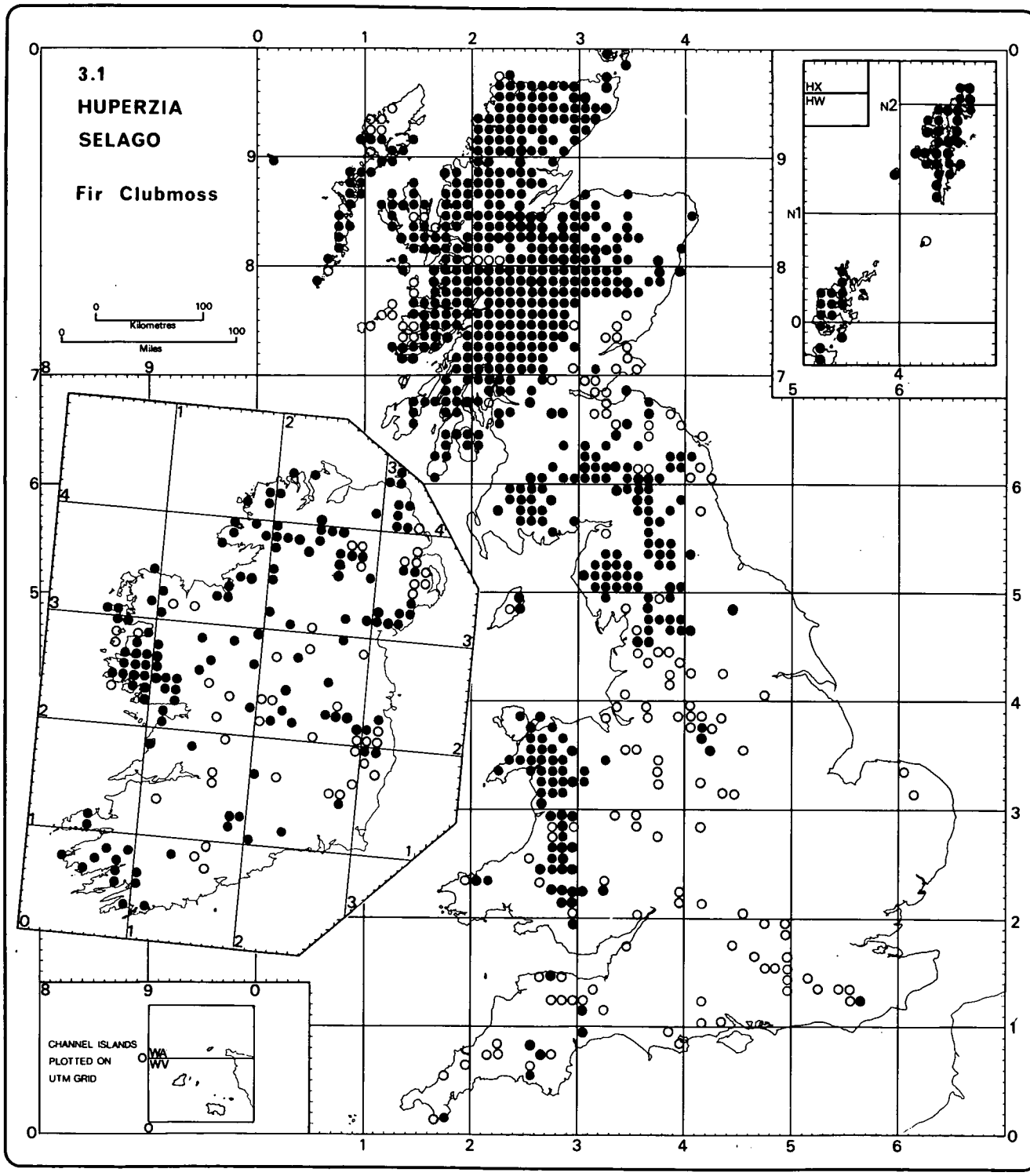
A plant of acid grasslands and heaths on sandy soil where the slope allows drainage water to flush through; otherwise in areas with higher rainfall. Decreasing in eastern and central England because of intensification of agriculture and utilization of rough marginal ground.



2.1 **Lycopodiella inundata** (L.) Holub

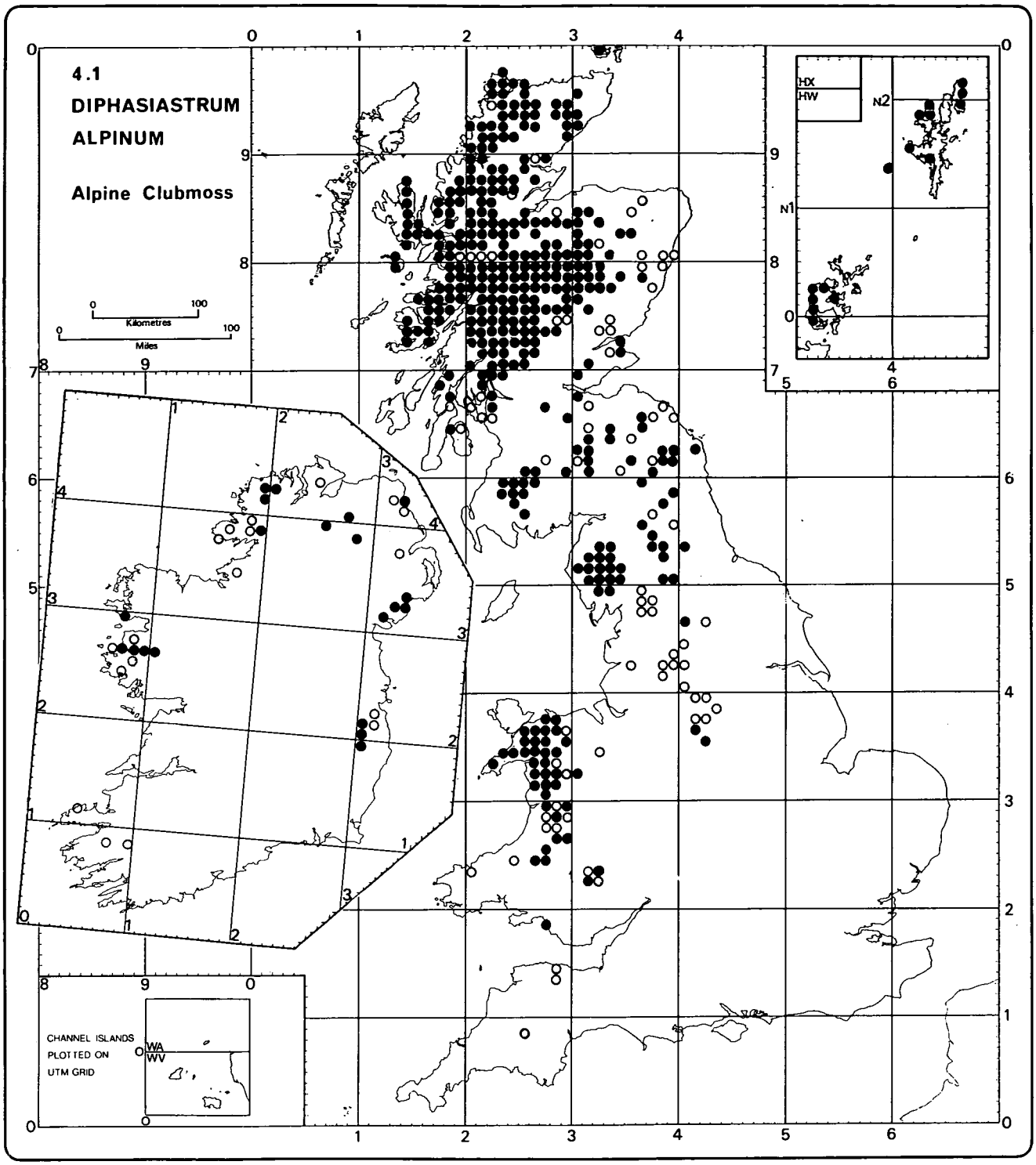
(*Lycopodium inundatum* L.;
Lepidotis inundata (L.) C.Börner)

A sub-Atlantic species of lowland bogs of which the distribution has been fragmented considerably by the drainage of acid wetland sites.



3.1 **Huperzia selago** (L.) Bernh. ex Schrank & Mart.
(*Lycopodium selago* L.)

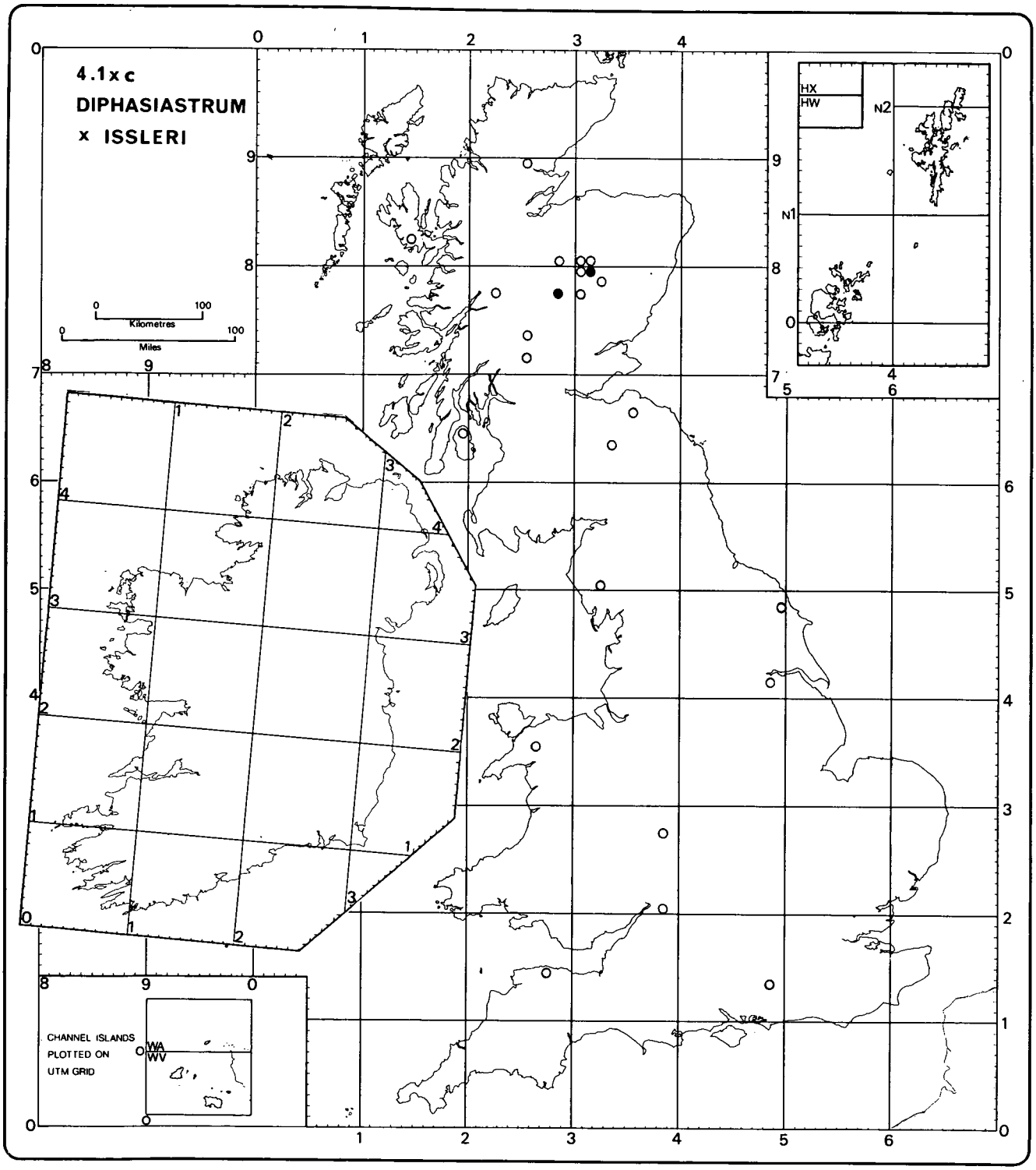
A northern sub-Atlantic/montane species spread over lowland areas where frost hollows probably give the required lower temperatures in areas of high rainfall. Land-use changes in lowland England have considerably reduced the sites where this species used to grow. The sites in v.cs 1 and 3 particularly need conservation.



4.1 **Diphasiastrum alpinum** (L.) Holub

(*Lycopodium alpinum* L.;
Diphasium alpinum (L.) Rothm.)

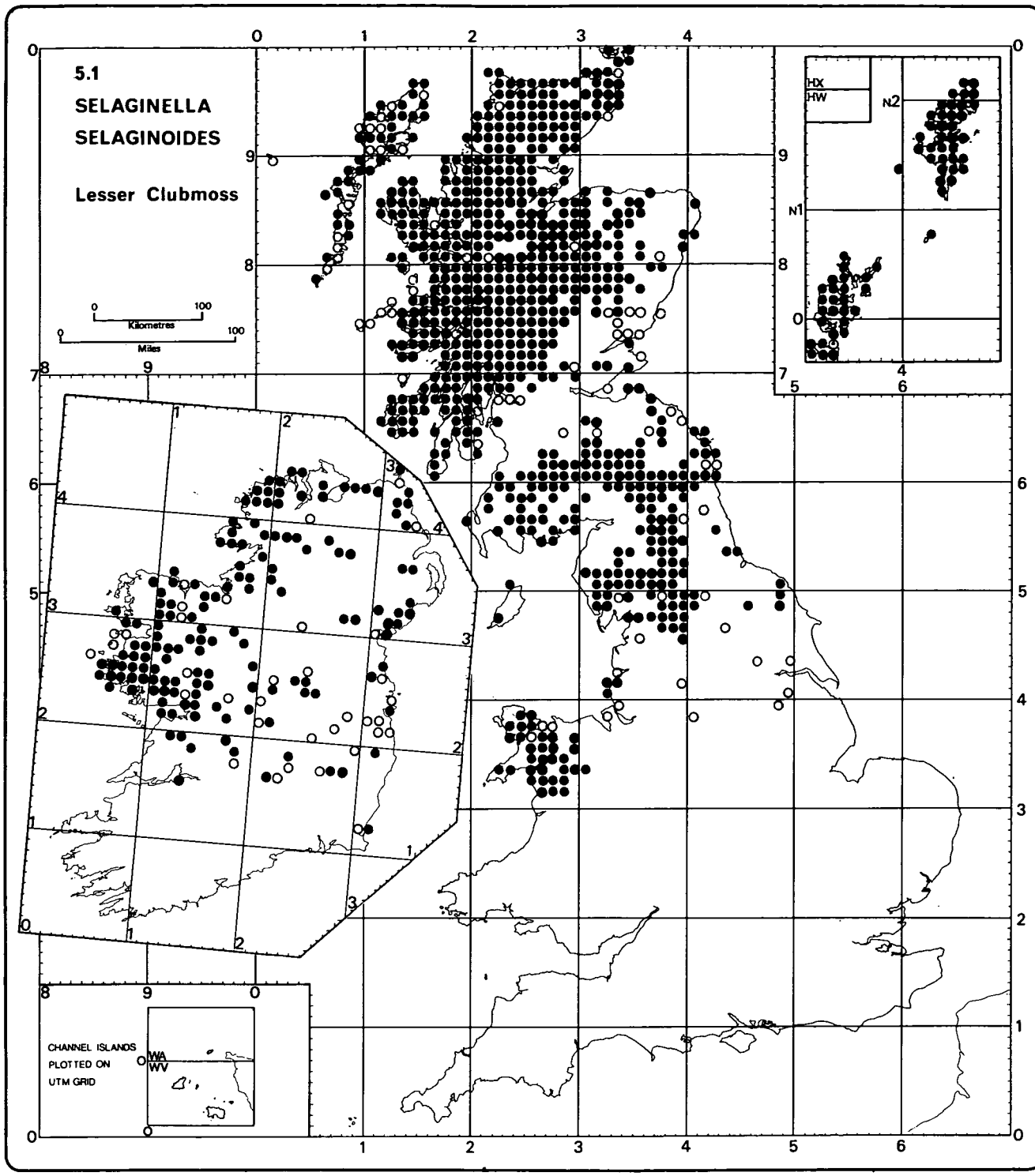
An arctic-alpine species of which the occurrence in lowland Britain has puzzled ecologists until those plants were redetermined as *D.* × *issleri*. Land-use changes in north England (e.g. Pennines) have considerably reduced the range of this species. The Devon records need confirmation.



4.1 × c. **Diphasiastrum × issleri** (Rouy) Holub

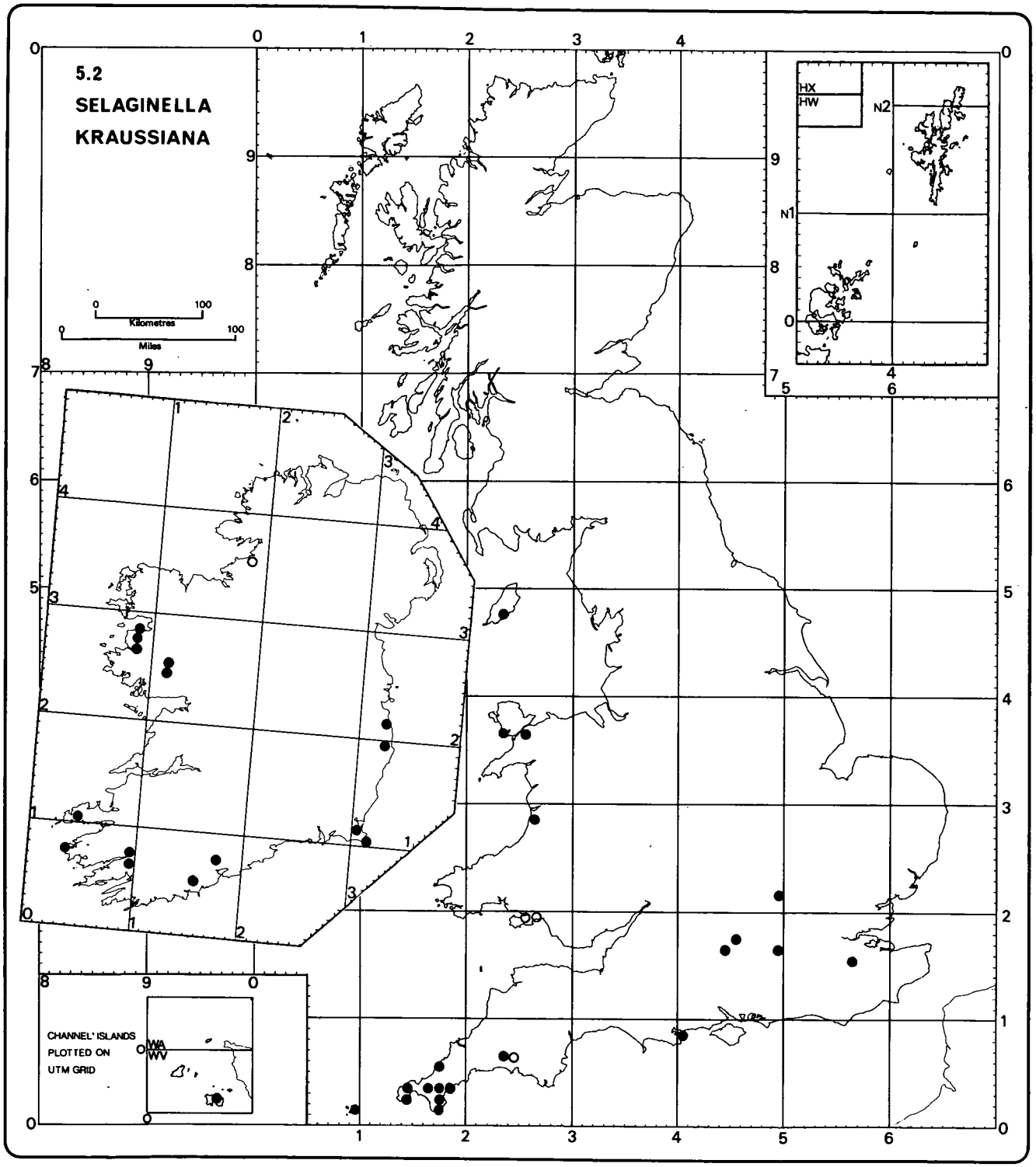
(*D.alpinum* × *complanatum* (L.) Holub; *Lycopodium issleri* (Rouy) Lawalrée; *Lycopodium alpinum* L. var. *decipiens* Syme ex Druce)

Following studies by Lawalrée (*Bull. Soc. R. bot. Belg., 9:* 109-120; 1957) records of this taxon appeared in British literature but confusion and doubt has persisted as to its true identity. J.Wilce (*Beih. Nov. Hedw. 19:* 93; 1965) suggests it is a hybrid derivative of the species mentioned above. Work carried out by I.Kukkonen (*Ann. Bot. Fenn., 4:* 441-470; 1967) and A.Pacyna (*Fragm. Fl. Geobot., 18:* 255-297, 309-341; 1972) supports this and Pacyna has identified British material as being conspecific with Polish plants. The shape of the ventral median leaf and elongated leafy peduncles are diagnostic. Sowerby (*Engl. Bot.*, ed 3.t. 1834*; 1886) illustrates plants from v.c. 37, named by Syme in the legend as *Lycopodium alpinum* var. *decipiens*, a name later validated with a description by Druce (*Ann. Scot. nat. Hist., 1892:* 184; 1892). Subsequent botanists have used this name for a number of atypical *D.alpinum* gatherings from Scotland, some of which are most certainly growth forms from dense vegetation of the latter species. Although of hybrid origin the spores are only partly abortive and it can spread outside the range of the parents. However, *D.complanatum* may yet be found in Britain in dwarf shrub communities in areas of ancient woodland.



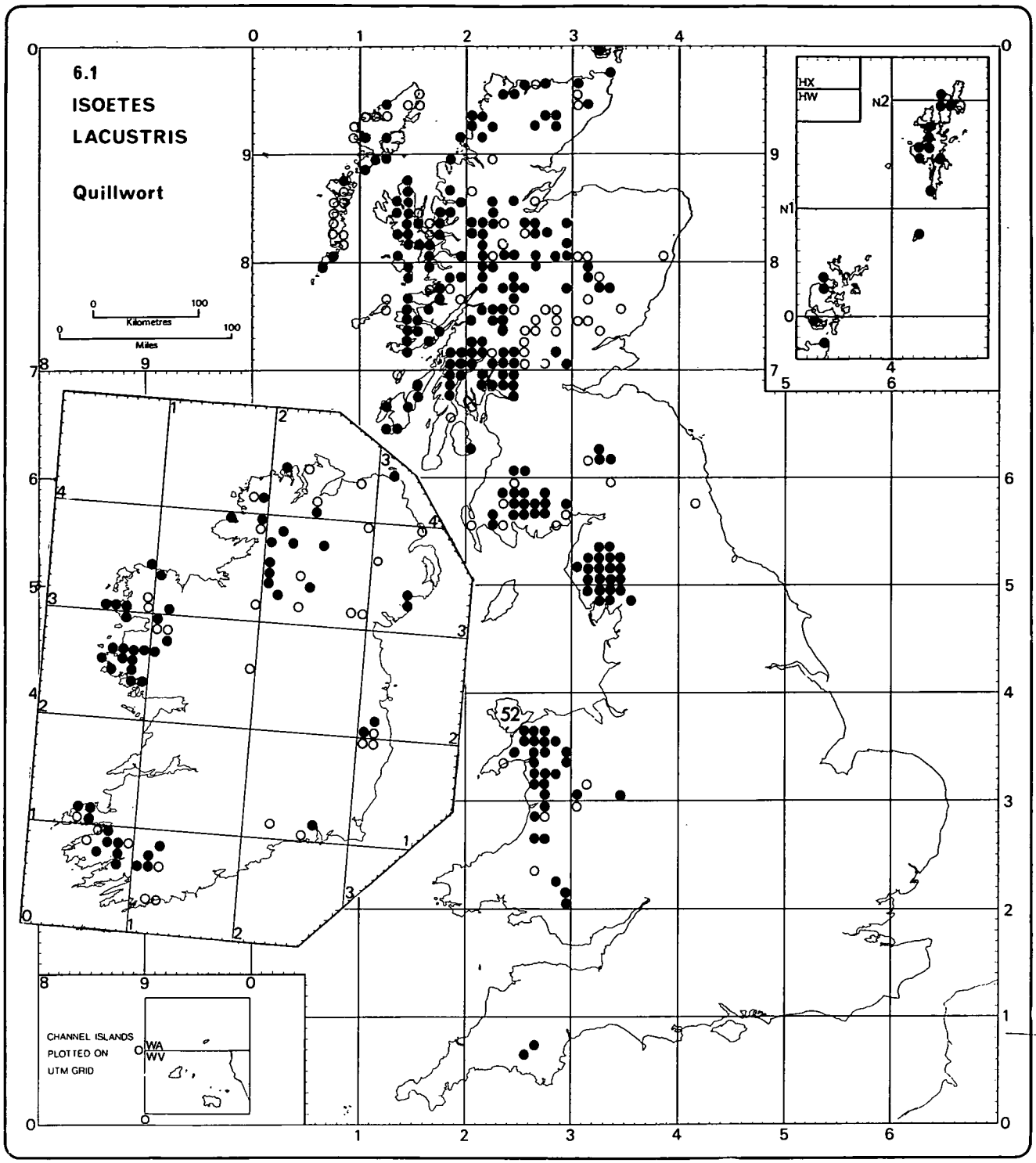
5.1. **Selaginella selaginoides** (L.) Link

A northern and montane species with a distribution pattern in Britain and Ireland which is difficult to explain. Localities in Ireland are disappearing through changes in land-use but it is hoped that the southernmost sites will be conserved so that the ecological requirement of this species on the edge of its range can be studied. In England the south-eastern populations have disappeared, the species last being seen at Scotton, v.c. 54, in 1948 (J.E.Gibbons, *Fl. Lincolnshire:* 80; 1975).



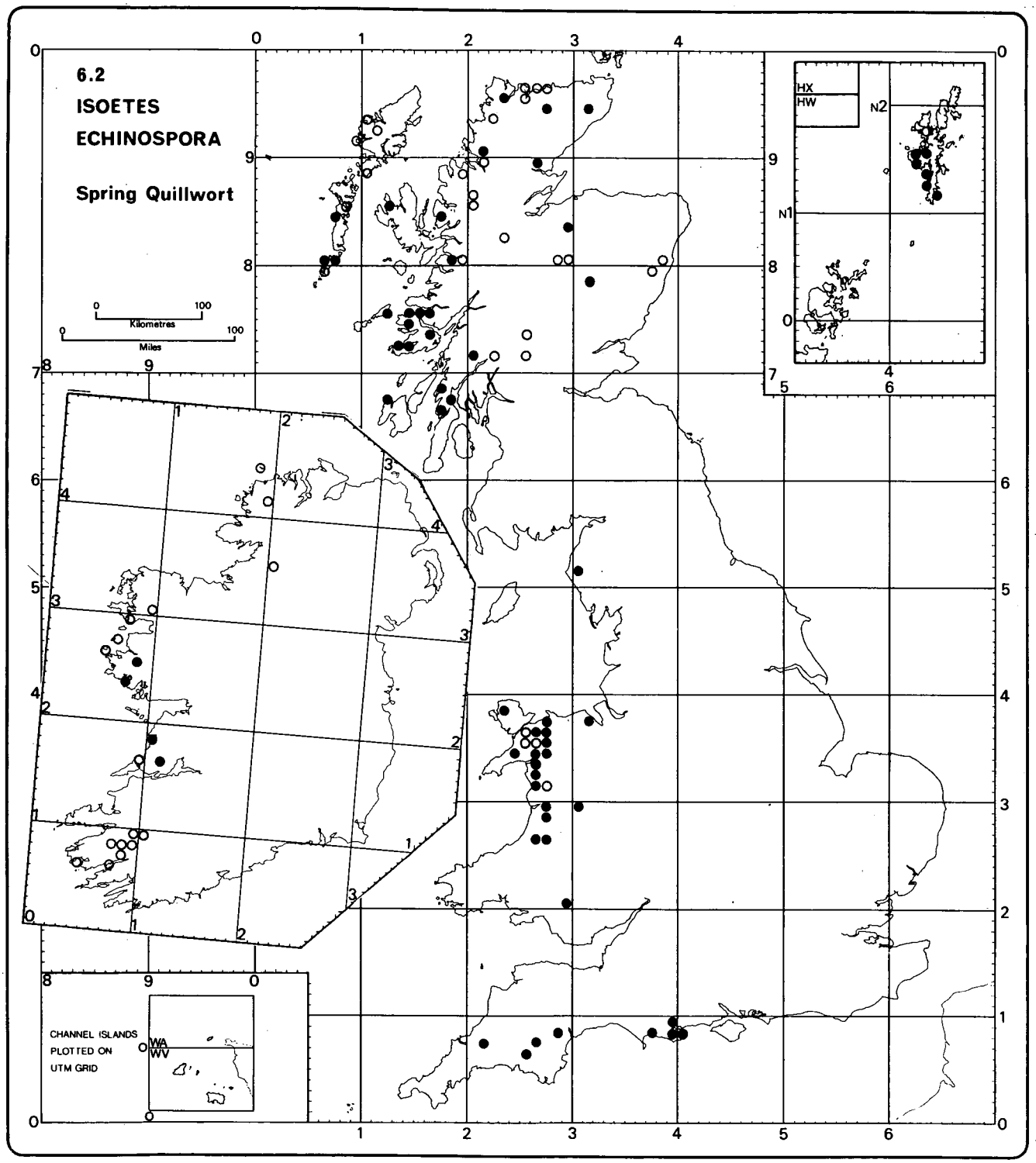
5.2 **Selaginella kraussiana** (G.Kunze) A.Br.

A species native to the Azores and tropical and South Africa which was introduced for bedding or ground cover in conservatories and which has established itself in the more oceanic areas of S.W. Britain and Ireland where it can successfully overwinter. It produces spores abundantly and could spread naturally, although so far the species has shown no signs of dispersal from introduced areas.



6.1 Isoetes lacustris L.

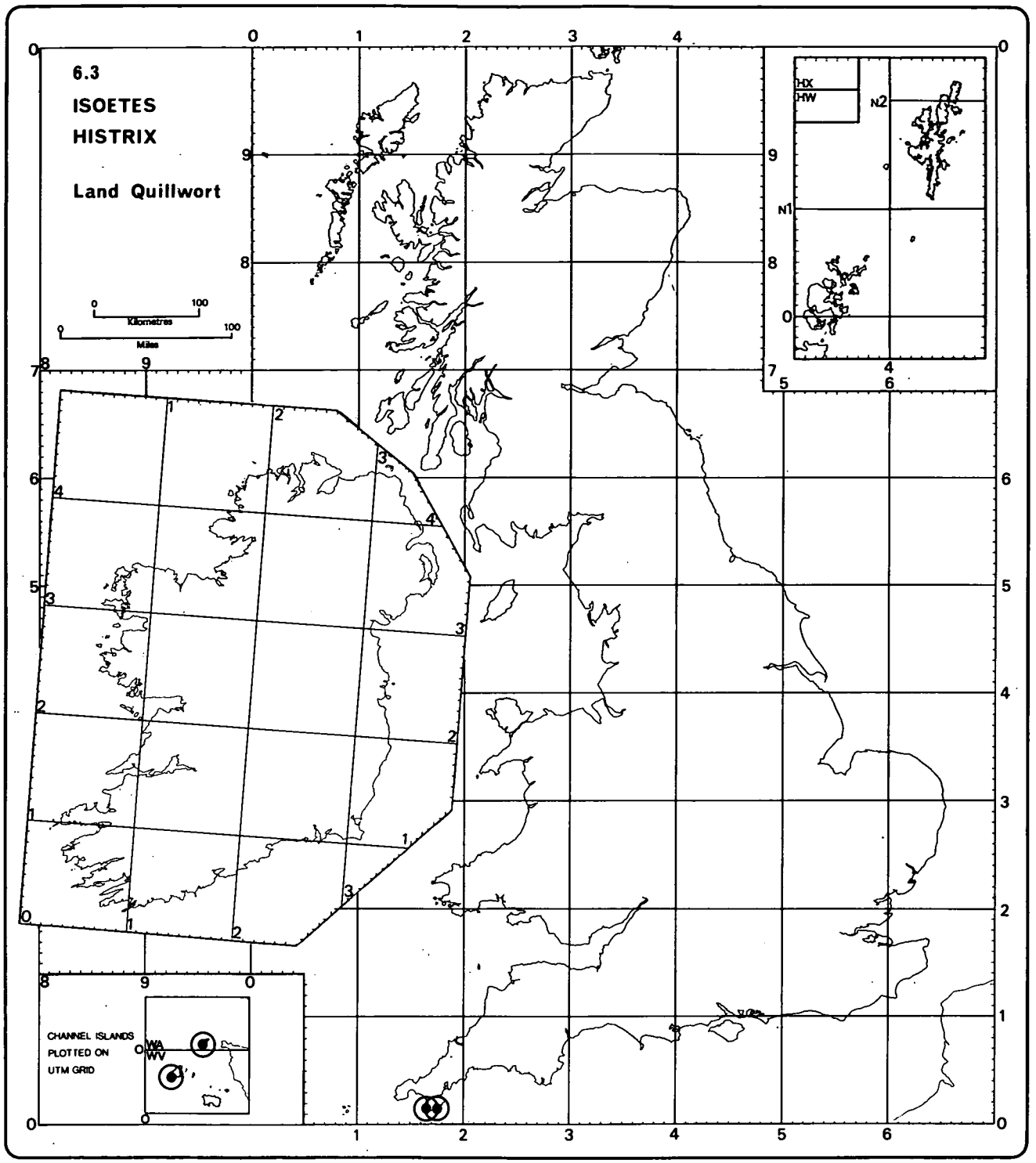
A northern sub-Atlantic species probably more frequent in upland Scotland than records show. It can tolerate more mesotrophic waters than *I.echinospora* possibly through its ability to compete with other water plants.



6.2 **Isoetes echinospora** Durieu

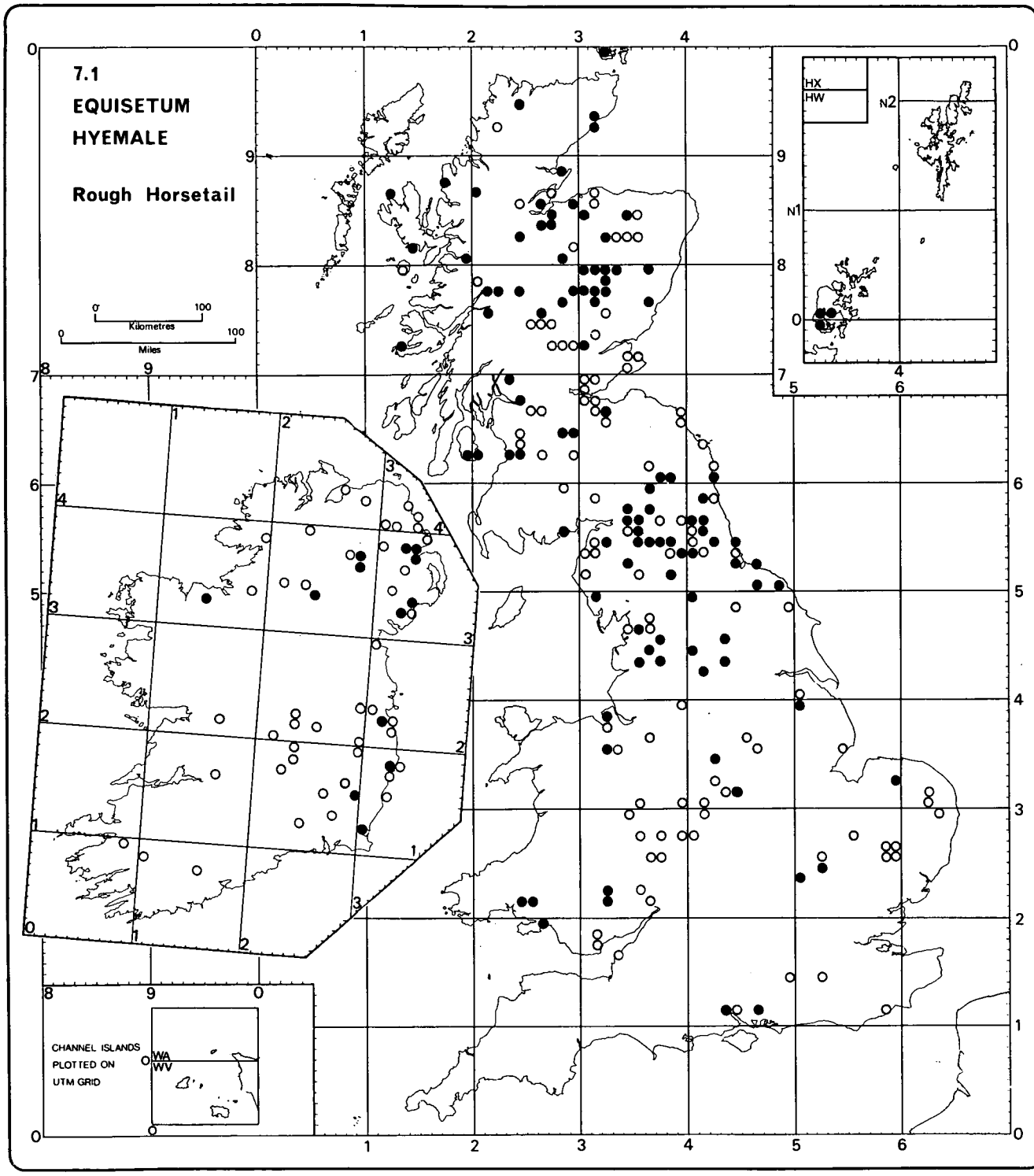
(I.setacea auct.)

A species with a northern sub-Atlantic distribution similar to *I.lacustris*, preferring more oligotrophic waters than *I.lacustris* and will probably prove to be equally common in Scotland at least. The ecology and distribution of the species in Wales is discussed by B.Seddon (*Ecology 46:* 747-748; 1965).



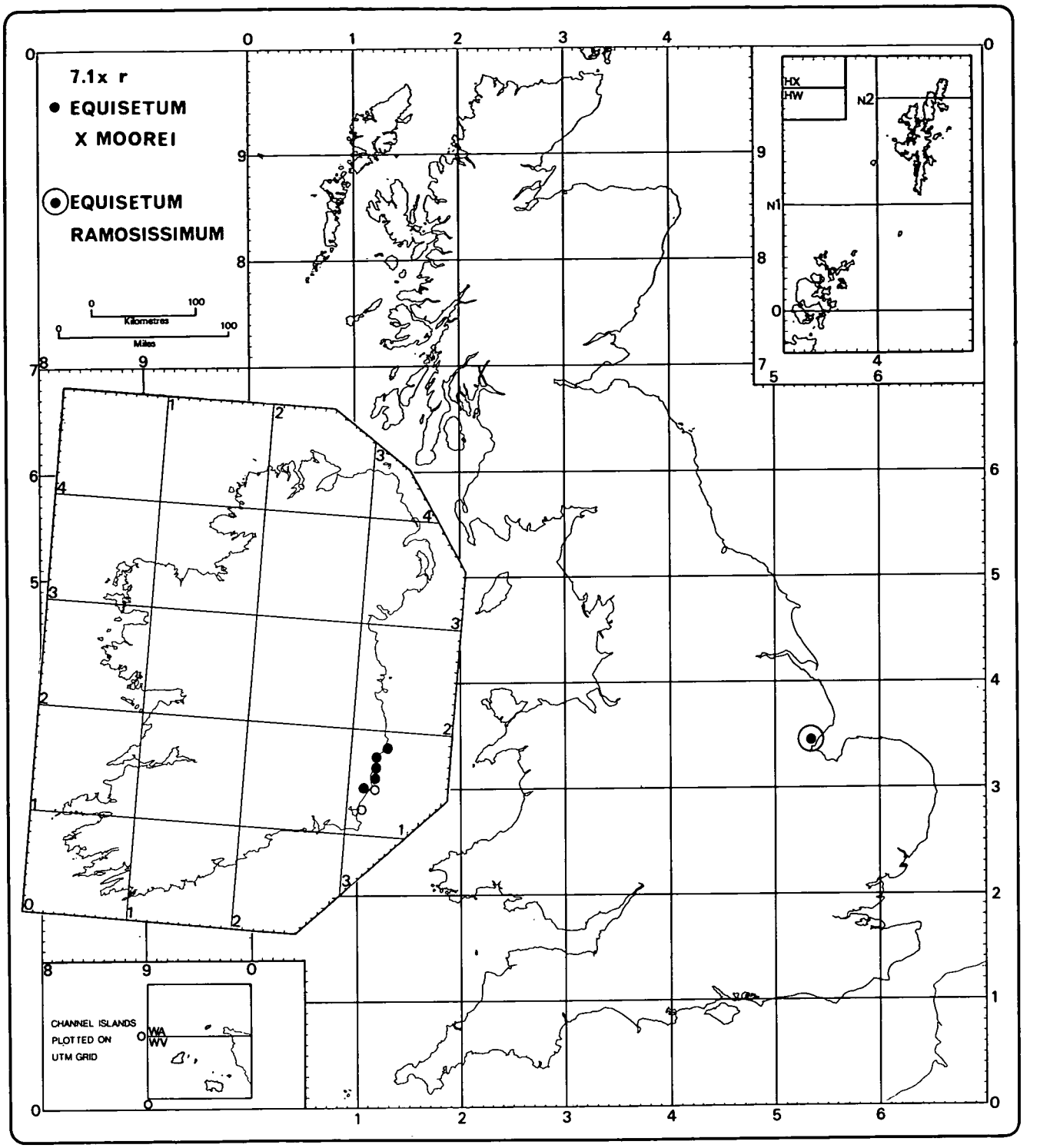
6.3 **Isoetes histrix** Bory

A Mediterranean-Atlantic species which reaches its northernmost location in Britain (v.c. 1). It is terrestrial and the leaves die down and disappear in March or April. The absence of this species from S.W. Ireland is difficult to explain.



7.1 Equisetum hyemale L.

A widespread species which requires its roots to be within reach of laterally moving water. The drainage of potential sites is taking its toll and the species is becoming local although in some places it still occurs in large stands.

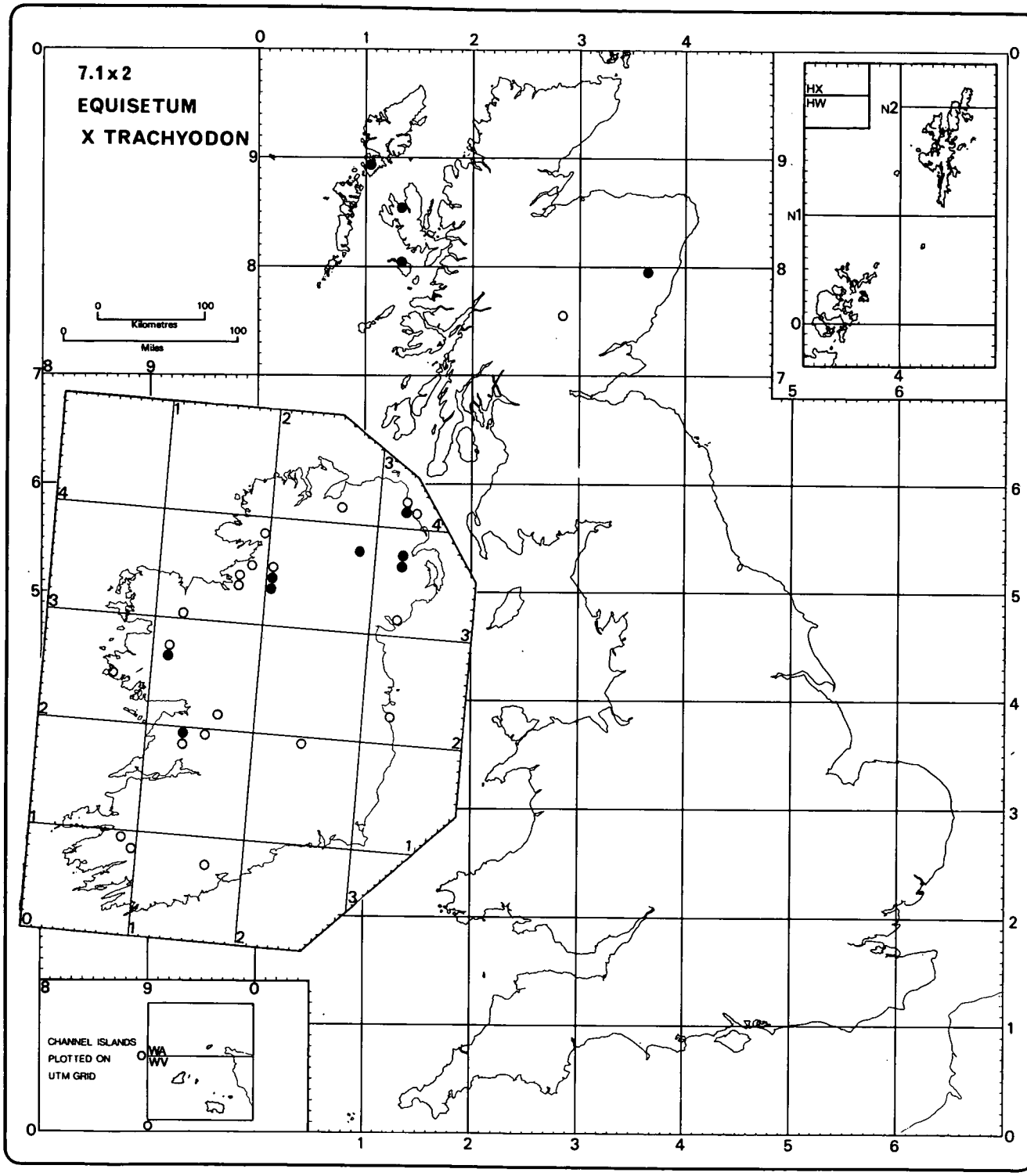


7.1 × r. **Equisetum × moorei** Newm.

(E.hyemale × ramosissimum Desf.)

This sterile taxon has long been treated as a hybrid of the above species but, in view of its sterility, its distribution in Ireland and other areas in Europe where *E.ramossissimum* is absent, this is highly problematical. It was originally described from Rockfield, v.c. H20, in 1856; a plant introduced into a garden in Shere, v.c. 17, (J.E.Lousley, *Flora of Surrey:* 94; 1976) has vigorously maintained itself. There are no specimens to substantiate previous Scottish records (v.c. 88 and 92); *E.hyemale* is found in these localities, however (see J.G.Duckett & C.N.Page in C.A.Stace (ed.) *Hybridization and the Flora of the British Isles:* 99; 1975).

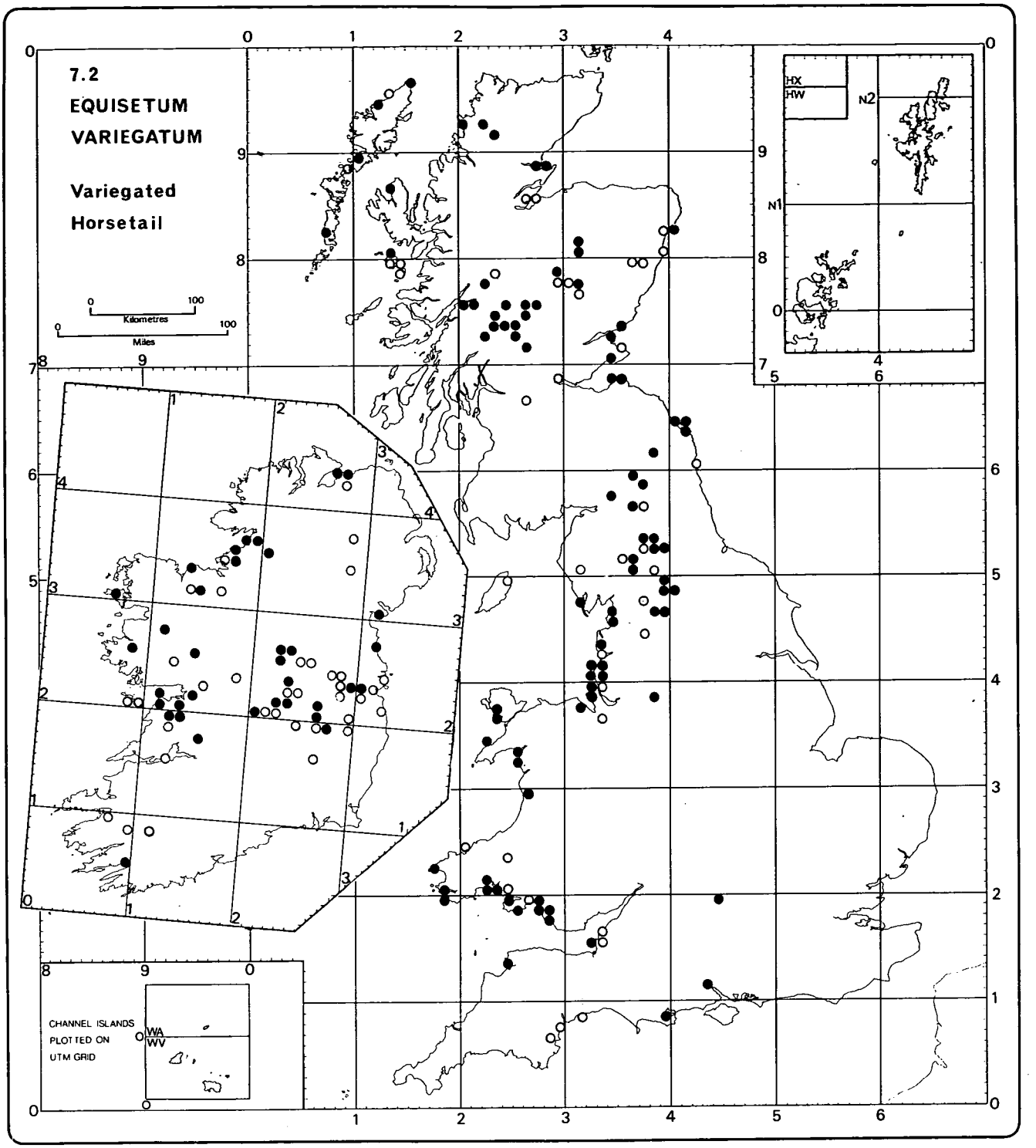
E.ramosissimum, a southern European species, was first recorded for the British Isles in 1947 when collected on the bank of the R.Witham, v.c. 53 (see A.H.G.Alston, *Watsonia, 1:* 149-153; 1949). Whilst it has maintained itself it has not spread, and it is believed to have been introduced with soil when the river wall was being strengthened. It is therefore regarded as an alien in the British flora.



