Archeologiniams tyrimams 200 metų

SØREN DIINHOFF

Santrauka

Priešistorinių gyvenviečių struktūra geriausiai atsiskleidžia plačiame regioniniame kontekste. Tačiau kaip remdamiesi radinių paplitimu, mes galime nustatyti kultūros raidą? Norėdami atsakyti į šį klausimą, turime atsižvelgti į dar du: kaip radiniai atspindi priešistorinę realybę ir kokiais būdais mes galime tai nustatyti. Šis straipsnis – tai regioninė ankstyvojo geležies amžiaus gyvenvietės tipo studija. Ji paremta Vendsyssel gyvenvietės šiaurės Danijoje pavyzdžiu. Straipsnyje apžvelgiamos metodologinės priemonės, kuriomis atskleidžiamas priešistorinių bei šiuolaikinių įvykių kompleksiškumas. Tie įvykiai leidžia atrasti ir dokumentuoti priešistorines gyvenvietes bei nustatyti archeologinių šaltinių reprezentatyvumą.

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IV. Methods and Technics

The use of on-site pollen analysis, local pollen diagrams and modern pollen samples in investigations of cultural activity

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Introduction

Scale and representativity have been of primary concern in palynology. Different source areas are represented in different deposits and there are differences between forested areas and open landscapes. Investigations of sites representing different scales are therefore recommended for reconstructions of vegetation and human activity in an area (e.g. Jacobson & Bradshaw 1981, Andersen et al. 1983, Berglund 1985, Birks & Moe 1986, Bradshaw 1991, Edwards 1991a). In addition to the local and regional scales given by natural deposits, in-context (on-site) pollen analysis gives a direct connection between a site, its artefacts and the contemporaneous pollen assemblage (Madsen 1985, Bjerck 1988).

In the interpretation of pollen diagrams, two main approaches have been used, both based on modern analogues (Birks & Birks 1980:236ff). One is the "indicator species approach" where one looks at the ecological demands and tolerances of different species today, and assumes that these tolerances have not changed through time. The narrower amplitude a species has for an environmental factor, the better it is as an indicator of that factor. This has been the most widely used approach, and has also been used for interpreting cultural activity (e.g. Iversen 1941, Behre 1981, Berglund 1985).

The other method is called the "comparative approach" (Wright 1967) in which one analyses surface pollen samples from different vegetation types, and uses these spectra in comparison with fossil pollen assemblages to reconstruct past plant communities. In this approach the whole pollen composition is taken into account. This method has been widely used in the reconstruction of natural vegetation communities (overview in Birks & Birks 1980:237ff). As the vegetation in Europe is highly influenced by man, the use of the comparative approach in this part of the world has been limited. Recent developments in available multivariate methods for comparing modern and fossil pollen assemblages as well as new developments in computers, have given rise to new possibilities for the use of modern analogues in pollen analysis (Birks 1992). The method has proved to be useful in detecting cultural activities; when they occurred and what type of activities were involved (e.g.Berglund et al. 1986, Gaillard et al. 1992, 1994).

Both methods have clear limitations (Birks & Birks 1980:236ff). Limitations of the use of indicator species include not knowing whether the ecological demands for different species have changed through time, and the fact that different species with different ecological demands may produce indistinguishable pollen. These factors are also relevant in the use of the comparative approach, but in that case the whole plant community is investigated, not just single taxa. Difficulties in finding modern analogues for past plant communities is the greatest limitation for the comparative approach.

In this paper I will give two examples from interdisciplinary research projects in Western Norway, focusing on:

1) the use of different site scales (including on-site pollen analysis) in an investigation,

2) the use of modern analogues in the interpretation of cultural activity from a pollen diagram.

Pollen diagrams reflecting different scales

When working with palynology in relation to archaeology, it is important to choose a scale appropriate to the question one wants to answer. An overview of the pollen sampling properties of different basins; lakes, peats and small hollows, as well as different basin sizes, is given by Jacobson and Bradshaw (1981).

Big lakes, with diameters from 300 to 1000 m, give a regional picture of the vegetation and may tell about occupation and land-use on a regional scale, within a kilometre or more of the site. Analysing cores from small lakes or mires, diameter about 100 m (and no inflowing stream), gives an opportunity to ask questions on a more local scale – did people live around the lake / mire? How did they utilize their environment? Did they have any kind of land-use / husbandry?

If we go down to the local scale, small hollows, mires or soil profiles, which get pollen directly from the occupation site / activity area, and which ideally are connected stratigraphically with the occupation site, we may ask more detailed questions about *that settlement.*

At all these scales, we usually require ^{14}C-datings in order to connect the vegetational development to the archaeological material. If there is no stratigraphic connection between the site analysed for pollen and the archaeological site, this will give an indirect connection between the two types of material.

If we then go into the site we may have archaeological, botanical (and osteological) material from *the same context.* This may give good results if we have organic material preserved. When working on a site, it is, however, important to bear in mind that standard pollen analytical interpretation models are no longer valid (Fægri 1985). In addition to the local and regional pollen rain, the human activity in itself may be a pollen source of great importance. Pollen may be brought in with food, plant material such as grasses, turf or soil for roofs or floors, and droppings from animals. All these types of material contain pollen, and soil/turf may even include pollen from an earlier time period. These pollen components may contribute significantly to the pollen assemblage, but they are irregular and unpredictable (Greig 1982, Krzywinski et al. 1983, Fægri & Iversen 1989:175 ff).

