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Society and the environment: a case study of Early Bronze Age settlement complex from Rybiny, Kujawy, Poland

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In this paper, authors discuss relations between a specific human group – a microregional community of the so-called Trzciniec Horizon – and the natural environment it occupies. Using archaeological, archaeozoological and paleobotanical data, they reconstruct different aspects of the society's life. Drawing on the information from a ^{14}C dated palynological profile, the authors analyze changes in the natural environment induced by human economic and settlement activities as well as the impact of such changes in the environment on the life of "Trzciniec" populations. The authors record a gradual shift from a more mobile economy, geared exclusively to animal raising, to a more diversified economy, where – despite the domination of animal raising – ever greater role is played by land cultivation and assimilation strategies (mainly fishing).

KEY-WORDS: Early Bronze Age, Trzciniec Horizon, cultural change, quasi-pastoral society, kinship structure, local group, pollen analysis, deforestation, anthropogenisation.

The present paper is an effect of collaboration of an archaeologist and a paleobotanist. An attempt to explain the relations between man and the environment and vice versa with respect to a specific cultural group occupying a single microregion over a relatively short period of time has resulted in a closer cooperation going far beyond an ancillary role usually played by representatives of these two disciplines.

The purpose of the research is not just a simple reconstruction of the history of a selected community against a background of environmental changes, nor the study of the impact of anthropopressure on the changes in the environment occupied by the community. What we suggest is to combine these two perspectives working on the assumption that it is not only the natural environment that influences the social and cultural choices as well as human behavior, but that it is also a human group that exerts impact – at least from the middle of the Atlantic

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period – on its natural and geographic environment. We do not wish, however, to take part in the dispute between orthodox humanists and scientists concerning the determinants of society development. We do not prejudge whether the development is determined by man's incessant and progressive subjugation of the environment or it is man who is more strongly influenced by the changing ecological potential of a given area. Our aim is to describe and interpret the relationships existing between a village and microlocal community (society) and the environment (oecumene, microregion) they exploit in a specific time.

Another inspiration behind this paper was a need to augment the meager palynological data base concerning Kujawy which is one of a more thoroughly archaeologically studied cultural and settlement mesoregions on the Central European Plain. Specialist studies concerning the area have covered so far a small number of bodies of water and bogs (*e.g.*, Jankowska 1980; Noryśkiewicz 1970; 1987; 1995; Ralska-Jasiewiczowa, van Gell 1992; see also Czebreszuk 1996; Szmyt 1996; Makarowicz 1998). To expand historical and archaeological analyses and, in the first place, to deepen their interpretations, it is necessary to build a network of reference points, peculiar paleobotanical bench-marks, that would form a basis for the correlation of chronostratigraphy and paleoenvironmental changes. The present attempt aims at beginning such an archive with respect to the Decline Neolithic and the Early Bronze Age.

A. DESCRIPTION OF THE INVESTIGATED AREA

Our investigations have covered southern Kujawy or Kujawy Lake District, specifically a fragment of the valley of the Zgłowiączka, a western tributary of the Vistula, together with a surrounding plateau, located 40 km west of the rivers' confluence. Geomorphologically diversified, the river valley, 150–200 m wide, stretches basically parallel-like for *ca* 55 km from the southeastern arm of Lake Głuszyńskie in the east to the Vistula in the west, Fig. 1 (Makarowicz 1989).

The investigated area is located in the opening section of the valley utilizing a subglacial channel. The channel cuts here into the morainic plateau 15 to 25 m deep, while the grade of slopes reaches 30–45°. The river valley, with a well developed system of terraces, is a few hundred meters wide (Niewiarowski 1983; Andrzejewski 1984: 19). The bottom of the valley is covered mainly with kinds of peat and silt as well as, at places, with interbedded fine sand and mud containing large amounts of organic matter. These organic deposits are 4–8 m thick. There are many small lakes and other bodies of water. A characteristic feature of the geomorphology of this section of the valley and its immediate surroundings are sandy flats which occur in the area of contact with the plateau. The largest of them