7.1 × 2 **Equisetum × trachyodon** A.Braun

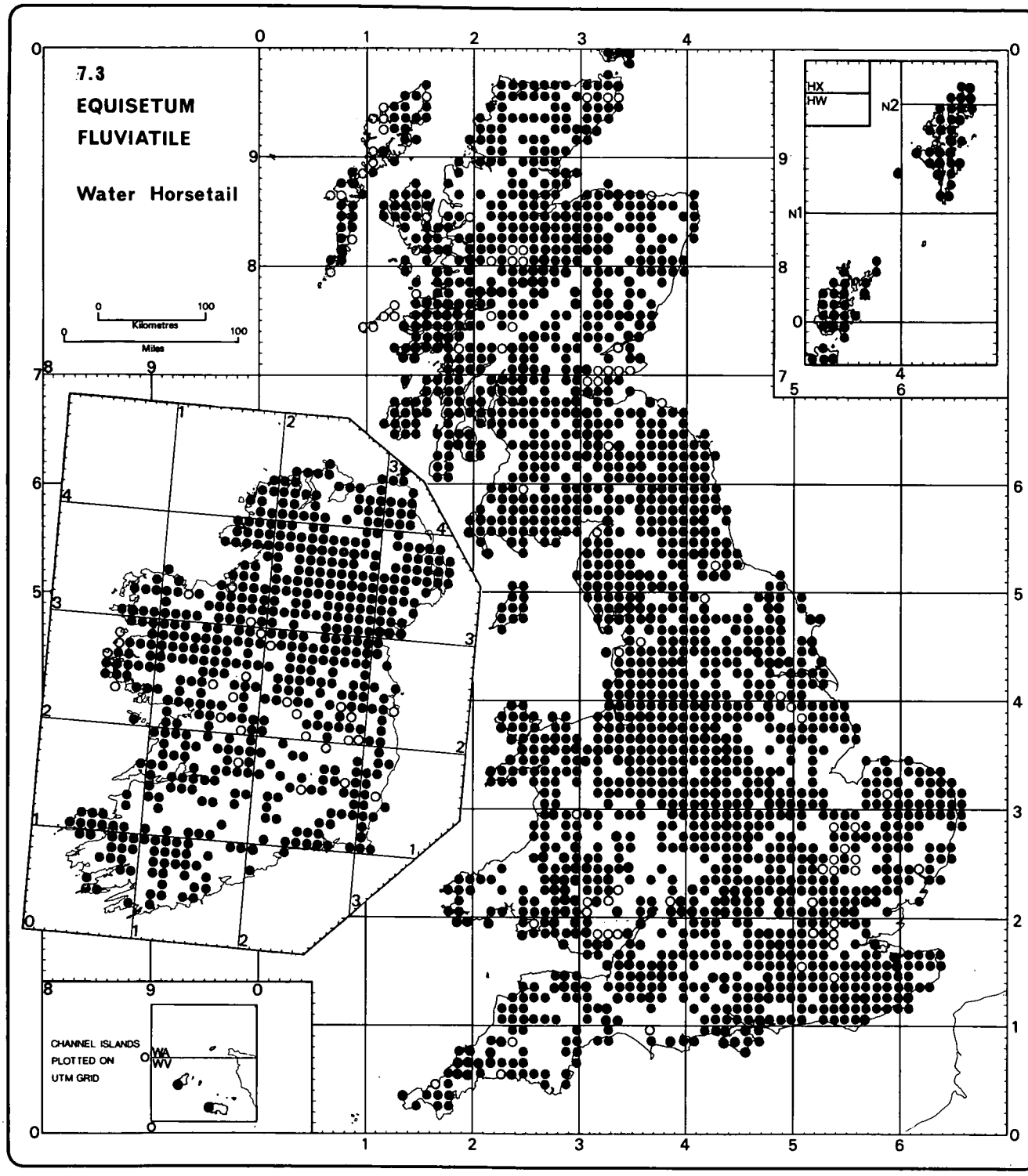
(*E.hyemale* × *variegatum*)

A hybrid with a distinct Atlantic distribution which however may be under-recorded on the European mainland. The *E.variegatum* parent is most likely the lowland (and often coastal) ecotype of that species and the hybrid is therefore more rare in Scotland where the mountain form predominates than the distribution of the parent species would suggest. Some previously reported records from Ireland have proved to be forms of *E.variegatum*. Small plants may be separated from that species by the long sheath and the long teeth with narrow membraneous margins; the cones have abortive spores (see J.G.Duckett & C.N.Page, in C.A.Stace (ed.), *loc.cit.*: 100).



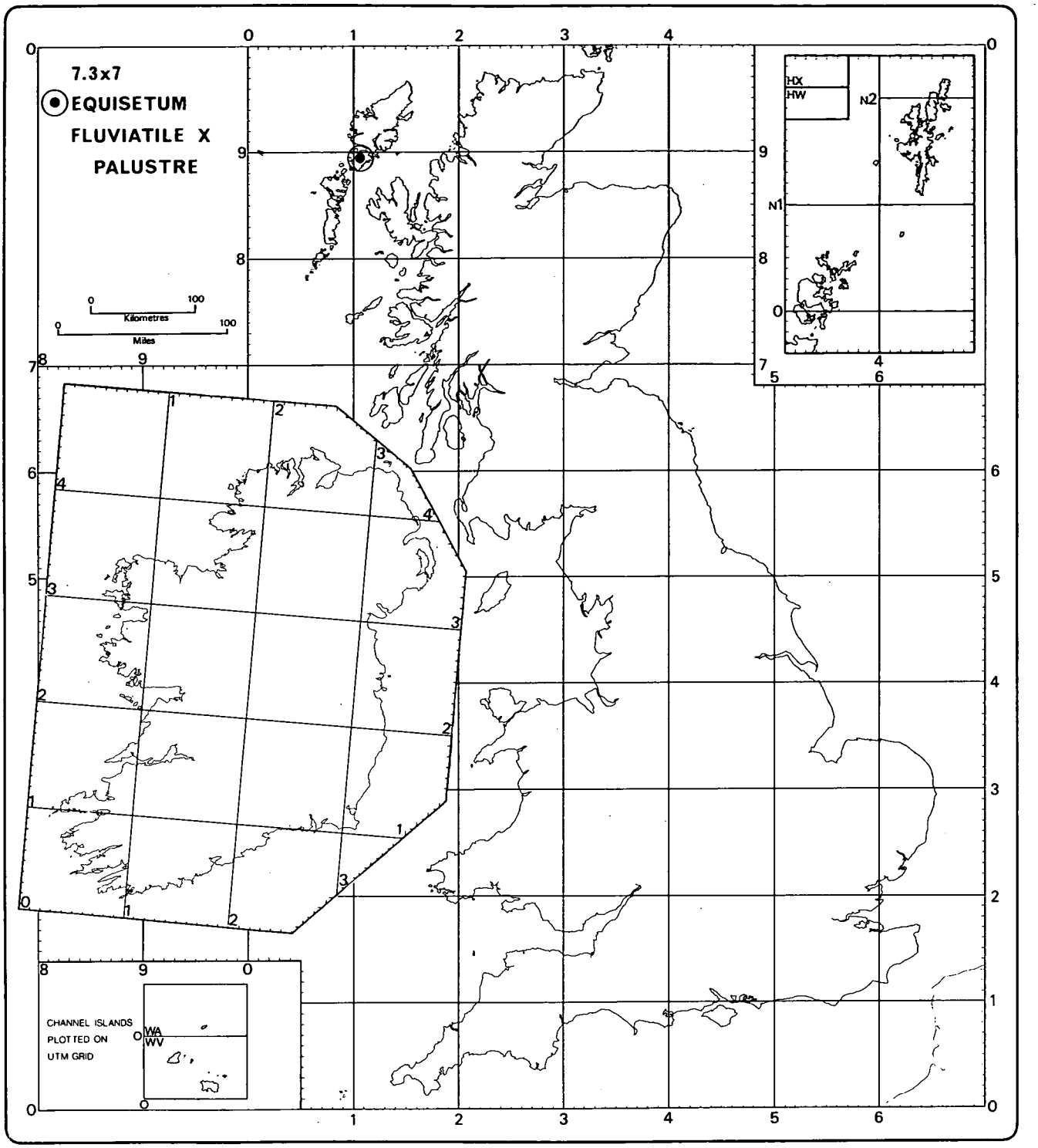
7.2 **Equisetum variegatum** Schleicher ex Weber & Mohr

A northern-montane species of wet alpine ledges yet also characteristic of coastal sand-dune slacks in the west. *E.wilsonii* Newm., originally described from Muckross, v.c. H2, hitherto regarded as this species needs further investigation as do sand-dune populations in Britain (see J.A.Crabbe, A.C.Jermy & G.A.Matthews, *Proc. Bot. Soc. Brit. Isles, 6:* 40-42; 1965).



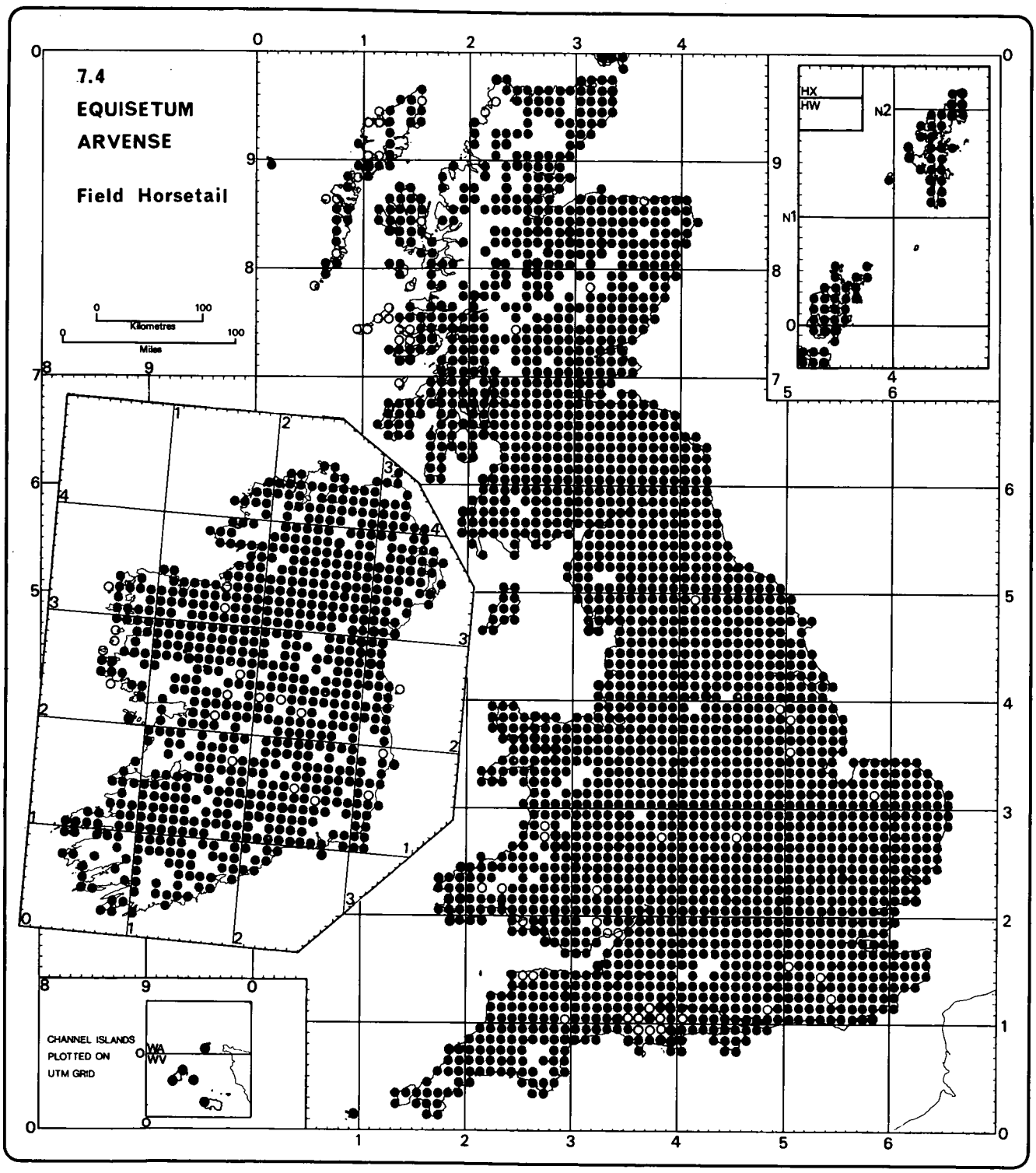
7.3 Equisetum fluviatile L.

A widespread species of which the ecological requirements are little understood and need further investigation. Detailed distribution (e.g. on the tetrad basis) of selected areas or counties, might shed light onto this problem.



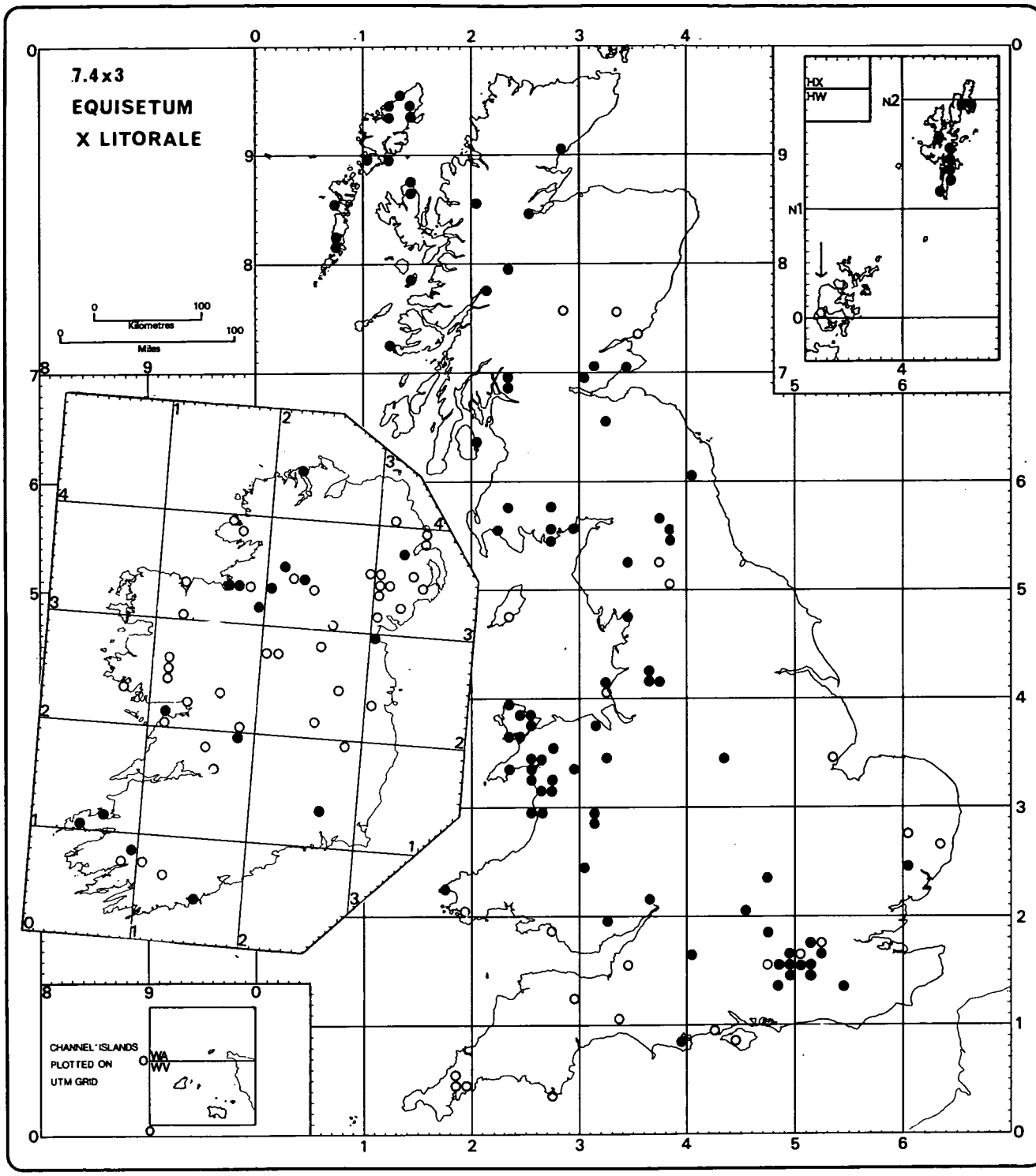
7.3 × 7 Equisetum fluviatile × palustre

A single population found in 1962 in Harris, v.c. 110 (see C.N.Page, *Br. Fern Gaz., 9:* 118-120; 1963 and J.G.Duckett & C.N.Page, in C.A.Stace (ed.) *loc. cit.:* 100). It is morphologically intermediate between the parents but superficially more like *E.palustre* than the other putative parent. It may also be confused with *E.* × *litorale* but the length of the first internode of the branches, number of stem ridges, length and direction of the branches are all indicative of *E.palustre* rather than *E.arvense*. However, as in all *Equisetum* hybrids, confirmation by anatomical characters (e.g. size of central hollow and vallecular canals) is often needed for correct determination.



7.4 Equisetum arvense L.

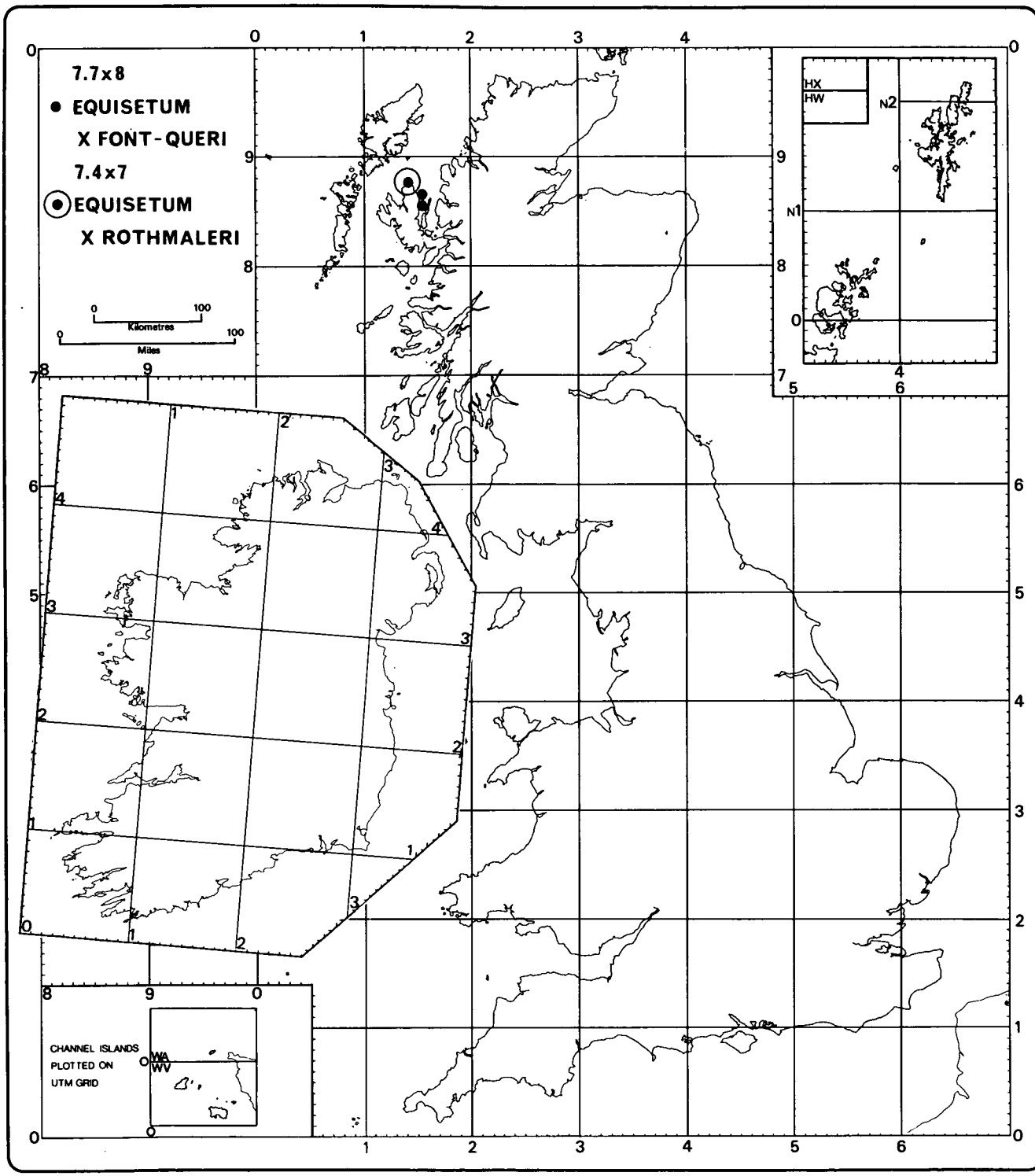
A widespread species of inorganic soils and therefore absent from squares which are covered predominantly by peat. An interesting high mountain flush ecotype would be worth mapping separately; it could be overlooked as *E.palustre* but has the lowermost internodes of the branches characteristically longer than the main stem sheath subtending those branches.



7.4×3 **Equisetum × litorale** Kuhlew. ex Rupr.

(E.arvense × fluviatile)

Considering the dissimilarity of the habitat required by each parent this hybrid is surprisingly frequent. It is also extremely variable: in drier habitats specimens often approach *E.arvense* and in wet ones *E.fluviatile* (see J.G.Duckett & C.N.Page, in C.A.Stace (ed.), *loc.cit.*: 101; 1975).



7.4×7 **Equisetum × rothmaleri** C.N.Page

(*E.arvense* × *palustre*)

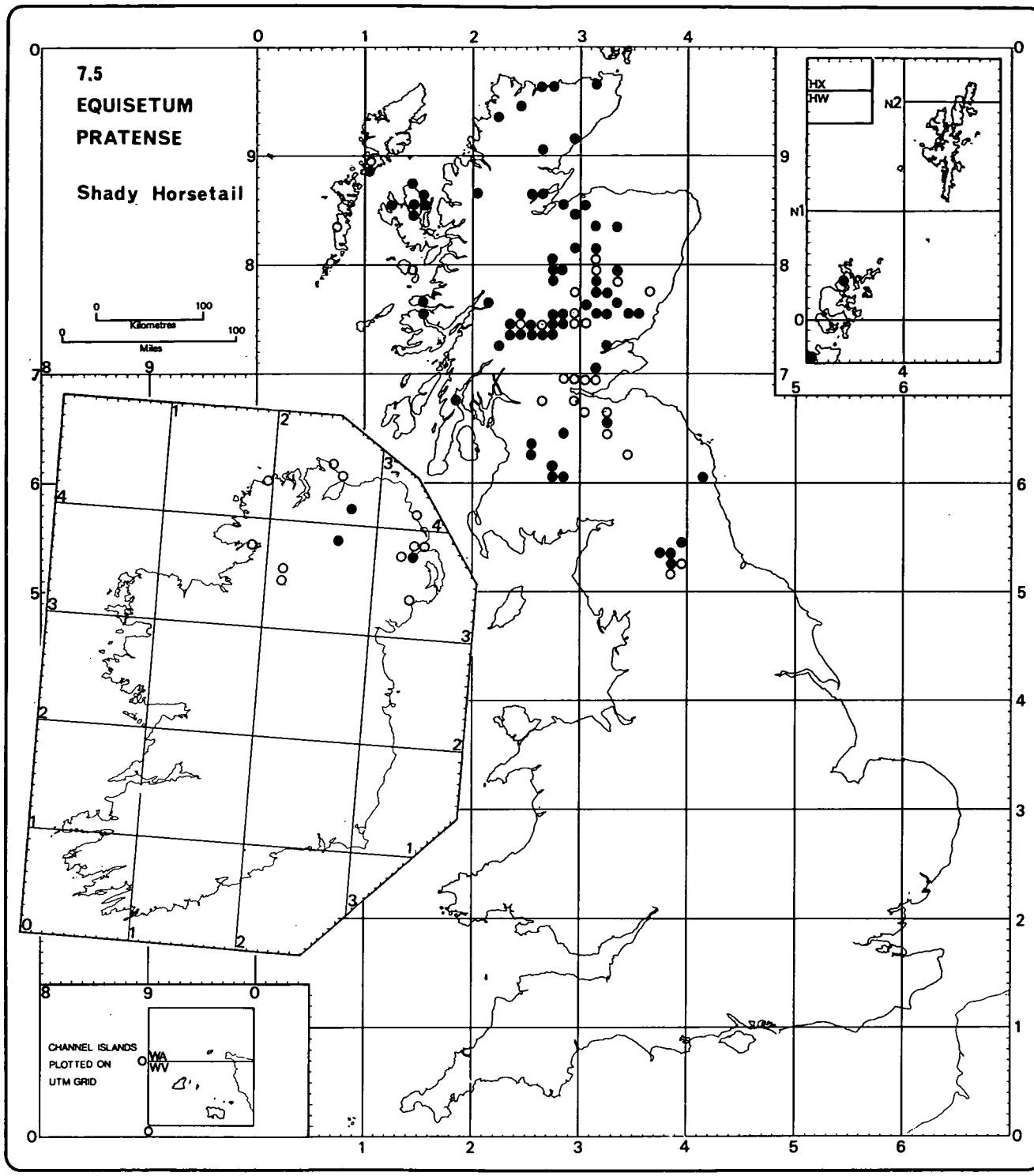
A single small colony of this hybrid was found on the Trotternish peninsula, v.c. 104. It resembles a yellow-green *E.palustre* with a broader outline and more conspicuously angled branches.

See C.N.Page, *Watsonia 9:* 229-237; 1973, and J.G.Duckett & C.N.Page, in C.A.Stace (ed.)*loc. cit.;* 102; 1975 for notes on both these hybrids.

7.7×8 **Equisetum font-queri** Rothm.

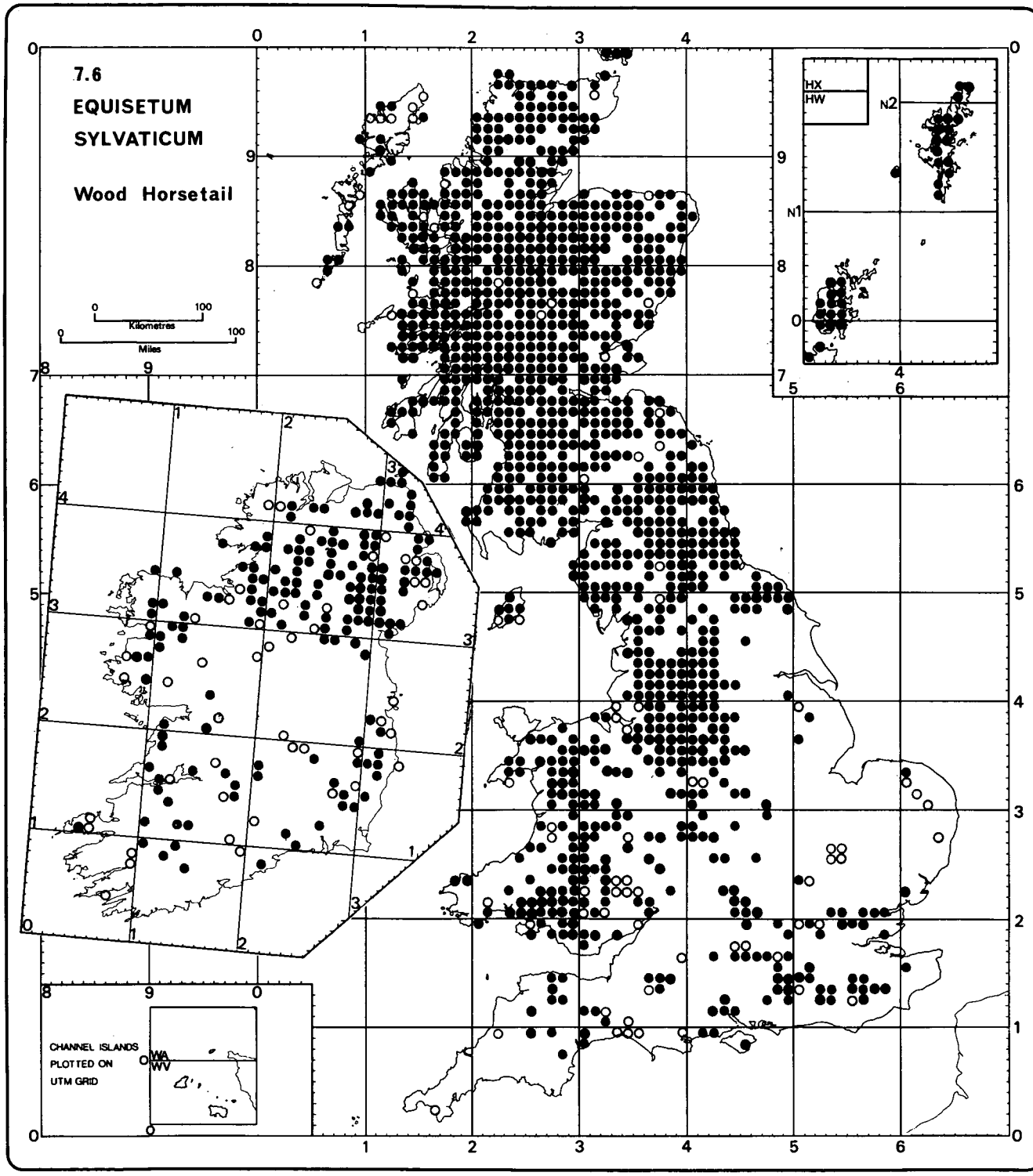
(*E.palustre* × *telmateia*)

Similarly found on the Trotternish peninsula, v.c. 104, but as an extensive colony. It has the overall appearance of a narrower *E.telmateia* with cones on the vegetative shoots (as in *E.palustre*).



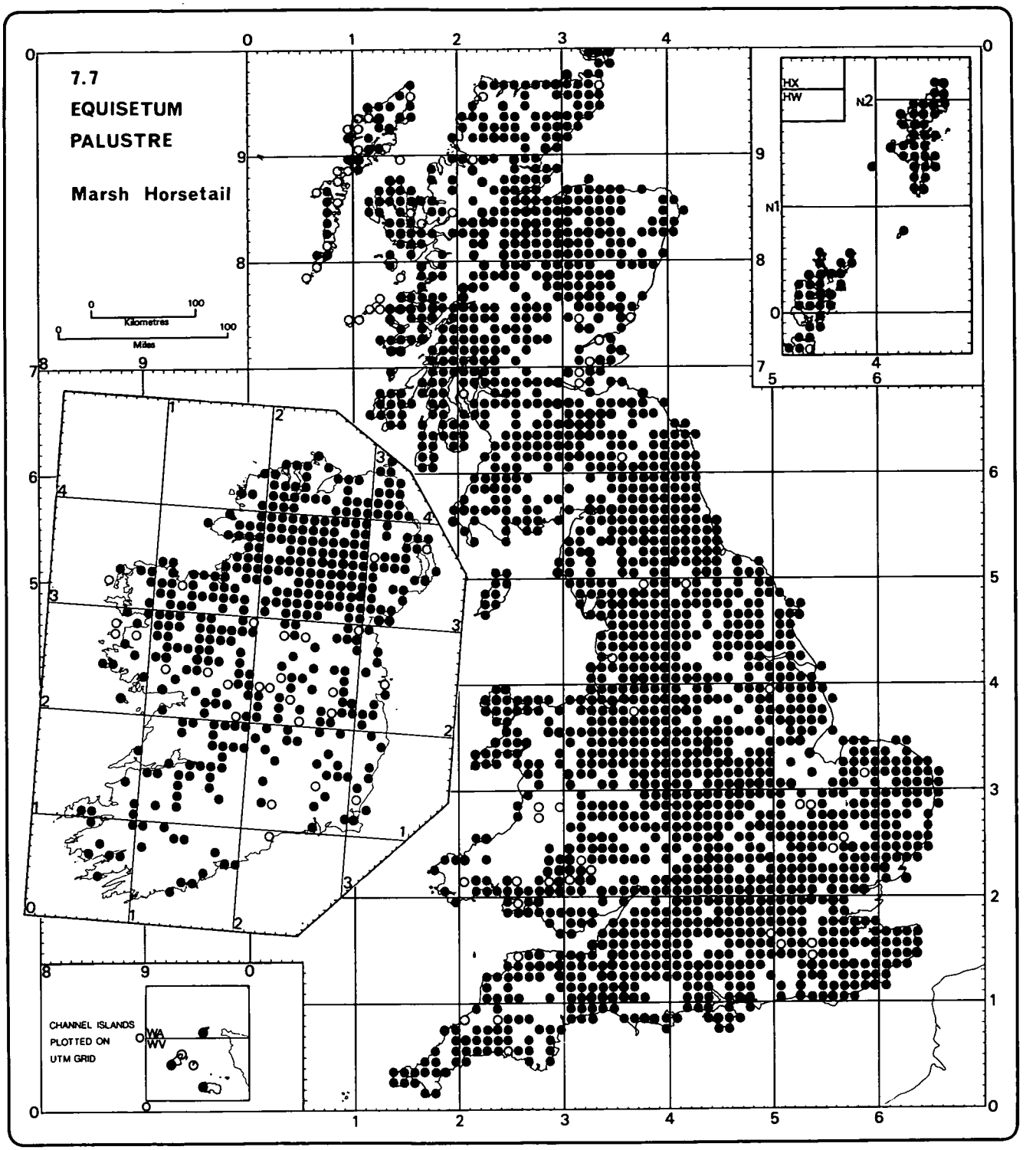
7.5 **Equisetum pratense** Ehrh.

A northern-montane species which may be further recorded as regional studies are carried out in Scotland. This species can be confused with *E.sylvaticum* which has the teeth of the sheaths joined in groups of two or three; *E.pratense* has narrow single teeth equal in number to the stem ridges.



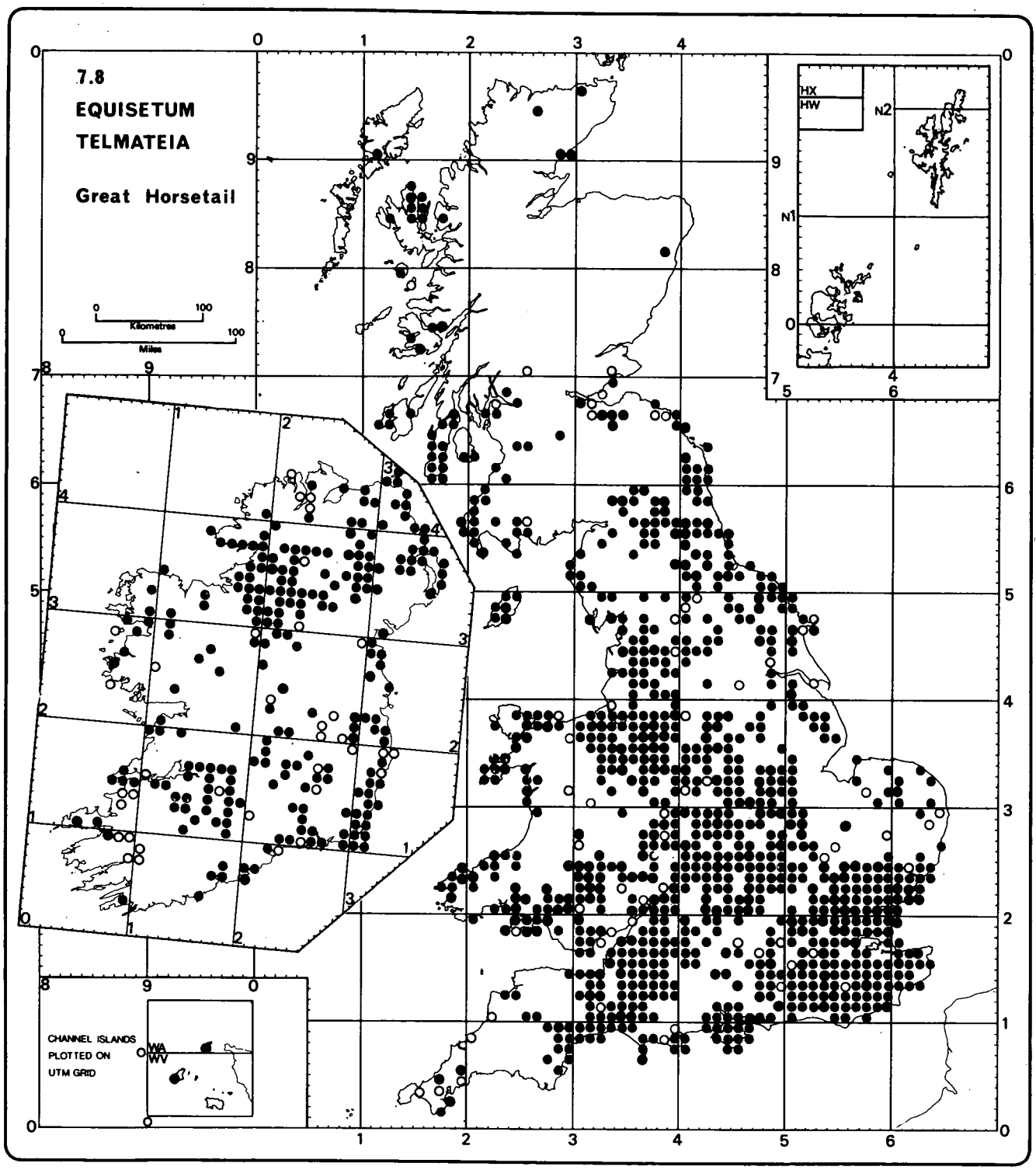
7.6 **Equisetum sylvaticum** L.

A widespread species of wet woodland or upland peat which was formerly wooded. Absent from a large part of the agricultural areas of central and southern Britain.



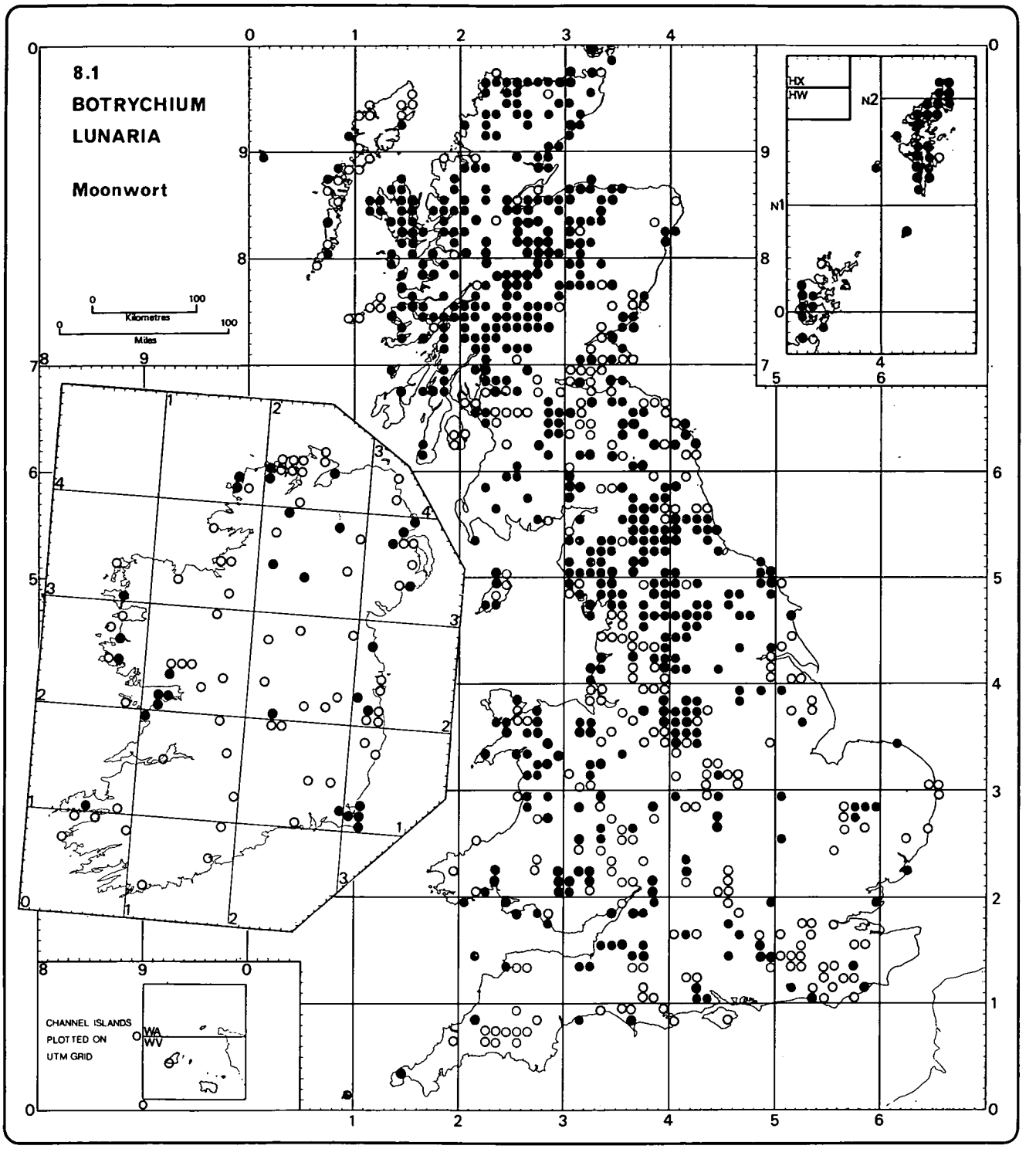
7.7 **Equisetum palustre** L.

A widespread species requiring moving ground water with a medium base-content (calcium/magnesium). The absence of records from peat and base-poor soils is probably realistic.



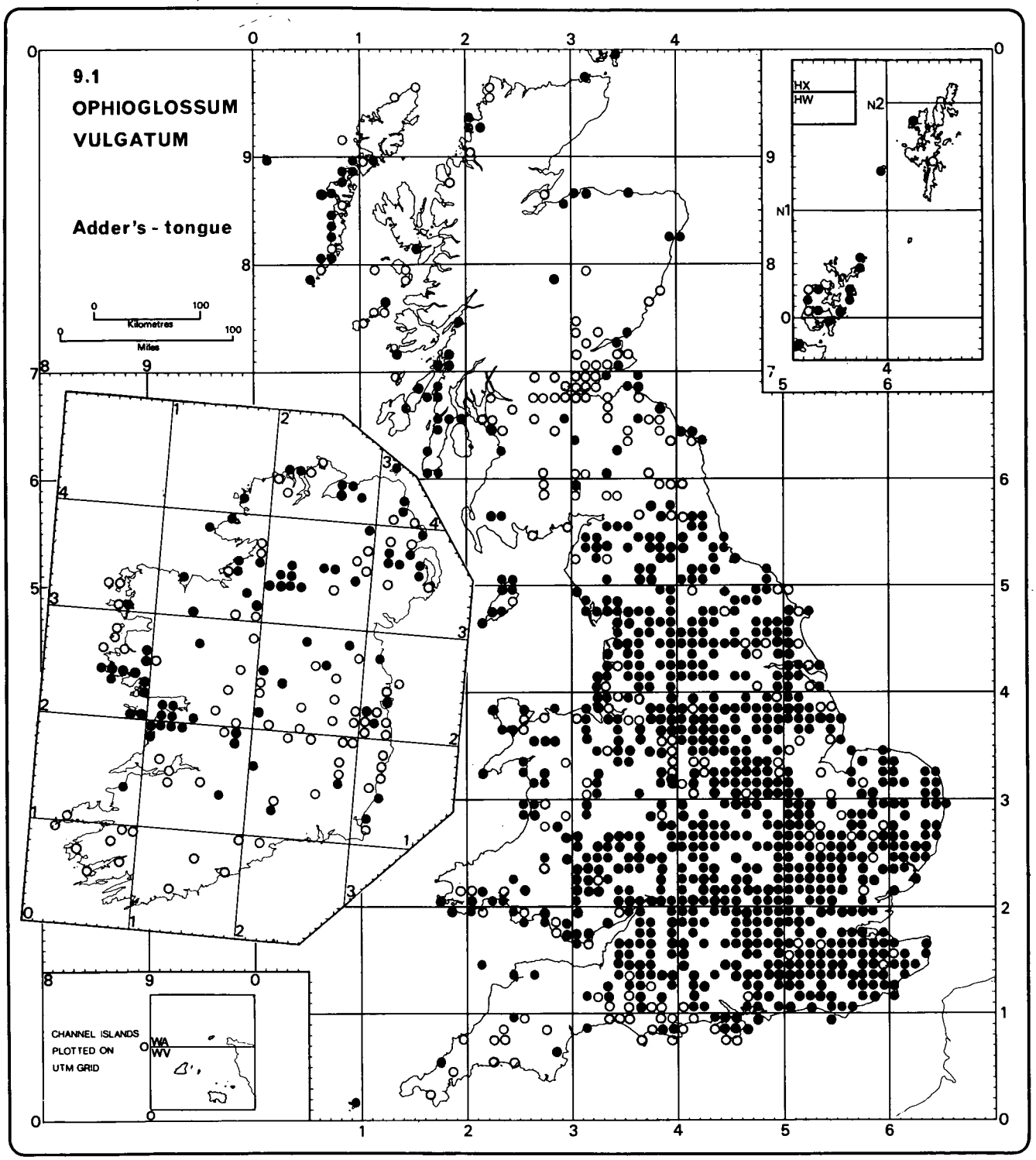
7.8 **Equisetum telmateia** Ehrh.

A southern sub-Atlantic species which reaches its northernmost station in Britain. It requires a high base-status and is recorded on siliceous or peaty soils only where there are base-rich flushes.



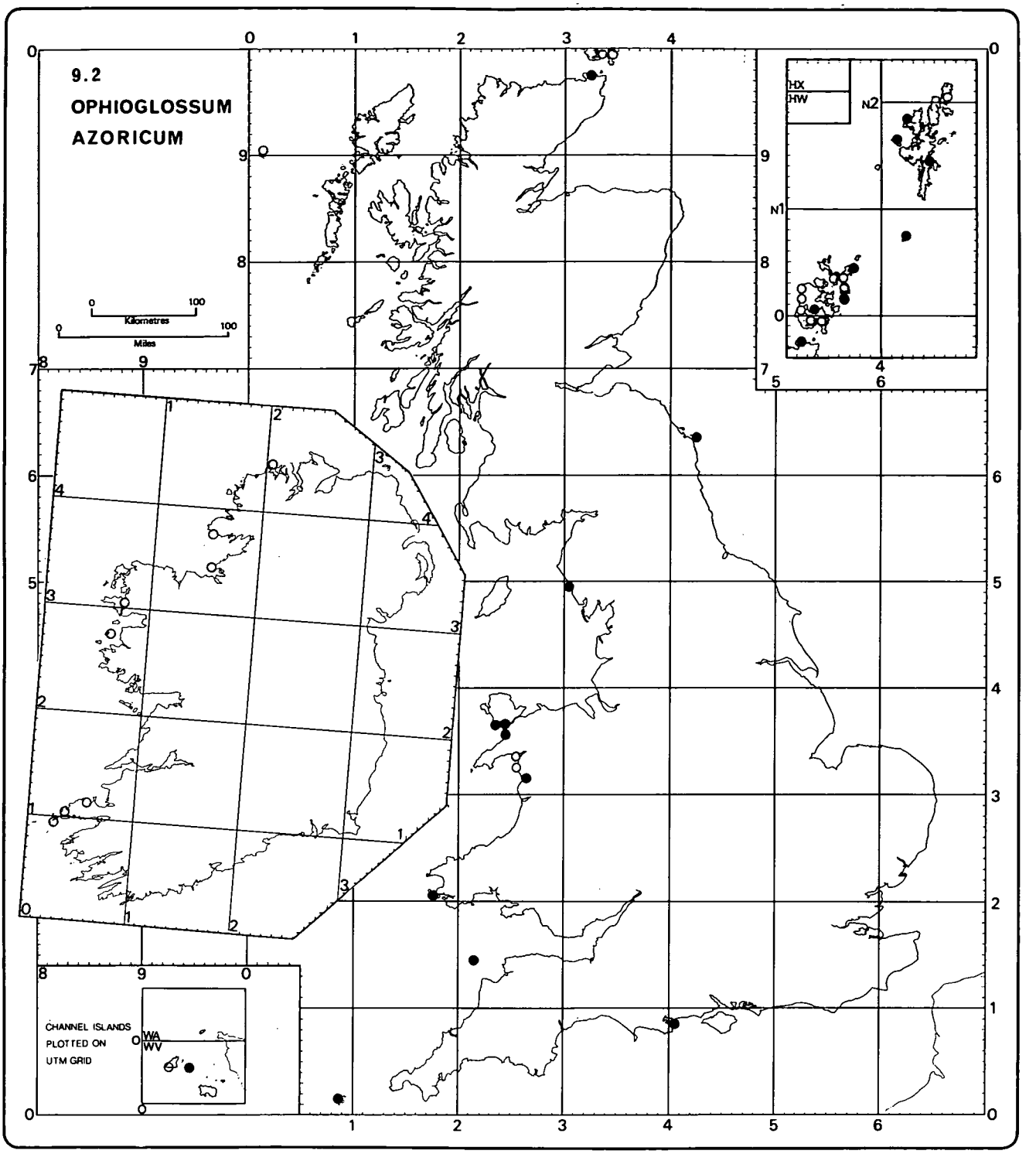
8.1 **Botrychium lunaria** (L.) Swartz

A widespread northern-continental species requiring well-drained sites with a high base-content. It is decreasing in lowland sites due to intensive land management. The specimens that gave rise to the records of *B.lanceolatum* (S.G.Gmel.) Ångstr., *B.matricariifolium* A.Br. ex Koch and *B.multifidum* (S.G.Gmel.) Rupr. (J.E.Dandy, *List Brit. Vasc. Pl.*: 7; 1958) are abnormal forms of *B.lunaria*.



9.1 **Ophioglossum vulgatum** L.