In on-site deposits from Medieval time periods detailed questions as to the use of houses, of diet, and of trade with foreign countries have been asked, based on pollen and macrofossil analyses. It should also be possible to ask these types of questions in the analysis of deposits from occupation sites from earlier time periods. Analysis of on-site deposits may be important, especially when one works with questions of early agriculture. The cereals (*Hordeum*, *Triticum* and *Avena*) are self-pollinated and the amount of pollen which is dispersed is low (cf. Iversen 1941:48). Pollen is retained inside the grains / chaff even through prosessing of the grains, and grain products used for human food and drink contain cereal pollen (Greig 1982:59). Investigations of modern pollen dispersal around cultivated fields, have shown that cereal pollen is found in greater quantities at harvest time than at flowering time, suggesting that the pollen dispersal is a result of the cutting and transporting of the crop (Vuorela 1973). These properties explain the relatively low values of cereals found in pollen diagrams from fields (e.g. Prøsch-Danielsen 1993) and the high percentages found in latrines (e.g. Krzywinski et al. 1983). The probabilities of finding cereal pollen inside an occupation site where the cereals were used, may therefore be greater than in an organic deposit outside the site.

Examples of the use of on-site pollen analysis from an occupation site in Western Norway

I will show how we used this approach by presenting examples from the Kotedalen site in Western Norway (Hjelle 1992, Olsen 1992). Pollen samples from hearths within the occupation plateau, dated to the occupation phases between 5200 and 4200 BP, were analysed. These hearths were well defined within the occupation layers, and there is no reason to believe that their pollen content was not contemporanous. Redeposited occupation layers in a trench east of the occupation site were also analysed, and Kaland (1992) made two local pollen diagrams from peat deposits south of the site (Fig. 1, 4).

The pollen samples from hearths inside the occupation site gave clear indications of the presence of cereals in the Middle Neolithic (Fig. 2). Cereals were found in the five investigated hearths stratigraphically connected to the youngest occupation phase (dated to 4500-4200 BP) and in two of the hearths stratigraphically connected to the occupation phase 4700-4500 BP. In the same hearths *Calluna* and herbs such as *Ranunculus acris* type, *Rumex acetosa* type, Asteraceae Cichorioideae, *Potentilla* type and *Plantago lanceolata* were usually also present, sometimes with high percentage values. One hearth stratigraphically connected to the phase 5000-4700 BP also contained Cerealia, but there is some doubt about the stratigraphy at this location. The remaining hearths from this and the older occupation phase contained neither cereals nor *Plantago lanceolata*.

The investigated deposit in the trench east of the occupation plateau had an inverse stratigraphy. It contained Mesolithic artefacts at the top and younger material further down in the deposit (Olsen 1992:25). The size of the charcoal and minerogenic particles decreased from west to east in the trench, indicating

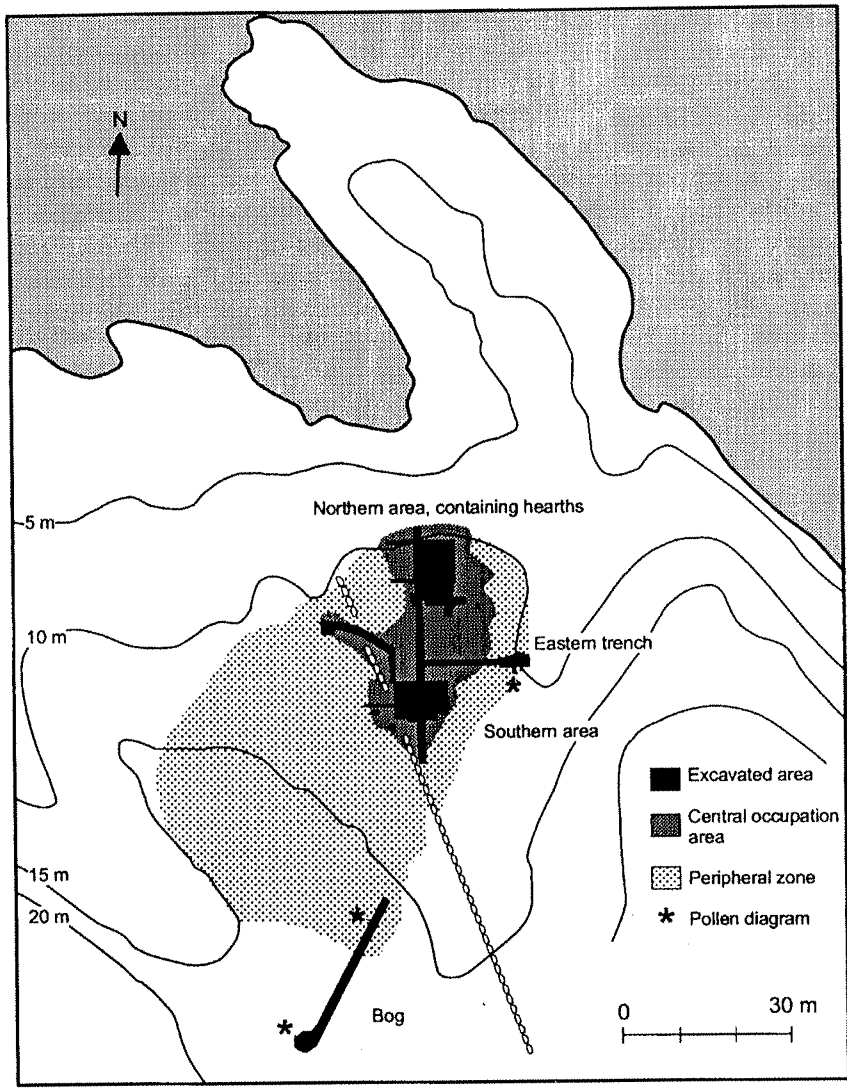

Fig. 1. Map showing the site Kotedalen, Western Norway

sorting, and the development in the curves of the pollen diagram (Fig. 3) indicates that the deposition was a gradual process (Hjelle 1992:118,119). The presence of Cerealia pollen gave a clear indication of cultivation. This shows that the reverse stratigraphy is a result of redeposition due to cultivation and ploughing. The field was most probably situated on the earlier occupation plateau, and the ploughing resulted in erosion and redeposition in the bottom of the valley. The pollen diagram reflects both this cultivation activity and the local vegetation in the valley at the time of the cereal cultivation. This activity most probably occurred during the Late Neolithic/Bronze Age.