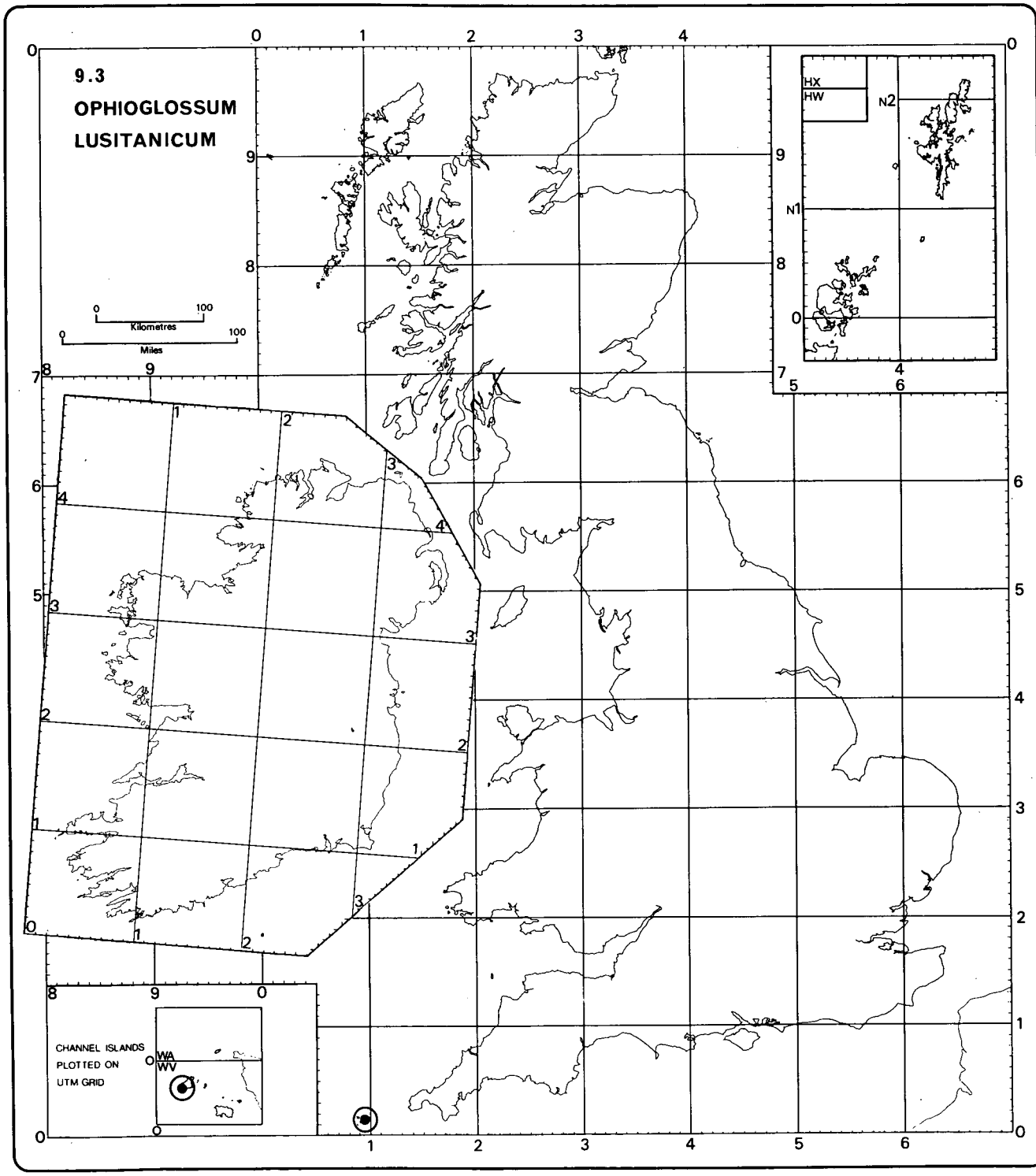
A plant of wet meadows and fens and in similar deep loam soils; also in coastal sand-dune slacks and in Scotland in flushed areas on machair. Land reclamation is reducing the known sites.



9.2 **Ophioglossum azoricum** C.Presl

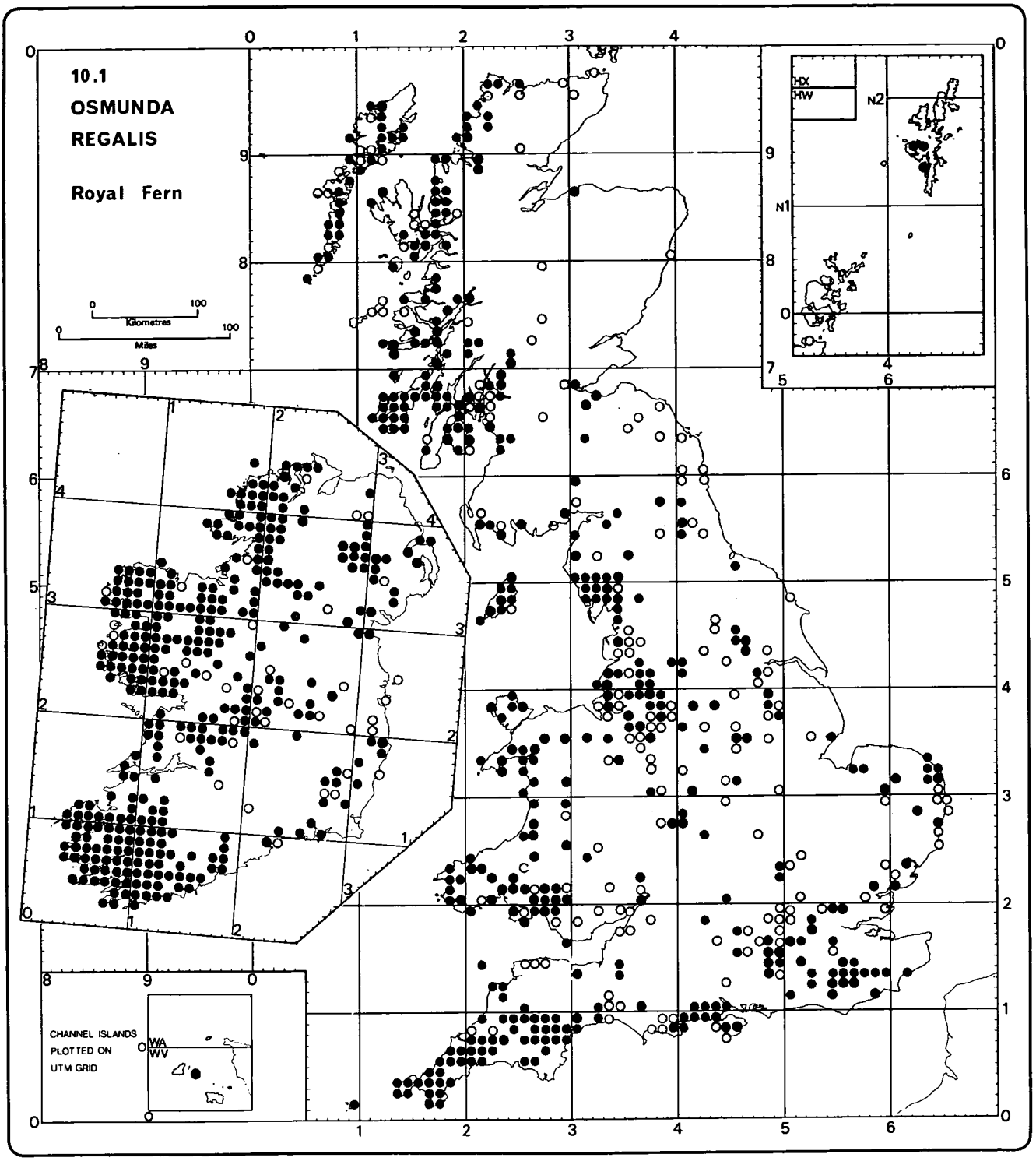
(*O.vulgatum* L.subsp. *ambiguum* (Coss. & Germ.) E.F.Warb.)

This is a taxon that requires further investigation and its relationship to *O.vulgatum* is not clear. As in the *Critical Suppl.* this map is based on specimens having 14 or fewer sporangia, a sterile blade less than 3.5cm and occurring in short turf near the sea.



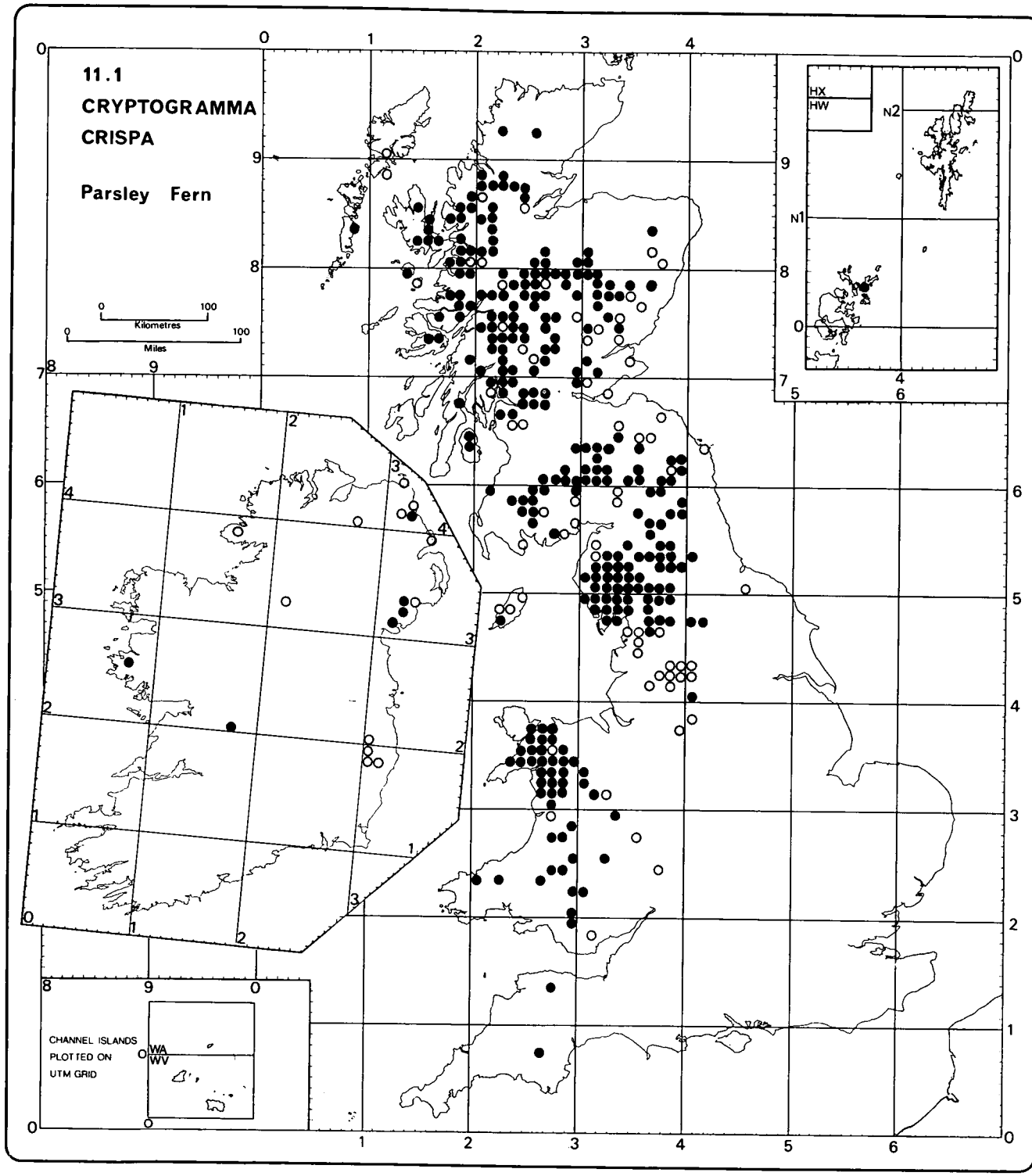
9.3 **Ophioglossum lusitanicum** L.

A Mediterranean and south Atlantic species which reaches its northernmost station in Britain (Isles of Scilly). As the plant is evident between November and February only, dying down completely during the rest of the year, it may have been overlooked in S.W. Ireland.



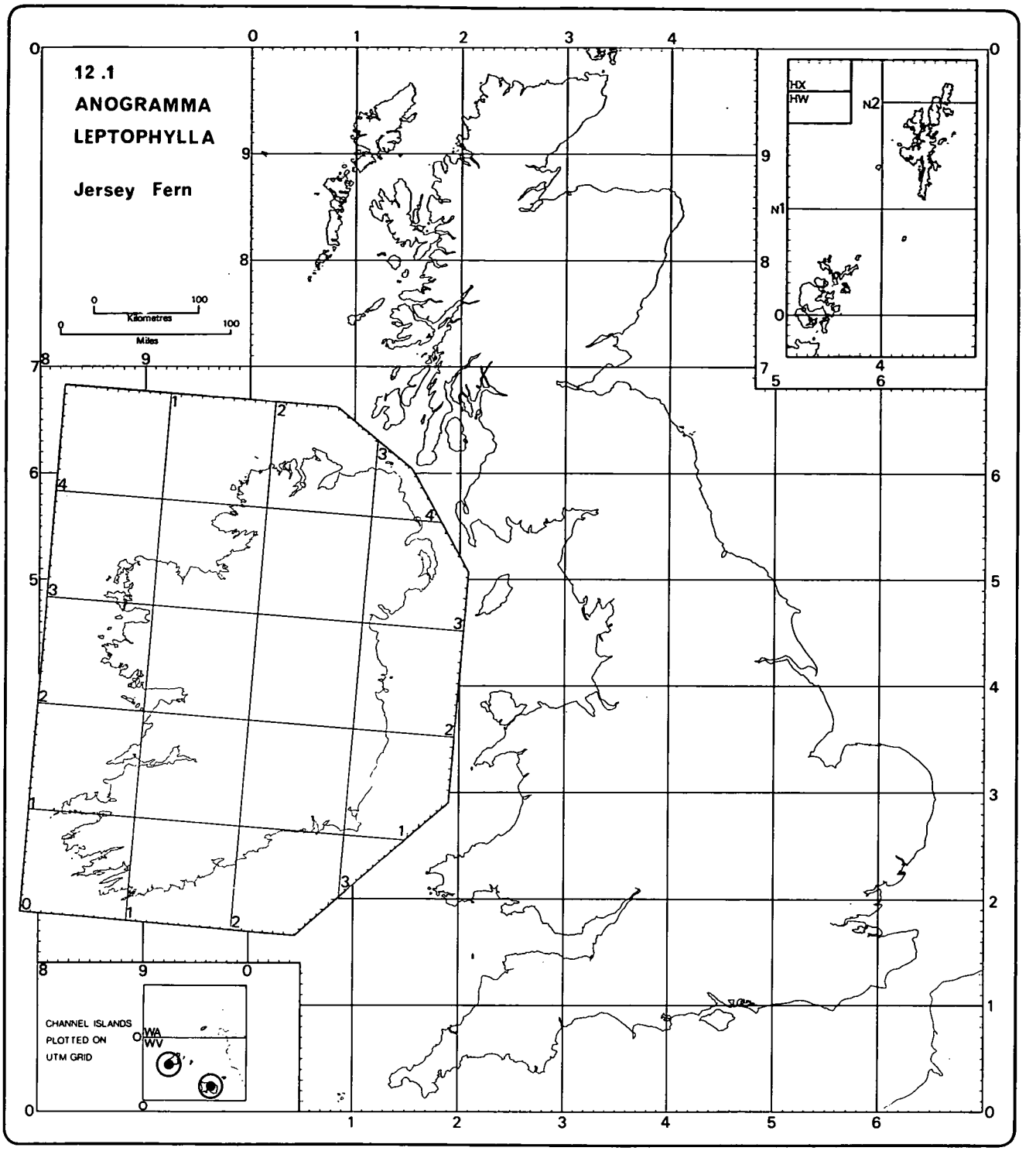
10.1 **Osmunda regalis** L.

A sub-Atlantic species reaching the northern limit of its natural distribution in Zetland (v.c. 112). It is a species often removed from the wild and introduced into gardens, from which spores spread naturally, thus its native occurrence in some parts of Britain is difficult to assess. Its distribution shows that it prefers a high rainfall. It is a feature of western bogs which receive considerable base cations from salt-laden winds. Further inland it is characteristic of valley mires.



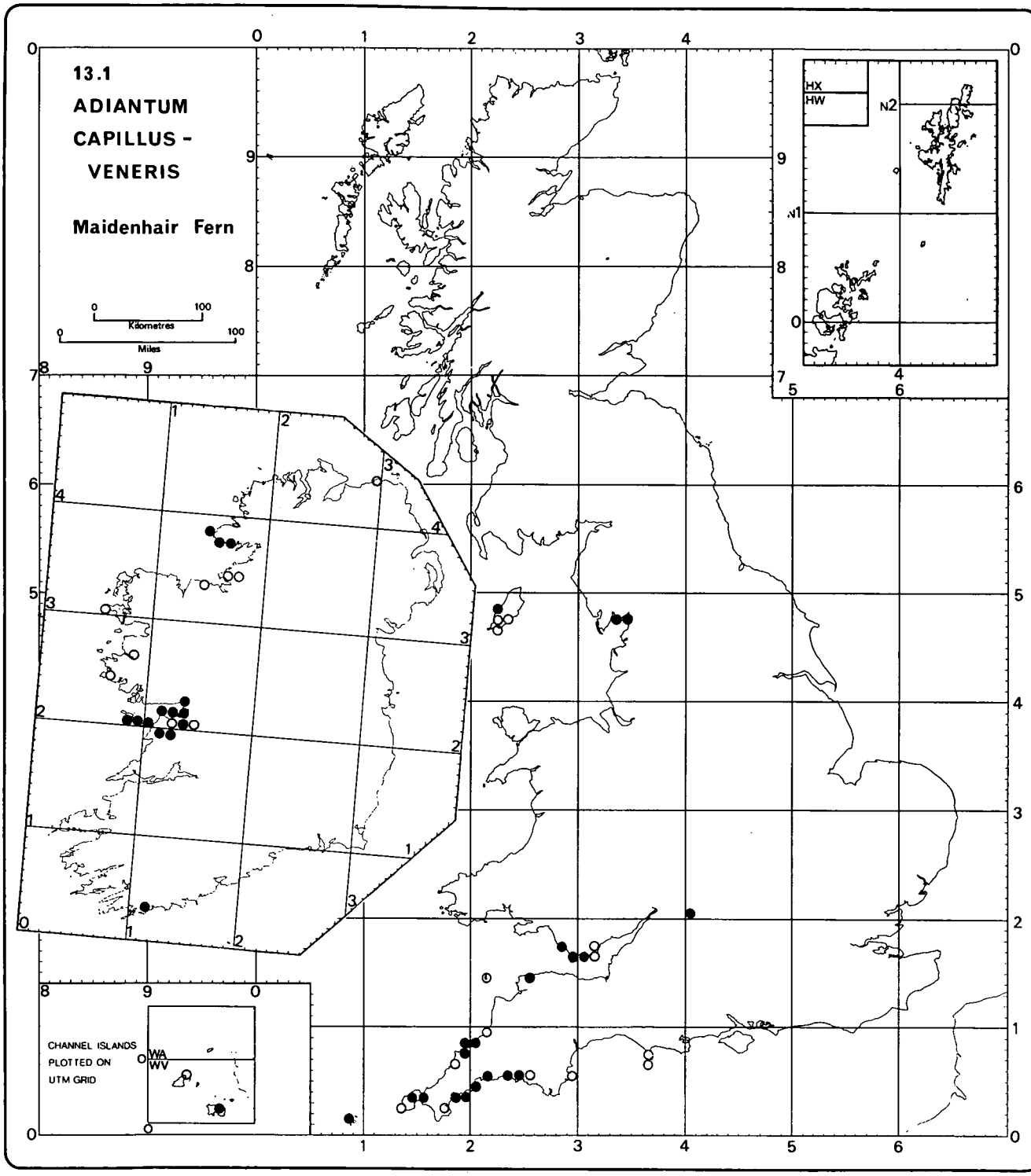
11.1 **Cryptogramma crispa** (L.) Hook.

An arctic-alpine species restricted to calcium-free siliceous soils and rock screes. Absent from such habitats in the west where these are enriched with base-rich cations from salt-laden winds. A very local plant in Ireland. A.P.Conolly & E.Dahl (in D.Walker & R.West (eds.), *Studies in the vegetational history of the British Isles:* 196; 1970) correlate the present-day distribution of this species with the 24°C maximum summer temperature summit (i.e. for the highest places in the landscape) isotherm for Ireland and Highland Scotland and the 26°C isotherm for Wales, England and Lowland Scotland.



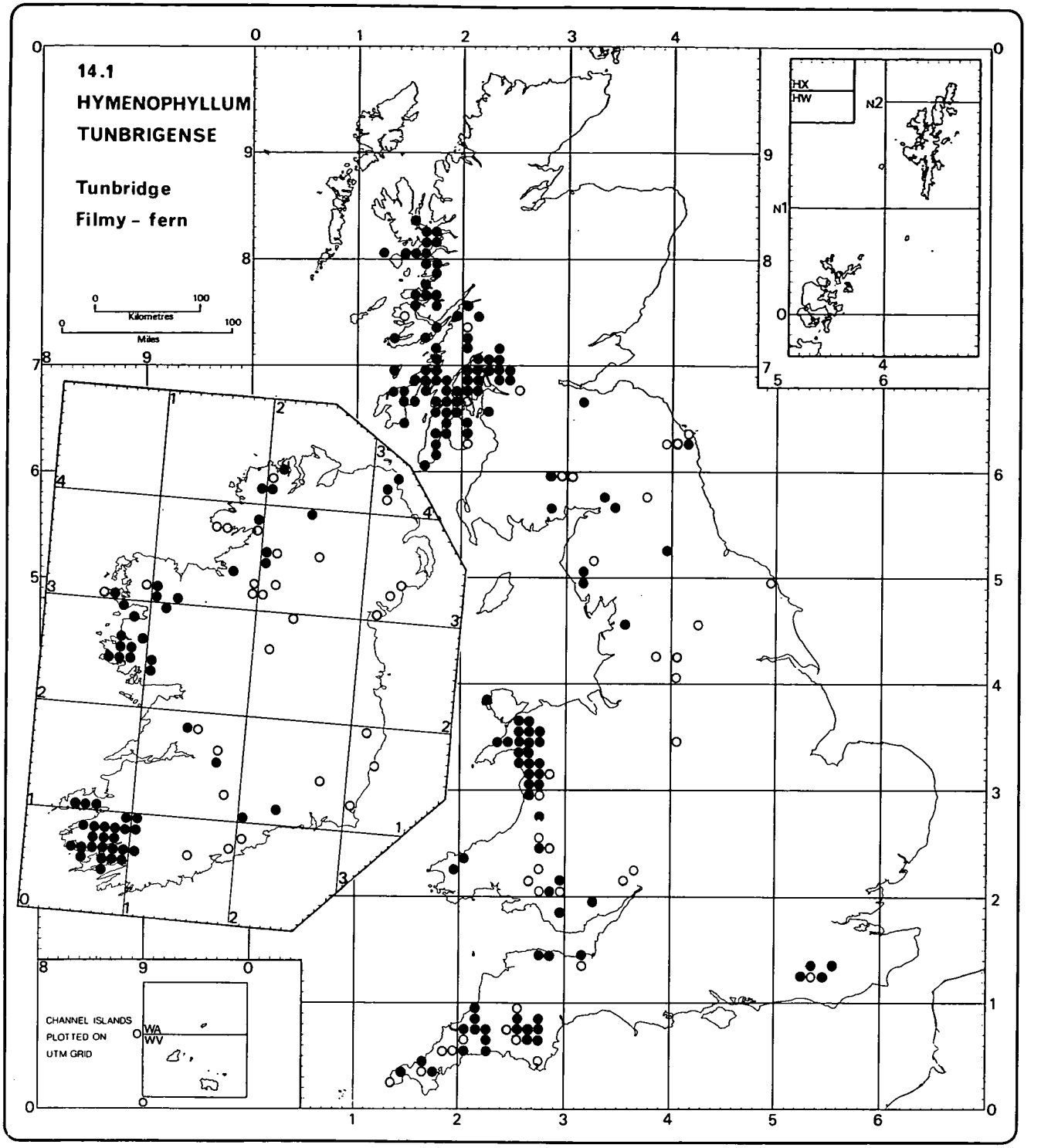
12.1 **Anogramma leptophylla** (L.) Link

A Mediterranean and south Atlantic species which reaches its northernmost limits in Guernsey (Sarnia). It is an annual plant and any catastrophe which prevented the maturation of fertile fronds could seriously deplete a population.



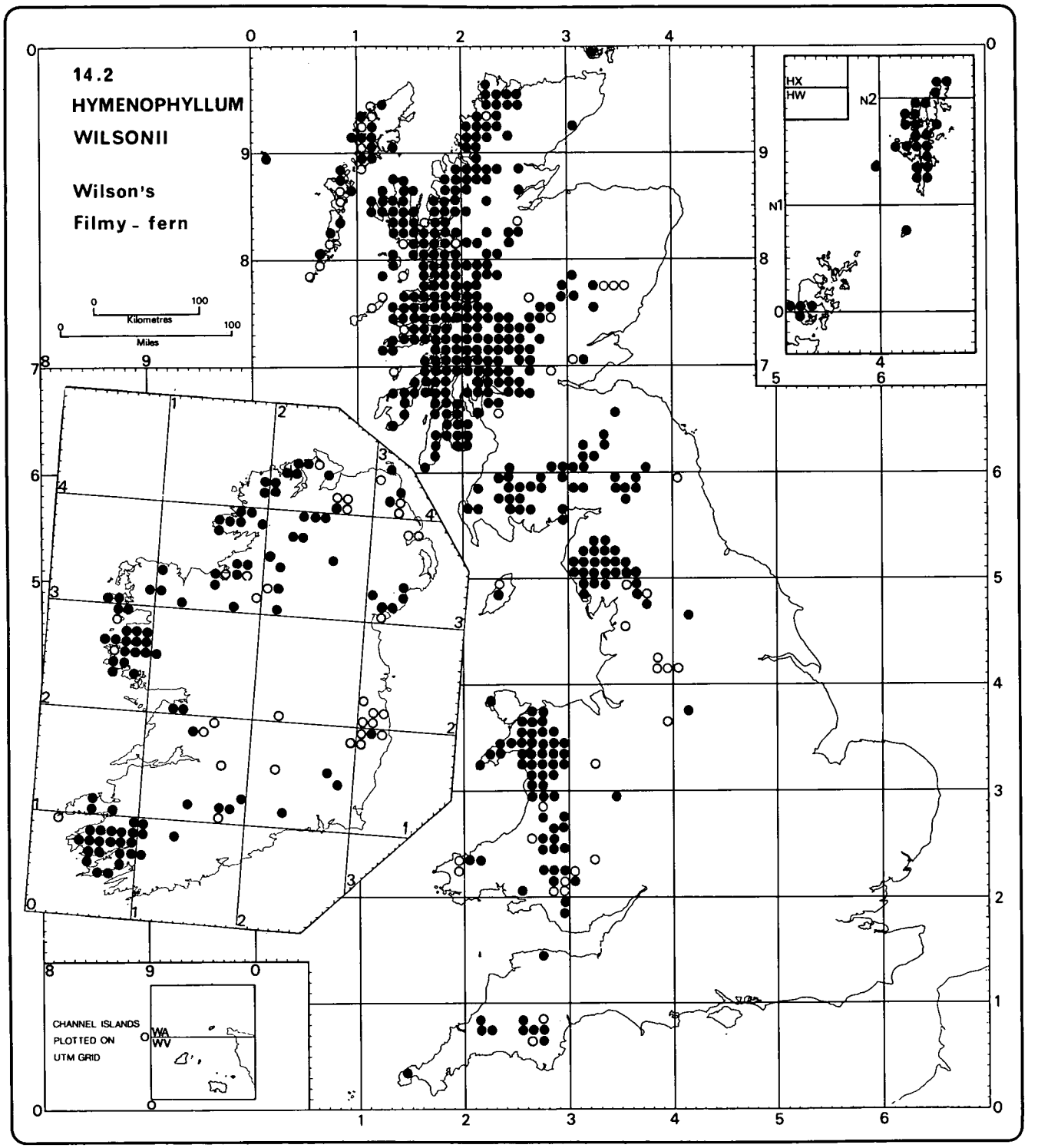
13.1 **Adiantum capillus-veneris** L.

A Mediterranean and south Atlantic species which reaches its northernmost limits as a native plant on the coast of v.c. H.35. It is a species frequently grown in gardens or as a house plant and spores from this source will establish themselves on calcareous substrates (e.g. mortar or calcareous stone walls) in warm situations; such records are not mapped.



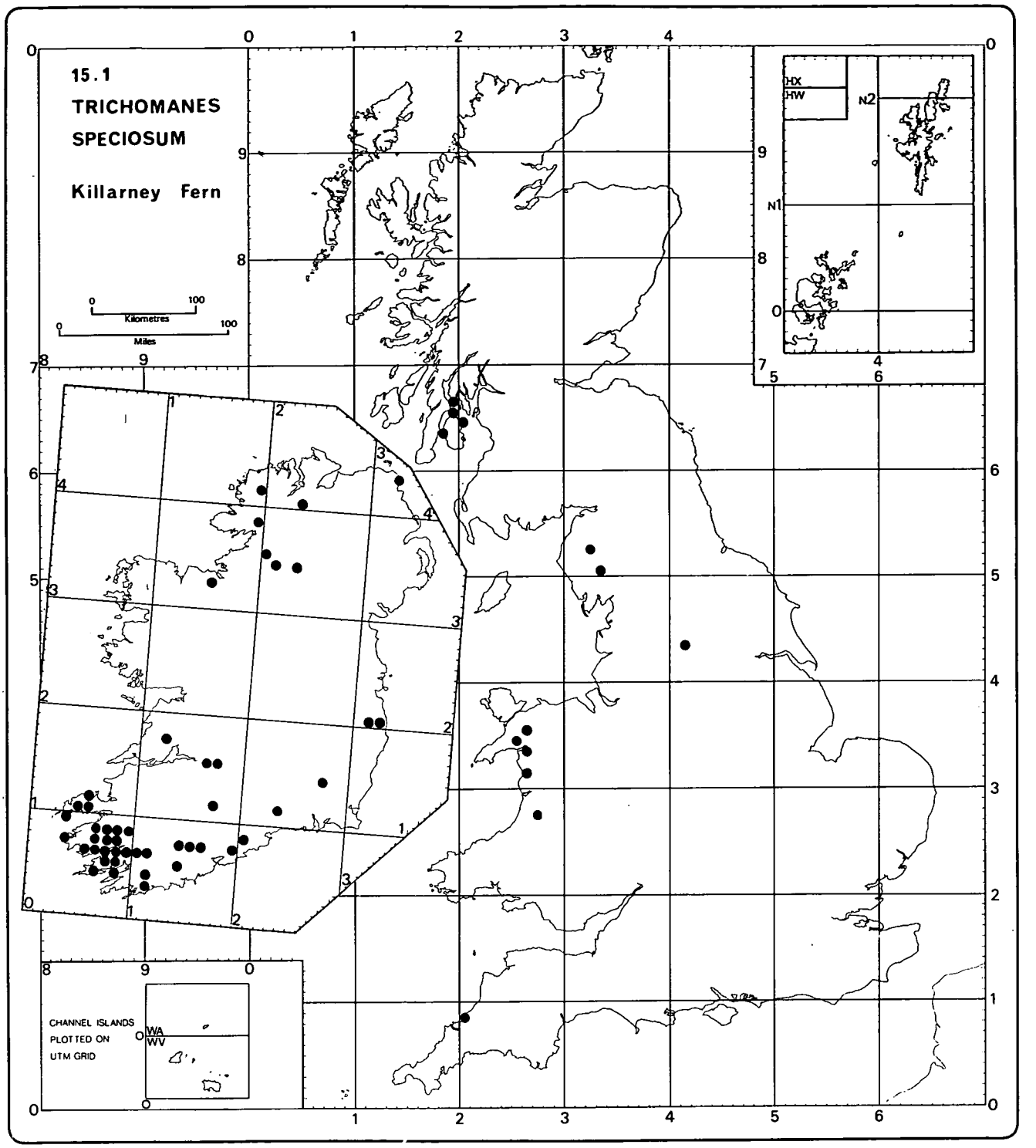
14.1 **Hymenophyllum tunbrigense** (L.) Sm.

A species of restricted occurrence in Europe not recorded north of its British localities in v.c. 104. Its distribution in Britain and Ireland is mainly determined by the occurrence of suitable microclimates and substrata (see P.W.Richards & G.B.Evans, Biological Flora of the British Isles: *Hymenophyllum, J.Ecol. 60:* 245-258; 1972).



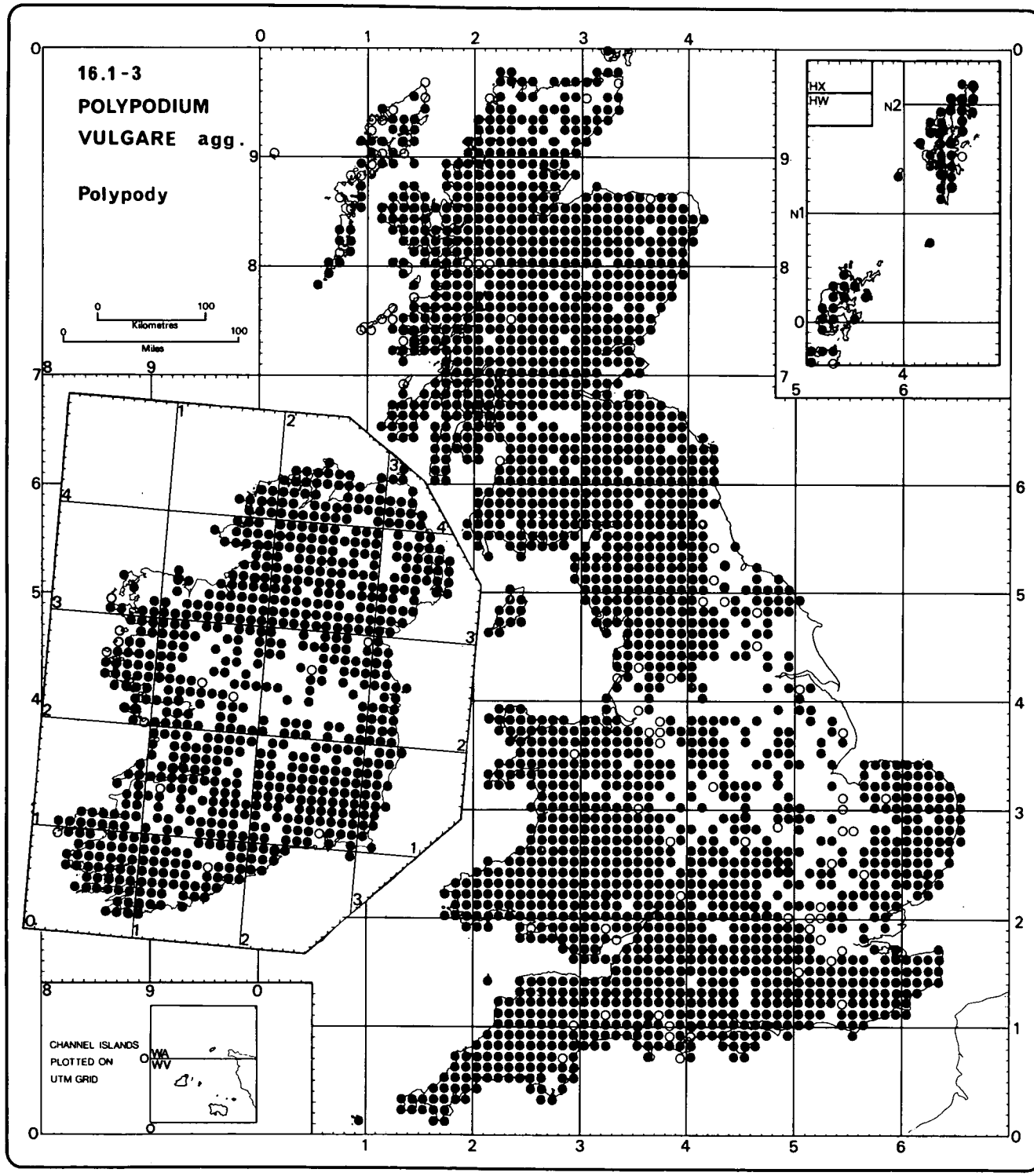
14.2 **Hymenophyllum wilsonii** Hook.

A species of very restricted range (Madeira; Azores; Brittany; Faeroes; and Norway) generally widespread in W.Britain and Ireland. Its distribution depends on factors affecting atmospheric humidity but is more tolerant of exposure and desiccation than *H.tunbrigense*. (See P.W.Richards & G.B.Evans, Biological Flora of the British Isles: *Hymenophyllum, J. Ecol. 60:* 258-268; 1972).



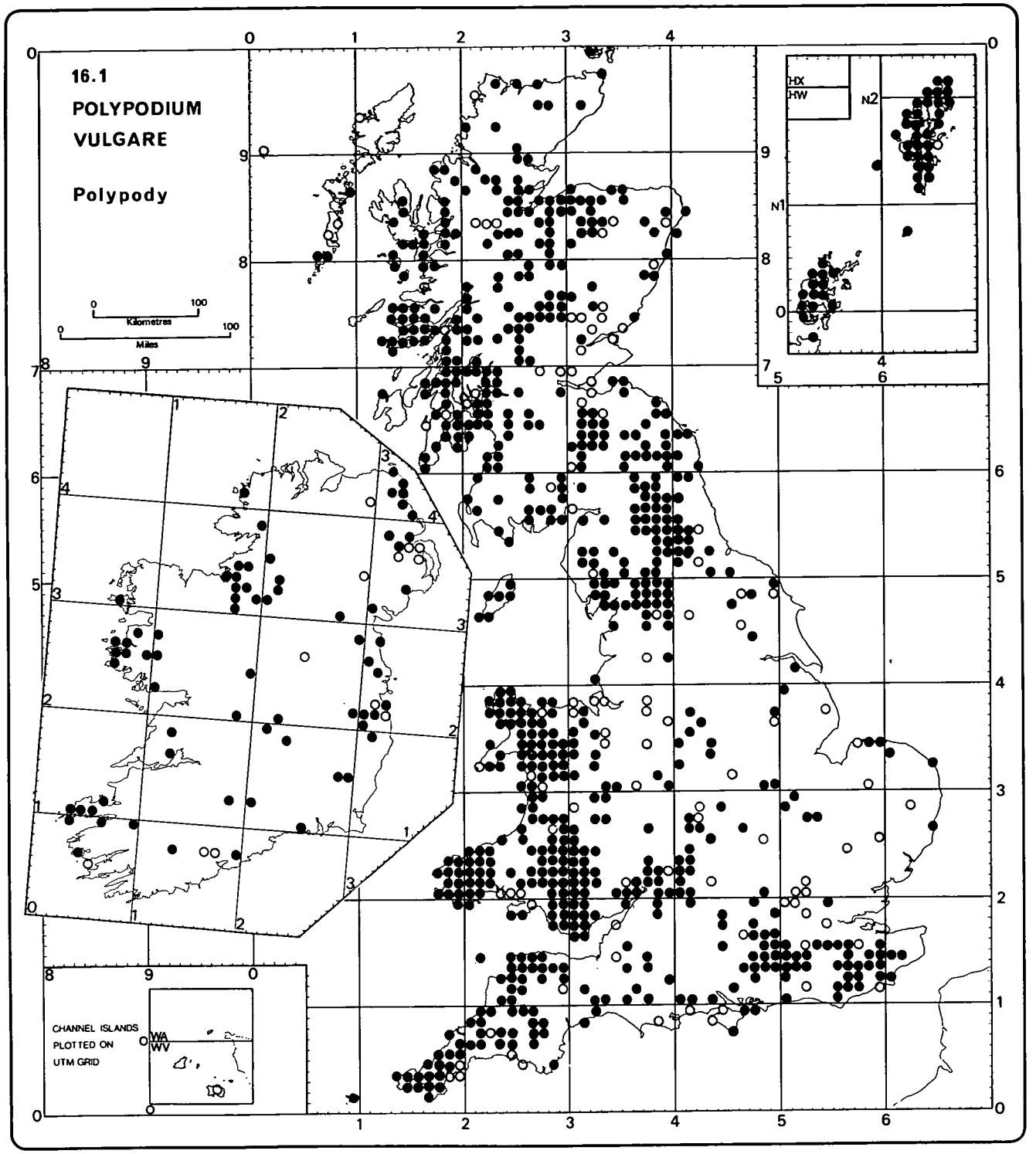
15.1 **Trichomanes speciosum** Willd.

A species confined in Europe to the western seaboard although the distribution is controlled within that climatic zone by suitable substrate (preferably a coarse sandstone interbedded with some impervious layer which can produce lateral movement of ground water). Many old sites have been made extinct by the depredation of collectors; it may yet be refound on Arran, v.c. 100, and on the northernmost locality so far recorded, Ardlamont Point, v.c. 98 (see W.Stewart, *Trans. Nat. Hist. Soc. Glasgow 6:* 18-21; 1899). The map shows as a solid dot all squares where the species has been at any time recorded. *Trichomanes speciosum* is protected by the *Conservation of Wild Creatures and Wild Plants Act, 1975.*



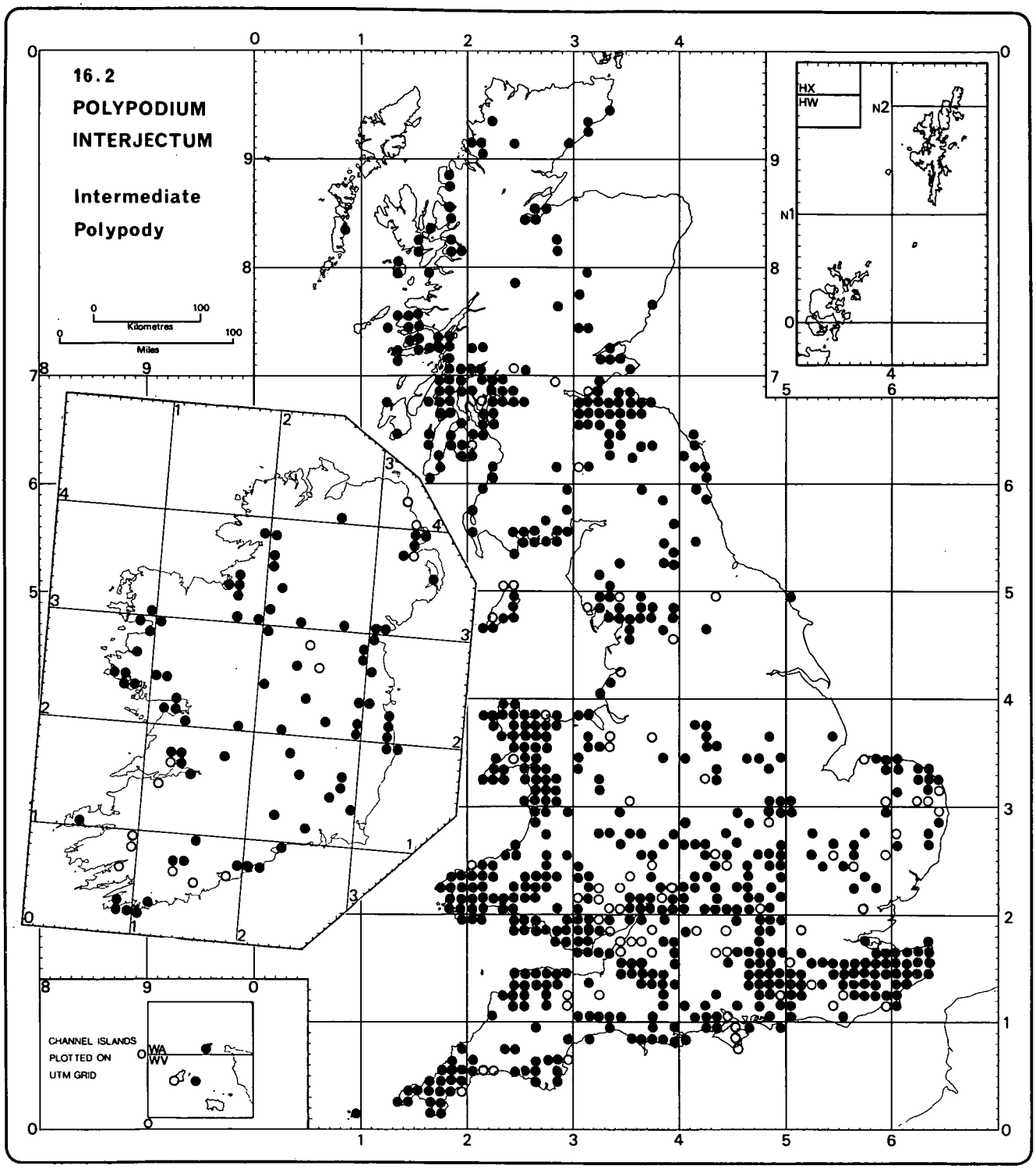
16.1-3 **Polypodium vulgare** aggregate

As many previous records and those for the *Atlas* were made on an aggregate basis, treating the complex as a single species, a map of such general distribution is given here. For taxonomy and notes on identification see M.G.Shivas, *J. Linn. Soc. Bot. 58:* 27-38; 1961; *Br. Fern Gaz., 9:* 65-70; 1962; P.M.Benoit, *Br. Fern Gaz. 7:* 277-282; 1966; R.H.Roberts & D.M.Synnott, *Watsonia, 9:* 34-41; 1972.



16.1 **Polypodium vulgare** L.

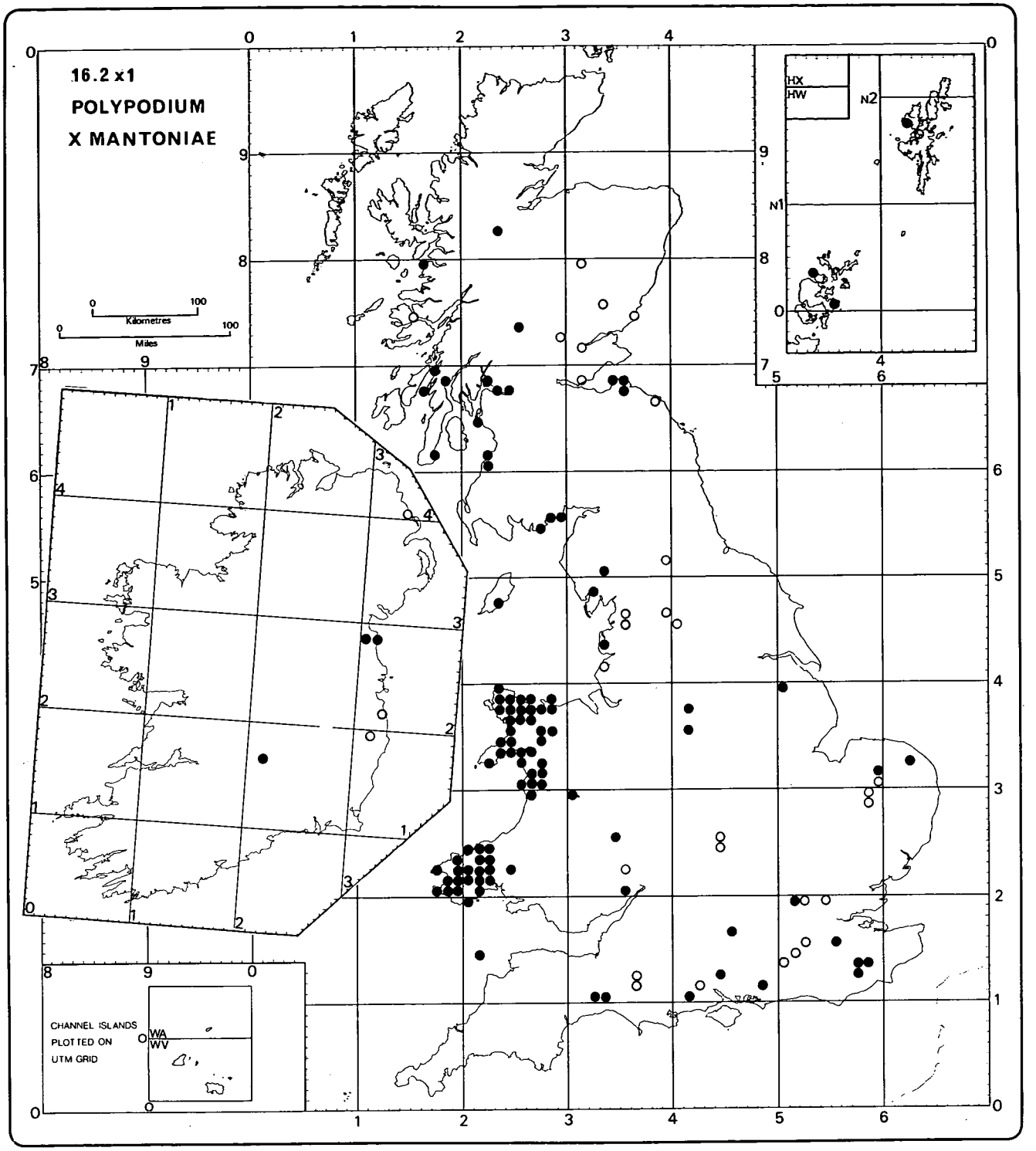
A widespread species absent from parts of central and N.E. England through lack of suitable habitat. It is absent from industrial areas possibly because, not having an annual flush of new fronds, its leaves become soot covered and non-functional.



16.2 **Polypodium interjectum** Shivas

(*P.vulgare auct.; P.vulgare* L. subsp. *prionodes* Rothm.)