The presence of Cerealia pollen in the Middle Neolithic hearth contexts was supported by scattered finds of cereals from the bog outside the site (Kaland

1992), whereas the ploughing activity resulting in the redeposition of layers in the eastern trench was not at all clear in the pollen diagrams from the bog. There was evidence from the bog of some kind of activity having occurred, but no indication of cereal cultivation. Thus, the on-site pollen analysis from these two deposits gave a much more detailed picture of the use of plant material and agricultural activity than was given in the local pollen diagrams. However, it is only the bog diagrams which can give information on the continuous vegetation history around the site (cf. Jacobson & Bradshaw 1981, Birks & Moe 1986, Edwards 1991b), and the on-site pollen analysis can by no means replace the bog diagrams.

These findings were the earliest documentation of cereals from an occupation site in Norway at the time, and their validity has therefore been discussed and doubted (Rowley-Conwy 1995, Prescott 1996). The earlier datings than other places in Western Norway is not an argument against the presence of cereals. The question of scale is an important factor here. As already pointed out by Bakka & Kaland (1971:28), the possibility of finding cereals in lake sediments at some distance from the sites is low, especially when the cultivation is on a small scale.

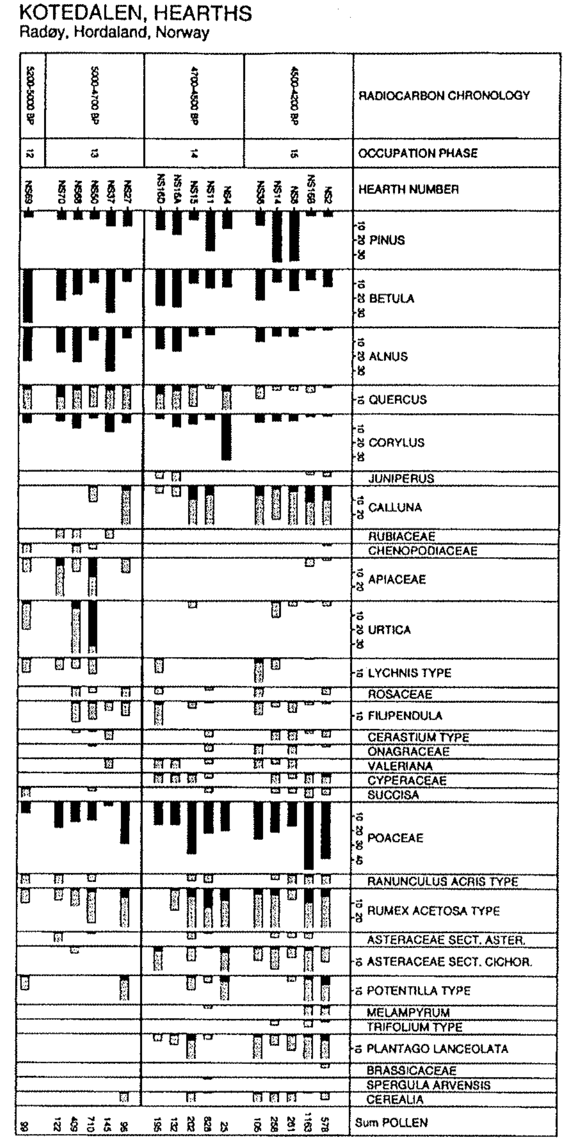

Fig. 2. Pollen samples from hearths, shwing some selected taxa. The radiocarbon chronology and the occupation phases are given at the top of the diagram. The pollen spectra (hearths) are not ordered chronologically in each of the occupation phases. Black histograms show the pollen percentages and grey the 10x exaggerations

At Kotedalen, after finding evidence of cereals using the different deposits to investigate the site at different scales, it was decided to focus on finding more cereal pollen grains. In the bog samples, extra pollen slides were scanned (Kaland 1992:72) so that a high pollen sum was obtained (Edwards 1988, 1991b), which is necessary in order to find cereals in a forested area (Berglund 1985). From the