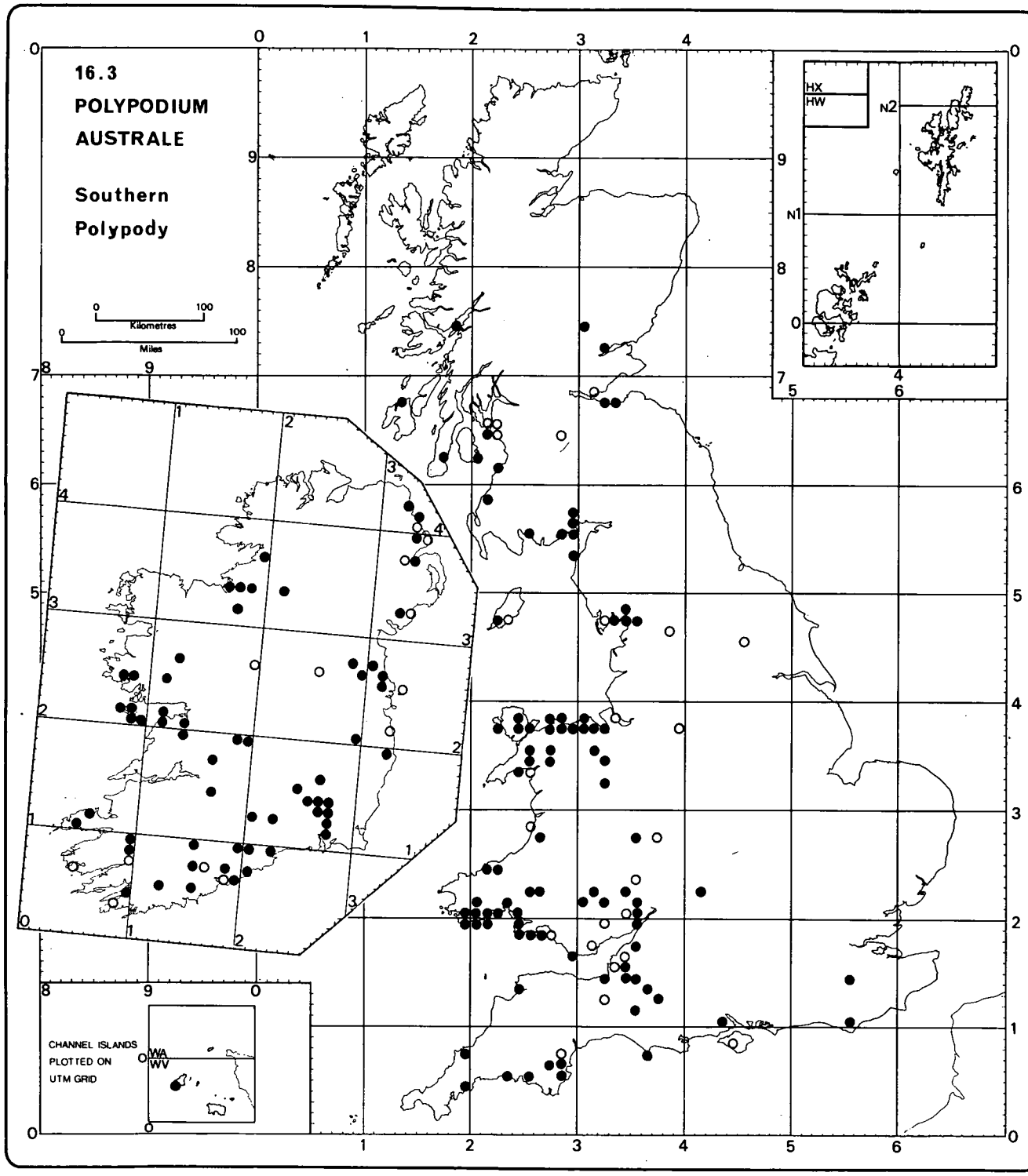
A sub-Atlantic alloploid species derived from hybridization of 16.1 and 16.3 having intermediate characters, both morphological and ecological. Its weak lime requirements are satisfied in coastal habitats by salt-laden winds and it is often a common component of mature sand-dune systems. It may also require a generally higher humidity than *P.vulgare*.



16.2×1 **Polypodium × mantoniae** Rothm.

(P.interjectum × vulgare)

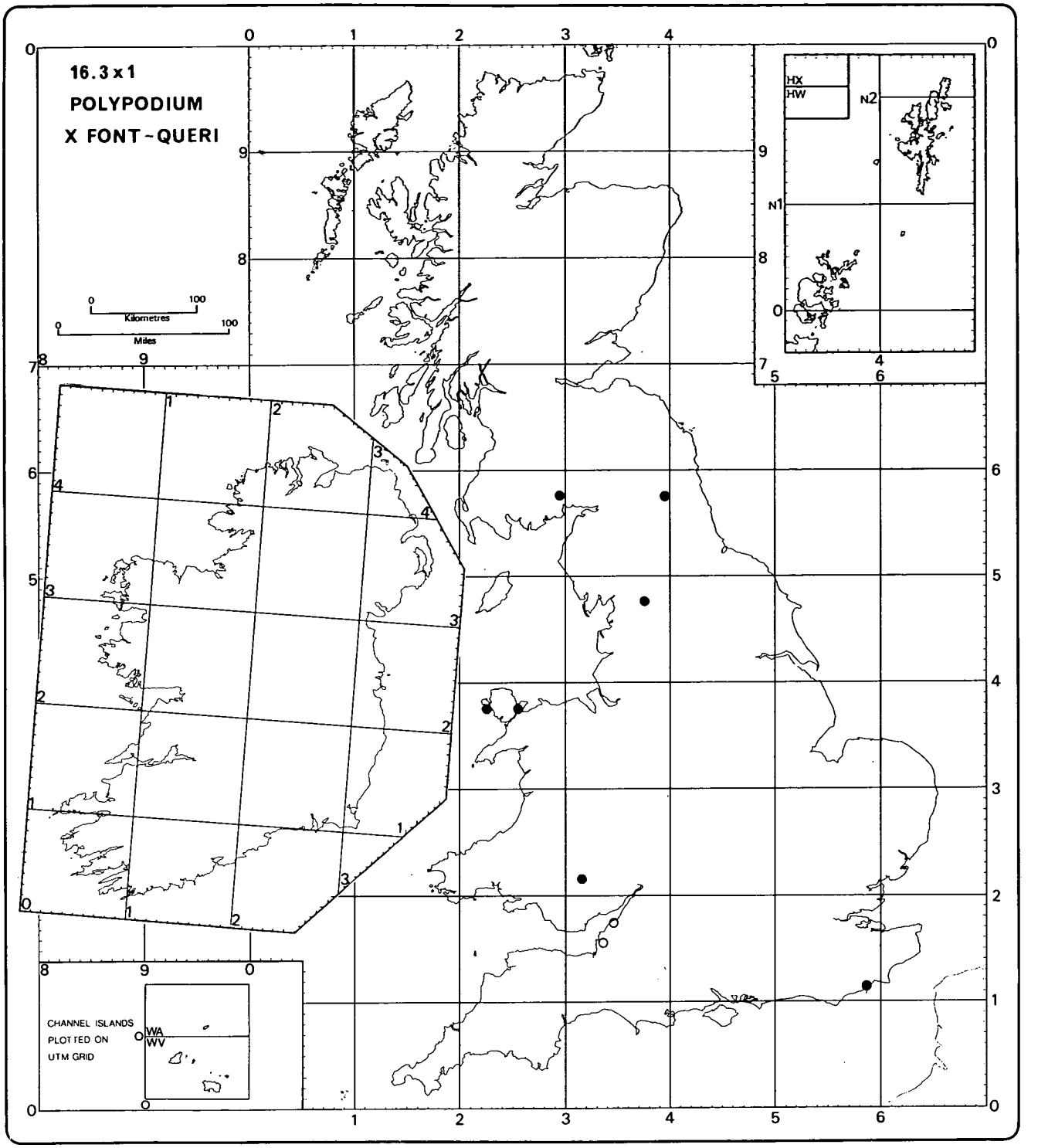
This hybrid can be recognized by its vigour, often forming large clones; morphologically it is intermediate between the parents. Frequent throughout Britain but less so in Ireland. The density of records for this hybrid in north and south-west Wales reflects concentrated field-work and its apparent scarcity elsewhere may not be a biological reality.



16.3 **Polypodium australe** Fée

(*P. vulgare* auct.; *P. vulgare* subsp. *serrulatum* /Arcangeli)

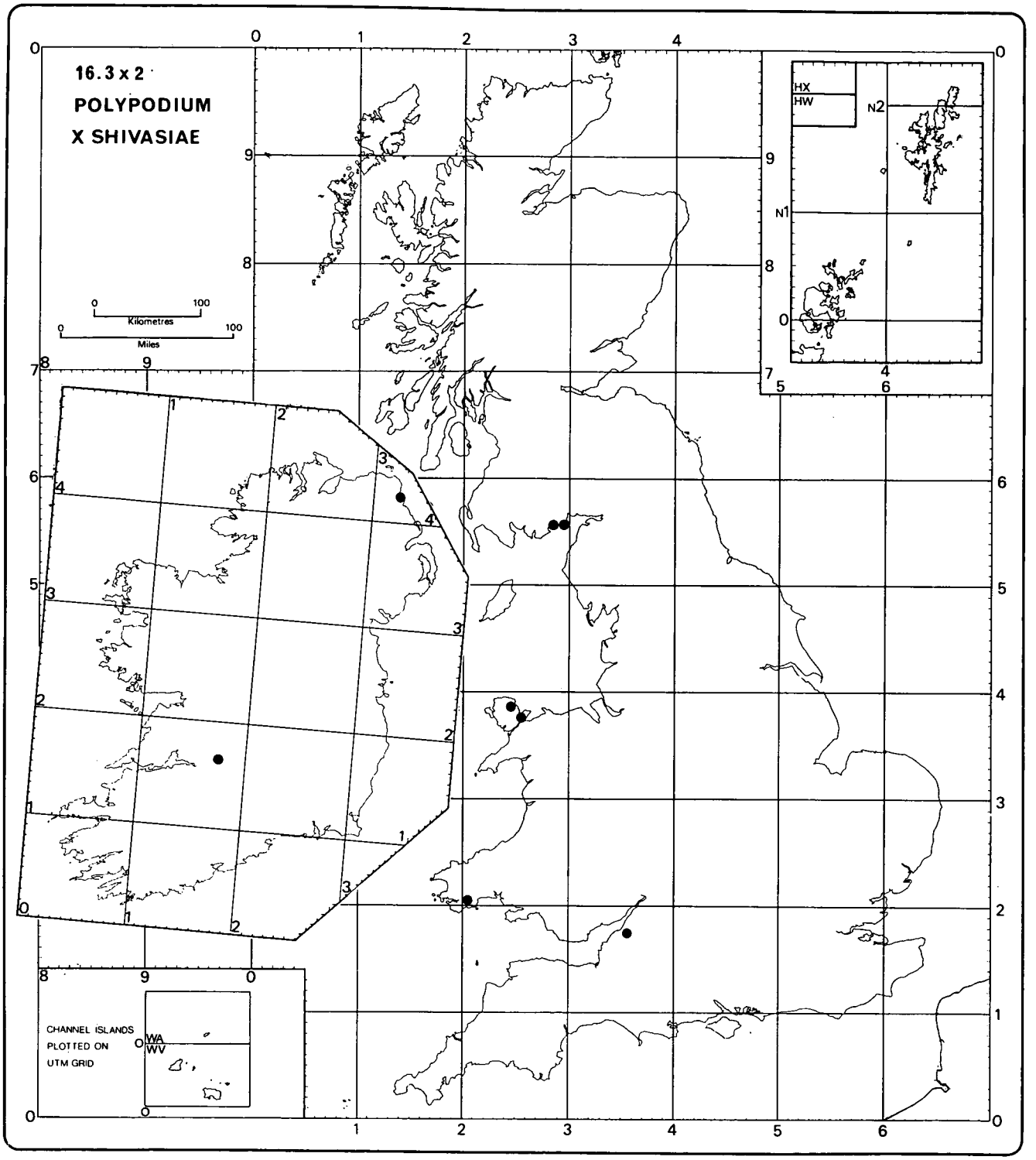
A Mediterranean/south Atlantic species reaching its northern limit on Lismore, v.c. 98. For the most part requiring limestone or similar high-calcium bearing rock substrate (e.g. mortared walls); usually on the warmer south-facing aspect when in its colder locations. Many records under the name *P. vulgare* var. *serratum* Willd. have been shown to be this taxon or a hybrid of it. (See R.H.Roberts & D.M.Synnott, *Watsonia, 9:* 34-41; 1972; A.Rutherford & A.McG.Stirling, *Watsonia, 9:* 357-361; 1973).



16.3 × 1 **Polypodium × font-queri** Rothm.

(*P.australe* × *vulgare*)

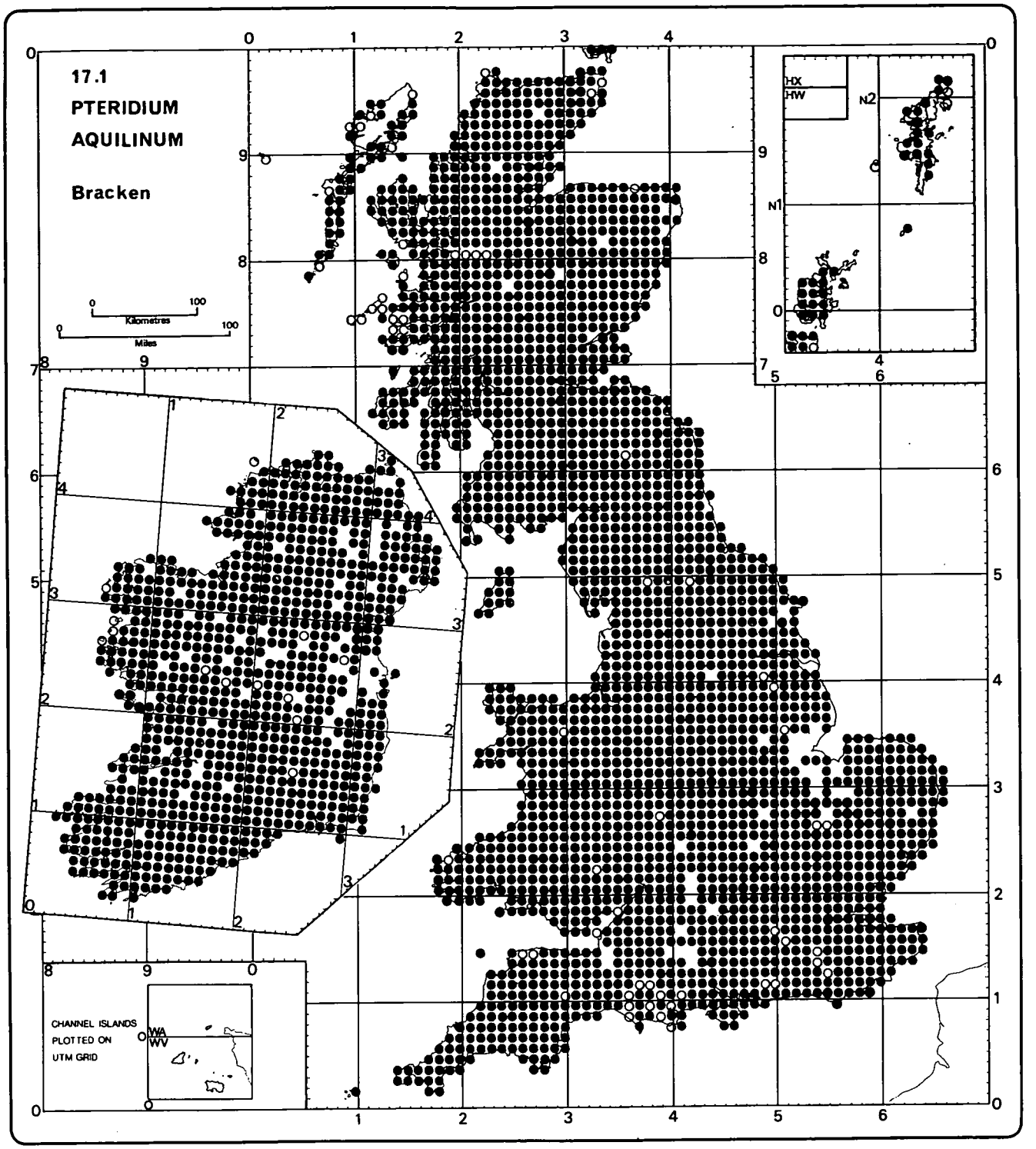
Recognized by the large thin-textured lamina, often with twisted pinnae; plants often show hybrid vigour. For the most part it is intermediate between the parents, preferring base-rich rocks or as an epiphyte within reach of salt-laden winds. (See A.Rutherford & A.McG.Stirling, *Br.Fern Gaz. 10:* 233-235; 1972).



16.3×2 **Polypodium × shivasiae** Rothm.

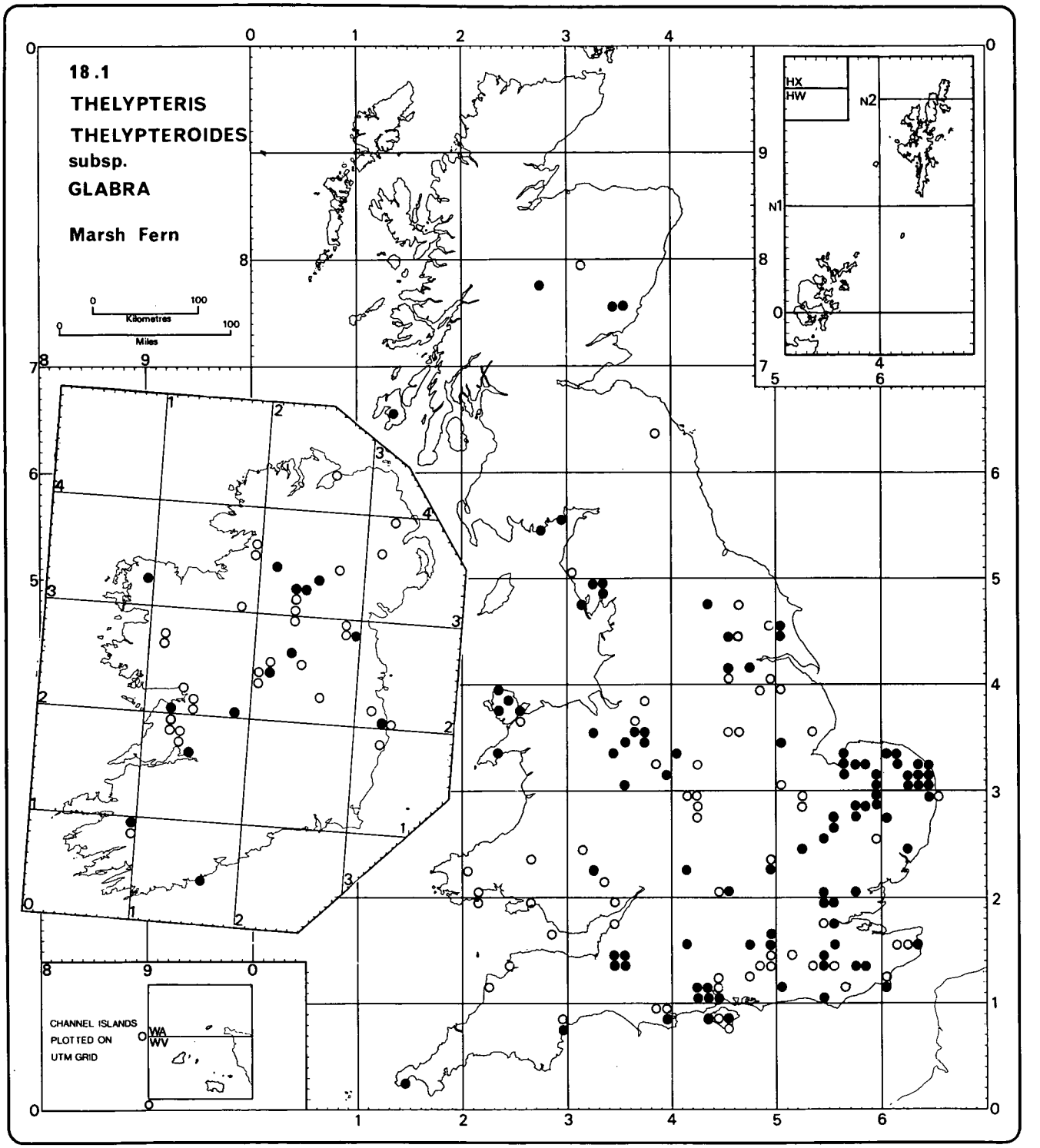
(*P.australe* × *interjectum*)

Occasionally found with parents but an uncommon hybrid and absolutely sterile. Possibly mistaken for sterile and depauperate *P.interjectum*.



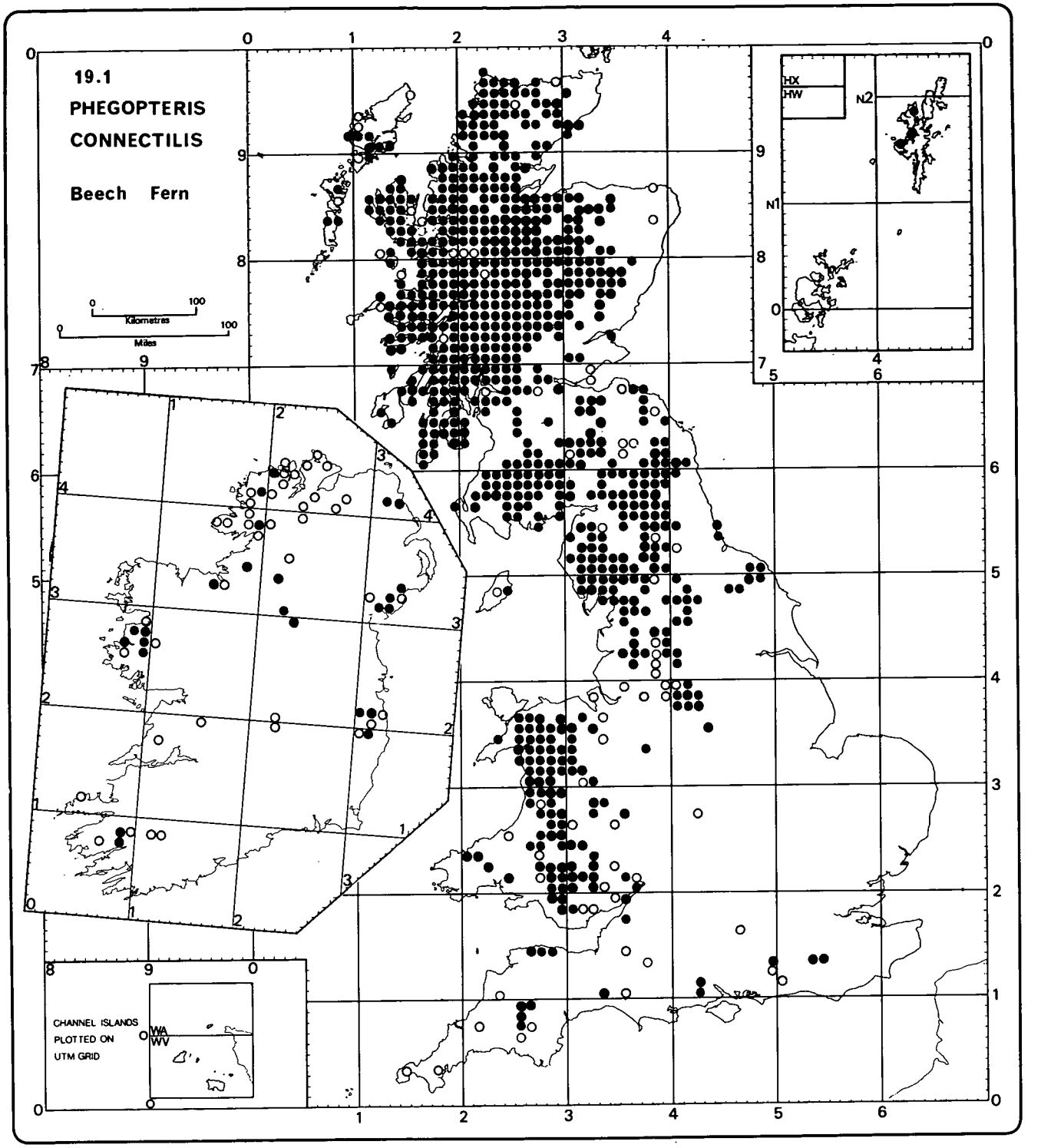
17.1 **Pteridium aquilinum** (L.) Kuhn

A widespread and cosmopolitan species absent only from intensely used agricultural areas. Normally a calcifuge (and hitherto tetraploid) in Britain; material on limestone in Spain has been counted as $2n = 52$ (diploid). It is impossible to distinguish this cytotype on morphology but calcicole ecotypes in S.W. Britain and Ireland should be studied further.



18.1 **Thelypteris thelypteroides** Michx subsp. **glabra** Holub
(*T.palustris* Schott)

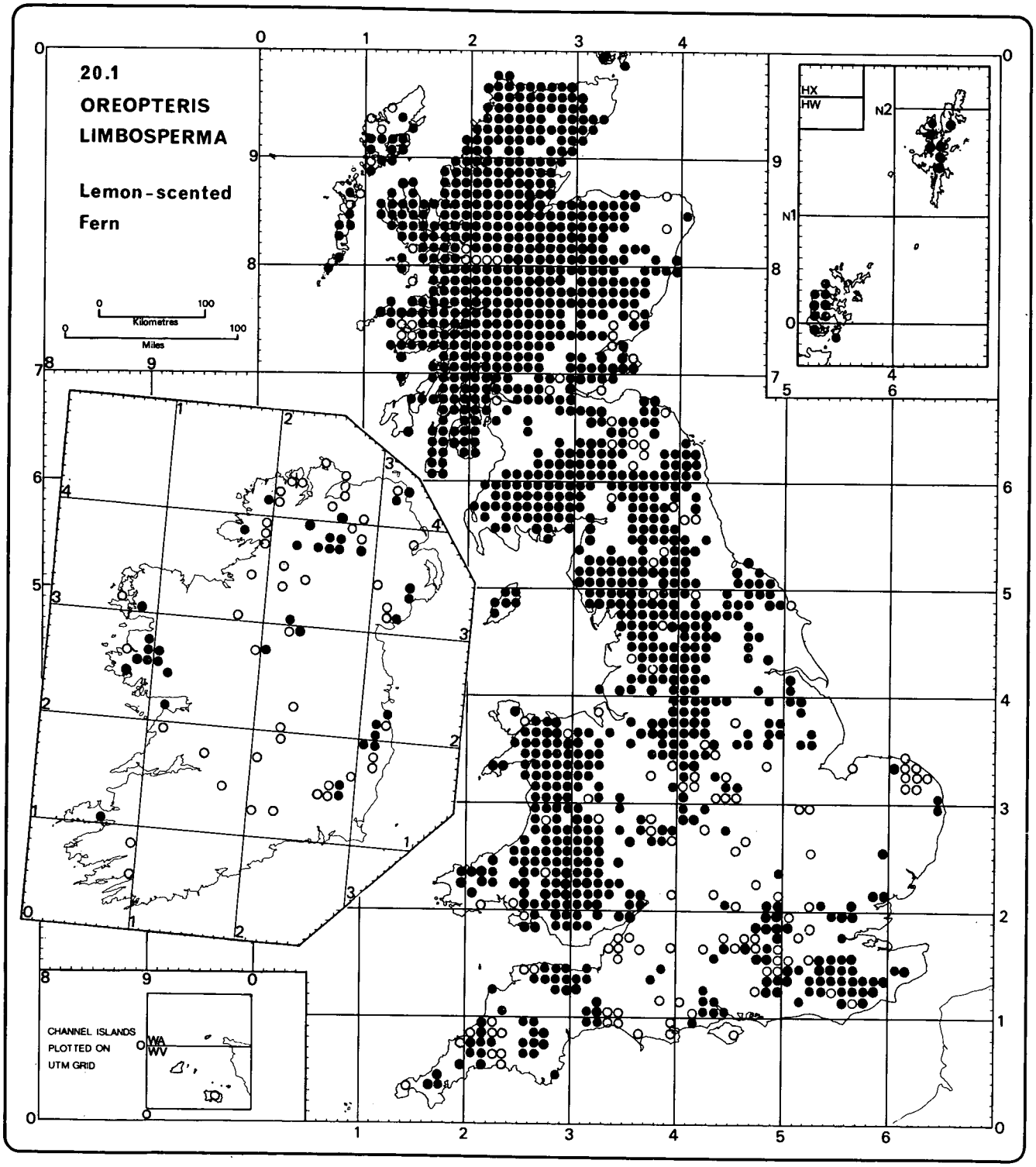
A widespread northern continental species absent from the Atlantic seaboard where the annual temperature range is smaller and winters are relatively warmer. It is becoming rare in many vice-counties through drainage of mires.



19.1 **Phegopteris connectilis** (Michx) Watt

(*Thelypteris phegopteris* (L.) Slosson)

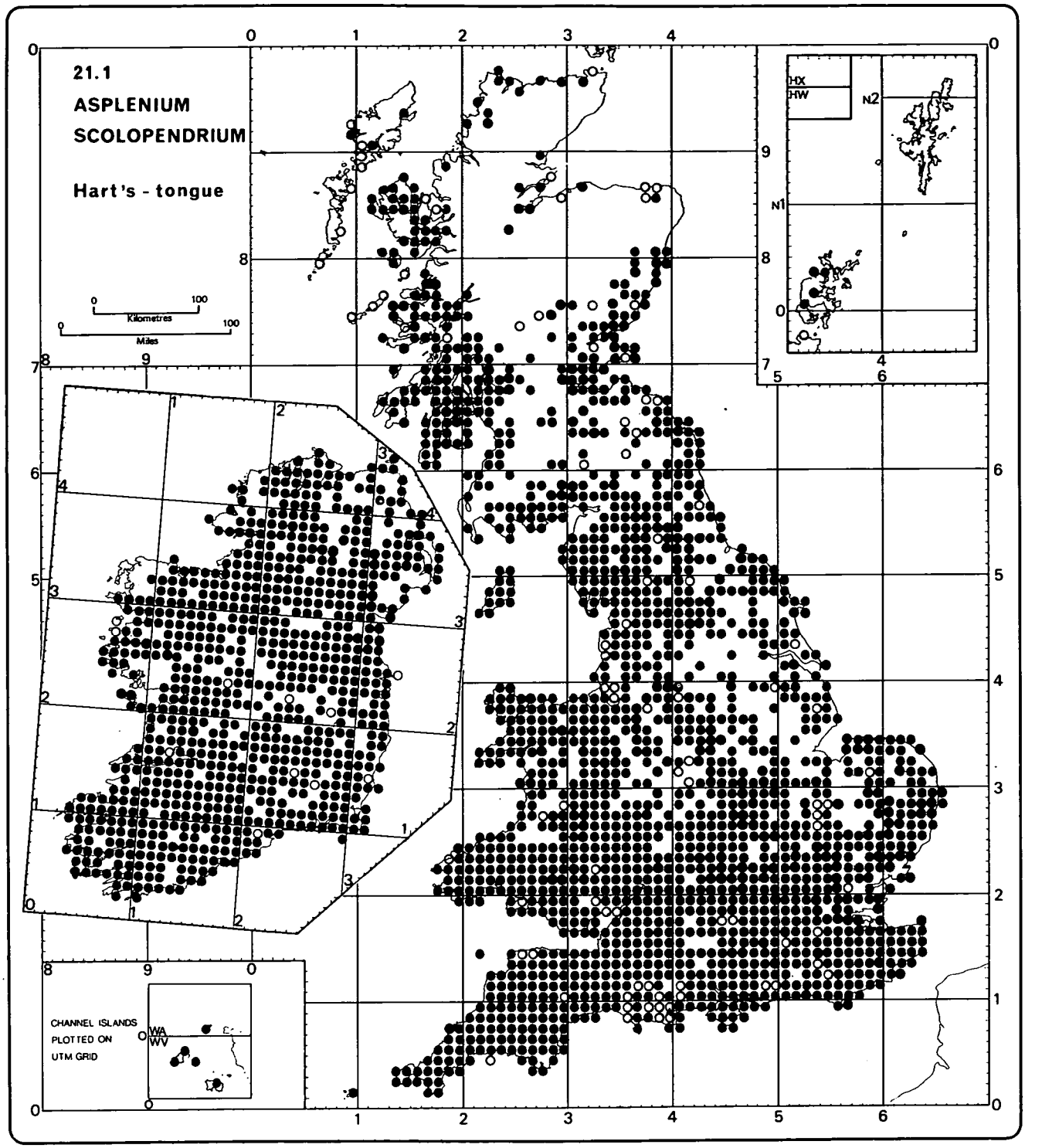
A northern continental species in the west and north of Britain with outliers in the Weald and East Anglia; rare in Ireland. It prefers humid banks where moving water can flush through its root system.



20.1 **Oreopteris limbosperma** (All.) Holub

(*Thelypteris oreopteris* (Ehrh.) Slosson;
T.limbosperma (All.) H.P.Fuchs)

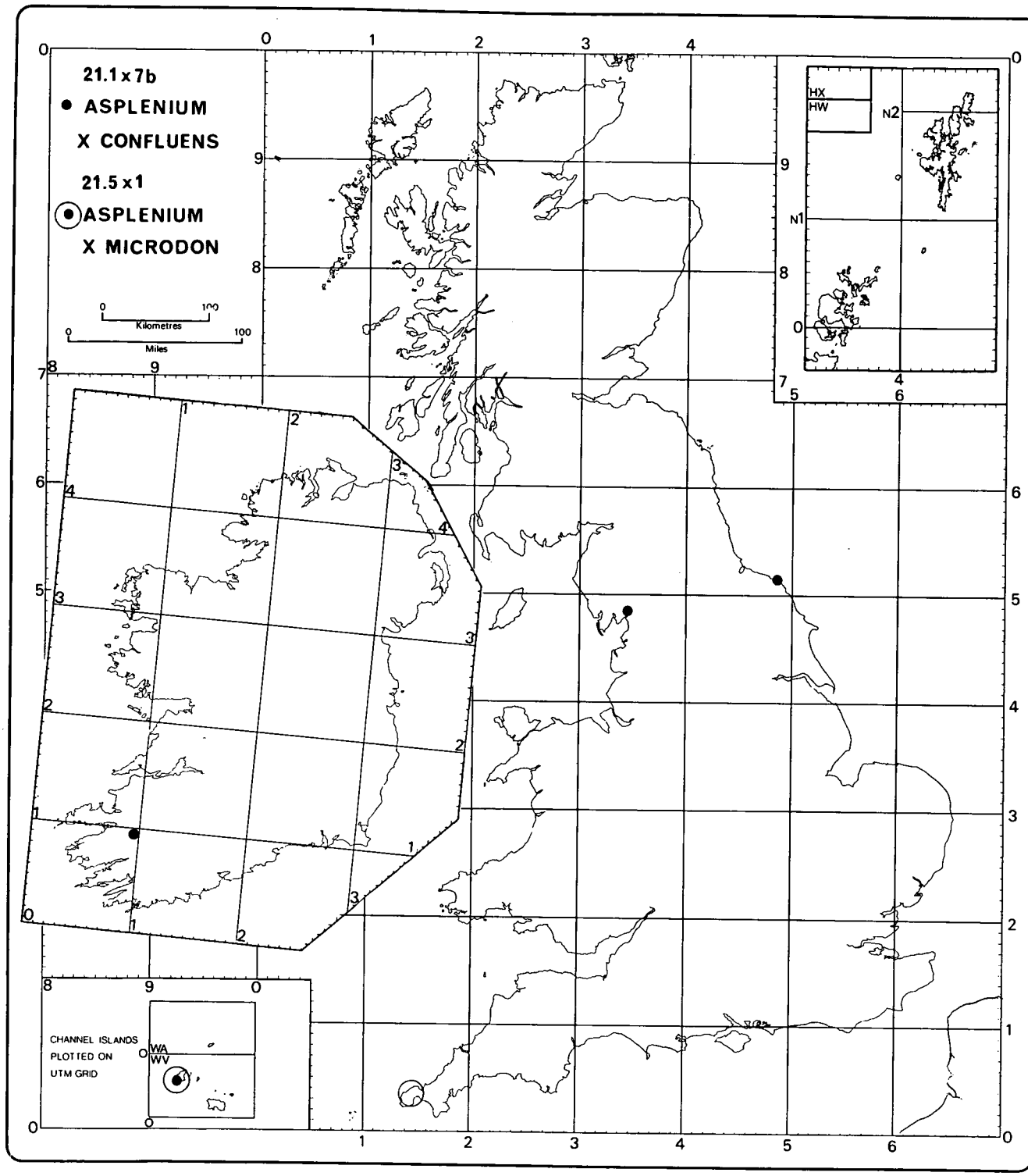
A northern sub-Atlantic species which prefers ground water flowing (at least seasonally) through its root system. In the drier areas of Britain and Ireland it is therefore often associated with streamsides and changing land-use with drainage is diminishing the available sites.



21.1 **Asplenium scolopendrium** L.

(*Phyllitis scolopendrium* (L.) Newm.)

A southern sub-Atlantic calcicole species which becomes rare in central and northern Scotland partly through lack of calcareous substrate and partly because of the lower winter temperatures.



21.1 × 7b **Asplenium × confluens** (T.Moore ex Lowe) Lawalrée

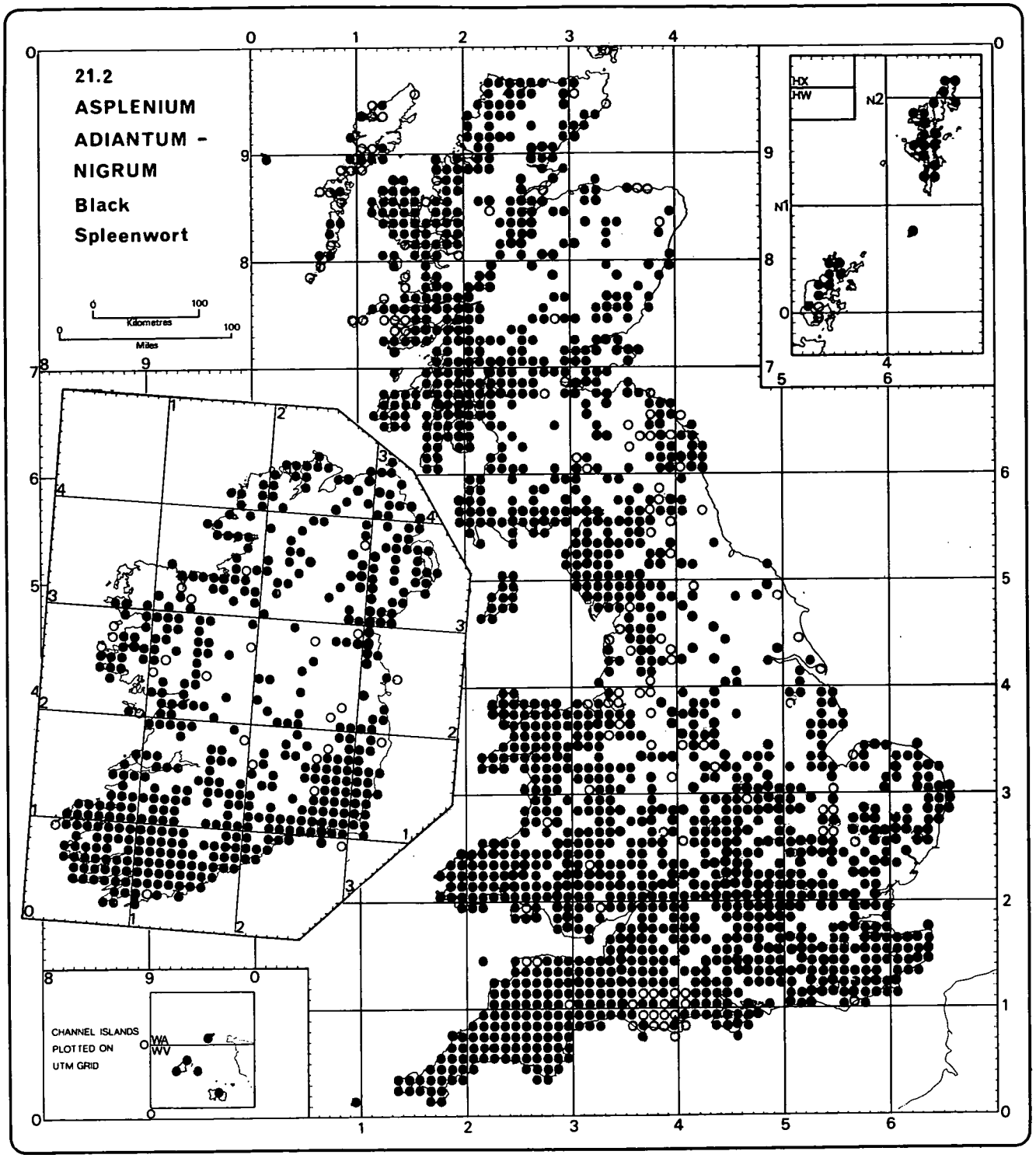
(*A.scolopendrium* × *trichomanes* subsp. *quadrivalens;* × *Asplenophyllitis confluens* (T.Moore & Lowe)

This hybrid was found at Levens Park, v.c. 69, in 1865 and at Whitby, v.c. 62, and Killarney, v.c. H2, around 1875; it has not been found since. The plants are more like *A.trichomanes* with stouter rachides and thicker leaf tissue, the upper pinnae being confluent. (See A.G.H.Alston, *Proc.Linn.Soc.Lond., 152:* 139; 1940 and J.D.Lovis in C.A.Stace (ed.), *Hybridisation and the Flora of the British Isles:* 105; 1975).

21.5 × 1 **Asplenium × microdon** (T.Moore) Lovis & Vida

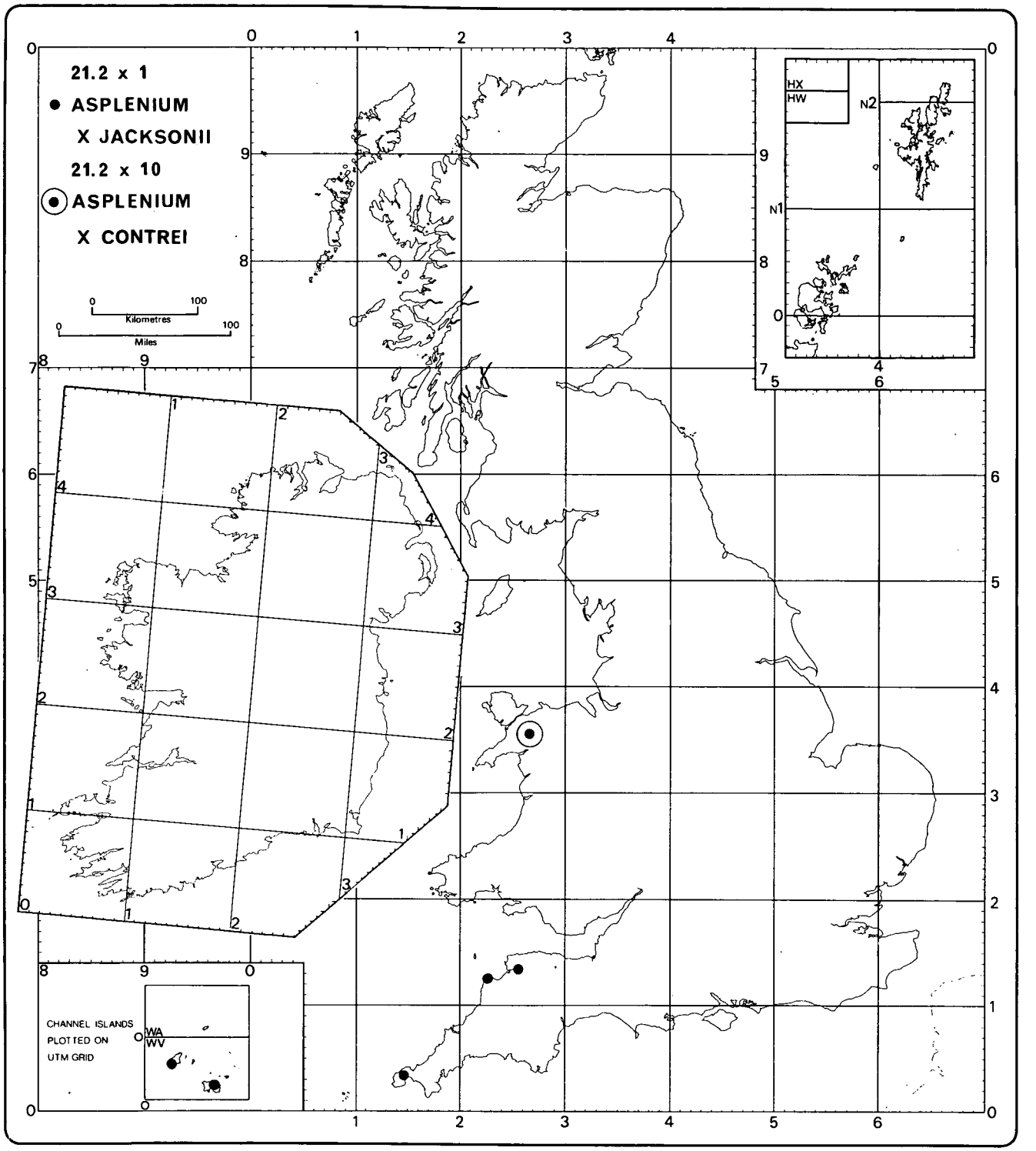
(*A.billotii* × *scolopendrium;* × *Asplenophyllitis microdon* (T.Moore) Alston)

This hybrid, intermediate between parents, is likely to be confused only with *A.* × *jacksonii:* the latter has a triangular frond-shape instead of a tapered one as in *A.* × *microdon.* (See P.J.Girard & J.D.Lovis, *Br.Fern Gaz. 10:* 1-8 (1968); J.D.Lovis & G.Vida, *Br.Fern Gaz. 10:* 53-67 (1969); J.D.Lovis in C.A.Stace (ed.), *loc.cit.:* 104; and A.G.H.Alston, *loc.cit.:* 140).



21.2 **Asplenium adiantum-nigrum** L.

A southern sub-Atlantic species widespread throughout Britain and Ireland. A rock plant with some base (possibly calcium and/or magnesium) requirement, tolerating medium exposure; it is frequently found in man-made habitats (e.g. mortared walls) in lowland Britain. This is a species which can tolerate considerable shade and it will remain as a terrestrial plant in climax woodland established over calcium-bearing rock scree.



21.2 × 1 **Asplenium × jacksonii** (Alston) Lawalrée

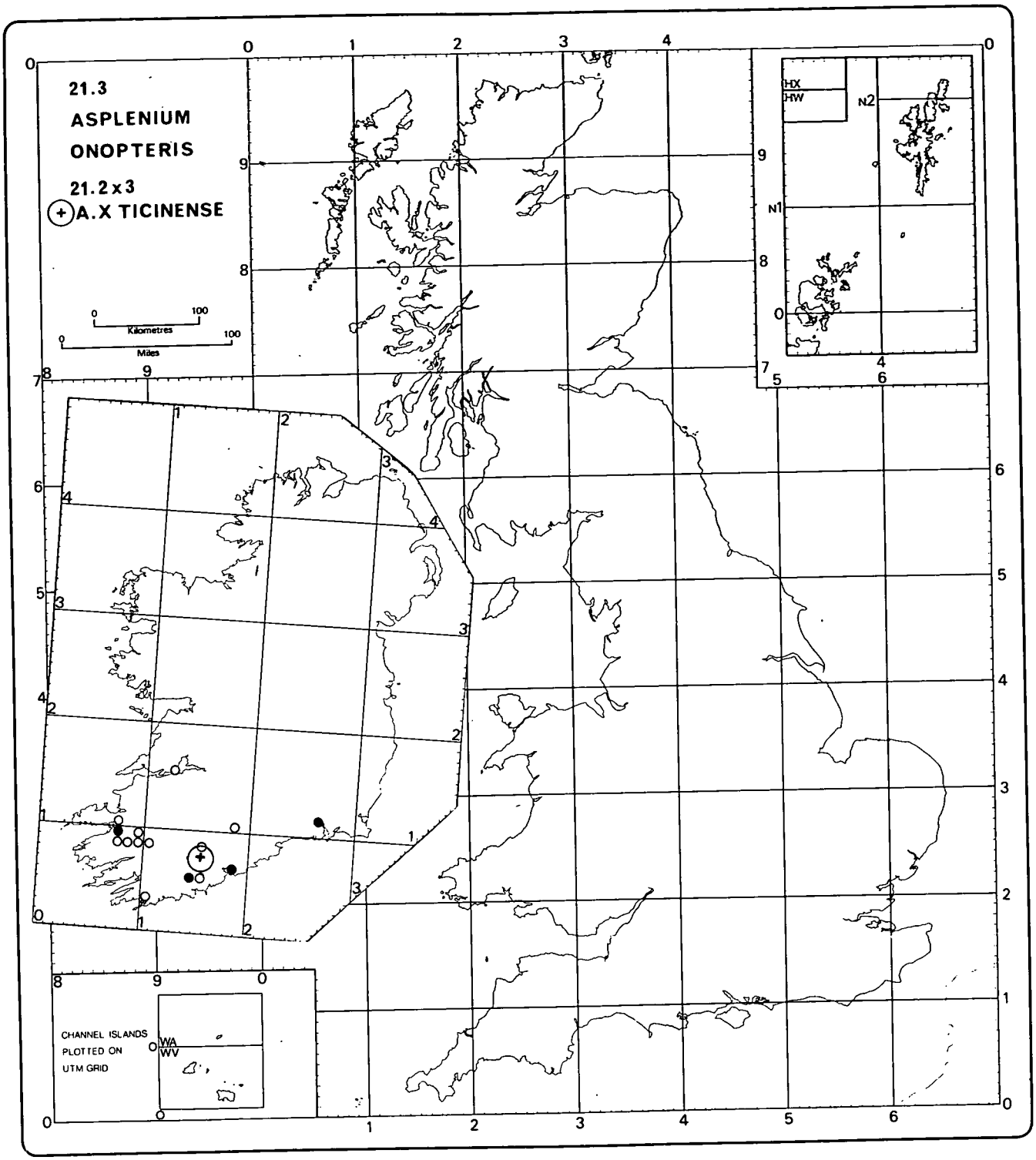
(*A.adiantum-nigrum* × *scolopendrium;*
× *Asplenophyllitis jacksonii* Alston)

A hybrid, with simply pinnate fronds and a lamina the texture of *A.scolopendrium,* which could be confused only with *A.* × *microdon*. The latter however has a decrescent frond whereas *A.* × *jacksonii* has the triangular frond-shape of *A.adiantum-nigrum*. (See J.D.Lovis in C.A.Stace (ed.), *loc. cit.:* 104; J.D.Lovis & Vida, *loc.cit.;* A.G.H.Alston, *loc.cit.:* 142.)