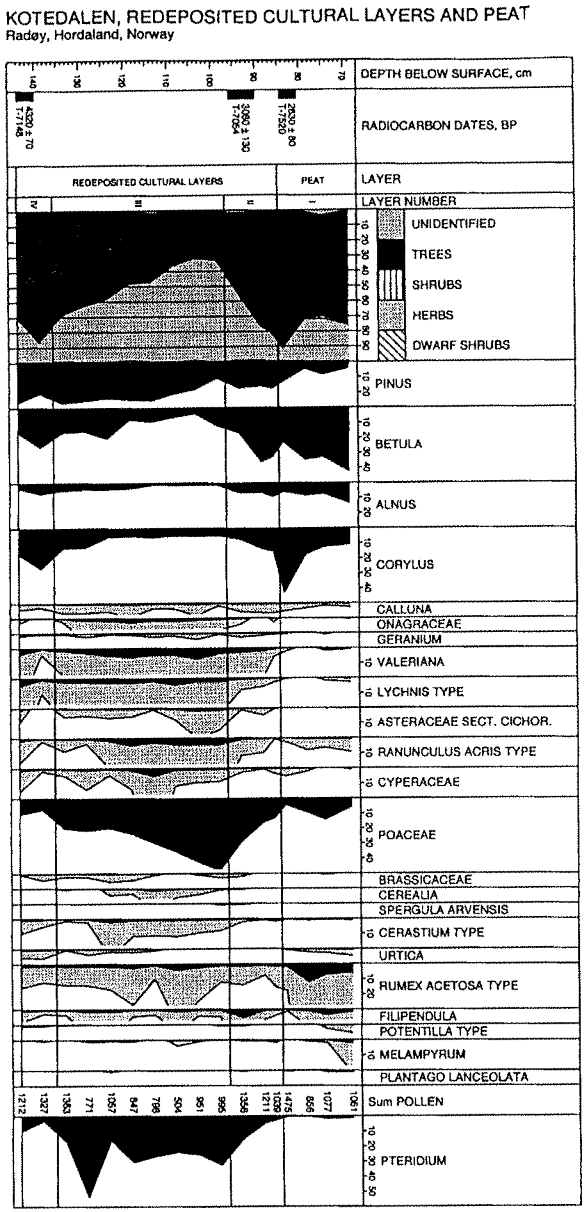

Fig. 3. Pollen diagram, showing some selected taxa from redeposited cultural layers and peat in the valley east of the site

hearths within the site, pollen samples were analysed when pollen was present, although the pollen preservation was extremely bad. Few pollen grains of cereals were found, but this was also true for other species; few pollen grains were present in the hearths altogether (Hjelle 1992:97, 102ff). The poor pollen dispersal of cereals makes it nearly impossible to find Cerealia pollen if cereals have not been present. This means that a few pollen grains are enough to conclude the presence of cereals. However, the question of whether this is evidence of local cultivation, of cereals brought into the site or of exchange of cereals, is a matter of interpretation. The fact that people were already sedentary at Kotedalen at this time (Hufthammer 1992:63, Olsen 1992:153, 241), makes it most reasonable to believe that the cultivation also took place at the site. Finds of imported TRB pottery show contact with Southern Scandinavia (Olsen 1992:141), and locally produced pottery is found in the same levels as the cereals (Olsen 1992:234, Hjelle et al. 1992:147ff). Assuming that they knew the techniques of cereal cultivation, a small field did not need to influence their settlement pattern, and it did not need to have any effect on their economy. There is no doubt that the people were hunter-gatherers throughout the whole occupation period (Hjelle et al. 1992:146, Hufthammer 1992:61). I will not go into the discussion of small-scale animal husbandry at Kotedalen in the Middle Neolithic, but based on the indicator species approach, grazing has been suggested (Hjelle et al. 1992:149).

The work conducted at different local scales (including on-site pollen analysis) complemented each other and produced these results at Kotedalen. Pollen analysis from occupation layers has great advantages if usable deposits are found. At Kotedalen we were lucky and had hearths where the pollen grains were preserved. If we do not have these kinds of special contexts and are not dealing with waterlogged conditions, which is most often the case at prehistoric sites, the deposits may have undergone changes. Pollen grains from different time periods may have been mixed, and changes in the pollen composition may have taken place due to differential corrosion of different pollen taxa (Dimbleby 1985:4ff).

To conclude, one should try to analyse pollen samples from both within an occupation site, and from a basin outside, when the aim of the investigation is suited to such investigations. Evidence for the use of plants for food, and the use of other plant materials is better found from on-site pollen analysis than from a bog outside. On the other hand, little can be said about the vegetation composition around the site from such samples. This stands in contrast to a pollen diagram from a natural deposit which gives information about the vegetation communities present, and which allows for the possibility of using modern analogues directly in interpretation, in addition to indicator species.

Use of modern pollen samples in the reconstruction of past vegetation and cultural activity

Berglund et al. (1986) presented the idea of exploring the relationship between vegetation, modern pollen, and land-use, and used this relationship in a comparative approach to reconstruct past cultural landscapes from fossil pollen spectra. This pilot study was followed by investigations in which an increased number of modern samples have been analysed and different multivariate methods have been used (Gaillard et al. 1992, 1994). Gaillard et al. instructively explain the application of available methods.

In an on-going project in Western Norway, surface samples from different culturally dependant vegetation types have been collected (Hjelle, in progress). Due to the steep slopes in this part of Norway, there are still areas where traditional land-uses are practised. These are often small patches inside an area of modern agriculture. The investigated vegetation types are mown and/or grazed vegetation. Traditionally, the hay meadows were mown late in the summer and grazed during spring and autumn (Losvik 1988). Among grazed areas, both open pastures, grazed forests, and grazed heath have been investigated. Sites which have had the same land-use for a long period of time are preferred, but in many, some changes have taken place during the last 10-40 years. The grazing pressure has especially decreased, and in two of the mown meadows grazing has ceased. In some of the sites manure or small quantities of commercial fertilizer have been added. Areas which are today pastures have in some cases been mown earlier.

The aim of the project is to be able to characterize the different land-uses by their pollen assemblages, and to use the modern pollen assemblages in the reconstruction of past land-uses. Some preliminary results, using a comparative approach and discussing some of the possibilities and limitations, will be presented here.

Example of the use of modern pollen samples in the interpretation of past cultural activity

In the use of modern surface samples as an aid to the interpretation of fossil pollen data, the importance of having modern samples from the same geographical area as the fossil samples as well as having comparable deposits has been pointed out (e.g. Berglund et al. 1986, Gaillard et al. 1992, 1994). The pollen diagram used in this example is from a small mire located in the outfield at Skatestraumen in Western Norway (the project is still in progress). Modern pollen samples from the coastal region are therefore used in the comparison (Fig. 4). The modern data set comprises 97 moss samples from 20 different sites (details on the sampling procedure and the investigated sites will be published elsewhere).