21.2 × 10 **Asplenium × contrei** Callé, Lovis & Reichstein

(*A.adiantum-nigrum* × *septentrionale;*
A. × *souchei* auct. non Litard.)

A distinct hybrid likely to be confused only with *A.* × *alternifolium* from which it differs in having longer lowermost pinnae giving the fronds a triangular outline. It has been found once in 1870 on Craig Dhu, Llanberis Pass, v.c. 49 (specimen in herb. K). (See J.D.Lovis in C.A.Stace (ed.), *loc.cit.:* 107).



21.3 **Asplenium onopteris** L.

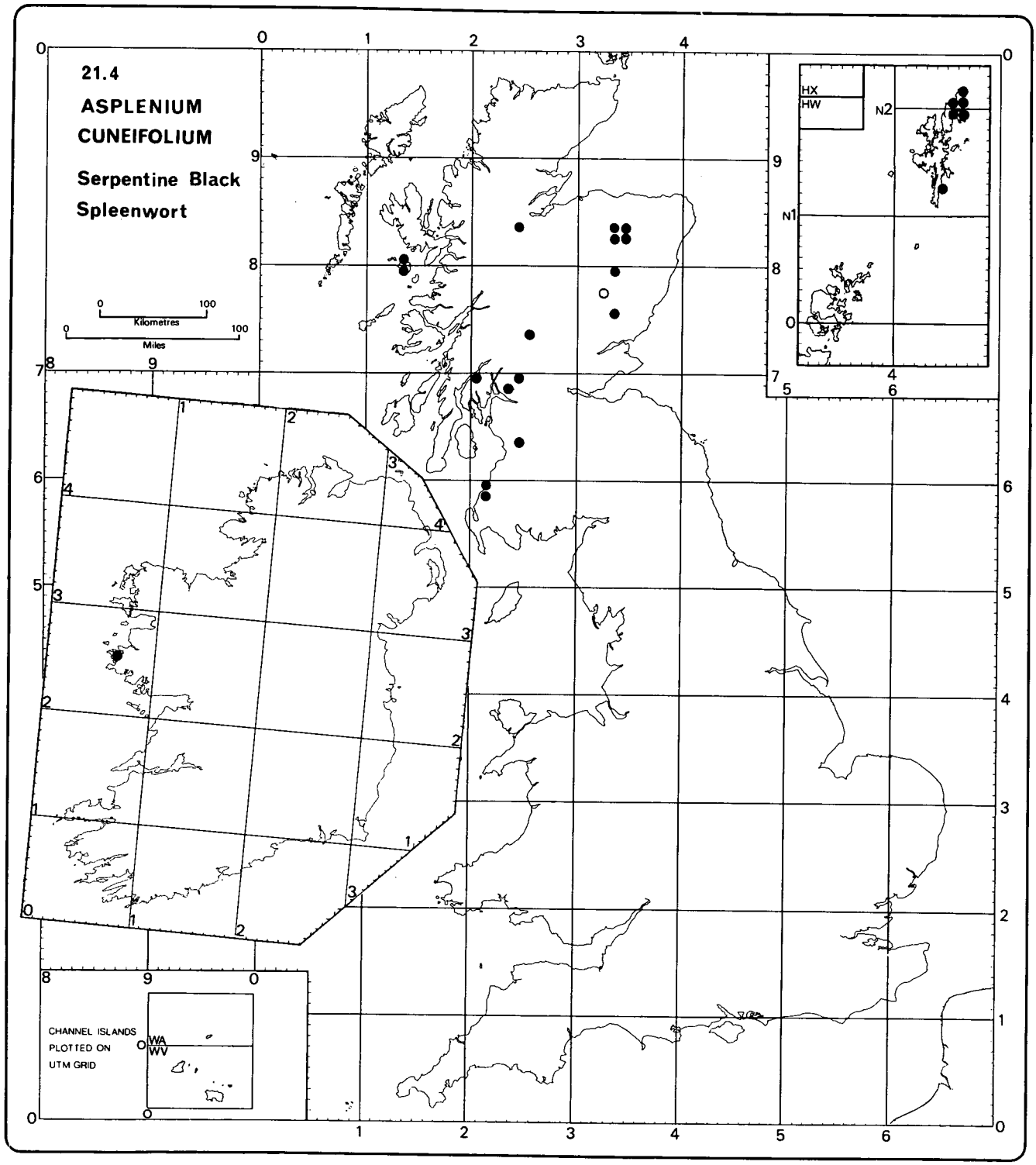
(*A.adiantum-nigrum* subsp. *onopteris* (L.) Luerss. *A.adiantum-nigrum* var. *acutum* (Bory ex Willd.) Newm.)

A Mediterranean diploid species difficult to separate from 21.2 except in its extreme form where the segments, pinnules and pinnae are elongate, the latter caudate. R.L.Praeger (*Irish Nat. 28:* 13-20; 1919) discussed variations and distribution; further investigation is needed of the N. Irish material which is omitted from this map. Records for the taxon at the Lizard, v.c. 1, where the species could be expected, need confirming; all specimens seen in herbaria could be either 21.2, 3, or 4. Plants with narrow acute segments from Breiddon Hill, v.c. 47, have proved to be tetraploid and are omitted from this map.

21.2×3 **Asplenium × ticinense** D.E.Meyer

(*A.adiantum-nigrum* × *onopteris*)

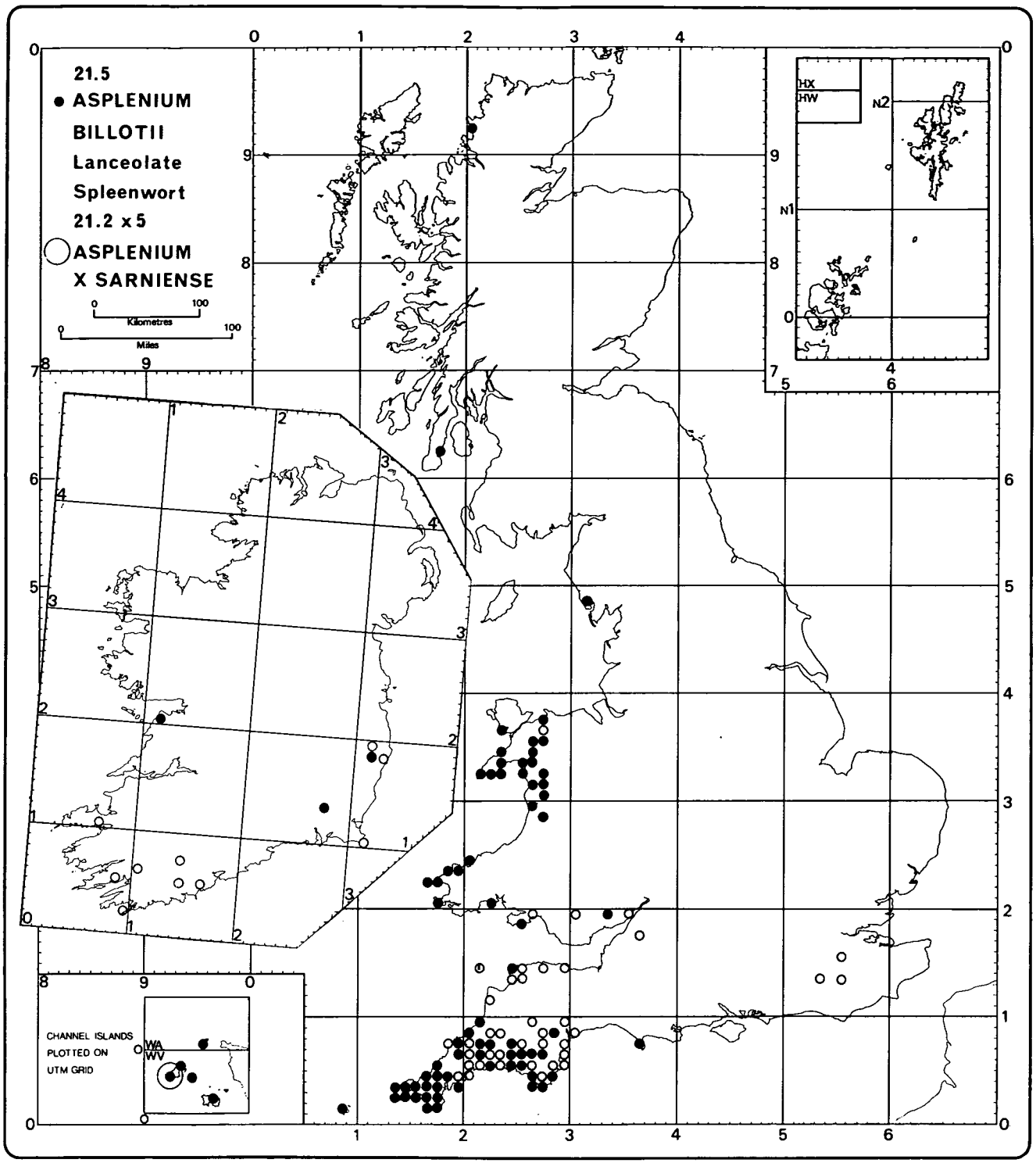
This triploid hybrid has been verified for one locality in S.Ireland and is probably elsewhere where the parents occur together (see R.H.Roberts & M.J.P.Scannell, *Irish Nat. J., 19:* 75-77; 1977).



21.4 **Asplenium cuneifolium** L.

(*A.adiantum-nigrum* subsp. *serpentini* (Tausch) Heuffl.)

This species is another diploid cytotype of the *A.adiantum-nigrum* complex, scattered across central Europe and recently recorded for Scotland; (see R.H.Roberts & A.McG.Stirling (*Fern Gaz., 1:* 7-14; 1974) where morphology is fully discussed). It is a plant of serpentine rocks best separated from 21.2 by the straight or concave margins at the base of the cuneate segment of the frond; in 21.2 this margin is convex. The above authors have identified all material of those records plotted, although not all populations have been cytologically verified. In some of the populations previously studied, plants of similar morphology have been found to be tetraploid (A.Sleep & A.McG.Stirling, *pers. comm.*) and it may be that a serpentine ecotype of *A.adiantum-nigrum* is involved, or that the plants are autotetraploids having originated from diploid *A.cuneifolium*.



21.5 **Asplenium billotii** F.W.Schultz

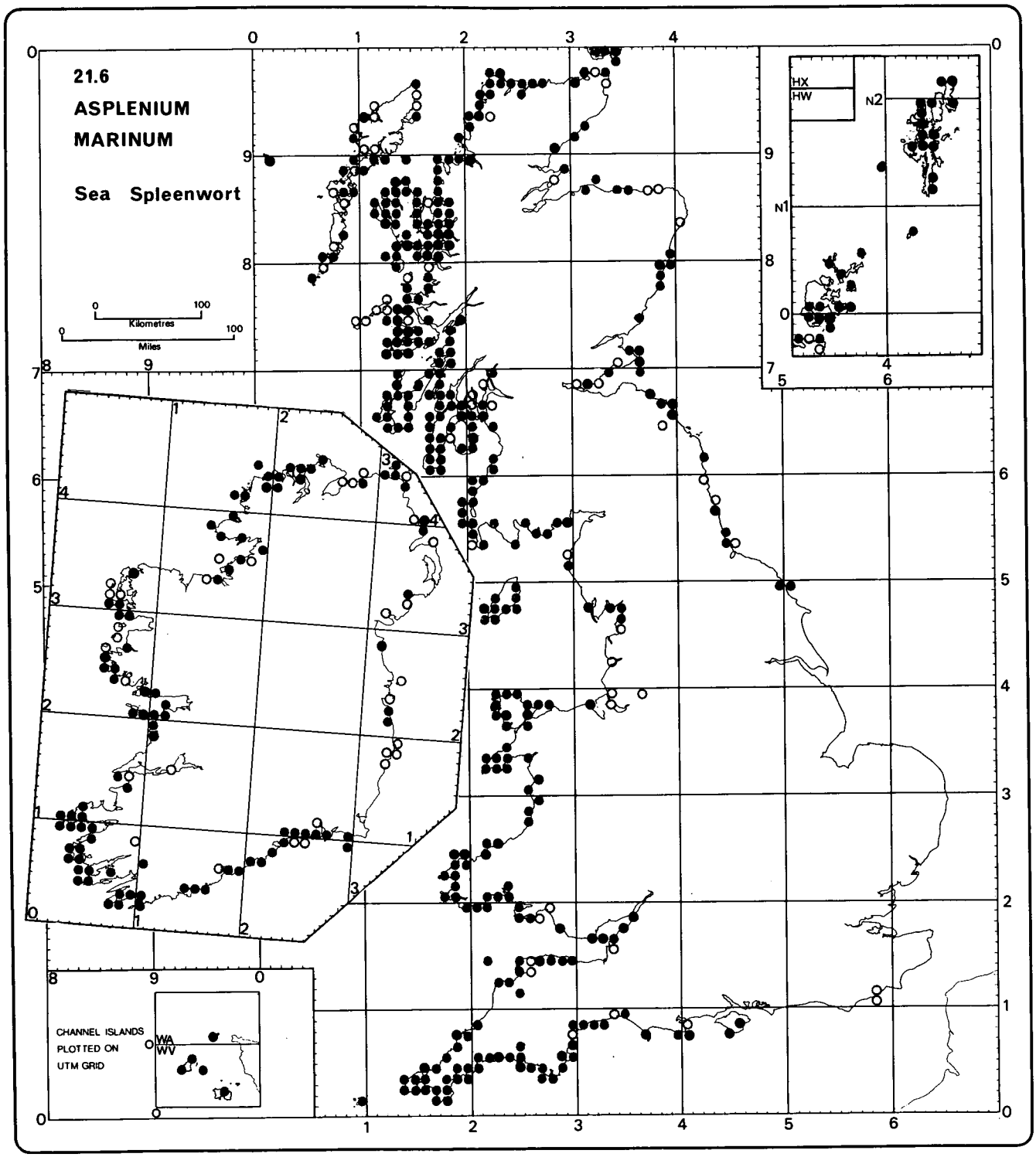
(*A.obovatum* auct. angl. non Viv.)

A southern sub-Atlantic species whose distribution is mainly coastal in Britain and Ireland. It reaches its most northern location in v.c. 108. Outliers in the Weald are authentic and reflect the oceanic climate of the area; the species is now extinct there. The Agden Reservoir, v.c. 63, record is also verified by a specimen in BM but the Goatland, v.c. 62, record of Druce (*Comital Fl.:* 381; 1932) is not mapped. We can trace no specimen and as it was growing on a mortared bridge we suspect *A.adiantum-nigrum*.

21.2×5 **Asplenium × sarniense** Sleep

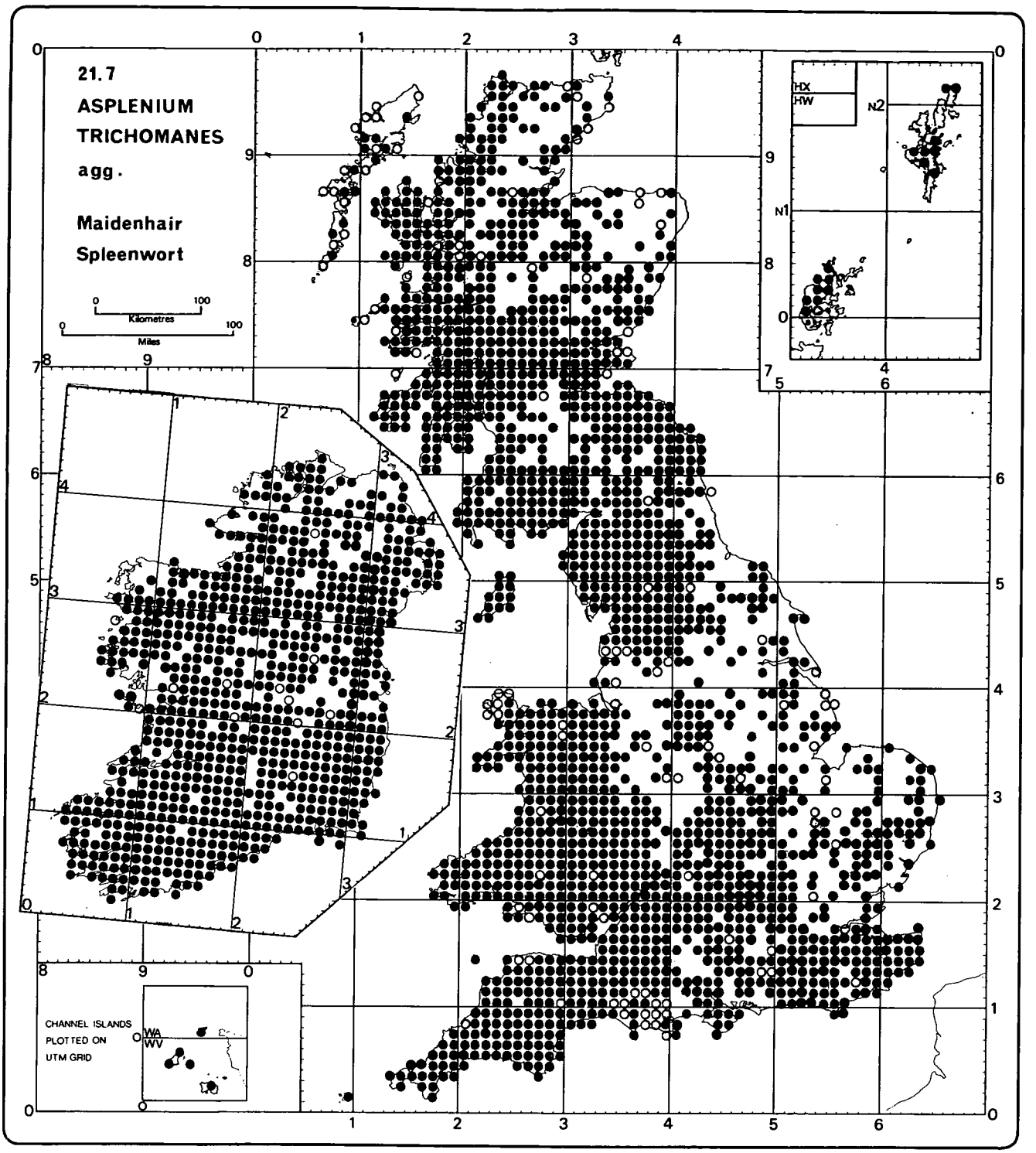
(*A.adiantum-nigrum* × *billotii*)

This hybrid was discovered in Guernsey, v.c. 0, (see A.Sleep, *Br. Fern Gaz., 10:* 209-211; 1971) growing with both parents on a sheltered hedgebank. It is similar to 2 but shows the influence of *A.billotii* in having oval pinnules on the middle pinnae (see also J.D.Lovis in C.A.Stace (ed.) *loc.cit.:* 106). Sterile specimens of similar morphology have also been collected on the adjacent Brittany coast (Jermy, unpublished).



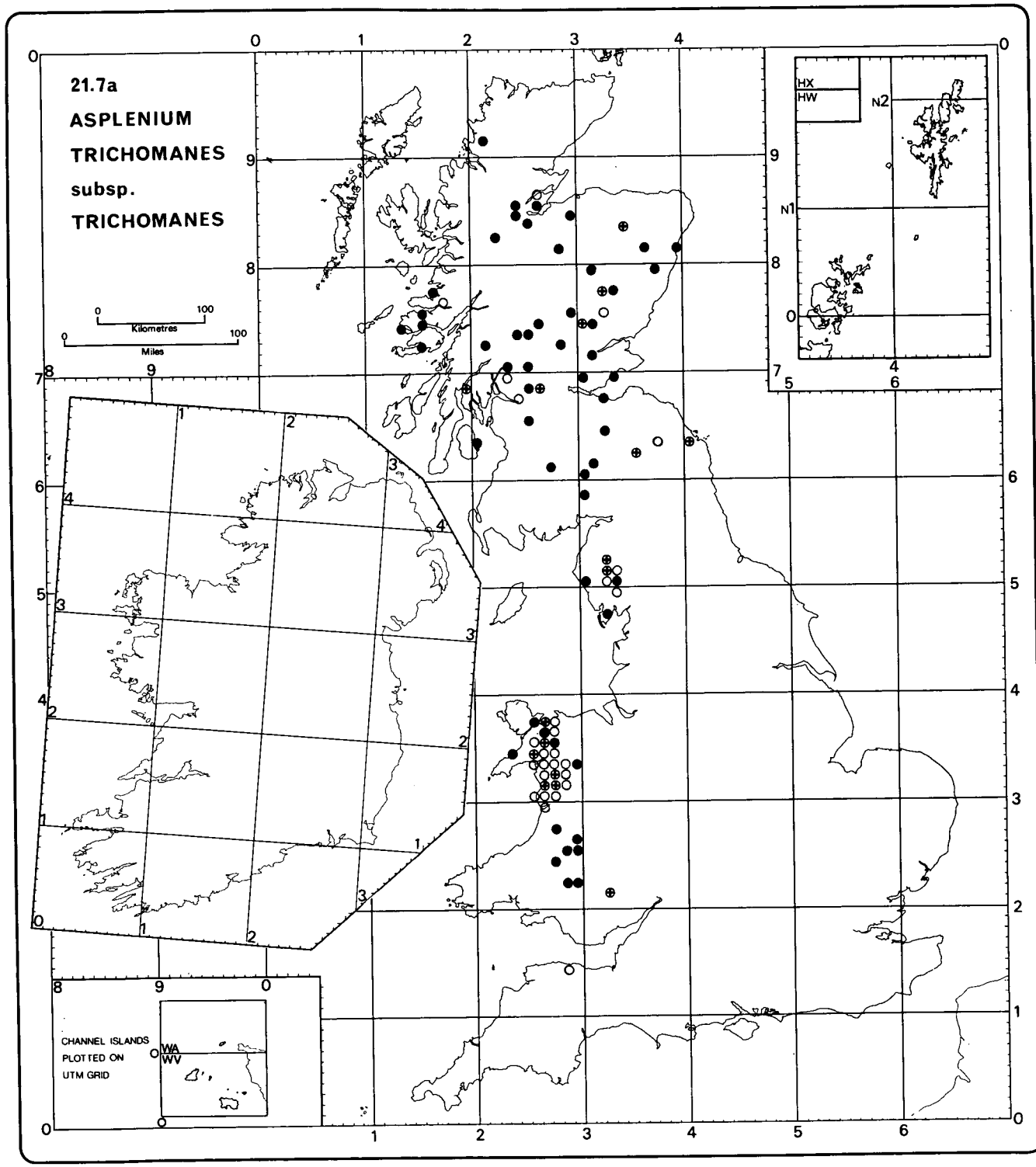
21.6 **Asplenium marinum** L.

An Atlantic species absent from the colder shores of E. England, south of Yorkshire (v.c. 62). It requires salt-spray and is absent from sheltered shores and those without the necessary rocky substrate.



21.7 **Asplenium trichomanes** L. aggregate

Two subspecies are now recognised in Britain (see J.D.Lovis, *Flora Europaea, 1:* 15; 1964; *Br. Fern Gaz., 9:* 147-160;1964; and this *Atlas,* p.60. The above map is that of the two taxa combined based on that in the *Atlas of the British Flora;* it is followed by maps of the two subspecies based on identifications by J.D.Lovis. The notes on page 60 have been provided by Dr Lovis with a view to encouraging British and Irish botanists to add further records. A hybrid between the two subspecies (*A.trichomanes* subsp. × *lusaticum* D.E.Meyer) is recorded in several places in v.c. 48 (P.Benoit, *pers. comm.*) and is possibly elsewhere where the parents grow together.

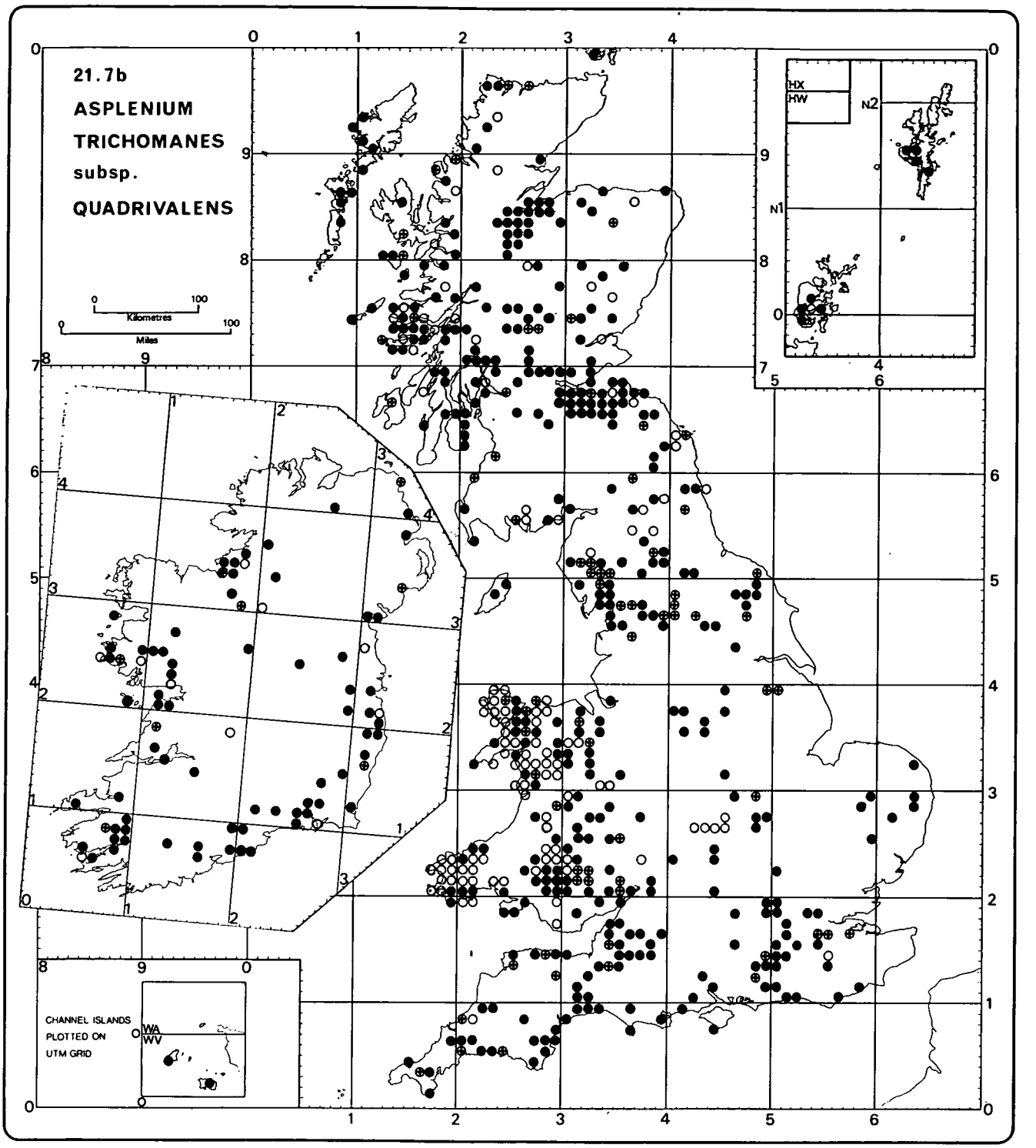


21.7a **Asplenium trichomanes** L. subsp. **trichomanes**

Apart from isolated localities in Northumberland, v.c. 68, subsp. *trichomanes* is confined to north and central Wales, the Lake District and Scotland, although in montane levels rather than at high altitudes. The taxon avoids calcareous rocks of any kind. No specimens have so far been confirmed for Ireland although the number of specimens seen from there has been comparatively smaller. The subspecies could turn up in v.c. 4 where a hybrid (*A.* ×*alternifolium*) involving this subspecies has been found and this parent may yet be found extant.

The following symbols have been used on this map:

- ● All records of any date identified by J.D.Lovis.
- ○ Other reliable records.
- ⊕ Squares from which populations have been cytologically studied.



21.7b **Asplenium trichomanes** L. subsp. **quadrivalens** D.E.Meyer emend. Lovis

In contrast to subsp. *trichomanes*, subsp. *quadrivalens* prefers calcareous sites and becomes widespread on mortared walls in the wetter parts of the country. It is clear from the number of specimens of this subspecies determined in herbaria that it is the commonest taxon. There would be a tendency, however, for collectors to take more specimens from walls near roads than from natural rock faces in the hills.

Identification of the subspecies of *Asplenium trichomanes* L. in Britain

Three subspecies of *Asplenium trichomanes* are recognised in Flora Europaea: subsp. *trichomanes,* subsp. *quadrivalens* D.E.Meyer and subsp. *inexpectans* Lovis. Only the two first named subspecies are found in the British Isles; the last is a south-eastern European taxon of limestone rocks. The absence of subsp. *inexpectans* from Britain makes the separation of the other two often possible on ecological characters alone as subsp. *trichomanes* is a calcifuge and subsp. *quadrivalens* predominantly a calcicole. The following notes on identification of these subspecies have been provided by Dr.J.D.Lovis.

The distinctions between the two subspecies are particularly apparent in the upper half of the frond; the most evident field character lies in the aspect of the upper pinnae, in which the lamina is conspicuously concave (i.e. the margins turning upwards) in subsp. *trichomanes* but convex with inrolled margins, or less commonly, flat, in subsp. *quadrivalens*. Both subspecies are very plastic and present a very different appearence when growing in exposed as opposed to sheltered conditions.

Plants of subsp. *trichomanes* from **sheltered** sites may be distinguished by the following combination of characters: stipe thin, wiry, red-brown; pinnae distant, arrangement mostly alternate, obliquely inserted, with a distinct stalk, asymmetric (oval to rhombic) up to 8mm long, often with a perceptible basiscopic auricle; lamina delicate, that of upper pinnae distinctly concave with upturned margin; sori small, short (up to 2mm), relatively few in number (4-6 (-9)); indusia narrow and delicate.

In contrast, plants of subsp. *quadrivalens* from similar sites have: stipe thick, often dark brown or blackish brown; pinnae more crowded, mostly opposite, with approximately transverse (square) insertion, almost sessile, symmetrical in shape, usually oblong, rarely auriculate, larger (up to 11mm long); lamina thicker, flat or convex, margin ± inrolled, with often crowded, more numerous sori (4-9 (-12)), longer (up to 3mm long); indusia conspicuous.

In very shaded situations, the lamina of subsp. *quadrivalens* is delicate and the pinnae are distinct, as in subsp. *trichomanes*. Moreover the lamina of the upper pinnae is flat, not convex but the main pinnae are large, with long sori and broad indusia, unless the shade is too extreme to permit normal growth, when only a few scattered sori of variable size are produced.

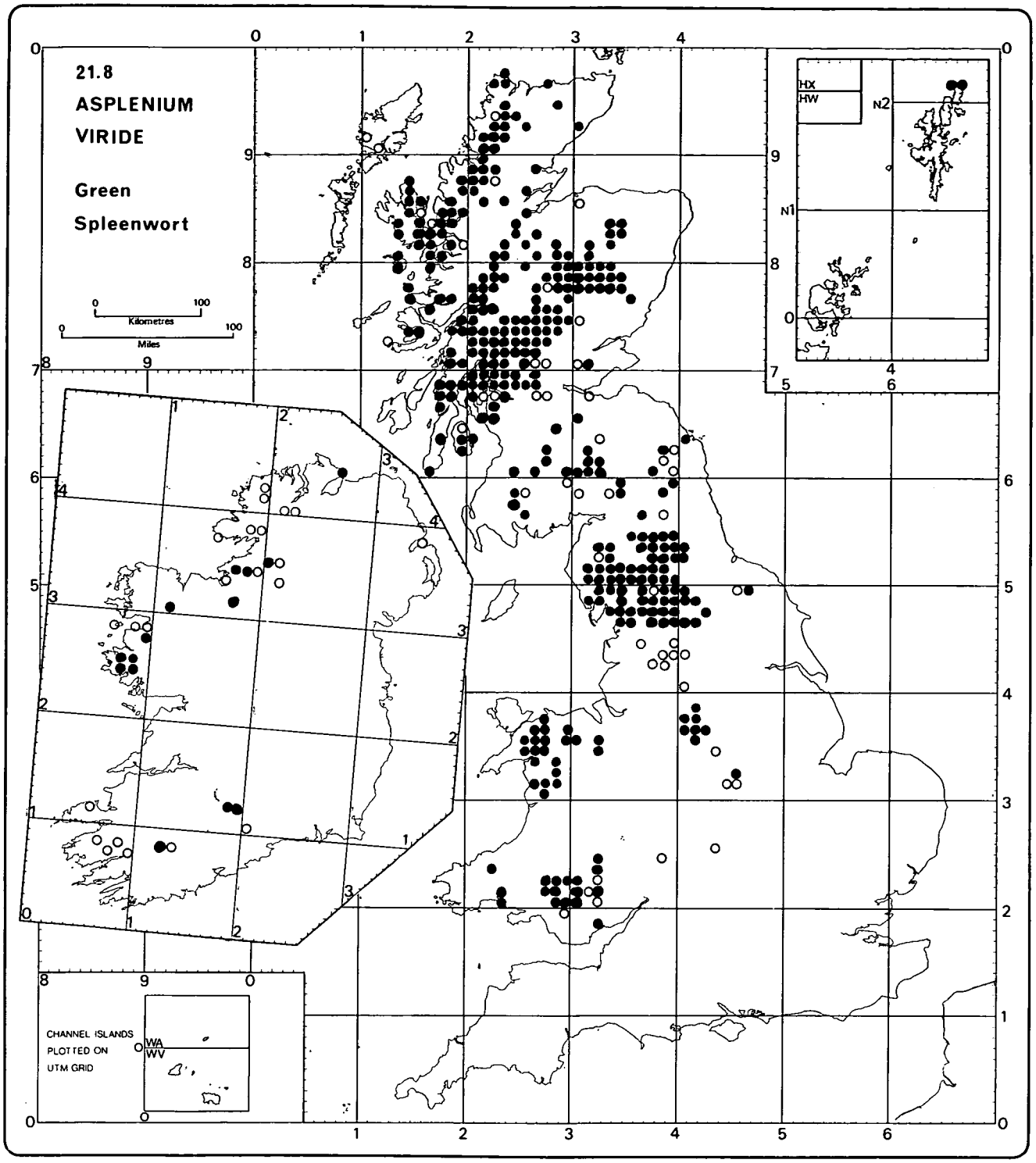
In **exposed** sites both subspecies are much reduced in size. Subsp. *trichomanes* may still be distinguished by a delicate rachis and orbicular, flat or concave pinnae with small sori, which are relatively few in number; in contrast subsp. *quadrivalens* will have a stout rachis, with oblong, thick, convex pinnae, and crowded, more numerous sori.

The following micro-characters may also be used:

1. **Rhizome scales** The scales of subsp. *trichomanes* possess a central red-brown stripe; those of subsp. *quadrivalens* have a dark-brown stripe, although this difference is only readily observed in a liquid medium. There is also a difference in the maximum size of the scales (3.5mm in subsp. *trichomanes,* 5mm in subsp. *quadrivalens*). This character must be observed with some care since both bear scales with a wide range in size, and only the largest provide usable characters. A fair sample of scales must be examined from each specimen, and in practice the scales do not provide a convenient character for the determination of a large number of specimens.
2. **Spores** These provide the most suitable micro-character, where confirmation is necessary. The sculpture of the perispore is highly variable in both species, and of no value as a criterion, but the spores of subsp. *trichomanes* are paler than those of *quadrivalens*. Spore size is often diagnostic and it is usual to measure only the exospore*. For reasons which are not yet satisfactorily explained, different workers have reported different size ranges. Ranges of exospore length measurements (in gum chloral) recorded by J.D.Lovis are as follows (mean values in bold): *trichomanes* 23-**29-36**-42μm; subsp. *quadrivalens* 27-**34-43**-50μm. P.M.Benoit (*Nature in Wales 9:* 75-79; 1964) has found the mean size ranges (measured in air) of spores of Merioneth plants to be quite discrete: subsp. *trichomanes 27-34*μm, subsp. *quadrivalens 38-48*μm. It is necessary to bear in mind that different mounting media have different effects on spore size. It would be prudent for new workers each to establish his or her own standards from material of confirmed identity.
3. **Stomata** The length of the guard cells can provide a valuable confirmatory character: subsp. *trichomanes* 31-**38-43**-52μm; subsp. *quadrivalens* 35-**41-49**-57μm.
4. **Chromosome number** The two British subspecies also differ in chromosome number: subsp. *trichomanes* is diploid, with n = 36, whereas *quadrivalens* is tetraploid, with n = 72 chromosomes.

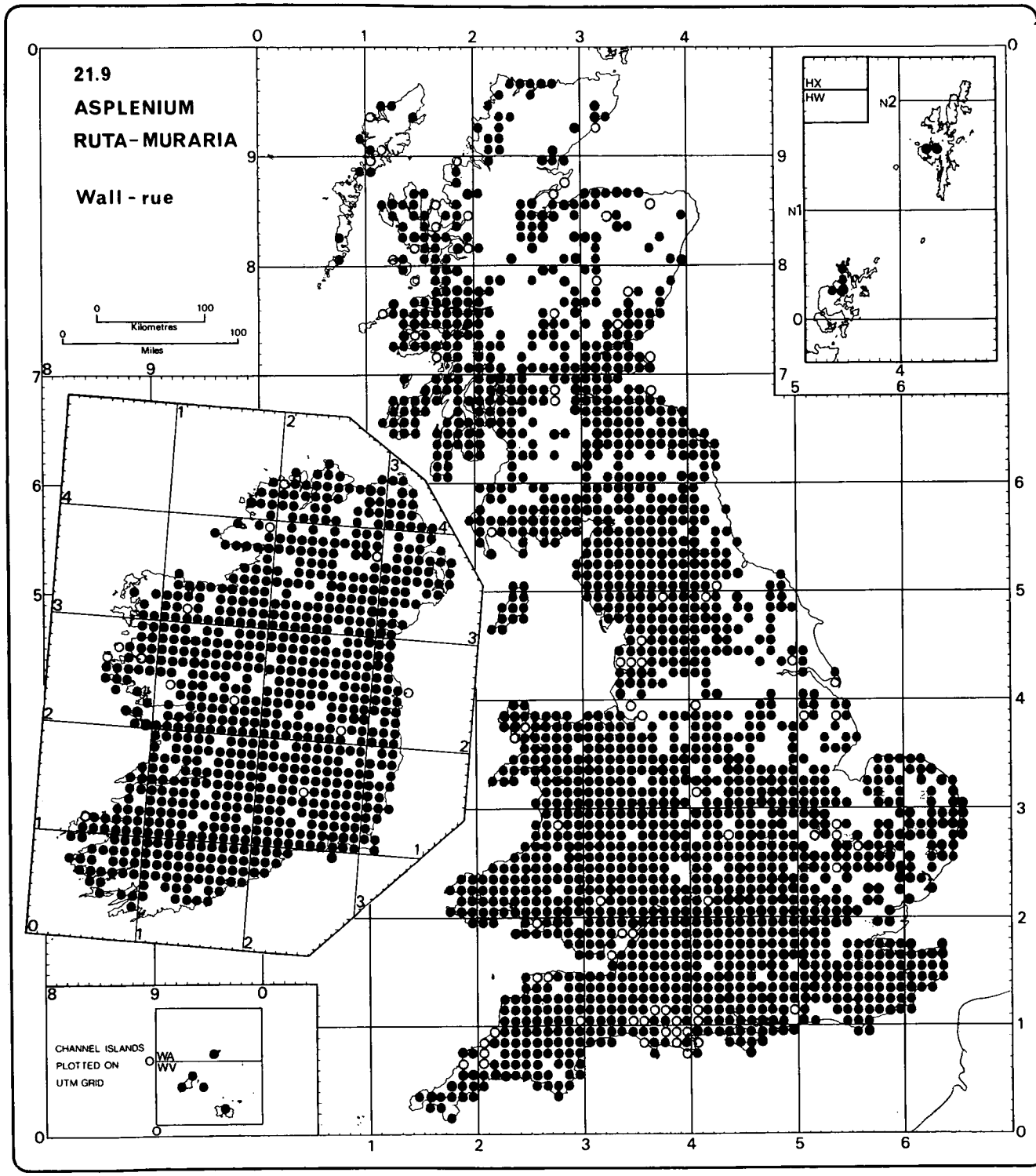
An excellent photograph displaying the general morphology of characteristic examples of fronds of the two subspecies is given in *Welsh Ferns* (ed. 5); pl. 10 (Hyde, Wade & Harrison, 1969). The frond of subsp. *trichomanes* is very typical of a luxuriant specimen from a rock-cleft in deep shade. See also J.D.Lovis, *Br. Fern Gaz.* 9: 147-160; 1964.

*the outer wall beneath the perispore



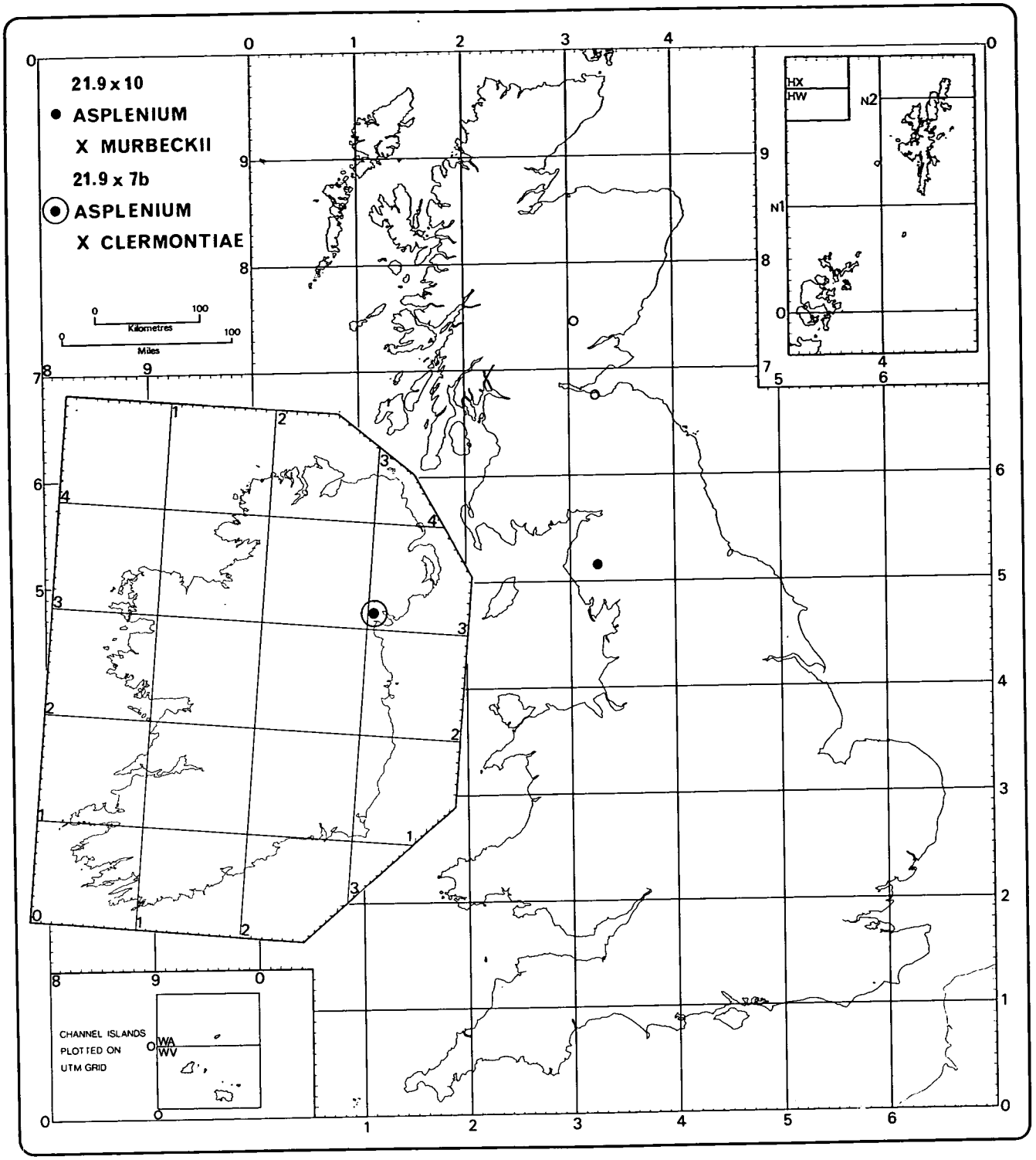
21.8 **Asplenium viride** Huds.

A northern-montane diploid species found on rocks with a moderate base content. This species has given rise, by hybridising with *A.trichomanes* subsp. *trichomanes* and subsequent doubling of chromosomes, to a tetraploid taxon *A.adulterinum* Milde found on serpentine rock in central Europe and Norway. Although *A.trichomanes* subsp. *trichomanes* and *A.viride* occasionally grow near each other neither the diploid hybrid (*A.* ×*protoadulterinum* Lovis & Reichstein) nor *A.adulterinum* has yet been found in the British Isles. A plant found in Levens Park, v.c. 69, described as intermediate between *A.trichomanes* and *A.viride* was doubtfully that hybrid but more likely *A.* ×*clermontiae*.



21.9 **Asplenium ruta-muraria** L.

A sub-Atlantic species widespread in Britain and Ireland. In lowland Britain restricted to man-made habitats (e.g. walls, especially of churches); lack of such habitats and of natural calcareous rock in central and north Scotland is reflected in its distribution. Two subspecies are recognised: subsp. *ruta-muraria,* a tetraploid and subsp. *dolomiticum* Lovis & Reichstein, a diploid described from N. Italy. Only the former is recorded from the British Isles (see J.D.Lovis & T.Reichstein, *Br. Fern Gaz., 9:* 141-146; 1964).



21.9×10 **Asplenium × murbeckii** Dörfl.

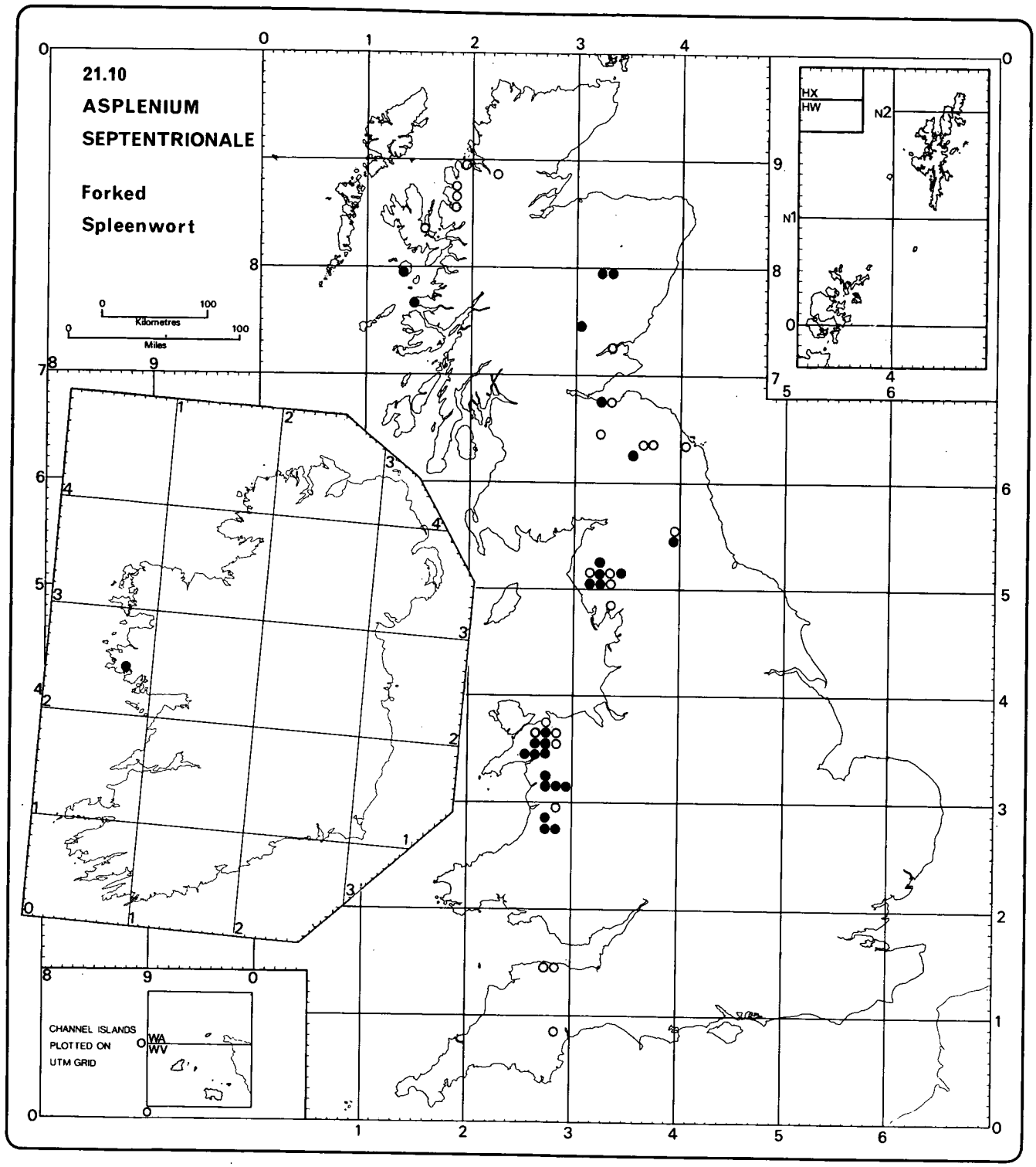
(*A.ruta-muraria* × *septentrionale*)

This rare hybrid, seen in recent years only in v.c. 70, can be confused with *A.* × *alternifolium* and from which it can be distinguished by the narrower teeth on the pinna segments and the irregular edge of the indusium. (See A.H.G.Alston, *loc. cit.*: 137; J.D.Lovis, *Br. Fern Gaz., 9:* 110-113; 1963; J.D.Lovis in C.A.Stace (ed.), *loc.cit.*: 111; 1975).