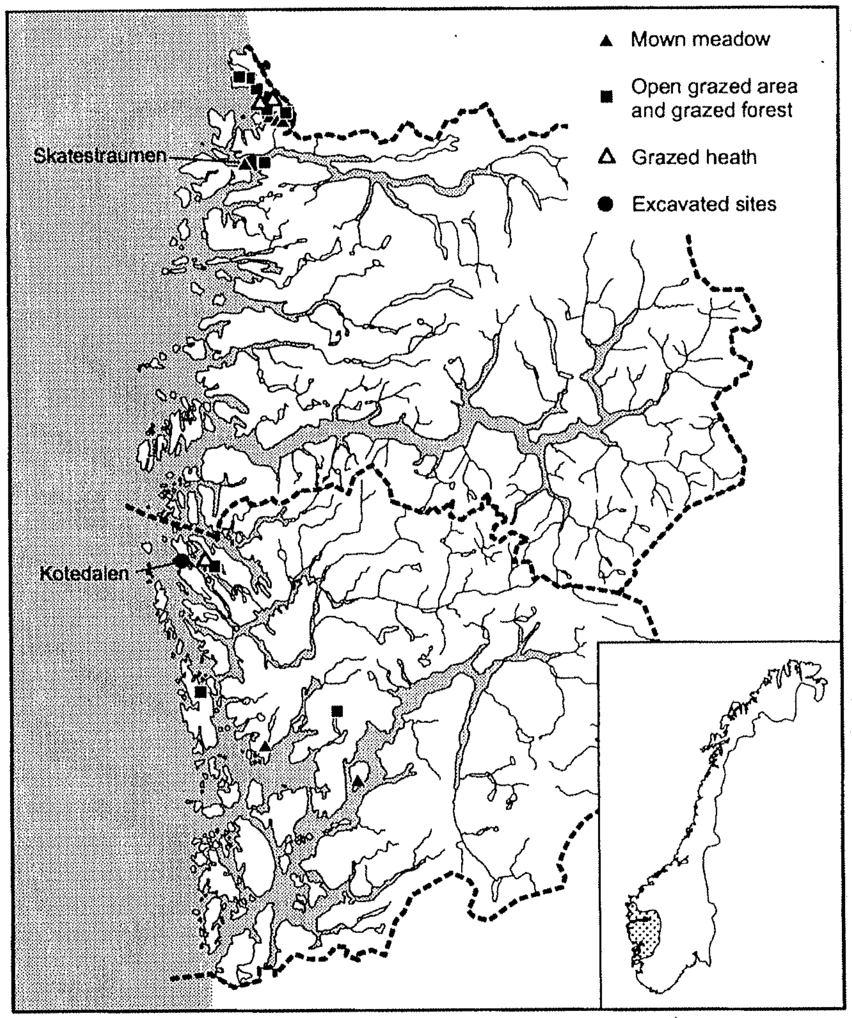

Fig. 4. Map showing the location of the 20 sites of the surface samples and the two excavated sites, Kotedalen in Hordaland, and Skatestraumen in Sogn og Fjordane

The pollen diagram (Fig. 5) shows the general vegetation history over approximately the last 4000 years. It shows an open forest with much *Rumex* and *Filipendula* in the bottom (zone 1). This is followed by a zone of more closed forest (zone 2), before a new opening at the Late Neolithic / Bronze Age transition (zone 3). The vegetation reflected in pollen zones 1 and 3 is influenced by human activity, indicated also by the presence of macroscopic charcoal in the respective layers. During the Bronze and Iron Ages (zones 4 and 5), trees were again dominant, but grasses (Poaceae) and some herbs like *Potentilla type*, *Solidago* typo, *Succisa* and *Plantago major*, were better represented than earlier. Also the composition of the forest changed from zone 2 to zone 4. In zone 4 *Betula* dominates and *Alnus* and *Corylus* have lower values than earlier, whereas *Sorbus*, a light-demanding pioneer tree, has higher values. A new opening of the forest is reflected in a level dated to 2070 BP, and the herbs present in zone 4 as well as charcoal, attain higher values in zone 5. Taken together, this indicates an open, disturbed forest throughout pollen zones 4 and 5, with an intensification of the utilization of the woodland in zone 5.