21.9×7b **Asplenium × clermontiae** Syme

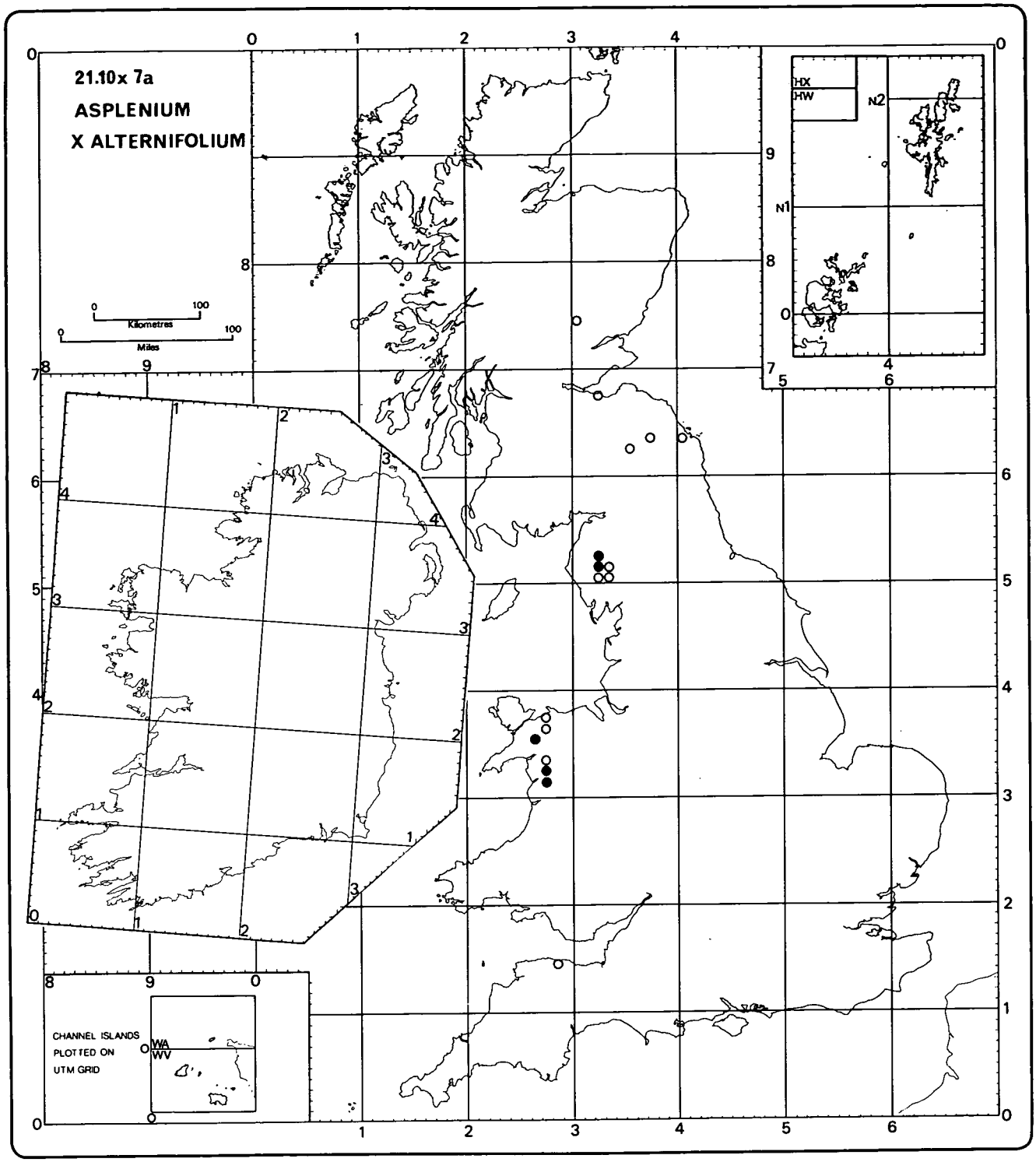
(*A.ruta-muraria* × *trichomanes* subsp. *quadrivalens*)

In view of the abundance of both parents on mortared walls this is an exceedingly rare hybrid. It was found in 1863 at Newry, v.c. H38, and has not been recorded since. A plant found in Levens Park, v.c. 69, tentatively attributed to *A.trichomanes* × *viride*, appears to be this hybrid. (See A.G.H.Alston, *loc.cit.*: 137; J.D.Lovis in C.A.Stace (ed.), *loc.cit.*: 109; 1975).



21.10 **Asplenium septentrionale** (L.) Hoffm.

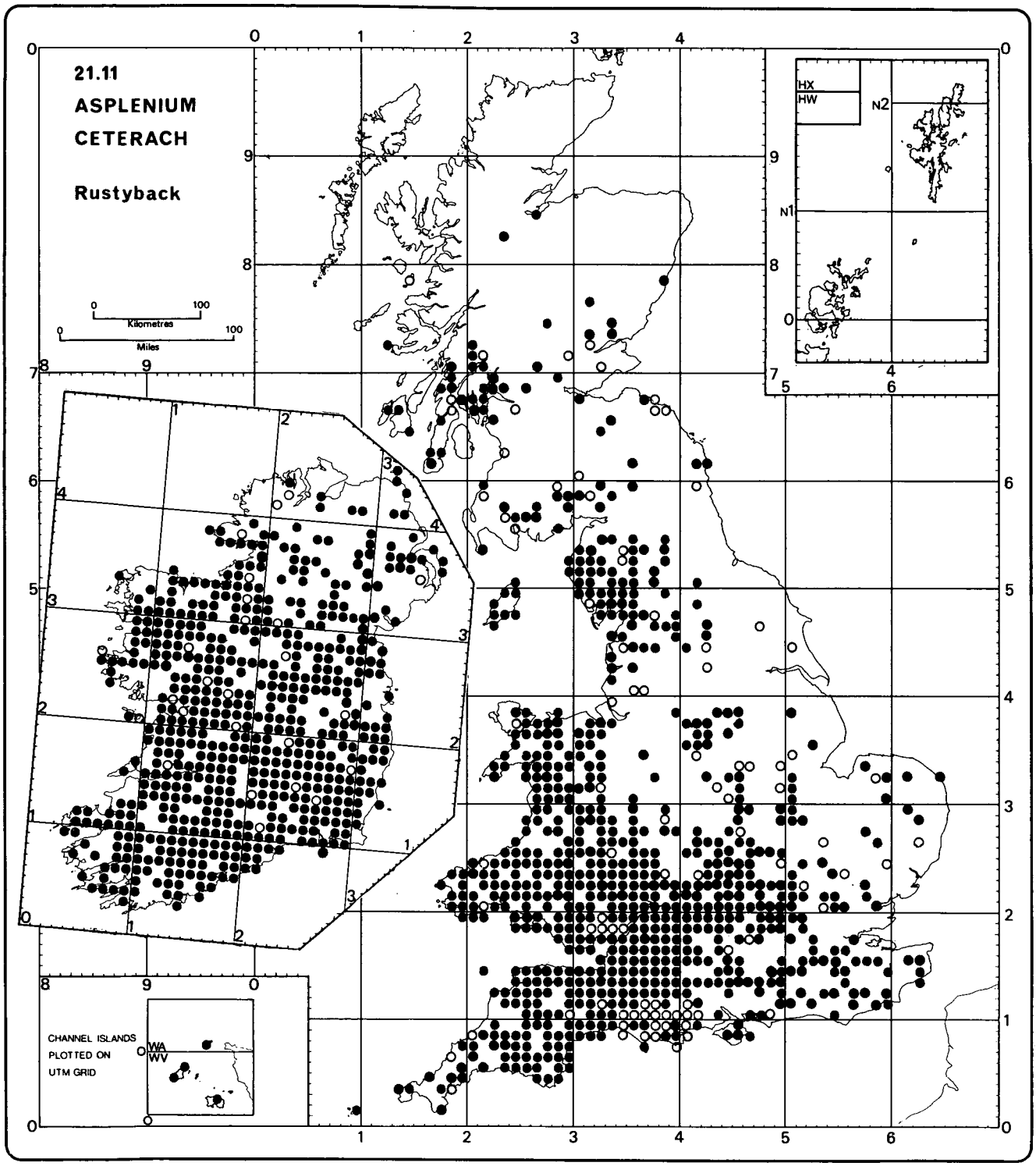
A northern continental species confined to ancient siliceous rocks. Although in the mountains of North Wales and the Lake District it is also found at low altitudes in the clement climate of West Scotland (v.c. 97) and Ireland (v.c. H16).



21.10×7a **Asplenium × alternifolium** Wulfen

(*A.septentrionale* × *trichomanes* subsp. *trichomanes*)

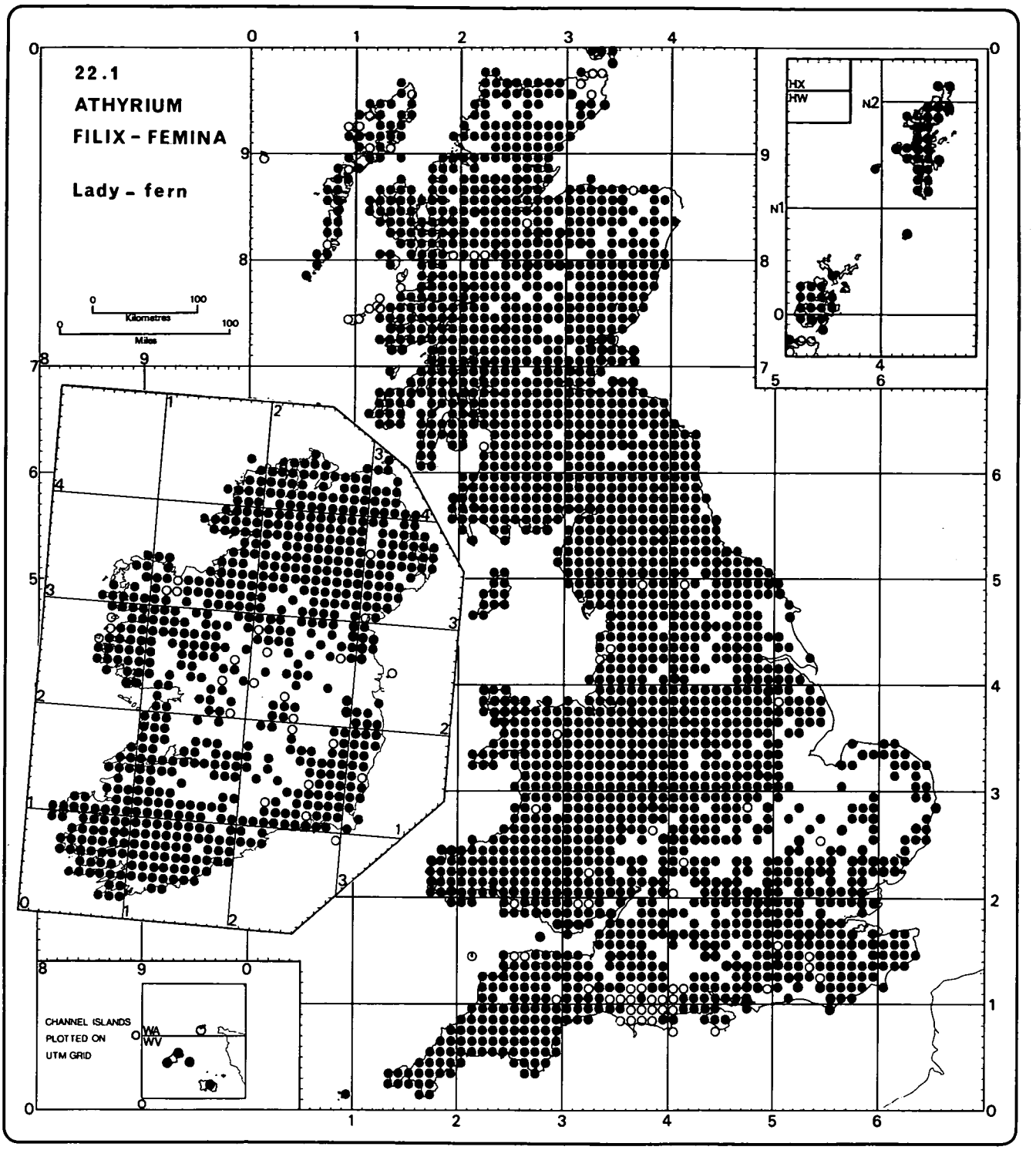
A hybrid recorded in lime-free rocks from several localities in Britain where the parents grow together. In the past it has been over-collected for herbaria. Both the parents are rare in Britain but, where they are common and growing together on the European mainland, the hybrid forms freely. It is sterile and could only be confused with *A.*×*contrei*, which has a distinctly triangular frond. The records for v.c. 69 have not been confirmed this century. (See J.D.Lovis in C.A.Stace (ed.), *loc.cit.*: 110; 1975; and A.H.G.Alston, *loc.cit.*: 132).



21.11 **Asplenium ceterach** L.

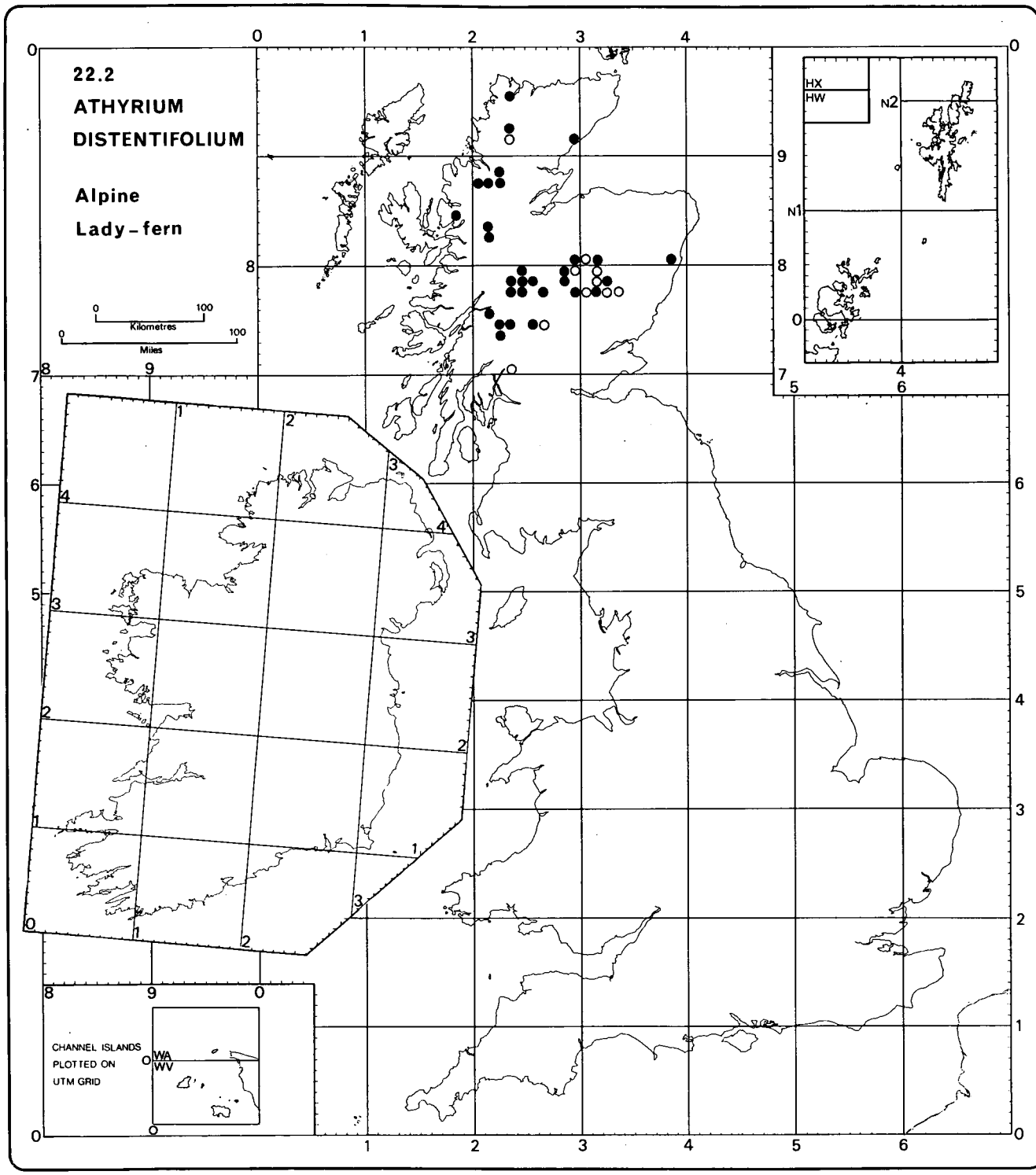
(*Ceterach officinarum* DC.)

A southern sub-Atlantic species reaching possibly its most northern locality in v.c. 96 (it is also recorded for Gotland, Sweden). Although a calcicole the lack of suitable substrate is only partly responsible for its restricted distribution which is most likely controlled by a complex of interrelated climatic factors.



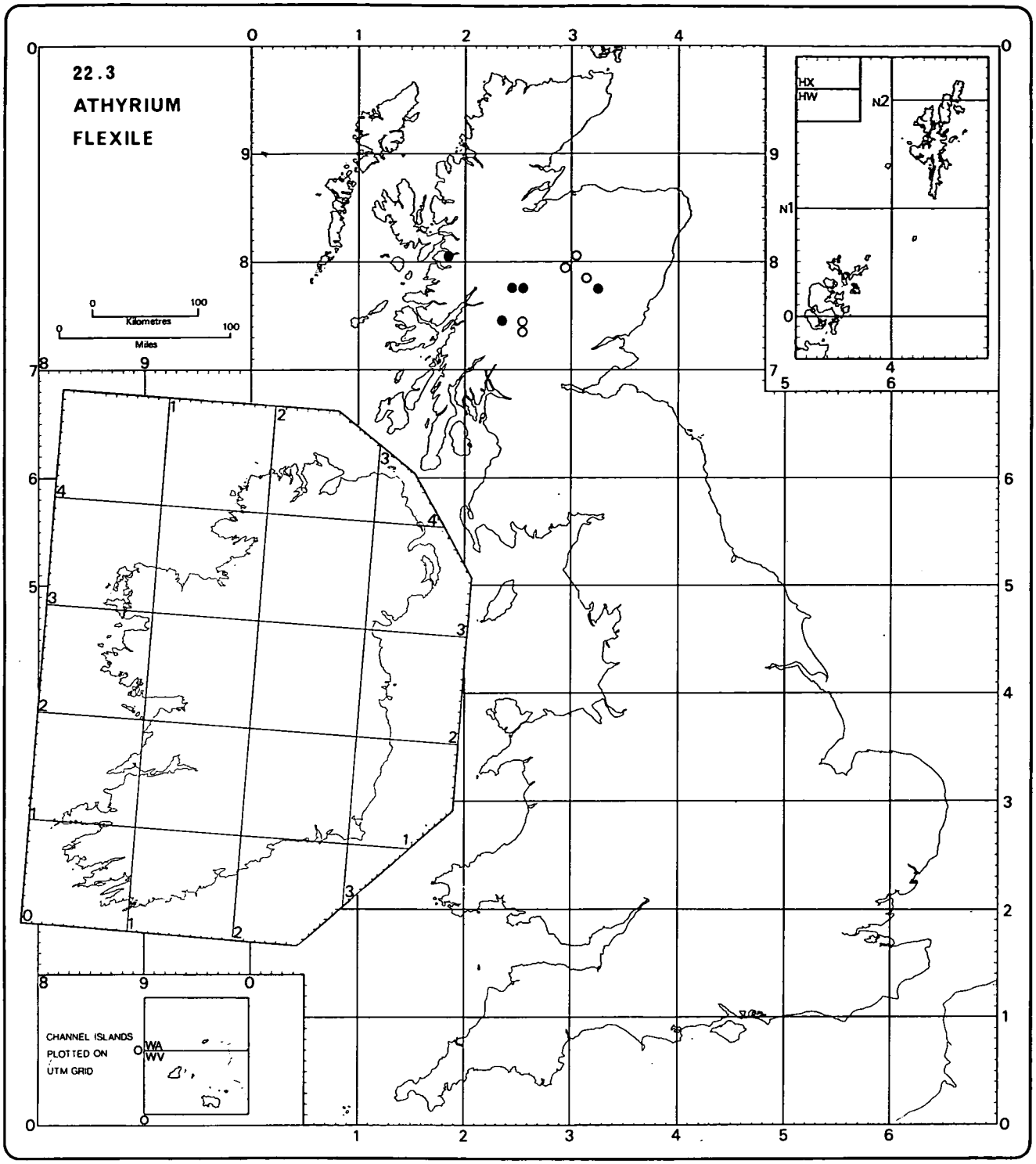
22.1 **Athyrium filix-femina** (L.) Roth

A widespread species but mainly a deciduous woodland plant and most abundant in flushes and spring lines. The drainage of wet habitats combined with the decrease of small deciduous copses in lowland Britain may reduce the abundance of this species in the future.



22.2 **Athyrium distentifolium** Tausch ex Opiz
(*A.alpestre* (Hoppe) Rylands)

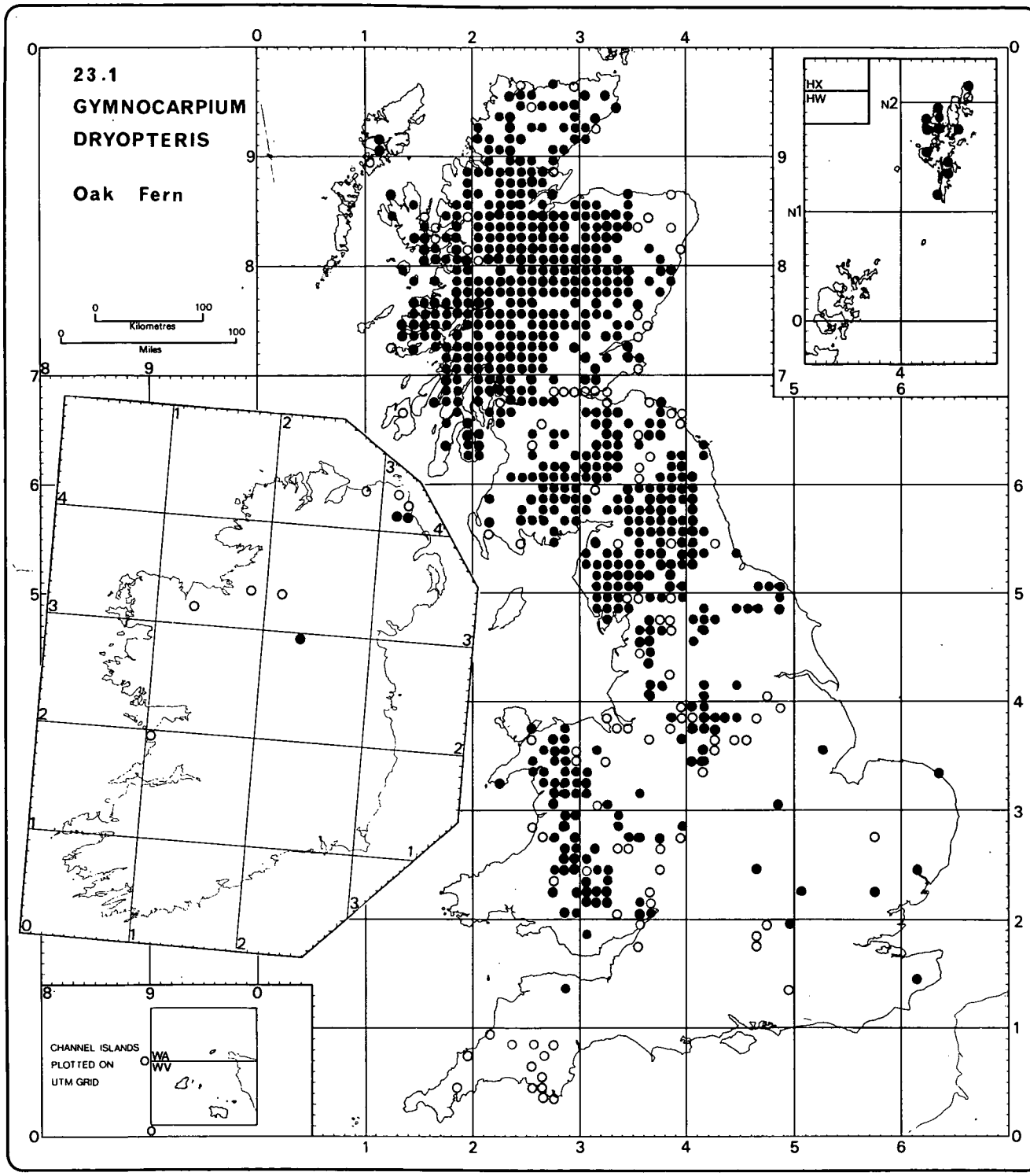
An arctic-alpine species characteristic of gullies where snow lies late in the spring. Whilst such habitats can give a good lead as to the identification of the species, confirmation can come only from the checking of mature fertile fronds, which lack indusia.



22.3 **Athyrium flexile** (Newm.) Druce

(*A.distentifolium* Tausch ex Opiz *var. flexile* (Newm.) Jermy)

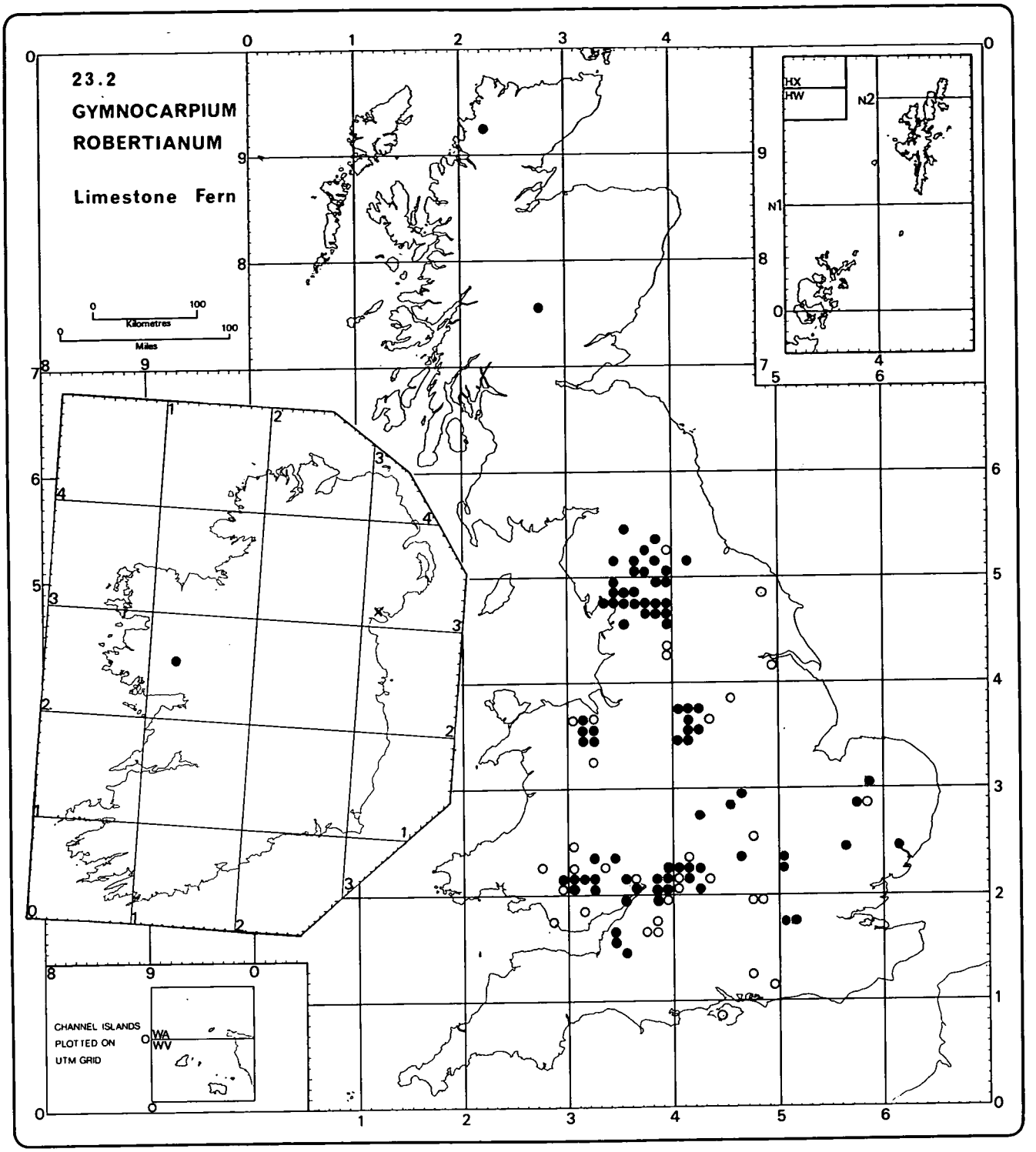
A distinct taxon similar to *A.distentifolium* in frond texture and cutting although the pinnae are smaller and have fewer pinnules or lobes. The fronds are characteristically reflexed and appear adpressed to the ground—a character retained in cultivation. *A.filix-femina* produces, especially in mountain habitats, an ecotype with a similar habit which may be confused with this species; the presence of indusia will distinguish it.



23.1 **Gymnocarpium dryopteris** (L.) Newm.

(*Thelypteris dryopteris* (L.) Slosson)

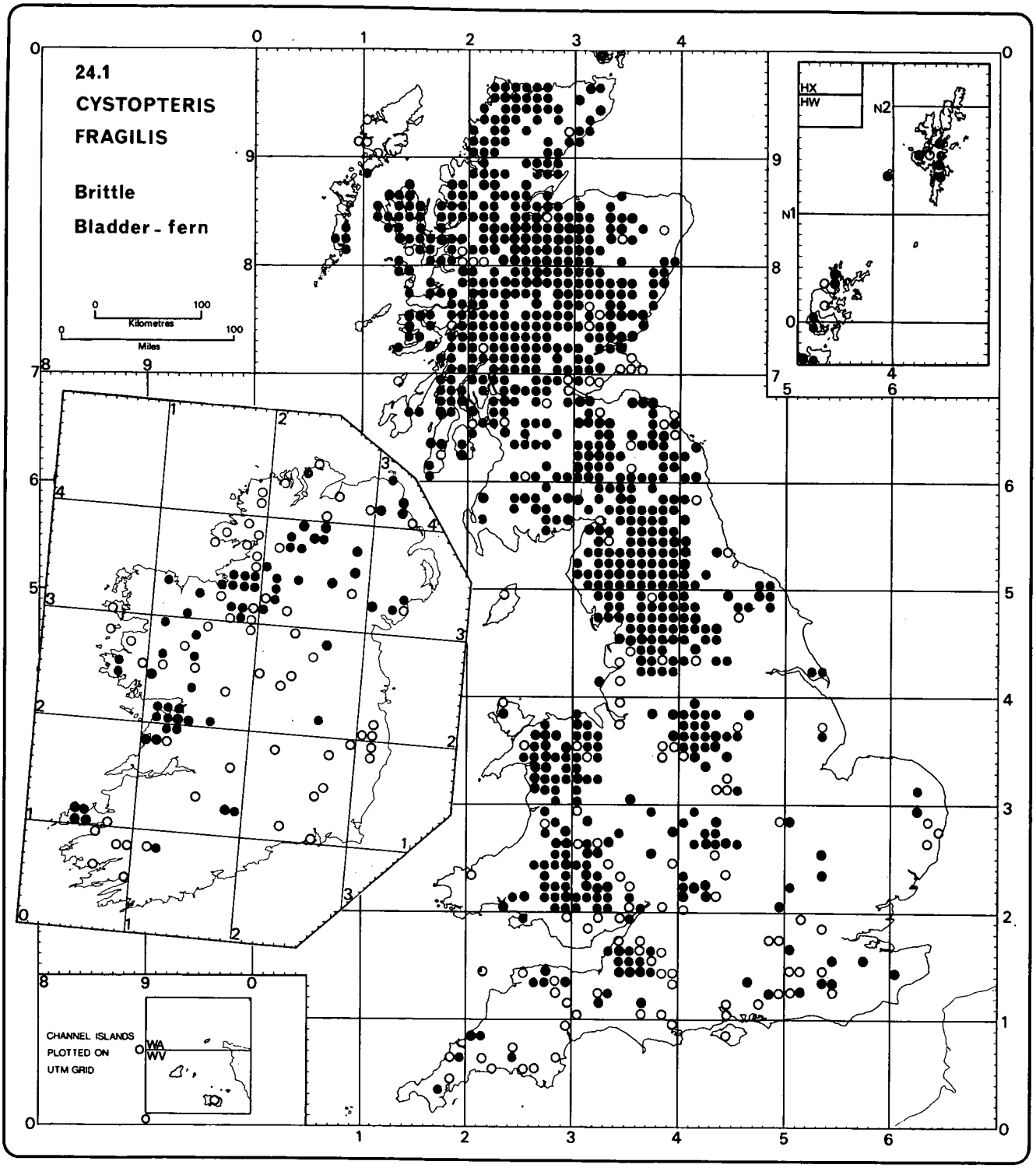
A northern-montane species with only isolated populations in east and south-central and south-west England. Decrease in the south-west and in the Welsh Marches is probably due to the cutting down of deciduous woodland.



23.2 **Gymnocarpium robertianum** (Hoffm.) Newm.

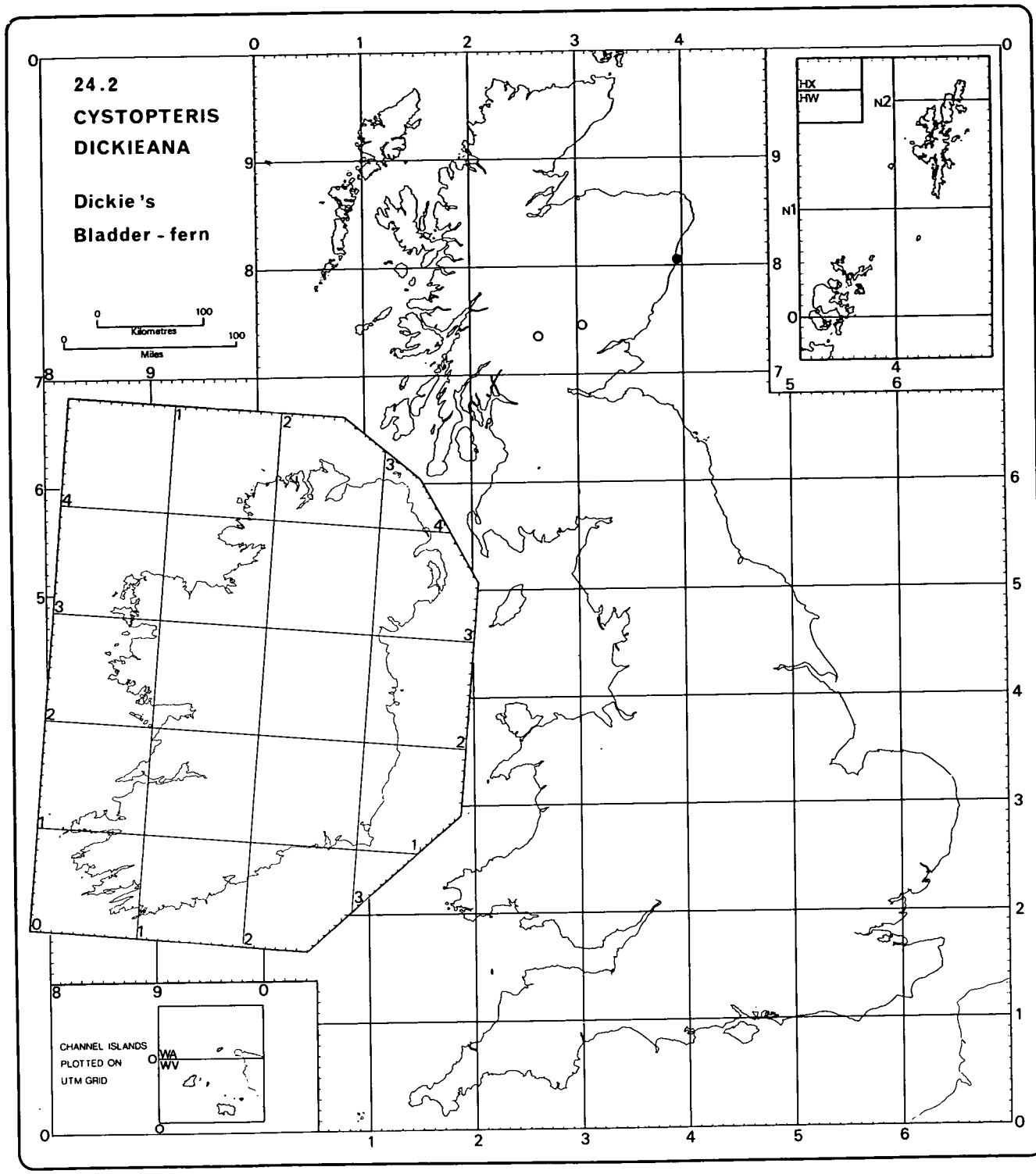
(*Thelypteris robertiana* (Hoffm.) Slosson)

A continental species restricted by substrate (limestone) rather than climate although obviously requiring the shelter of scree or grykes for establishment. It is a species that has become naturally established in artificial habitats in urban areas and on disused railway platforms or sidings in the east of England. There are outliers on karst limestone in v.cs 88, 108, and H26.



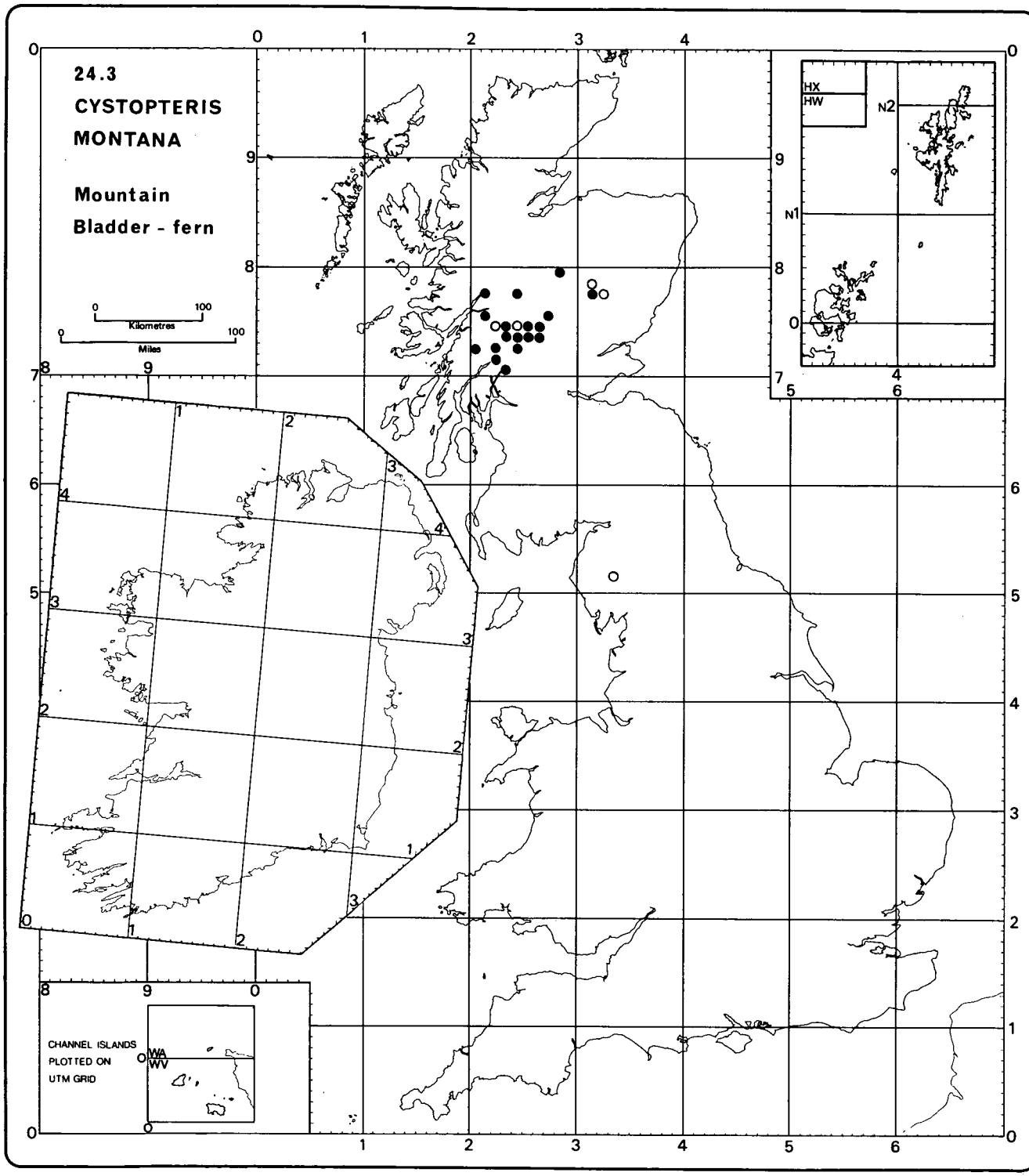
24.1 **Cystopteris fragilis** (L.) Bernh.

A widespread species preferring base-rich rock substrate in the wetter areas of the country. It is occasionally found in man-made habitats (shady moist walls) in the south and east. Both tetraploid and hexaploid (and sterile pentaploid) forms are recorded in Britain; the frond of the former is less dissected but no distribution patterns have so far emerged in the relatively small sample studied.



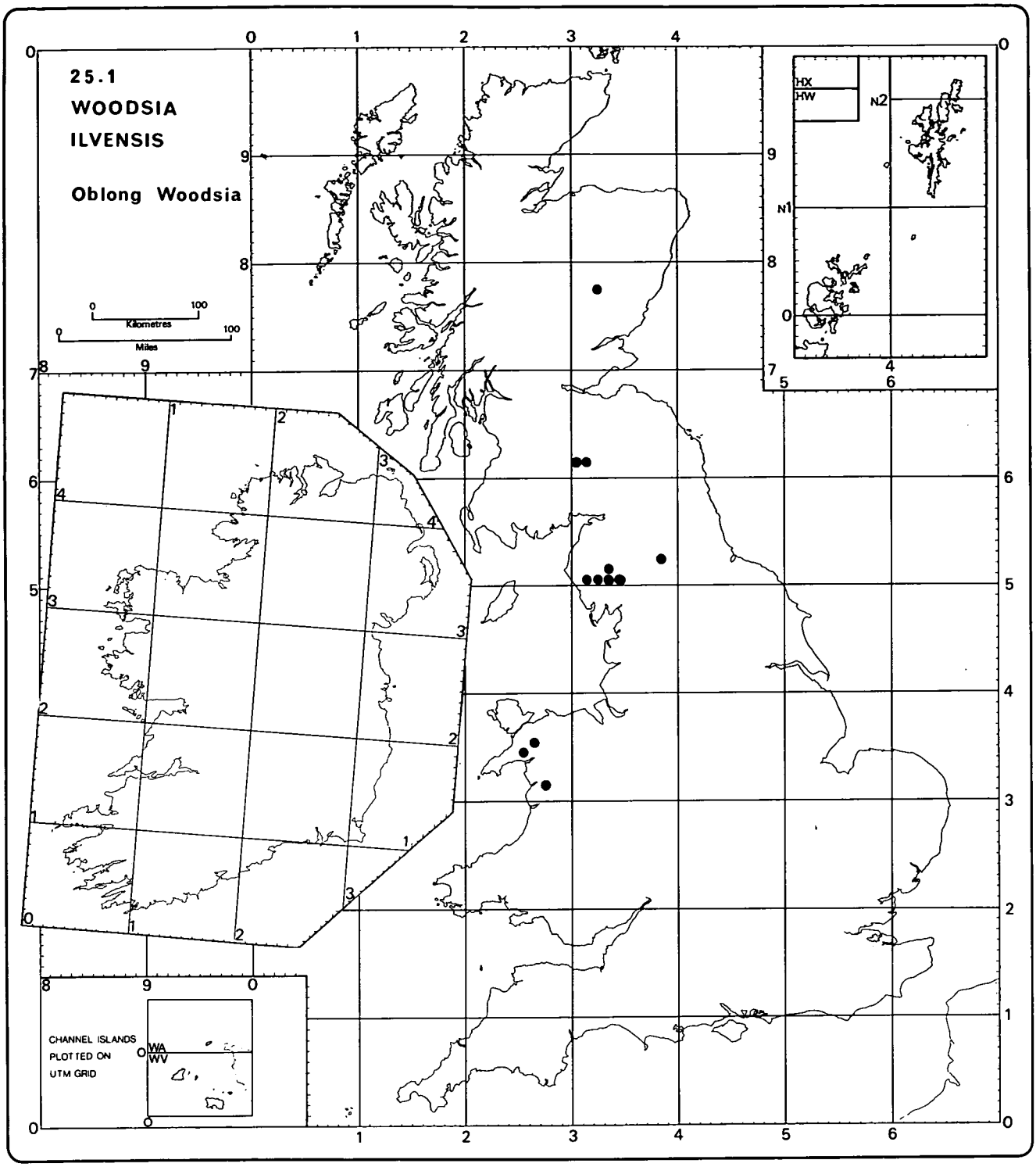
24.2 **Cystopteris dickieana** Sim

This species is best distinguished by its rugose mammillate spores and may well prove to be more widespread especially on northern mountains. This species was described from material collected in deep shade in an east-facing sea-cave on the Kincardine (v.c. 91) coast; it has broad pinnae which give it an attractive appearance hence it is sought after by horticulturists. Material from elsewhere in Scotland is identical to *C.fragilis* except for the non-spiny spores.



24.3 **Cystopteris montana** (Lam.) Desv.

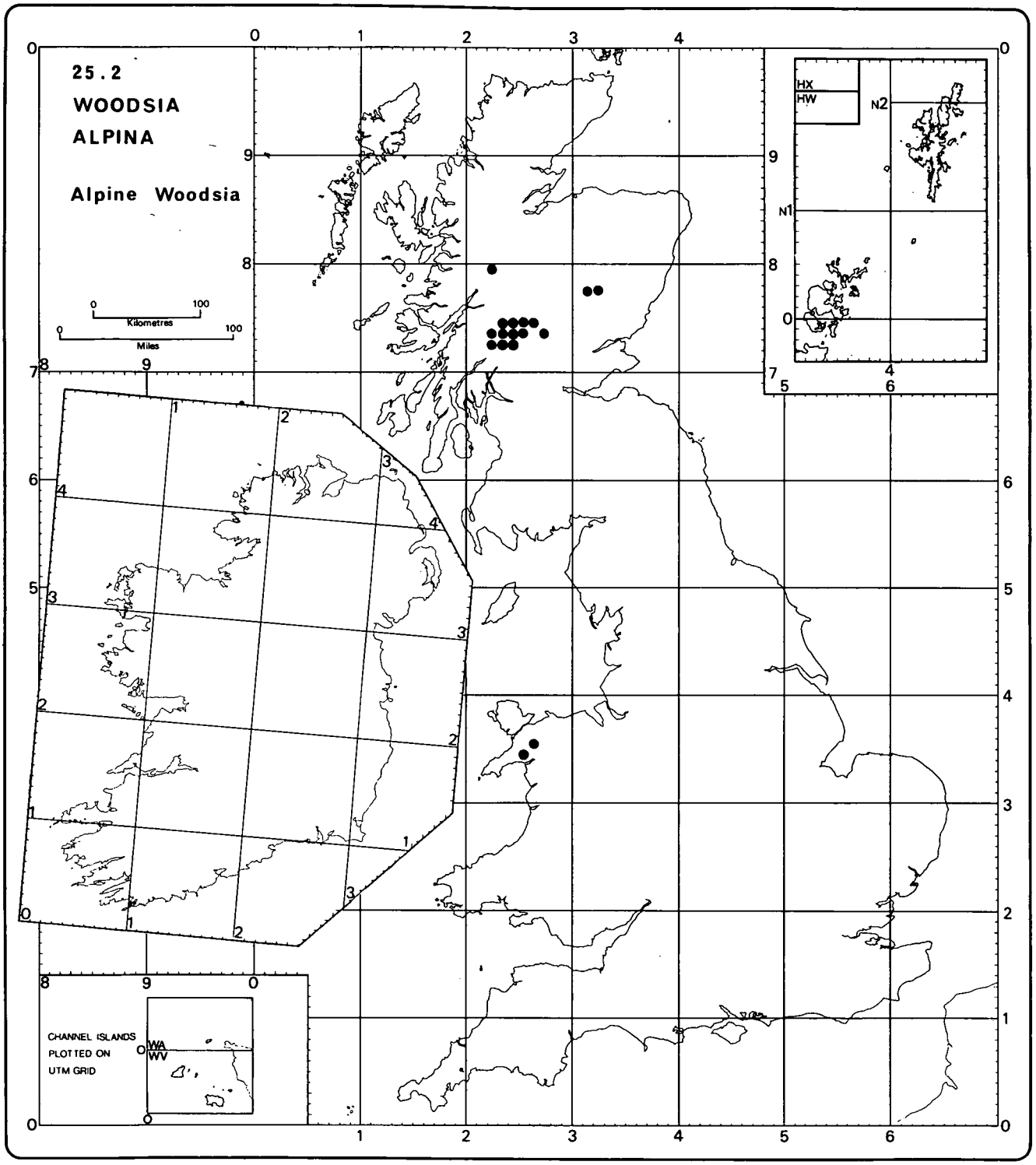
An arctic-alpine species requiring base-rich rocks or gullies flushed with calcium-rich water. One of our rarer ferns, occasionally in some quantity locally; restricted to the Grampian Mountains, with an outlier in the Lake District now extinct.



25.1 **Woodsia ilvensis** (L.) R.Br.

A northern-montane species which has become very rare through over-collecting and is now protected by the *Conservation of Wild Creatures and Wild Plants Act, 1975*. The history and distribution of this species is discussed in detail by M.H.Rickard in *Br. Fern Gaz., 10:* 269-275; 1972. Small plants of *W.ilvensis* can look very similar to young plants of *Cystopteris fragilis* grown in exposed situations.

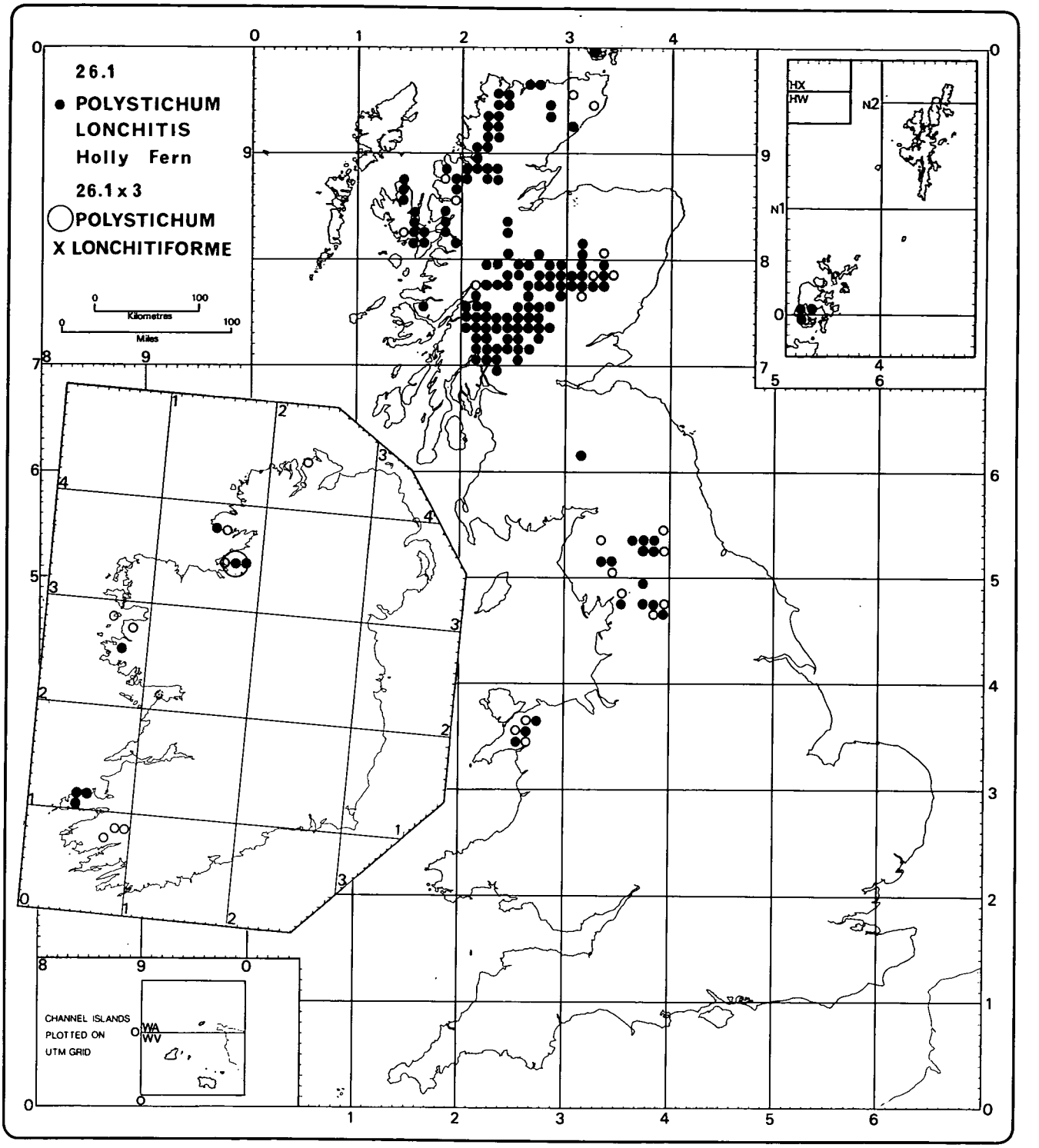
All squares from which the species has at some time been verified are indicated by solid dots.



25.2 **Woodsia alpina** (Bolton) S.F.Gray

An arctic-alpine species also depredated by Victorian botanists. As with *W.ilvensis* this species is similarly protected by the *Conservation of Wild Creatures and Wild Plants Act, 1975.* As also with the last species it can be mistaken for a small depauperate *Cystopteris fragilis.* Its history and distribution is fully documented by M.H.Rickard (*Br. Fern Gaz., 10:* 275-280; 1972).

All squares from which the species has at some time been verified are indicated by solid dots.



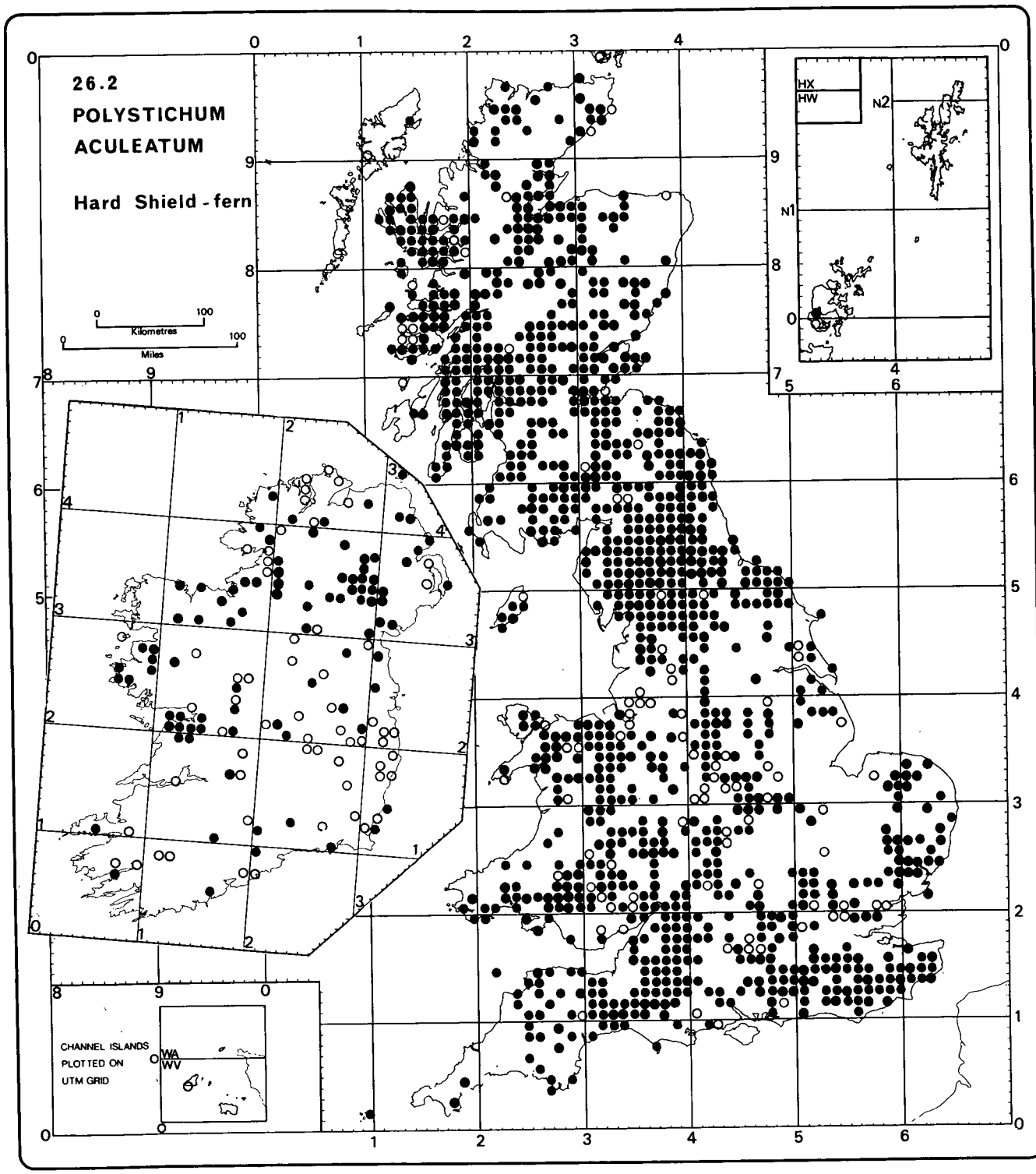
26.1 **Polystichum lonchitis** (L.) Roth

An arctic-alpine species requiring a base-rich substrate. Some more southerly sites in limestone grykes are liable to be destroyed through quarrying. An outstanding adventive record from a railway bridge in Wellingborough, v.c. 32, has been verified by Dr Anne Sleep, but is not plotted here.

26.1 × 3 **Polystichum × lonchitiforme** (Halacsy) Becherer

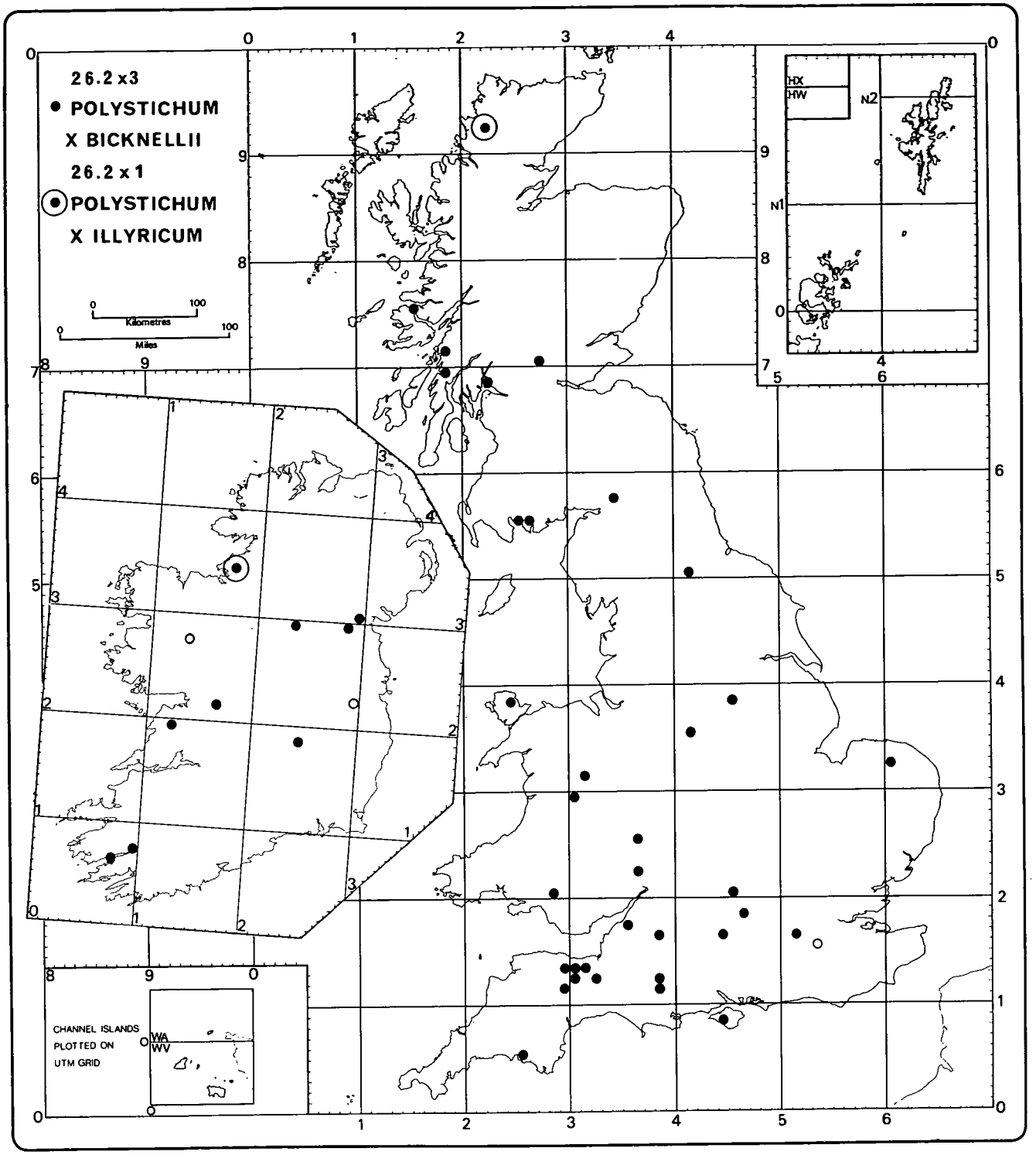
(*P.lonchitis* × *setiferum*)

This hybrid was found in Glenade, v.c. H29, with the parents and has been confirmed by observing meiosis in the spore mother cells (A.Sleep, *pers. comm.*). Without the cytological confirmation it is virtually impossible to separate from *P.* × *illyricum* (see M.J.P.Scannell, *Irish Nat. J., 19:* 79; 1977).



26.2 **Polystichum aculeatum** (L.) Roth

A sub-Atlantic species which is widespread throughout the British Isles. Its distribution pattern reflects its ecological requirements for a base-rich substrate, in places provided by man (e.g. canal-sides, locks and bridges) which in turn have been polluted by industrialisation. The basal pinnae are distinctly smaller than those in the middle of the frond and are only pinnatifid (cf. *P.setiferum*). The spores are larger than *P.setiferum* (av. 41.3μm) and papillate (A.Sleep, *pers. comm.*).



26.2 × 1 **Polystichum × illyricum**
(Borbas) Hayek

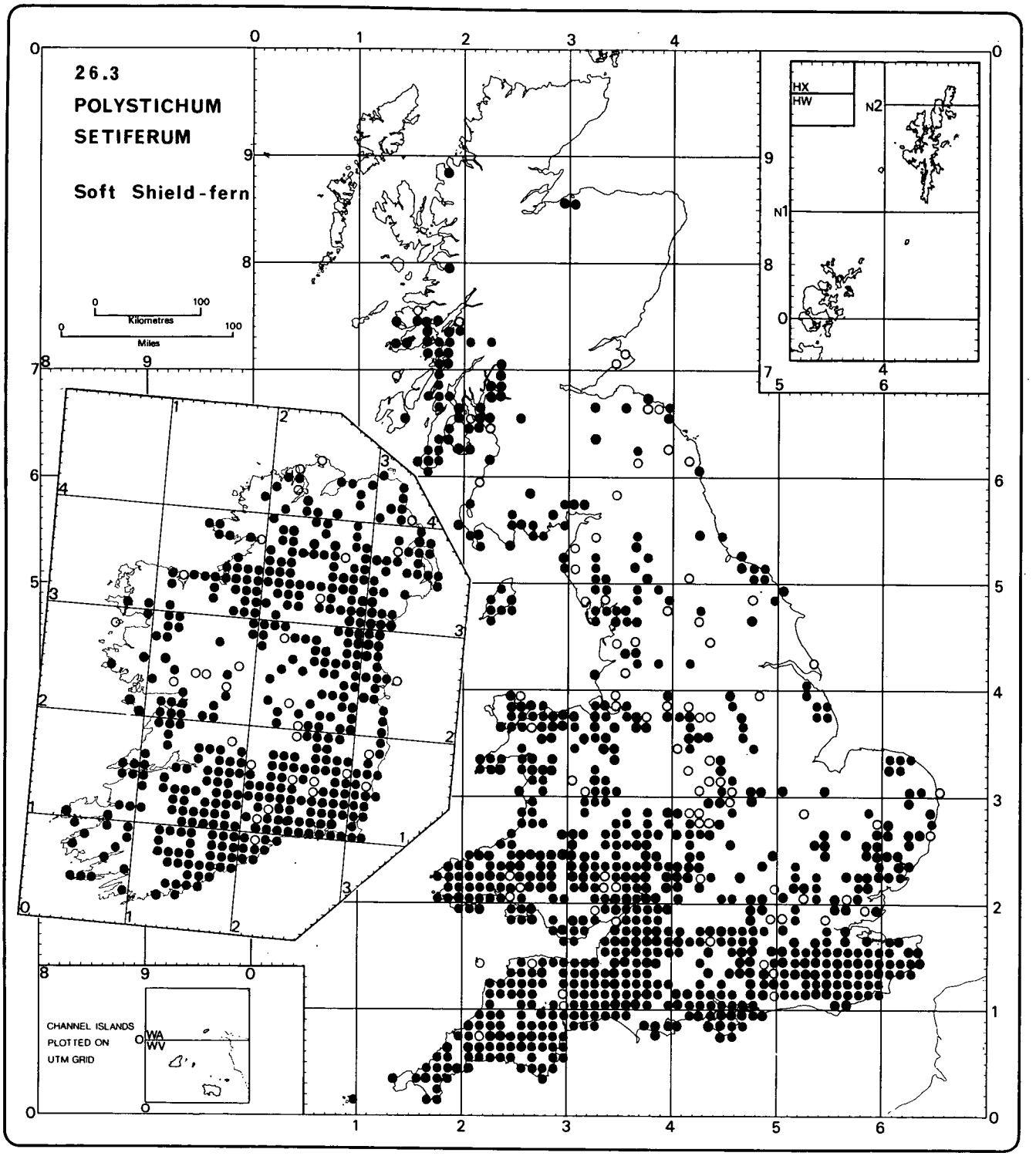
(P.aculeatum × lonchitis)

This hybrid was first detected in herbarium material collected in 1932 from Glenade, v.c. H29 (A.Sleep & D.M.Synnott, *Br. Fern Gaz., 10:* 281; 1972); it has since been collected alive and awaits cytological confirmation. It is intermediate between the parents although most similar, superficially, to *P.aculeatum;* the spores are abortive. This hybrid is very difficult to separate from *P.* × *lonchitiforme* if all three putative parents are in the vicinity. The record from Inchnadamph, v.c. 108, is outside the known range of *P.setiferum* however, and therefore is undoubtedly *P.* × *illyricum*. (See A.McG.Stirling, *Watsonia, 10:* 231; 1974, and A.Sleep in C.A.Stace (ed.), *Hybridization and the Flora of the British Isles:* 119; 1975).

26.2 × 3 **Polystichum × bicknellii**
(Christ) Hahne

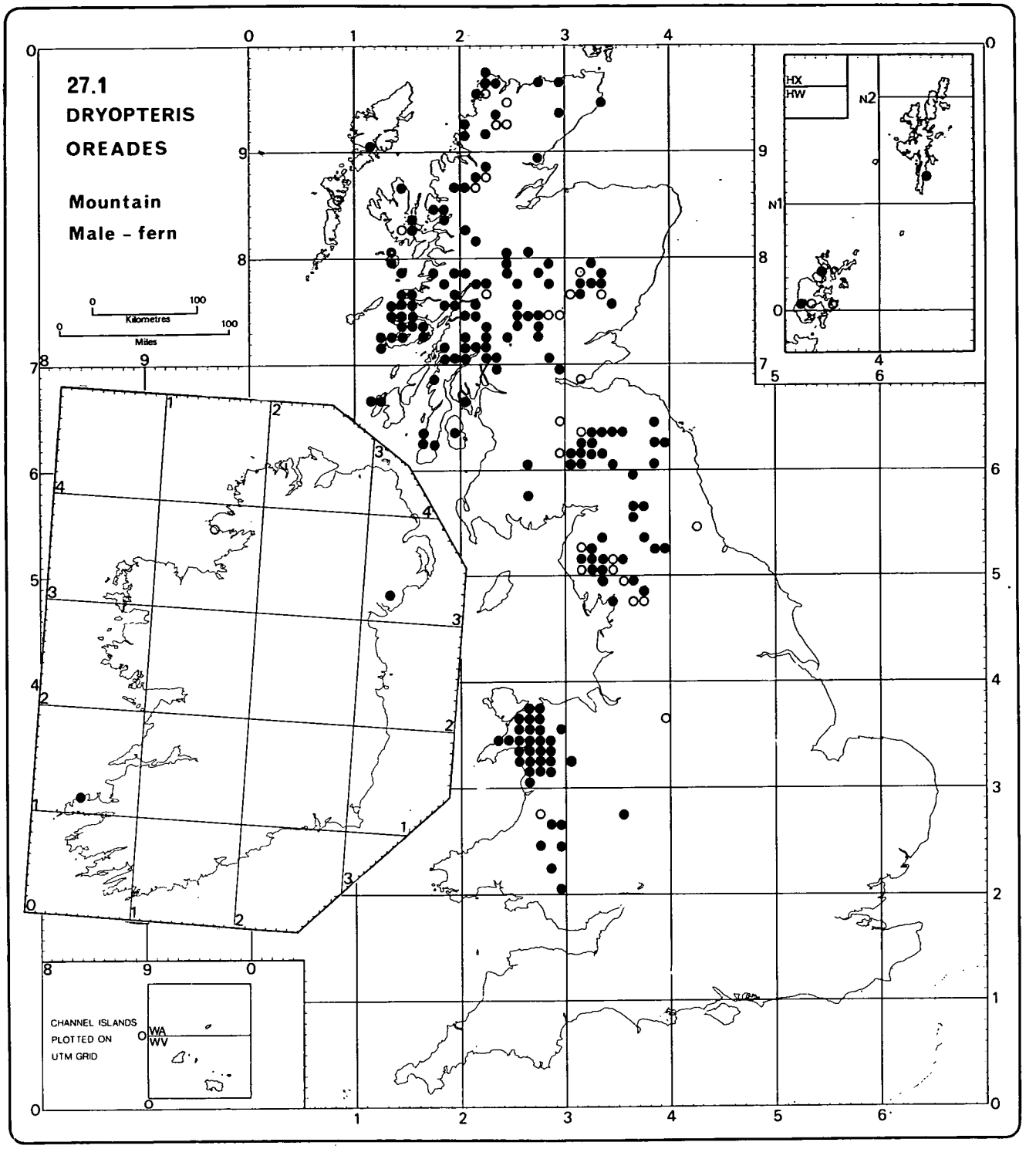
(P.aculeatum × setiferum)

A hybrid which appears frequently in habitats where the parents grow close together. It can appear very similar to *P.aculeatum* and is therefore very difficult to recognise. It is best confirmed by abortive spores. (See A.Sleep in C.A.Stace (ed.), *loc.cit.:* 118).



26.3 **Polystichum setiferum** (Forsk.) Woynar

A southern sub-Atlantic species which reaches its northernmost location in Britain (v.c. 95). Its distribution, whilst to some extent locally governed by an edaphic requirement of base-poor soils, indicates an optimum in areas with a warm wet winter. It is often a hedgerow plant in the south. It may be distinguished by the basal pinnae which are long, spreading and pinnate. The spores are smaller than *P.aculeatum* (av. 30.5μm) with a winged perispore (A.Sleep, *pers. comm.*).



27.1 **Dryopteris oreades** Fomin

(*D.abbreviata* auct., non *Polystichum abbreviatum* DC.; *D.filix-mas* var. *abbreviata* Newm.)

A species with a northern Atlantic-montane distribution, often misidentified and confused with *D.filix-mas;* some of the earlier lowland records have proved to be the latter species. *D.oreades* is frequently a scree plant and is found also on mountain ledges and in gullies. It is replaced by *D.pseudomas* on cliffs and gullies facing the sea suggesting that it may be a plant of nutrient-poor situations. All records have been seen by H.V.Corley or C.R.Fraser-Jenkins.

Identification of the species in the *Dryopteris filix-mas* complex

Dryopteris filix-mas (L.) Schott, *D.pseudomas* (Woll.) Holub & Pouzar and *D.oreades* Fomin have, since their inception, been confused by botanists both in England and abroad (see C.R.Fraser-Jenkins & A.C.Jermy, *Taxon, 25:* 659-665; 1976). The following descriptions of these three species have been drawn up with the help of C.R.Fraser-Jenkins.

D.filix-mas Rhizome little branched. Fronds spreading, semi-persistent (although in very clement western areas they may be persistent) petiole about $\frac{1}{3}$ length of the frond, ± densely clothed with pale coloured scales; lamina ovate-lanceolate, truncate at base, ± herbaceous, mid-green. Pinnae flat, ± horizontal; pinnules toothed, teeth ± acute, curved towards the acute apex, basal pair of each pinna ± stalked, usually longer than those above, lobes at base of pinnules usually forming auricles. Indusia 0.5-2mm, convex, thin sometimes glandular, white or translucent when young, at least part of the margin adpressed to lamina surface, amply covering sporangia but shrinking at maturity, becoming brown when old. A plant of forest, hedgerow and open places on rocks usually on lighter soils.

D.oreades Rhizome much branched. Fronds upright, frost sensitive; petiole about $\frac{1}{4}$ length of frond, densely clothed with pale scales; lamina lanceolate tapering to base, very slightly coriaceous, pale grey-green. Pinnae usually concave, inclined to apex; pinnules with an obtuse or rounded apex with blunt teeth arranged palmately or like a fan, basal pair adnate or slightly stipitate, longer than the pair above; basal lobes forming auricles. Indusia 0.5-1mm, highly convex, thick, glandular, green when young, fitting closely round sporangia, scarcely shrinking at maturity, becoming grey-brown when old. A plant of open screes, rocky banks and open hillside.

D.pseudomas Rhizome little branched. Fronds ± upright, persistently green throughout winter; petiole variable in length, densely clothed with gingery scales, many of which are narrow and with a dark base which remains as a blackish speck when the scale drops; lamina variable in shape ovate to lanceolate, leathery, yellow-green when young becoming blue-green when old. Pinnae flat, ± horizontal; pinnules with few or no teeth on parallel side, teeth at apex acute; basal segments not obvious; junctions of pinna rhachis with main rhachis darkly coloured. Indusia 1-2mm, highly convex, thick, margins inrolled, often glandular, brown when young, scarcely shrinking at maturity, becoming grey when old. A plant of woodland, hedgerows, especially on clay soil and on open hillsides, often replacing *D.oreades* in maritime situations.

Key to the *Dryopteris filix-mas* complex

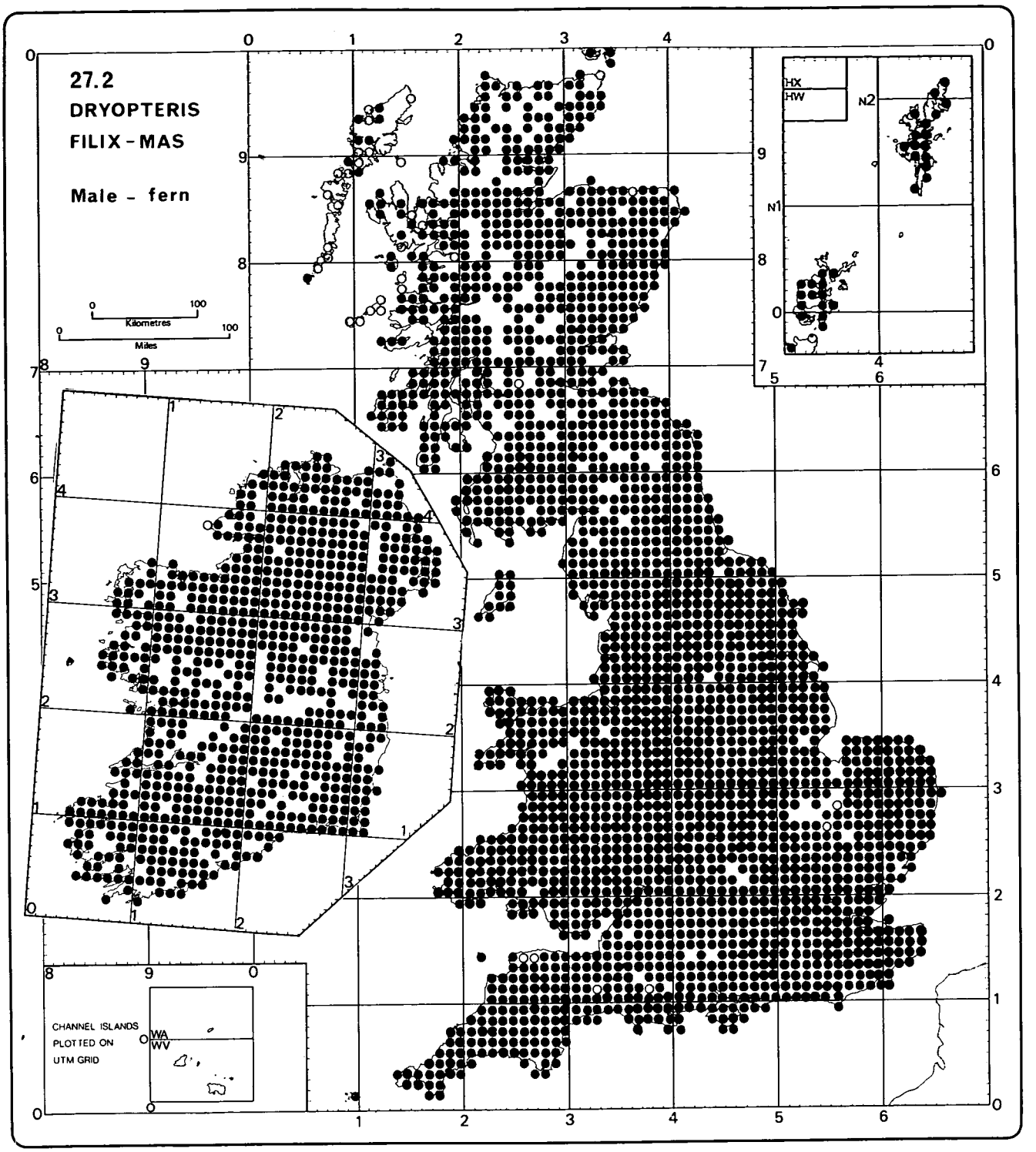
1. Frond texture thick, somewhat glossy and dark green on top (yellow-green when young); stipe and rhachis bearing long narrow scales with a dark base and usually a dark centre, junction of rhachis and pinna axis darkly coloured; lower margins of pinnules (pinna-segments) parallel, with few teeth. **D. pseudomas**

1. Frond texture thin, mid- or grey-green on top; stipe and rhachis bearing both narrow and wide concolorous scales, junction of rhachis and pinna-axis not darkly coloured; pinnule-shape tapering, lower margins usually bearing teeth or lobes.

    2. Frond grey-green; teeth of pinnules with obtuse tips spread out in a fan-like arrangement at the pinnule (or segment) apex; immature indusum thick, margins involute (tucked under sporangia) **D. oreades**

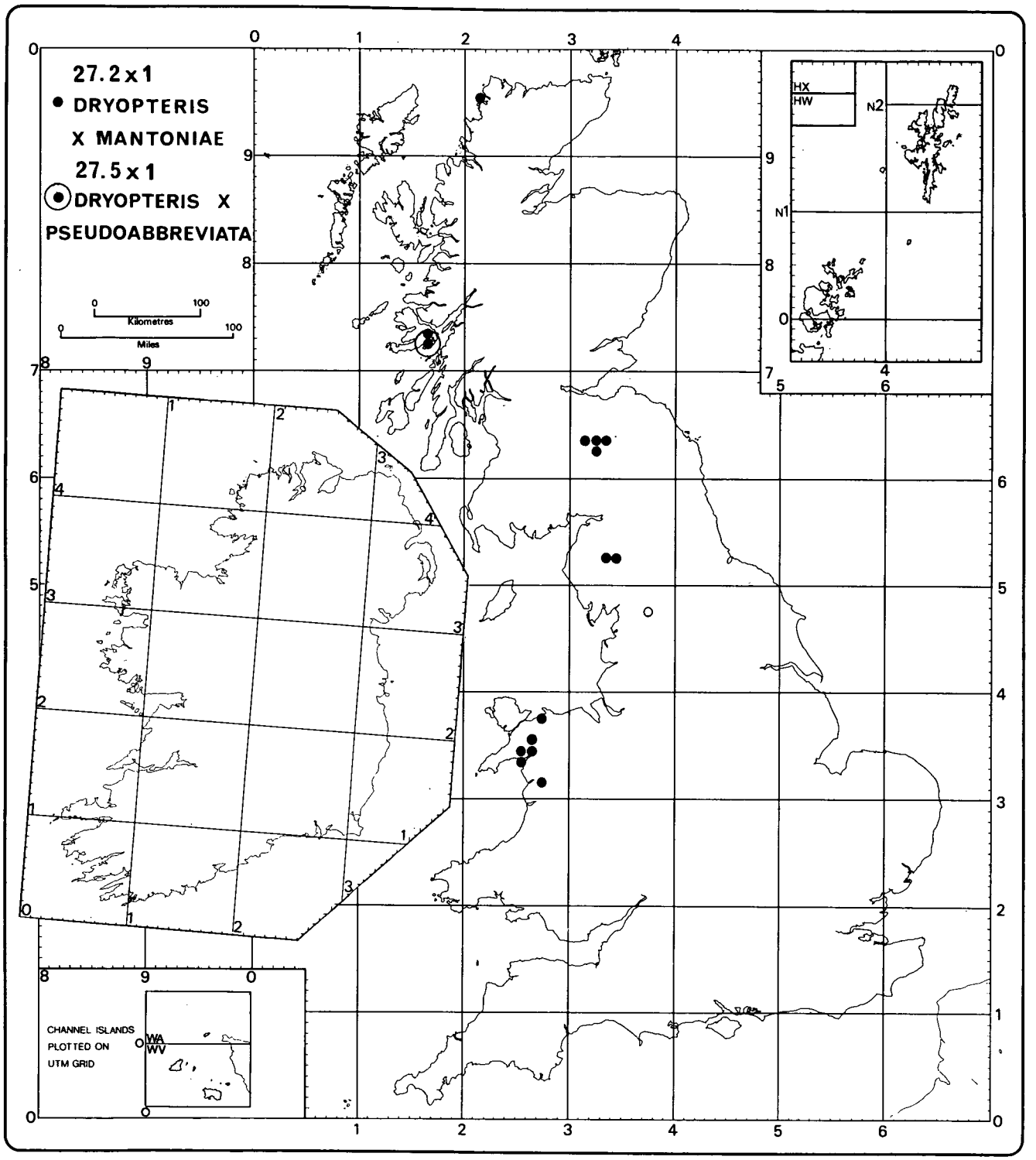
    2. Frond mid-green; teeth of pinnules with acute tips, converging towards the apex; immature indusium thin, margins not involute and usually extended over the lamina. **D. filix-mas**

NB: Hybrids between these species are intermediate in their morphology but it is likely that *D.* × *tavelii* will key out as *D. pseudomas* and *D.* × *mantoniae* as *D. filix-mas.*



27.2 **Dryopteris filix-mas** (L.) Schott

This species, probably the most widespread in the British Isles is by no means common in many parts of its range. Basically it is a woodland species, common in hedgerows and along road-sides; it is also one of the first fern species to become established on shady walls of all kinds. A species of wide ecological tolerance it is frequently planted in gardens, a factor which has possibly affected its ubiquitous distribution. For notes on identification see page 82.



27.2 × 1 **Dryopteris × mantoniae** Fraser-Jenkins & Corley

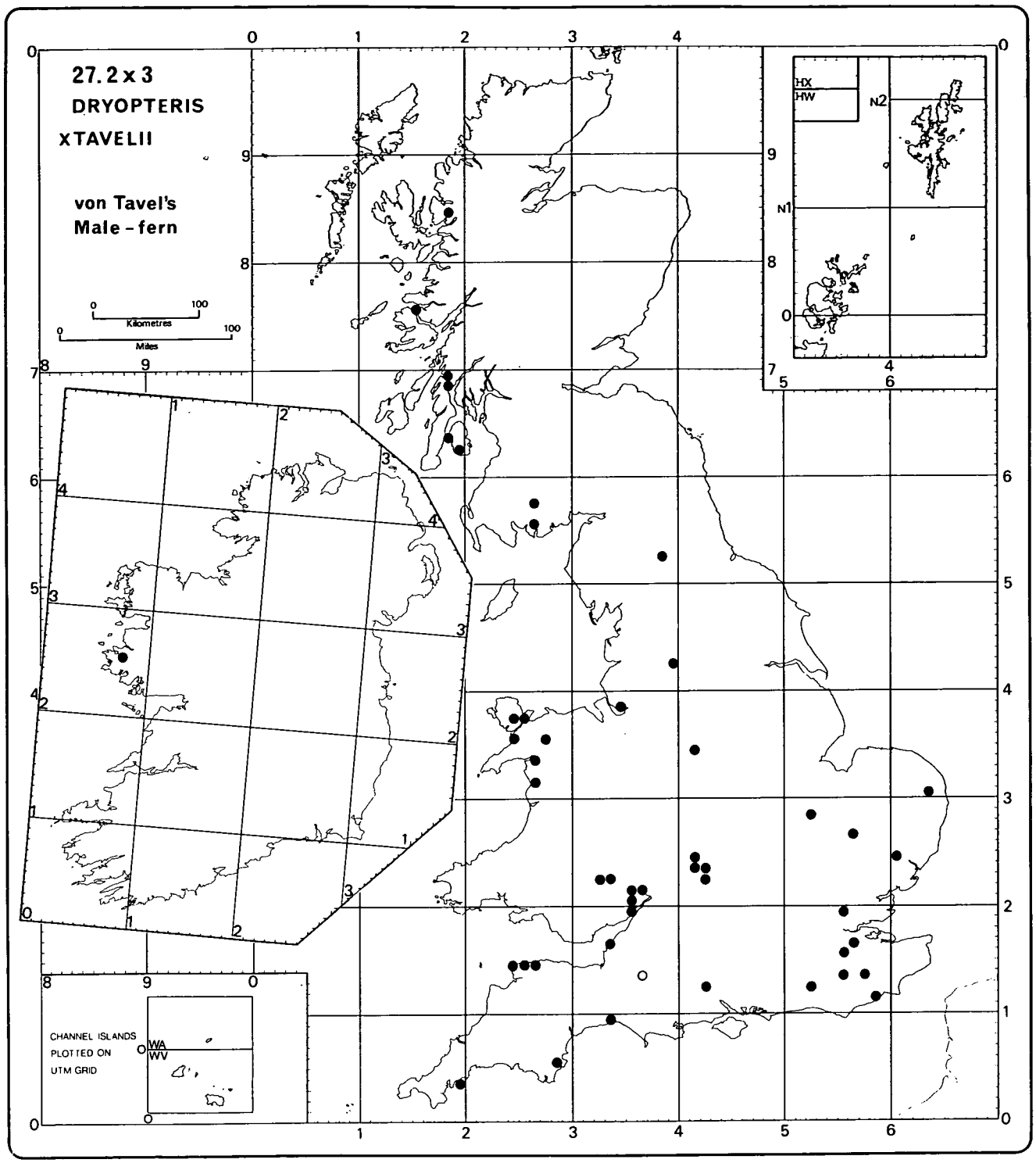
(*D.filix-mas* × *oreades*)

All records have been determined by C.R.Fraser-Jenkins or H.V.Corley. This is a sterile triploid hybrid likely to be found when its parents grow together. (See C.R.Fraser-Jenkins & H.V.Corley, *Br. Fern Gaz., 10:* 230; 1972; and A.C.Jermy & S.Walker, in C.A.Stace (ed.), *Hybridization and the Flora of the British Isles:* 113; 1975.)

27.5 × 1 **Dryopteris × pseudoabbreviata** Jermy

(*D.aemula* × *oreades*)

A single population of this hybrid was found in 1967 on the Isle of Mull, v.c. 103. Cytological investigation (2n = 82, M.Gibby, *pers. comm.*) has confirmed that *D.oreades* and not *D.pseudomas* (as has been suggested) is involved in the parentage. (See A.C.Jermy, *Br. Fern Gaz., 10:* 10-12;1968; and A.C.Jermy & S.Walker, in C.A.Stace (ed.), *loc.cit.:* 116;1975.)



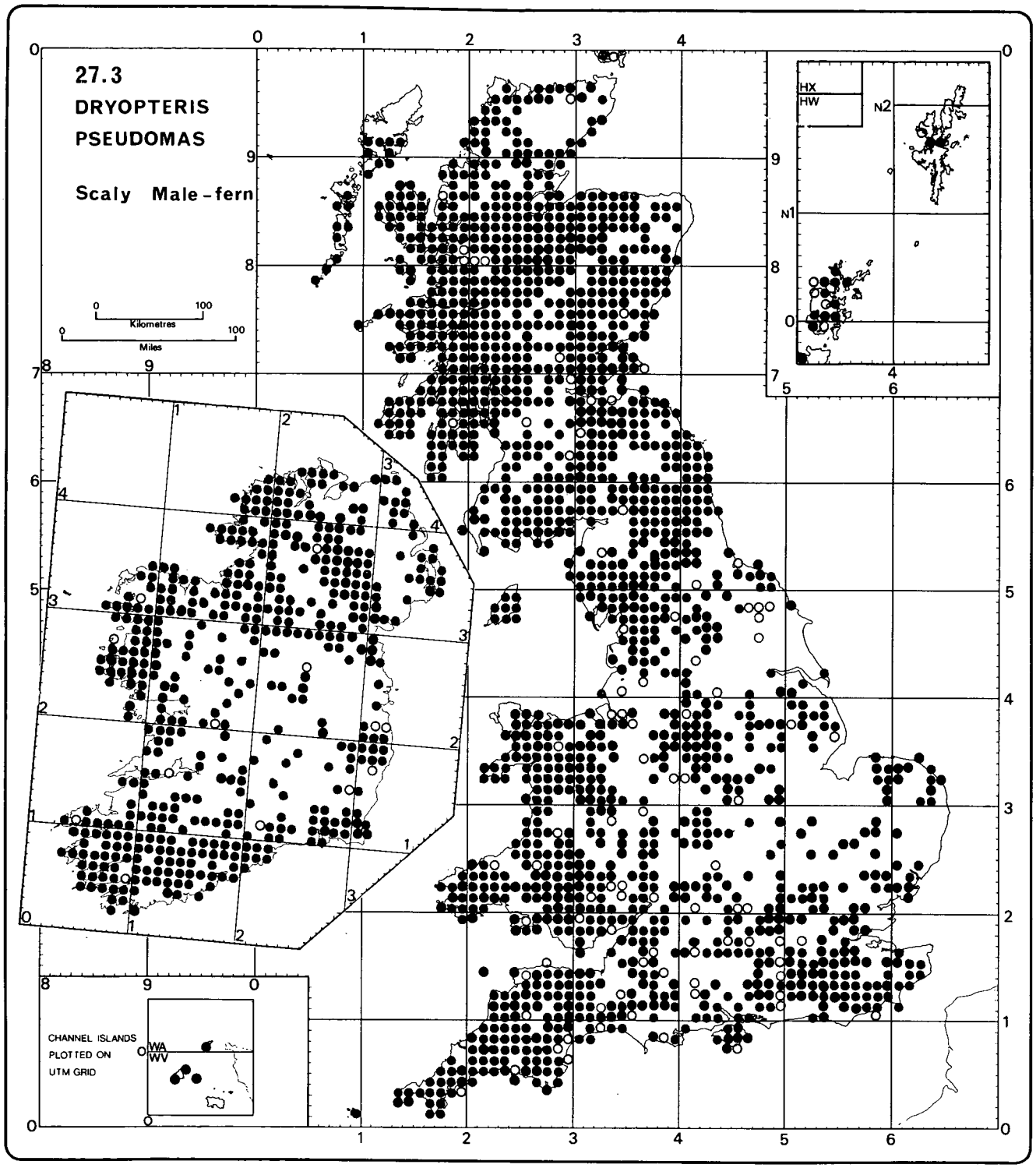
27.2×3 **Dryopteris × tavelii** Rothm.

(D.filix-mas × pseudomas)

This hybrid is intermediate in its morphology between its parent species. Two cytotypes are known, depending on the ploidy of the *D.pseudomas* parent; both have been recorded from the British Isles. Following the discovery by W. Döpp (Planta, 46: 70-91; 1955) that, in culture, it is capable of a low level of self reproduction, being apogamous, several authors have reported it widely on the Continent. Forms of *D.pseudomas* that tend towards the morphology of *D.filix-mas* are also often mistaken for it and have contributed to its over-recording.

The fronds have scales with dark bases and the junction of the pinna axes with the main rhachis is darkly coloured as in *D.pseudomas*. The lamina is a light green but retains the gloss of the latter species

The pinnules have parallel sides which are toothed or in some cases, especially on the lowest basiscopic pinnule (i.e. those at the base of the pinna pointing to the frond base), deeply lobed; the pinnule apex is pointed. The indusium often shows the characteristics of both parent species, the margin being tucked on one side and extended over the lamina on the opposite side. (See A.C.Jermy & S.Walker, in C.A.Stace (ed.) *loc. cit.*: 113; 1975).

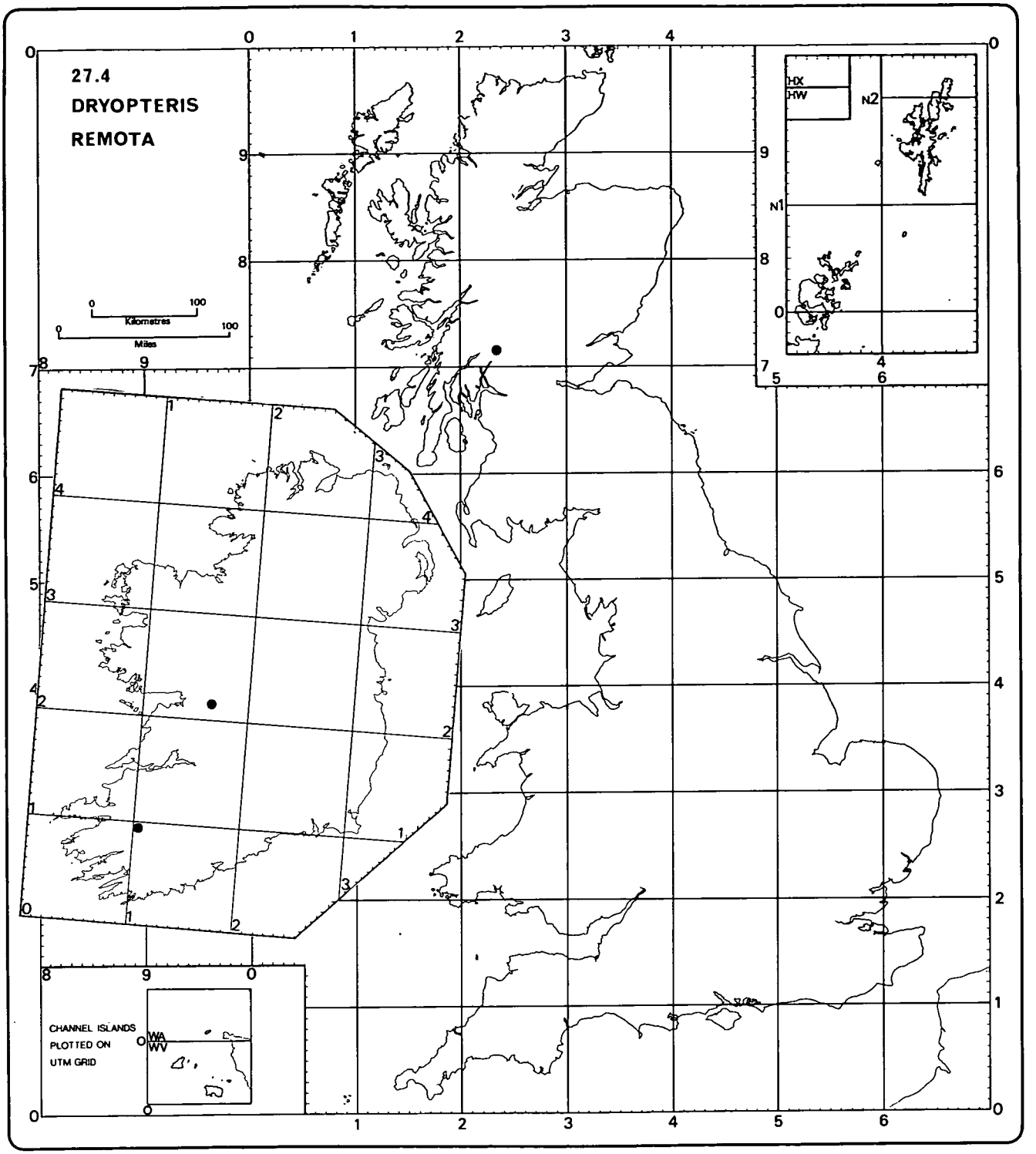


27.3 **Dryopteris pseudomas** (Wollaston) Holub & Pouzar

(*D.borreri* auct.; *D.filix-mas* (L.) Schott var. *borreri* Newm.)

An Atlantic species very common in northwest Scotland and the oceanic areas of the British Isles. In lowland and south and eastern England confined to woodlands or shady situations on heavy soils and clays. A combination of clay soils and higher rainfall increases its occurrence in the Weald.

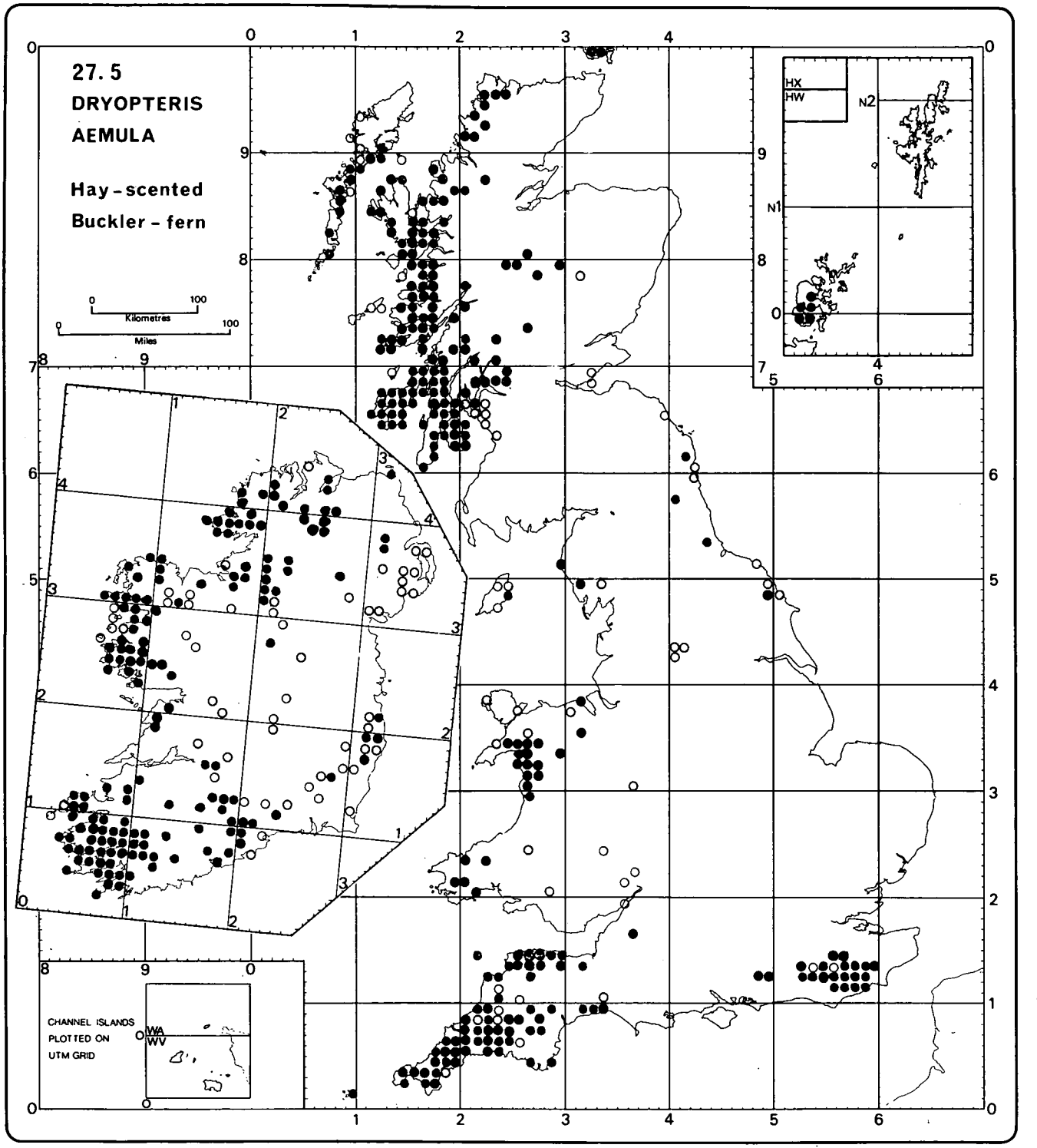
The map of this species (21/2) on p. 11 of the *Atlas of the British Flora* does not show a true picture as many records were registered as *D.filix-mas* agg. and are shown on Map 21/1-2 only.