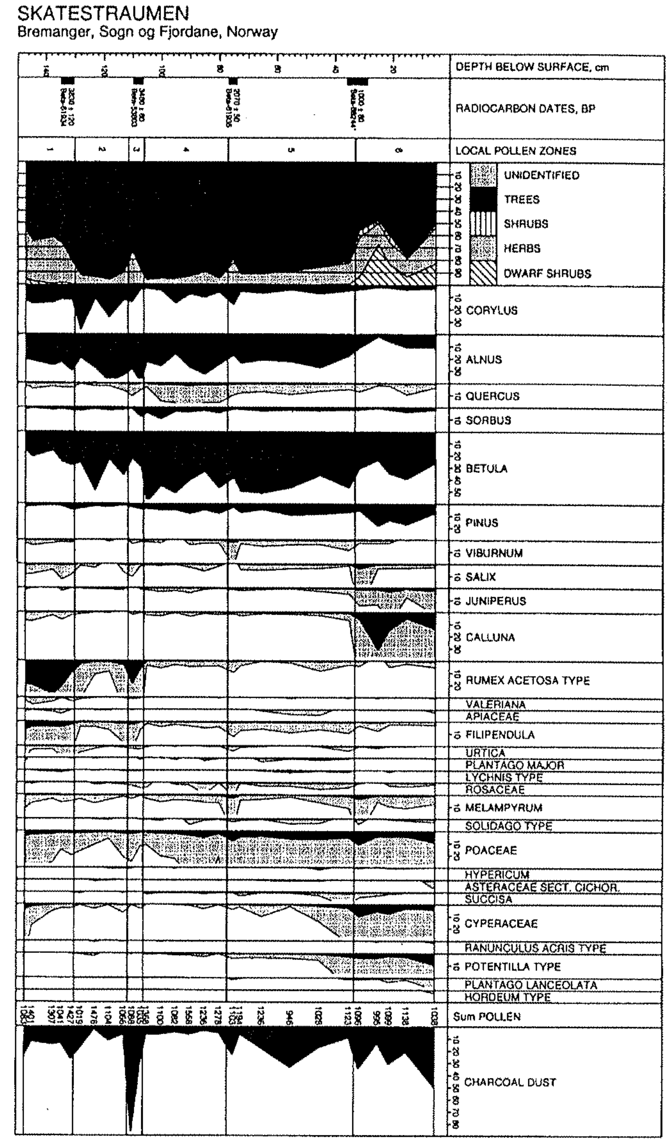

Fig. 5. Pollen diagram, showing some selected taxa from Skatestraumen

About 1000 years ago, heath vegetation became established (zone 6). From this level, the grazing indicator *Plantago lanceolata*, is also found continuously. In the open vegetation zones at the base, *Plantago lanceolata* is absent, whereas it is found at one level in the beginning of each of zones 4 and 5. Despite this absence of *P. lanceolata*, has there been grazing activity since the Bronze Age?

The pollen diagram is compared to the modern data set by using redundancy analysis (RDA), which is a direct ordination method. In direct ordination, the patterns of variation in the species data that can best be explained by the observed environmental variables are detected (ter Braak 1987:137). Redundancy analysis is based on linear response models. This analysis was chosen because the length of the gradient in the modern pollen data set, as given by detrended correspondence analysis (DCA), was less than two standard-deviation units (ter Braak & Prentice 1988). Squareroot-transformation and species centring were used (ter Braak 1988). The program CANOCO (ter Braak 1991) was used for the ordinations and the scatter plots were drawn using the program CanoDraw (Smilauer 1992). The fossil pollen spectra are positioned passively onto the plane of the ordination axes formed by the modern data set. The position of the passive samples is made on the basis of overall similarities in pollen composition and

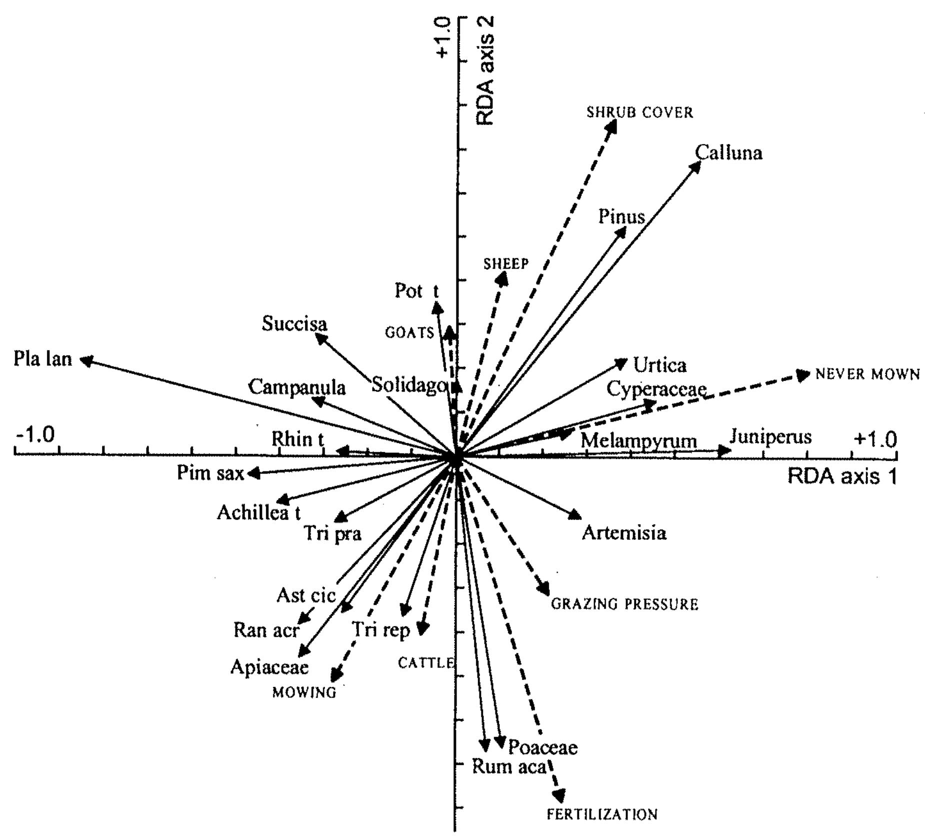

Fig. 6. RDA scatter plot showing the relationship between some selected species and environmental variables. Abbreviations: *t*, type; *Ast cic*, Asteraceae Cichorioideae; *Pim sax*, *Pimpinella saxifraga* type; *Pla lan*, *Plantago lanceolata*; *Pot* t, *Potentilla* type; *Ran acr*, *Ranunculus acris* type; *Rhin* t, *Rhinanthus* type; *Rum aca*, *Rumex acetosa* type; *Tri pra*, *Trifolium pratense* type; *Tri rep*, *Trifolium repens* type

relative abundance between the fossil samples and the modern, active samples. This makes the method a comparative approach (Gaillard et al. 1992).

Figure 6 shows the main pattern of variation in the modern pollen data from the coastal area, when they are related to environmental variables such as grazing and mowing. All the environmental variables in Fig. 6 were found to be significant using forward selection and Monte Carlo permutation tests with 99 unrestricted permutations (ter Braak 1990). Comparison of the variation explained by the first two axes in the species data in PCA (principal component analysis, eigenvalues 0.302, 0.195) and RDA (eigenvalues 0.241, 0.132), indicate that there is some variation in the species data which is not explained by the environmental variables used. However, nearly 40% of the variation in the species data is explained by the first two axes in RDA.

The first axis separates the sites which, as far as it is known, have never been mown, on the positive side (heath, grazed forest and outfield pastures), from herb rich sites (mown meadows and pastures which have earlier been mown) on the negative side (Fig. 6, 7). Species positively correlated with the first axis are

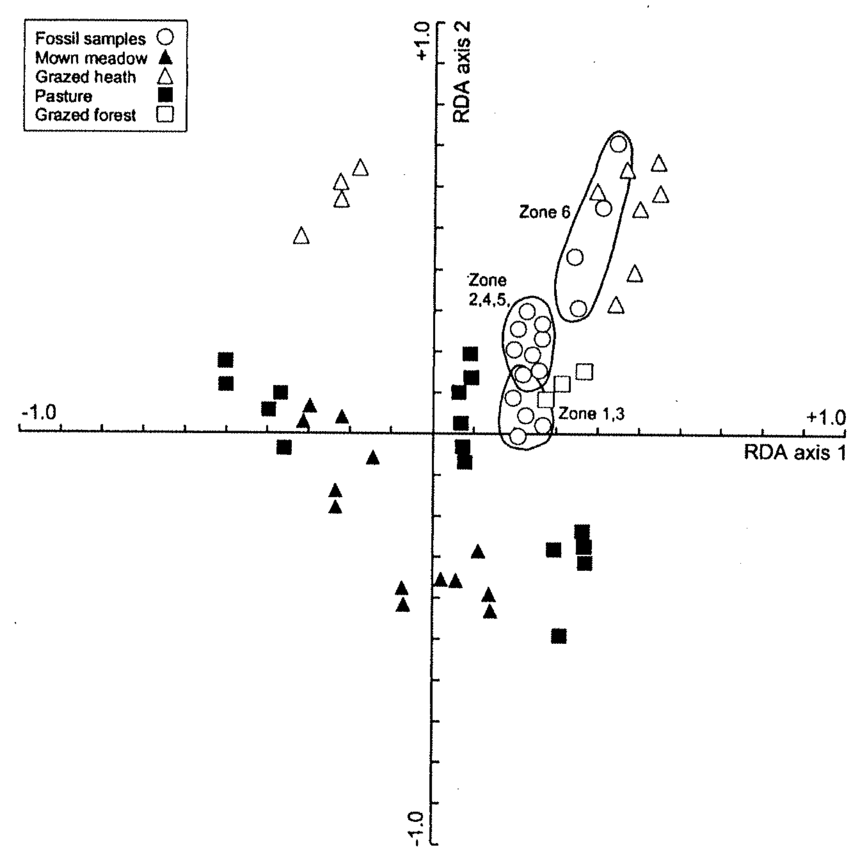

Fig. 7. The position of the Skatestraumen fossil pollen samples / pollen zones in relation to the modern pollen samples. The fossil samples are positioned as "passive samples" on the plane formed by RDA axis 1 and 2

Juniperus, *Melampyrum*, Cyperaceae and *Urtica*, whereas *Plantago lanceolata*, *Pimpinella saxifraga*, *Achillea* type, *Rhinanthus* type and *Campanula* are negatively correlated with this axis. The second axis reflects nutrient status, grazing pressure and mowing; separating outfield sites with low grazing pressure (grazed by sheep and goats) from heavily grazed pastures and fertilized sites (grazed by cattle). High values of Poaceae and *Rumex acetosa* type are positively correlated with fertilizing and mowing, whereas Apiaceae, *Ranunculus acris*, Asteraceae Cichorioideae, *Trifolium repens* and *T. pratense* are more closely related to mowing.

The fossil pollen spectra are all placed far from the mown meadows in the RDA scatter plot, Fig. 7. Zone 6 is found close to the heath squares, whereas the remaining zones are found close to grazed forest and outfield pastures. An indication of the similarities between the modern and the fossil pollen samples is given by the squared residual length per sample from the plane formed by RDA axes 1 and 2. Any fossil sample whose squared residual length is equal to or larger than the extreme 5 or 10 % of the modern samples, is considered to have a "very poor" or "poor" fit, respectively (Birks et al. 1990:273, Gaillard et al. 1994:50). All samples except one (15 cm) in pollen zone 6 have lower squared residual distances than the 5-10% extremes of the modern data set. The 15 cm sample as well as pollen zone 5 and two samples from pollen zone 4 (85 and 90 cm) are all within the 5% extremes of the modern data set, and hence are considered to have a "very poor" fit. Their positioning on the plane may therefore be unreliable (Gaillard et al. 1994:64). Pollen zones 3, 2 and 1 all have higher squared residual lengths than any of the modern pollen samples. This indicates that the three oldest pollen zones do not have modern analogues in this data set.

These results also indicate that the upper pollen zone, the last 1000 years, represents a kind of grazed heath community. The position of the samples from zone 5 must be interpreted with care, but grazing most probably influenced the vegetation around the site during the time period covered by this zone. In zone 4, the intensity of the utilization of the forest was lower than in zone 5, and lower than in any of the investigated modern vegetation types. Modern pollen samples from natural forest are needed in order to see if they are more or less similar to the fossil samples. As the same herbs that have higher values in zone 5 are also present in zone 4, it is probable that a weakly-grazed forest also existed around the site during the time period represented by zone 4. Pollen zones 1 and 3 are clearly influenced by human activity, but obviously none of the modern samples reflect this kind of activity, and none of the modern samples reflect the forest community of zone 2.