27.4 **Dryopteris remota** (A.Br.) Druce

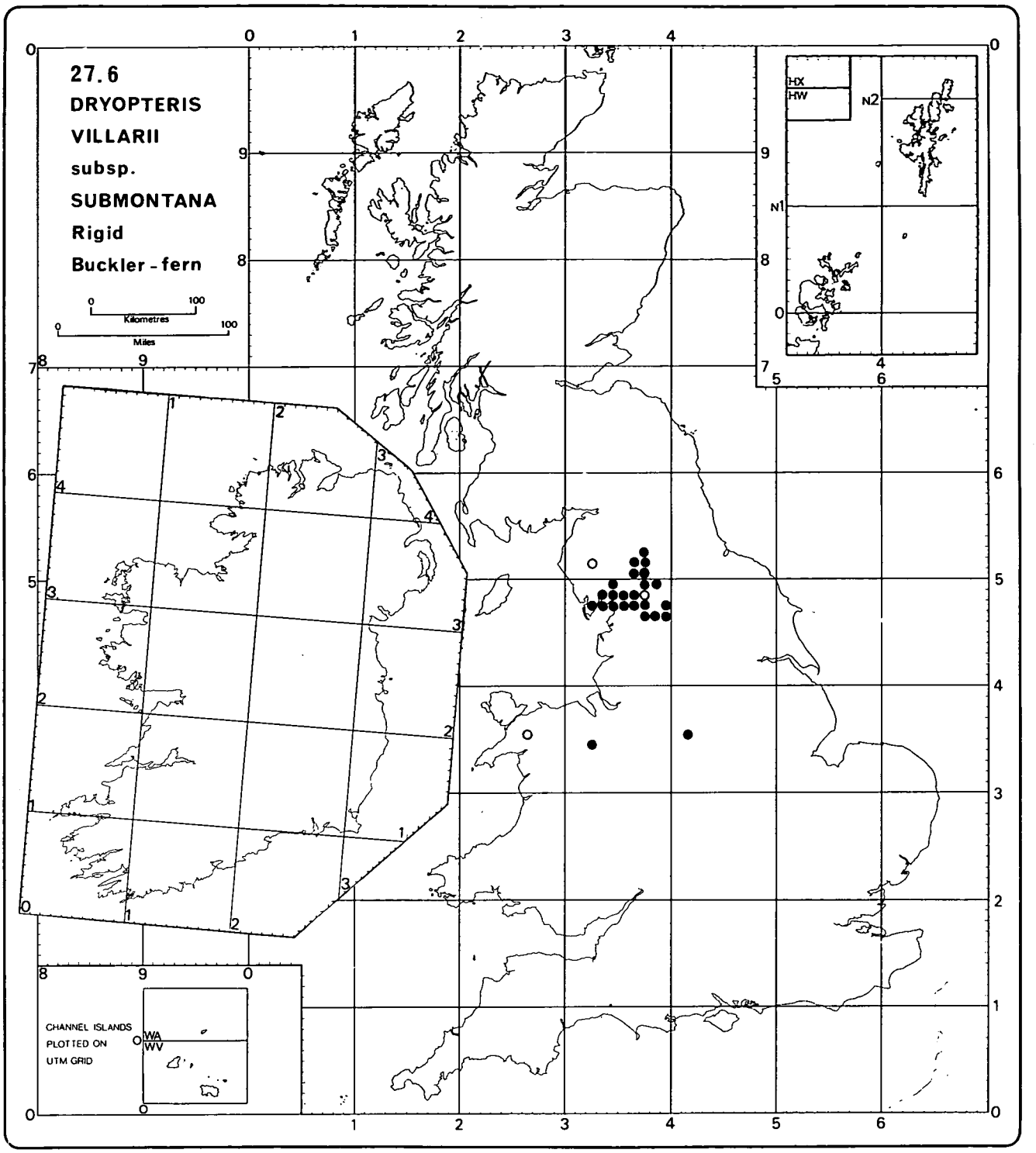
An apogamous species probably originating from the hybrid between *D.expansa* and *D.pseudomas* could be expected where these species grow together. It is, however, rare. Plants brought into cultivation as *Lastrea 'boydii'* from Loch Lomond appear to be this species but it has not been seen in the wild this century. The two Irish specimens are even more perplexing as *D.expansa* is so far not recorded from Ireland; both records (Glen Flesk, v.c. H2 and Dalystown, v.c. H15) need refinding (see A.C.Jermy & S.Walker, in C.A.Stace (ed.). *loc.cit.*: 115). It is known however, that in Europe *D.remota* occurs in the absence of either of the above species and probably does not now arise *de novo* from hybridisation.

The hybrid *D.austriaca* × *pseudomas* recorded as *D.* × *woynarii* Rothm. from Lochinver, v.c. 108, in A.C.Jermy & S.Walker, in C.A.Stace (ed.) *loc. cit.*: 115; 1975, is now considered to be doubtfully of that parentage and more likely *D.* × *ambrosiae.*



27.5 **Dryopteris aemula** (Ait.) Kuntze

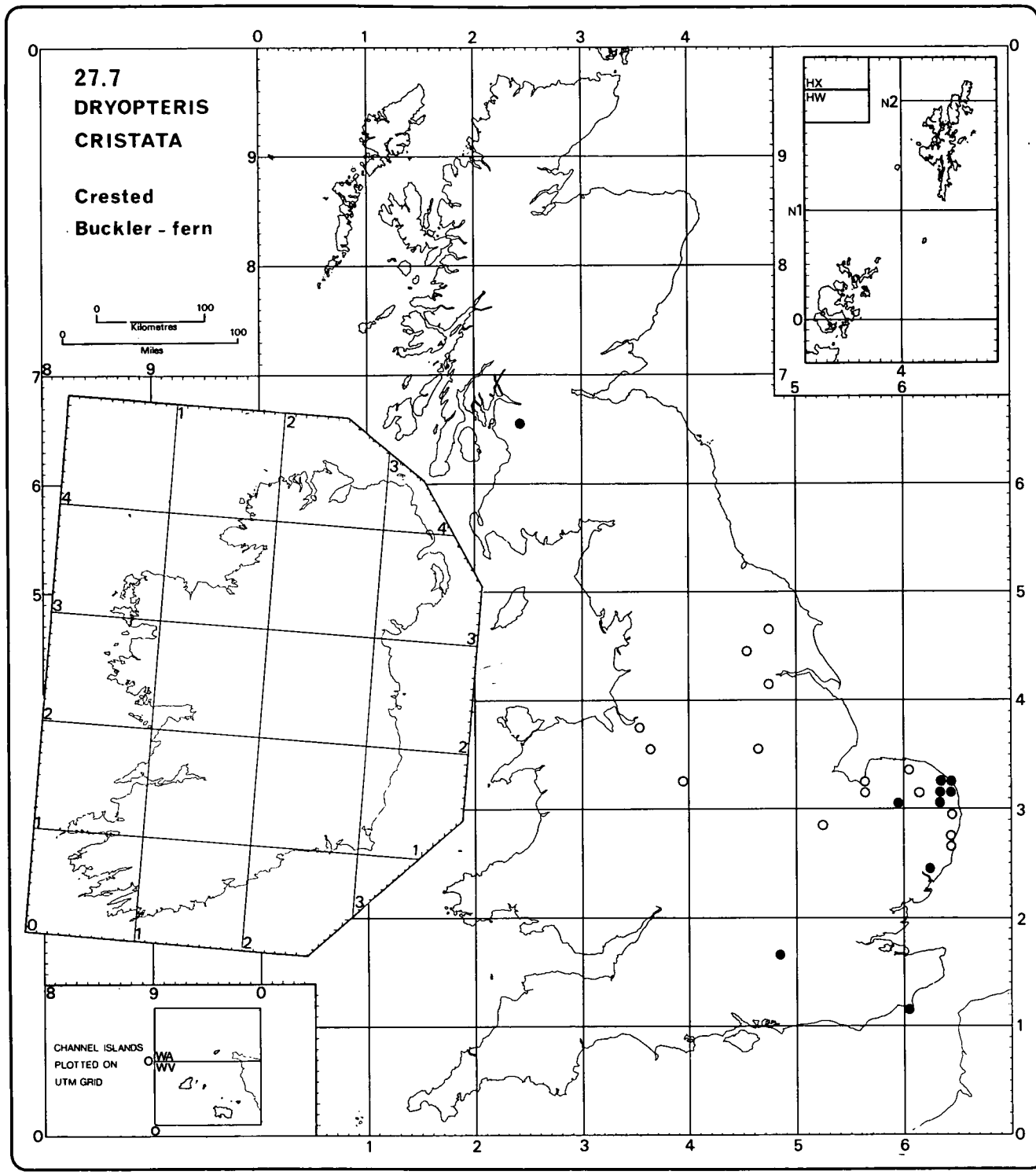
A northern Atlantic species found on the higher mountains of Madeira, Azores and Canary Islands and restricted in Europe to N. Spain, W. France and the British Isles where it has a distinct oceanic distribution. Its yellow-green frond and purplish stipe are diagnostic. Hybrids involving this species are very rare (see 27.5 × 1, *D.* × *pseudoabbreviata*, p. 84) but juvenile or immature plants which morphologically appear intermediate between *D.aemula* and *D.austriaca* have been found on Mull, v.c. 103, and Soay, v.c. 104, and need further investigation. Such hybrids could only be distinguished from the similarly triploid *D.austriaca* × *expansa* by the lack of chromosome pairing at meiosis.



27.6 **Dryopteris villarii** (Bellardi) Woynar ex Schinz & Thell. subsp. **submontana** Fraser-Jenkins & Jermy

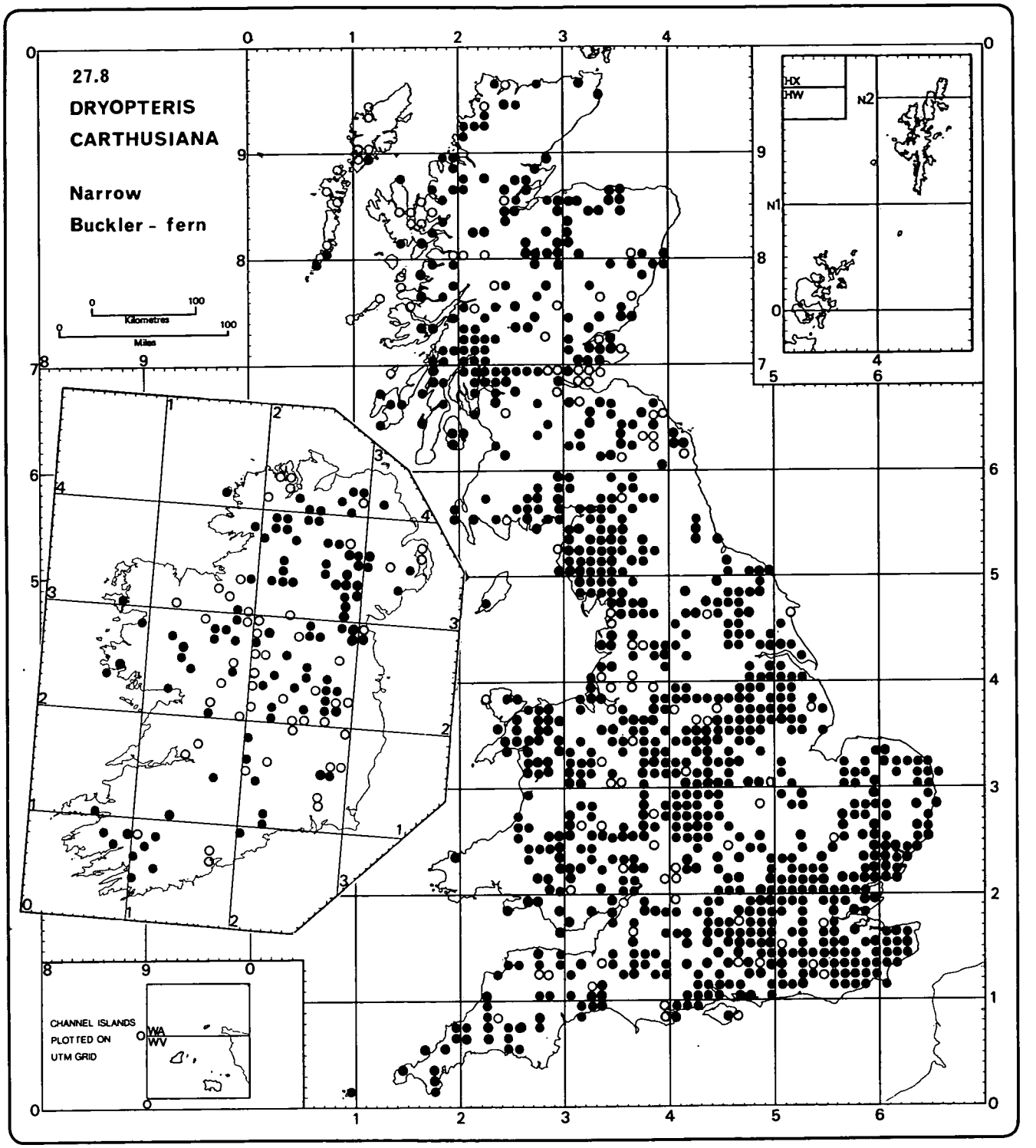
(*Dryopteris rigida* (Swartz) A.Gray)

A member of an alpine and southern European complex restricted in Britain to limestone pavement. All British material counted has proved to be tetraploid, a cytotype which is rare further south in Europe, most of the alpine material being diploid. (See O.L.Gilbert, *Br. Fern Gaz., 9:* 263-268; 1966, and Biological Flora of the British Isles: *Dryopteris villarii. J. Ecol., 58:* 301-313; 1970. Also C.R.Fraser-Jenkins & A.C.Jermy, *Br. Fern Gaz., 11:* 338; 1977).



27.7 **Dryopteris cristata** (L.) A.Gray

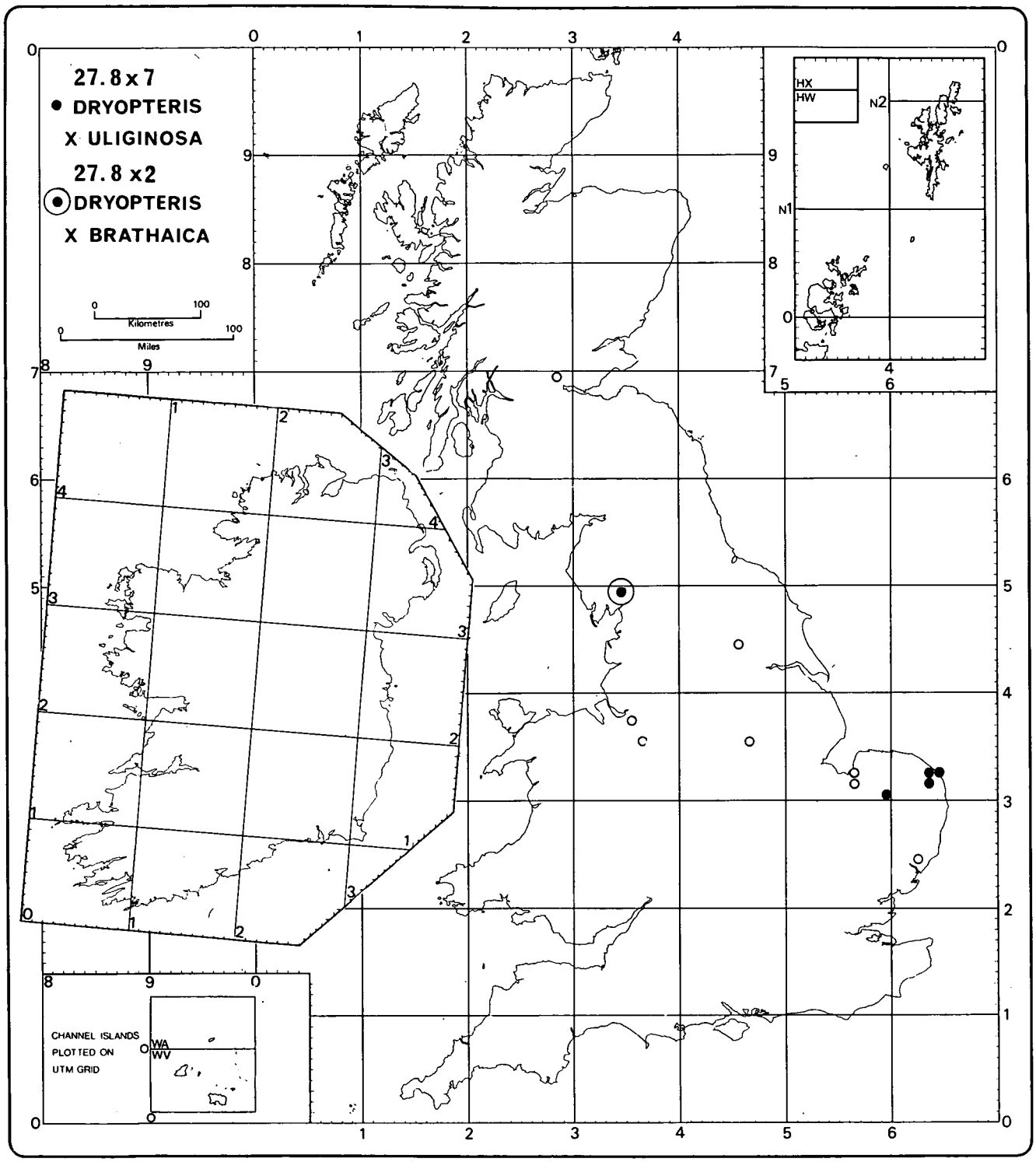
A northern continental species at one time frequent in the east of England and N.W. Midlands. Now, because of changes in land-use and increasing drainage of acid mires, it is almost restricted to East Anglia where it is locally frequent in the Norfolk Broads area, v.c. 27. Lack of regular fen cutting allows tussock growth of *Molinia, Carex elata* and *Sphagnum* spp. upon which establishment of *D.cristata* depends and the decrease of such mowing may be encouraging this species to regain its status. There has been recently a widespread increase of acid (base-poor) plant communities (including *Sphagnum fimbriatum, S.magellanicum, S.palustre, S.squarrosum* and *S.subnitens*) in the fens of the Norfolk Broads, the ecological reason for which is not fully understood. It is in these communities that *D.cristata* becomes well established.



27.8 **Dryopteris carthusiana** (Vill.) H.P.Fuchs

(*D.lanceolatocristata* (Hoffm.) Alston; *D.spinulosa* Watt)

A northern continental species widespread in the British Isles and a common fern in some wet woods of N.W. Scotland, where it often grows with *D.expansa*. The hybrid with the latter species has not so far been found in Britain and should be searched for in such mixed populations; it has the upright rhizome of *D.expansa* but with an intermediate frond (shape, cutting and marginal teeth). It is however extremely difficult to distinguish from *D.* × *deweveri* without cytological confirmation.



27.8×2 **Dryopteris × brathaica** Fraser-Jenkins & Reichstein

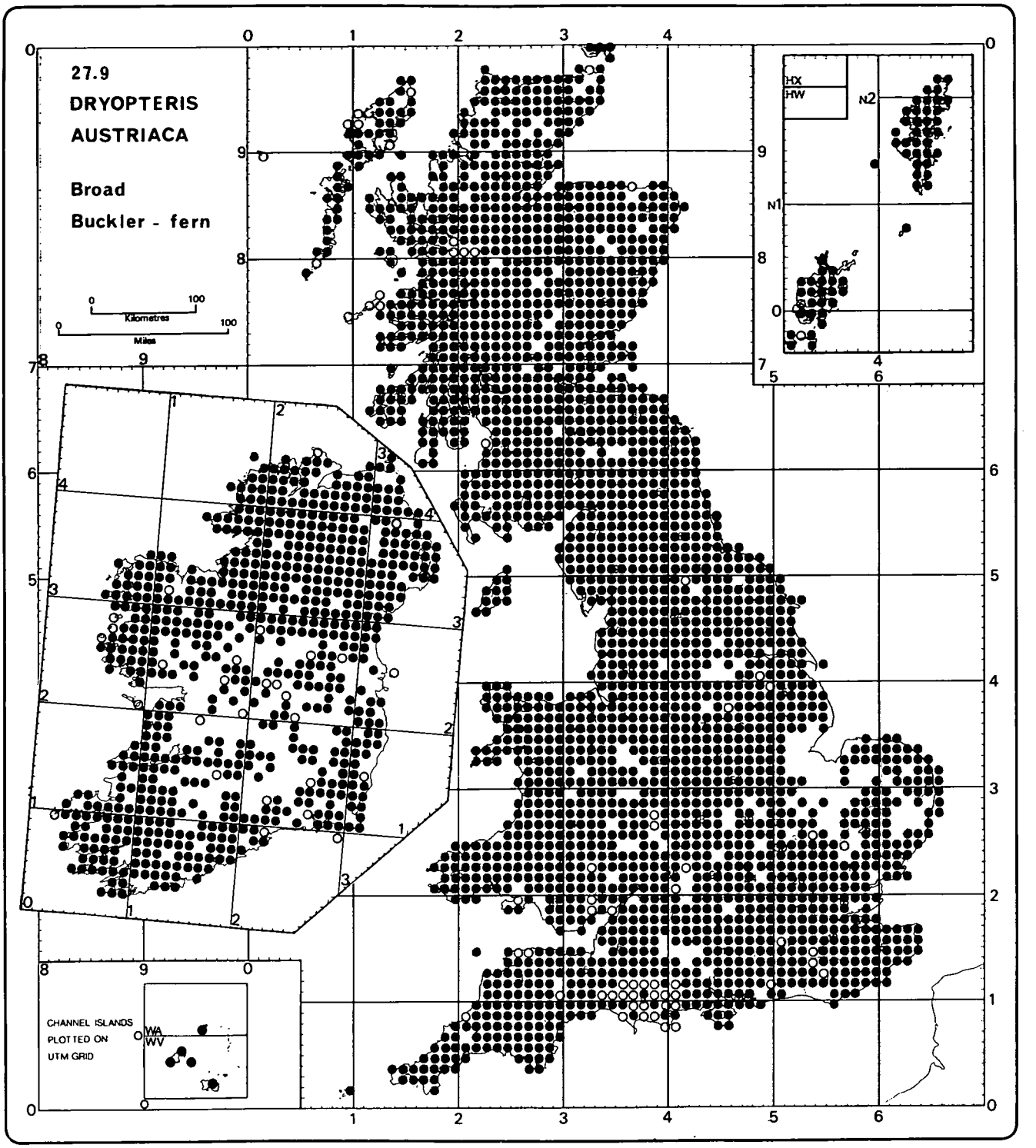
(*D.carthusiana* × *filix-mas; D.* × *remota* sensu Druce)

This hybrid has been found only once in woods on the N.W. side of Lake Windermere, v.c. 69; an offset, passed down through generations of gardeners, is still alive in Oxford University Botanic Garden and has been cytologically investigated. It is intermediate between the parents in the degree of pinnation and toothing of leaf segments but has the habit of *D.filix-mas*. (See C.R.Fraser-Jenkins & T.Reichstein, *Br. Fern Gaz., 11:* 342; 1977, and A.C.Jermy & S.Walker, in C.A.Stace (ed.), *loc.cit.:* 114.)

27.8×7 **Dryopteris × uliginosa** (A.Br. ex Döll) Druce

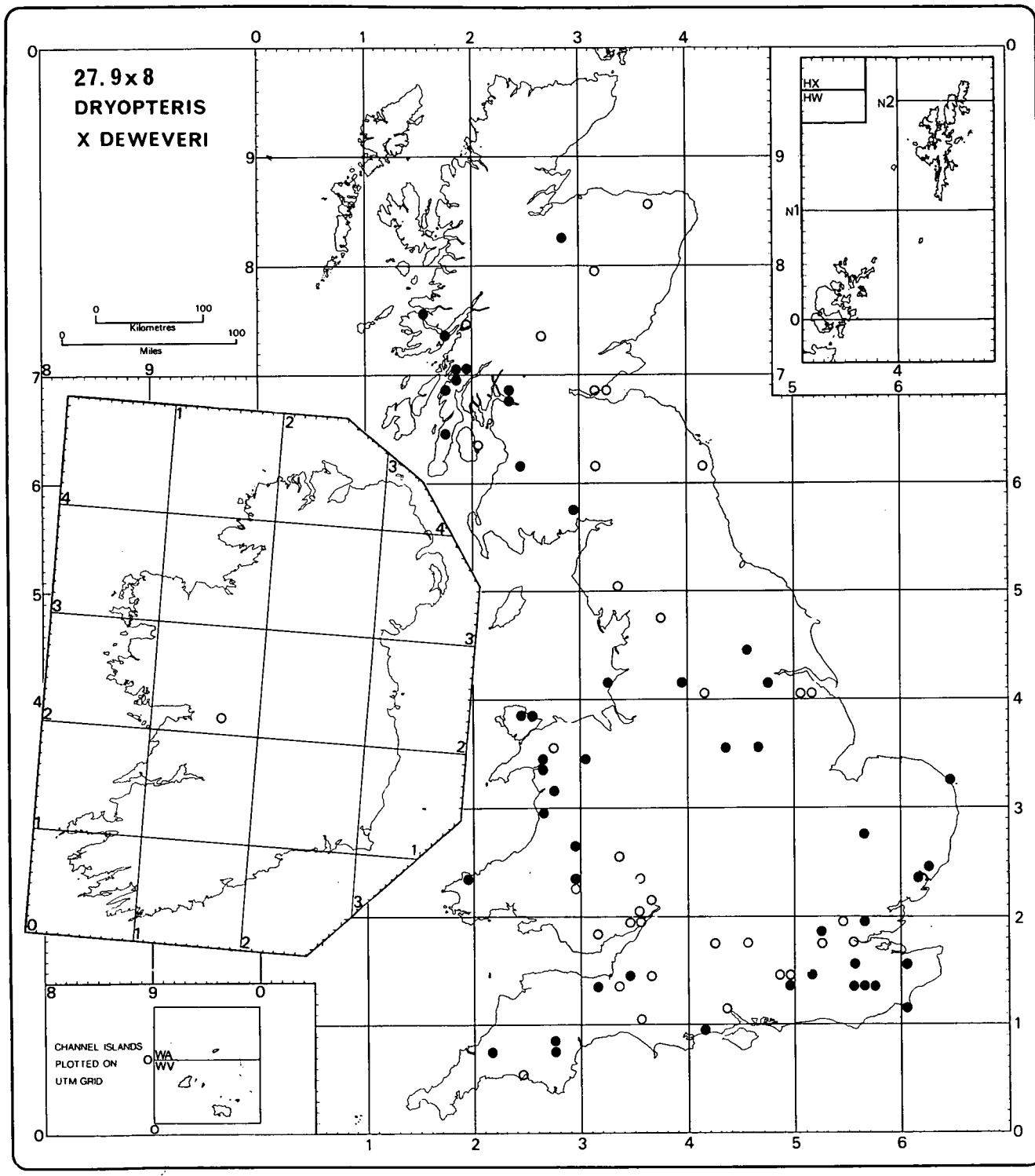
(*D.carthusiana* × *cristata*)

A rare hybrid now confined to Norfolk; when established, plants show distinct hybrid vigour. Although many former sites have been lost through drainage it could easily appear wherever *D.cristata* grows with *D.carthusiana*. (See A.C.Jermy & S.Walker, in C.A.Stace (ed.). *loc.cit.:* 116).



27.9 **Dryopteris austriaca** (Jacq.) Woynar
(*D.dilatata* (Hoffm.) A.Gray)

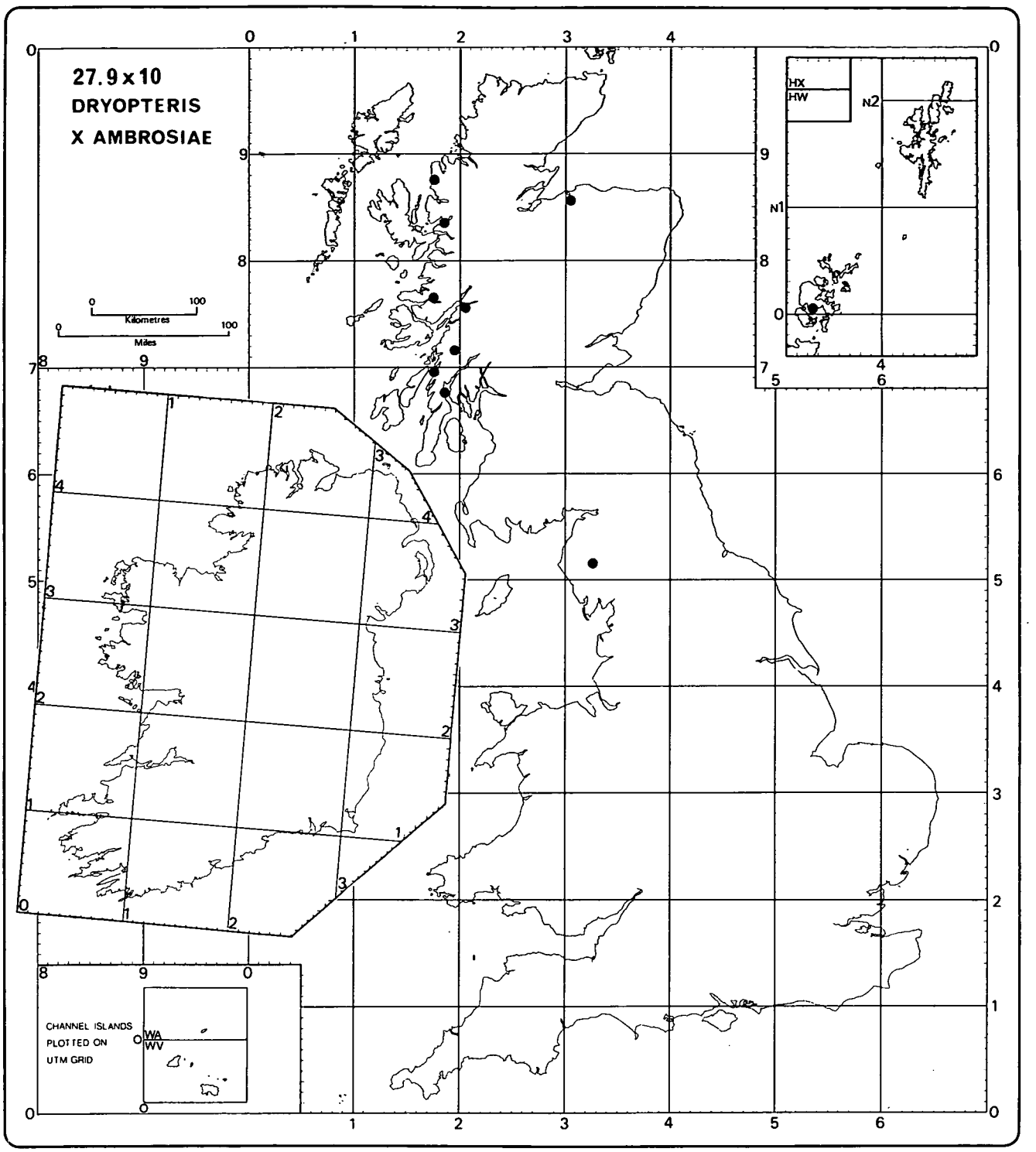
A sub-Atlantic taxon widespread throughout Britain and Ireland. A variable species occasionally confused with *D.carthusiana* because one common form produces stolons, from the bases of the stipes, which are mistaken for the creeping rhizome of the latter species. Leaves on such stoloniferous shoots have pale almost concolorous scales which add to the confusion; they eventually form a shuttlecock and the stem continues growth as an erect rhizome.



27.9×8 **Dryopteris × deweveri** (Jansen) Jansen & Wachter

(*D.austriaca* × *carthusiana*)

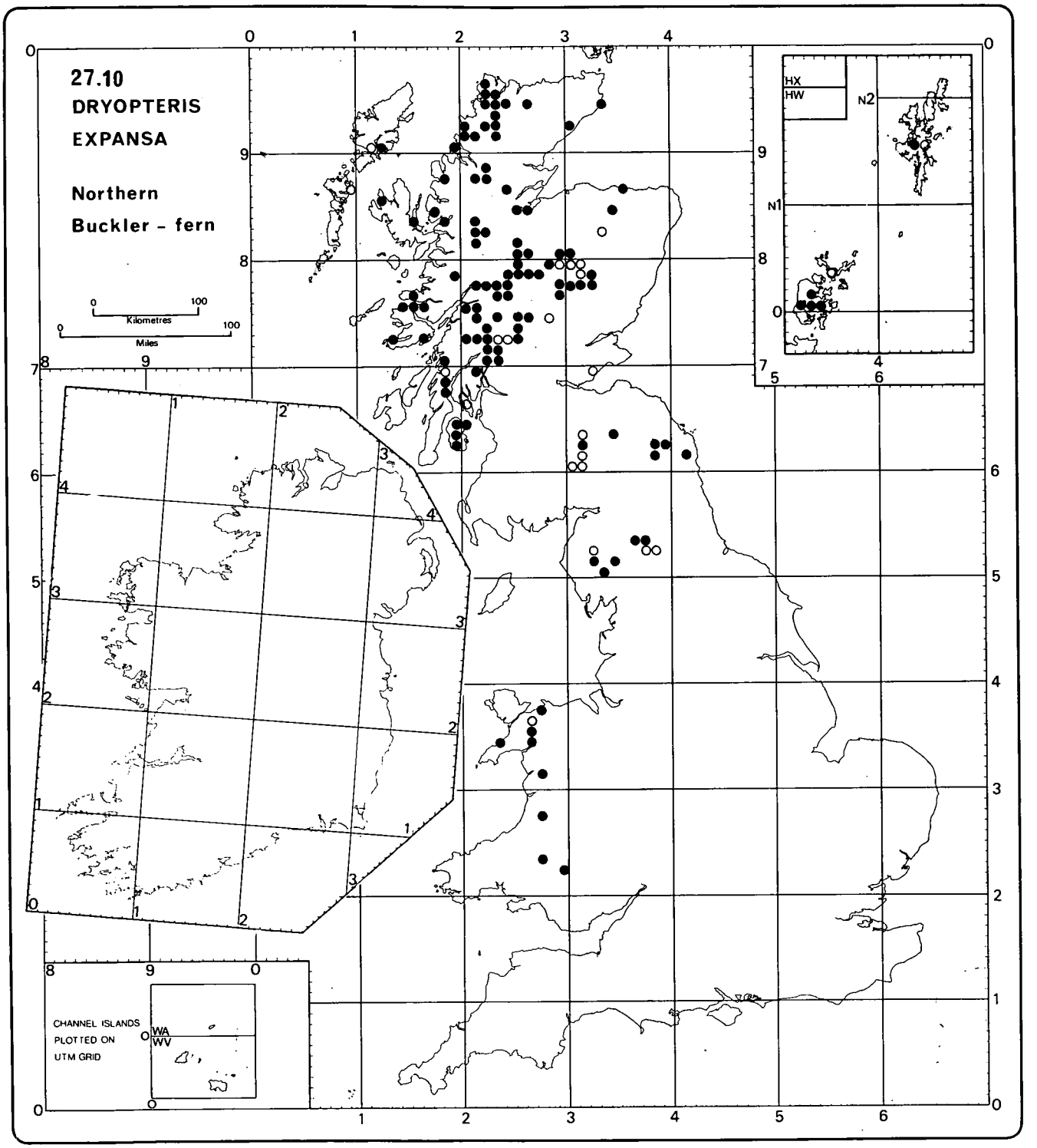
A common hybrid wherever the parents grow together. Easily recognized as being intermediate in all its characters, the scales concolorous but pale red-brown and the spores abortive. Such plants are often very glandular on the young lamina, veins and rachides and have been described in early literature as *Lastrea glandulosa* Newm. (See A.C.Jermy & S.Walker, in C.A.Stace (ed.), *loc.cit.*: 117).



27.9 × 10 **Dryopteris × ambrosiae**
Fraser-Jenkins & Jermy

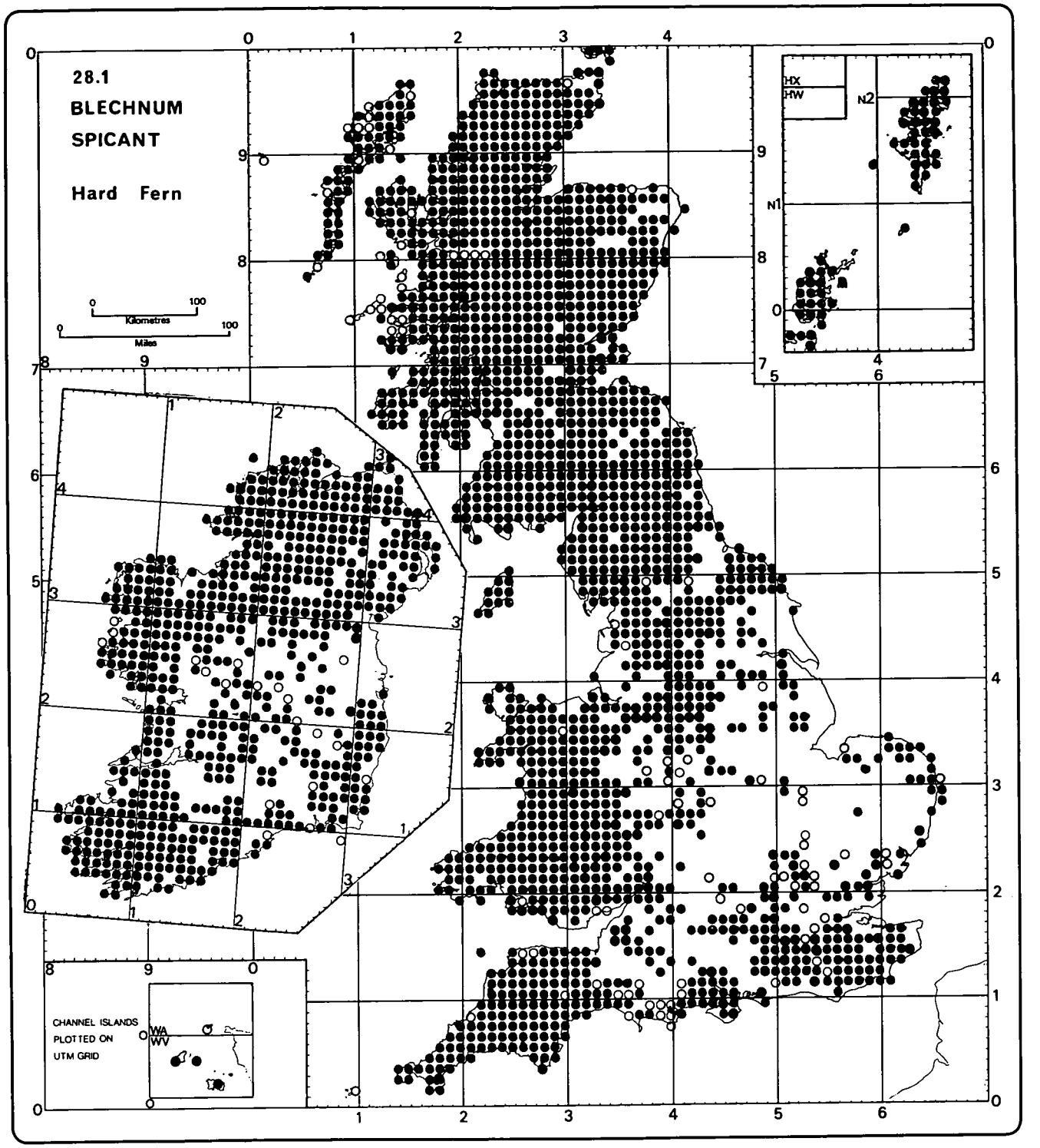
(*D.austriaca* × *expansa*)

This hybrid, which is likely to be recorded wherever the parents grow together, is difficult to distinguish from *D.austriaca;* any forms of the latter with abortive spores should be investigated. (See C.R.Fraser-Jenkins & A.C.Jermy, *Br. Fern Gaz., 11:* 337; 1977, and A.C.Jermy & S.Walker, in C.A.Stace (ed.), *loc.cit.:* 117).



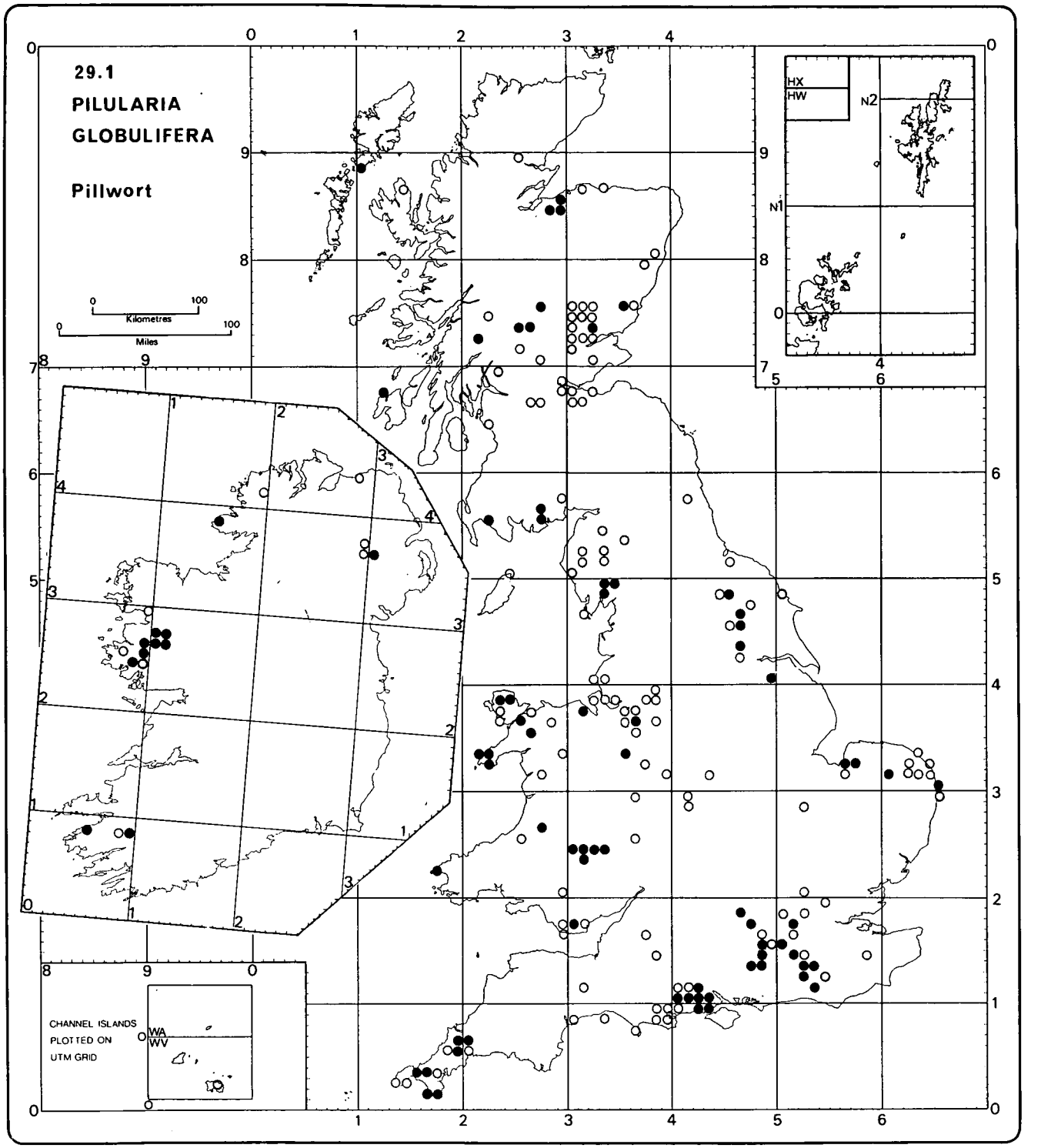
27.10 **Dryopteris expansa** (C.Presl) Fraser-Jenkins & Jermy
(*D.assimilis* S.Walker)

Most of the populations recorded show the distribution pattern of an arctic-alpine species. The taxon was first recognized by Thomas Moore as *Lastrea dilatata* var. *alpina* from Ben Lawers. It also grows, however, at sea-level in oak woodlands on the west coast of Scotland and this form (morphologically inseparable from the alpine form) may represent a more southern genotype which may yet be found in Ireland. (See J.A.Crabbe, A.C.Jermy & S.Walker, *Watsonia, 8:* 3-15; 1970).



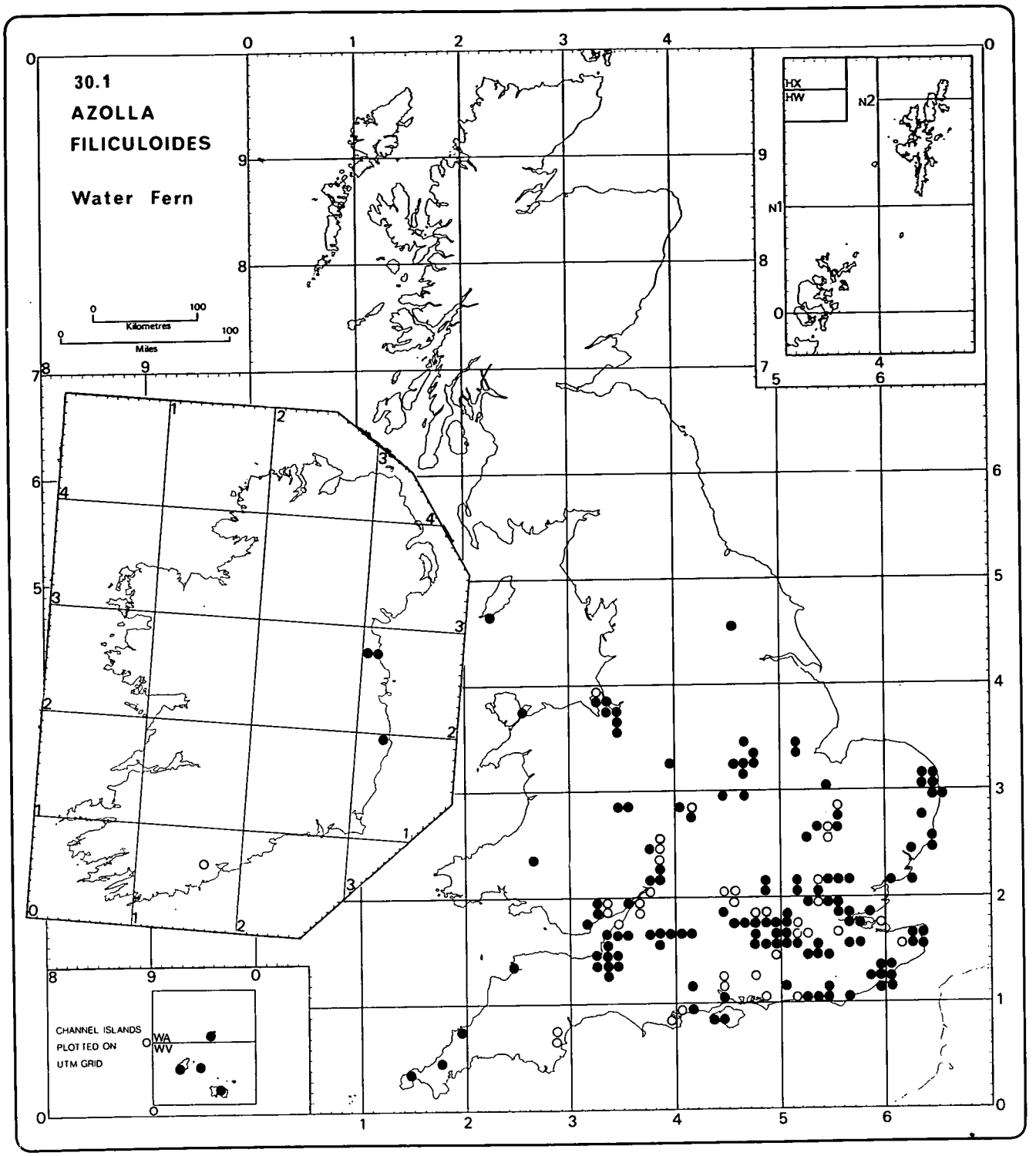
28.1 **Blechnum spicant** (L.) Roth

A sub-Atlantic species widespread throughout wetter parts of the British Isles. It is restricted by lack of suitable acid sandy substrate in much of lowland agricultural England. Similarly absent from the limestone areas of both Britain and Ireland.



29.1 **Pilularia globulifera** L.

A sub-Atlantic species spread throughout Britain and Ireland but generally decreasing because of drainage of marginal lands and ponds which formerly contained the species. Similarly declining in Europe where it is regarded as an endangered species. Unless sporocarps ("pills") and circinnately coiled leaves are present *P.globulifera* may be overlooked as a young *Juncus* plant.



30.1 **Azolla filiculoides** Lam.

Regarded by most botanists as having been introduced into Europe from tropical America. It is certainly well-established here and shows signs of increasing in Britain (cf. map 27/1, p.15, in the 1962 edition of the *Atlas of the British Flora,* with the above). With the present trend in eutrophication of ponds and inland waters it is difficult to explain this increase. Possibly the increased drainage operations have created more ditches and similar open water in drainage channels which have in turn become colonised. It suddenly, and inexplicably, disappears, often to return some five or ten years later.

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Synonyms are given in italics, map pages in roman