The modern data set used here, only 20 different sites, is small, but it shows some of the possibilities of using modern analogues. The fact that *Plantago lanceolata* is absent or has low values in some of the grazed heath samples and outfield pastures in the modern data set, supports the interpretation of a weakly grazed forest in zones 4 and 5 even though *Plantago lanceolata* does not have a continuous curve through these zones. This example also supports the fact that a wide range of modern pollen samples are needed for reconstruction purposes (Berglund et al. 1986, Gaillard et al. 1992, 1994). For this diagram a wide range of forest samples, from undisturbed woodland to weakly grazed and more heavily utilized forest, is needed. A wider range of culturally influenced vegetation types is also required, including ruderal communities.

Recent developments in numerical methods, as well as in computers, open up new possibilities in palynology (Birks 1992). It is now possible to go from a descriptive and explanatory approach towards an approach of finding the causes of vegetational changes by relating the species composition directly to environmental variables. It is then possible to do environmental (not only vegetational) reconstructions. In this way, environmental variables such as grazing pressure, mowing or soil chemistry may be reconstructed if these variables have been measured in the modern data set. It is also possible to test if the different land-use variables produce statistically significant and distinct pollen assemblages. Further, this allows new possibilities for hypothesis testing in palynology (Birks 1992, Gaillard et al. 1992, 1994). Having modern pollen samples from a wide range of land-uses, also makes it possible to calculate indicator values for different pollen types in relation to those land-uses (Birks 1990, Gaillard et al. 1992). This will again give increased value to the use of indicator species in the interpretation of cultural activity from pollen diagrams.

I think the use of local diagrams combined with modern surface samples, will have increased value in the cooperation between archaeologists and palynologists in the future. When possible, this approach should be combined with on-site pollen analysis.

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Žiedadulkių analizės *in situ*, vietovių žiedadulkių diagramų ir šiuolaikinių žiedadulkių pavyzdžių naudojimas kultūrinės veiklos tyrimuose

KARLI LOE HJELLE

Santrauka

Laiko skalės klausimas visada svarbus palinologijoje. Koks baseinas ar nuogulų sluoksnis bus analizuojamas, priklauso nuo konkrečių tyrimų tikslo. Čia aptariamos kai kurios įvairių nuogulų tipų savybės. Pagrindinis dėmesys skiriamas žiedadulkių analizės *in situ* ir vietinių žiedadulkių diagramų naudojimui tarpdisciplinariniuose tyrimų projektuose Vakarų Norvegijoje. Žiedadulkių iš gyvenviečių židinių analizė parodė, kad grūdinės kultūros kultivuotos 4700-4200 m. pr. Kr. Tuo tarpu apie vietinę šių kultūrų kultivaciją vėlyvajame neolite ir bronzos amžiuje liudija žiedadulkių diagrama, gauta iš perklostytų gyvenvietės sluoksnių. Nenutrūkstamą augalijos vystymąsi aplink tirtą vietovę patvirtina diagramos iš šalia esančios pelkės. Iš skirtingų nuogulų gauti rezultatai papildė vieni kitus. Kad būtų lengviau interpretuoti vietinių žiedadulkių diagramas iš mažų įdubų, liūninių pelkių bei dirvožemio profilių, galima panaudoti įvairių augalijos tipų šiuolaikinėse pelkėse pavyzdžius ir juos palyginti. Pateikiami preliminariniai rezultatai, gauti vykdant projektą, kurio tikslas – ištirti ganiavinių augalų tipų Vakarų Norvegijoje šiuolaikinių žiedadulkių pavyzdžius. Šių pavyzdžių rezultatai padeda interpretuoti pašarinių augalų pėdsakus žiedadulkių diagramose, gautose vakarinėje Norvegijos pakrantėje.

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Natural scientific methods, a potential, or more needed in future archaeology?

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From the earliest days of archaeology there has been continuous methodological development. Archaeological fieldwork today requires, as a minimum standard, stratigraphic and artefact description as well as collection of samples for independent dating, primarily 14C dating. Recent developments in fields dealing with the natural environment include many new methods applicable to palaeoenvironmental work that may also be of potential interest to those who deal with history and prehistory.

For some archaeologists it is an open question as to whether or not there is any need for cooperation with palaeoecologists. It is my opinion that such cooperation is not only important but very often necessary.

This paper deals firstly with different forms such cooperation may take, and secondly presents several recent palaeoenvironmental projects that have archaeological aspects, which at least for some researchers and for the public have provided new information about historic and prehistoric life ways.

Politicians as well as the general public today talk and ask about the environment in a broad sense, while most of the researchers today work within very narrow sectors or fields. For example, neither a botanist nor a geologist can manage to cover more than a small part within their field and be updated in the all the new techniques available.

To be able to communicate with the public, we specialists need firstly to communicate much more with each other, and secondly to learn how to answer questions from the public in general, including those from the media. Of special importance certainly is to answer, in a proper way, questions from the official institutions who normally support us financially.

Questions concerning prehistory from non-specialists most often have broad scope. The answers need to include information as to, when did it happen, what kind of climate existed, what kind of food-supply did the people have, what kind of small-game, big-game, fishes etc. existed at that time, what hunting strategies were used, and so on. During the last decades we have seen an increasing number of natural scientific methods in use in archaeological, – methods such as computers and laser equipment, different dating techniques, stratigraphic descriptions of sediment, chemical studies, as well as methods dealing with zoological and botanical fossils. Mineralogenic analysis might be of a special