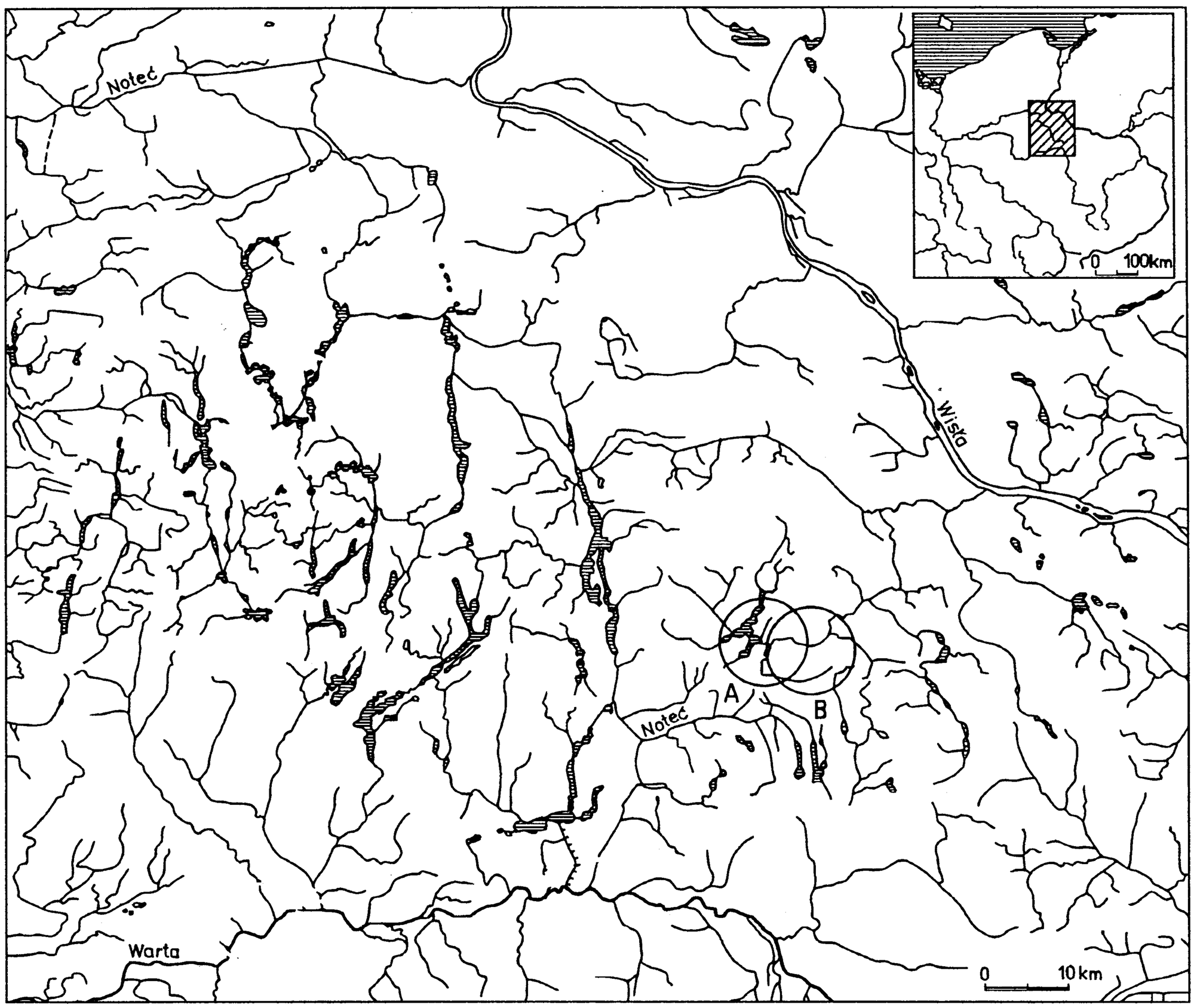


Fig. 1. Location of test areas.

stretches from the arm of Lake Głuszyńskie over the area 350 m wide and 3 500 m long. The flat stretches mainly along the left bank of the Zgłowiączka, 7 m below the plateau. Another specific element of this terrain are kames built of fine sand and mud (Bartkowski 1970). They stand out against the post-lake landscape as elevations of different height, particularly in the valley and its immediate surroundings. In the discussed area, there are several formations of this type of some few hundred sq. m elevated to the height of 3 to 8 m above the peat bottom (Andrzejewski 1984: 33f).

The subglacial channel now used by the Zgłowiączka runs perpendicularly to two smaller, peat-filled depressions which adjoin it from the north. Along their bottoms, two nameless water-courses flow. The area is characterized by the presence of many melt-out depressions which are now filled with vanishing bodies of water (Andrzejewski 1984: 40f).

To the south of Lake Głuszyńskie, the terrain is quite diversified. Clay morainic hillocks, 5–7 m high and with gentle slopes, are interspersed with smaller glacial channels, erosion plateaus and eskers (Sinkiewicz 1989 : 37f).

What is unusual about the area under discussion is a considerably large accumulation of settlement points from various periods: beginning with the Decline Neolithic until the Early Middle Ages. Particularly intensive is the settlement of a society from the Early Bronze Age representing a group from the Kujawy branch of the Trzciniec Cultural Circle (TCC).

B. STATE OF ARCHAEOLOGICAL EXPLORATION

The valley of the Zgłowiączka and its immediate surroundings have been penetrated many times by archaeologists. In 1980 a survey was carried out there as part of a project called Archaeological Photograph of Poland. Next, in different years and at different times of the year verifying and detailed surveys were carried out four times. These studies were a basis for excavations at the most interesting Early Bronze sites. In the 1980's and 1990's, two settlements from the classic Trzciniec Horizon were investigated (Rybiny, sites 14 and 17 – Makarowicz 1989; 1998); there were also preliminary investigations carried out concerning other sites from the same period. The data were supplemented with archival information.

Consequently, a map was drawn of those settlement points, which could be synchronized, with greater or smaller probability, with the period of activity of the two settlements. The settlements were taken to be *central settlements* (points), *i.e.*, with houses. Apart from them, there were also recorded stage points which were identified by the presence of auxiliary structures with no traces of houses remaining and traces of penetration identified by the occurrence of small amounts of movable sources on the surface as well as two cemeteries (Figs 2–3). Individual forms of settlement were assigned to three taxonomic units. They reflect various degrees of probability of the existence of a connection with the activities of communities inhabiting central settlements at Rybiny, sites 14 and 17 (Trzciniec Horizon 2 [TH2] – the highest, Trzciniec Horizon [TH] – lower, Early Bronze Age [EBA] – the lowest (Makarowicz 1998).

Following the analysis of material culture traits and ^{14}C datings (Fig. 4), it has been ascertained that both central settlements represent culturally the same populations being, however, chronologically different. The difference is rather small, it may not be longer then the life span of a single generation (20–25 years – Makarowicz 1998).

Around the settlement at Rybiny, site 17, a circle with a radius of 5 km has been drawn (Figs 2–3 – western equidistant – *test area A*) delineating – following classic works on site catchment analysis – a potential territory where the settlement's

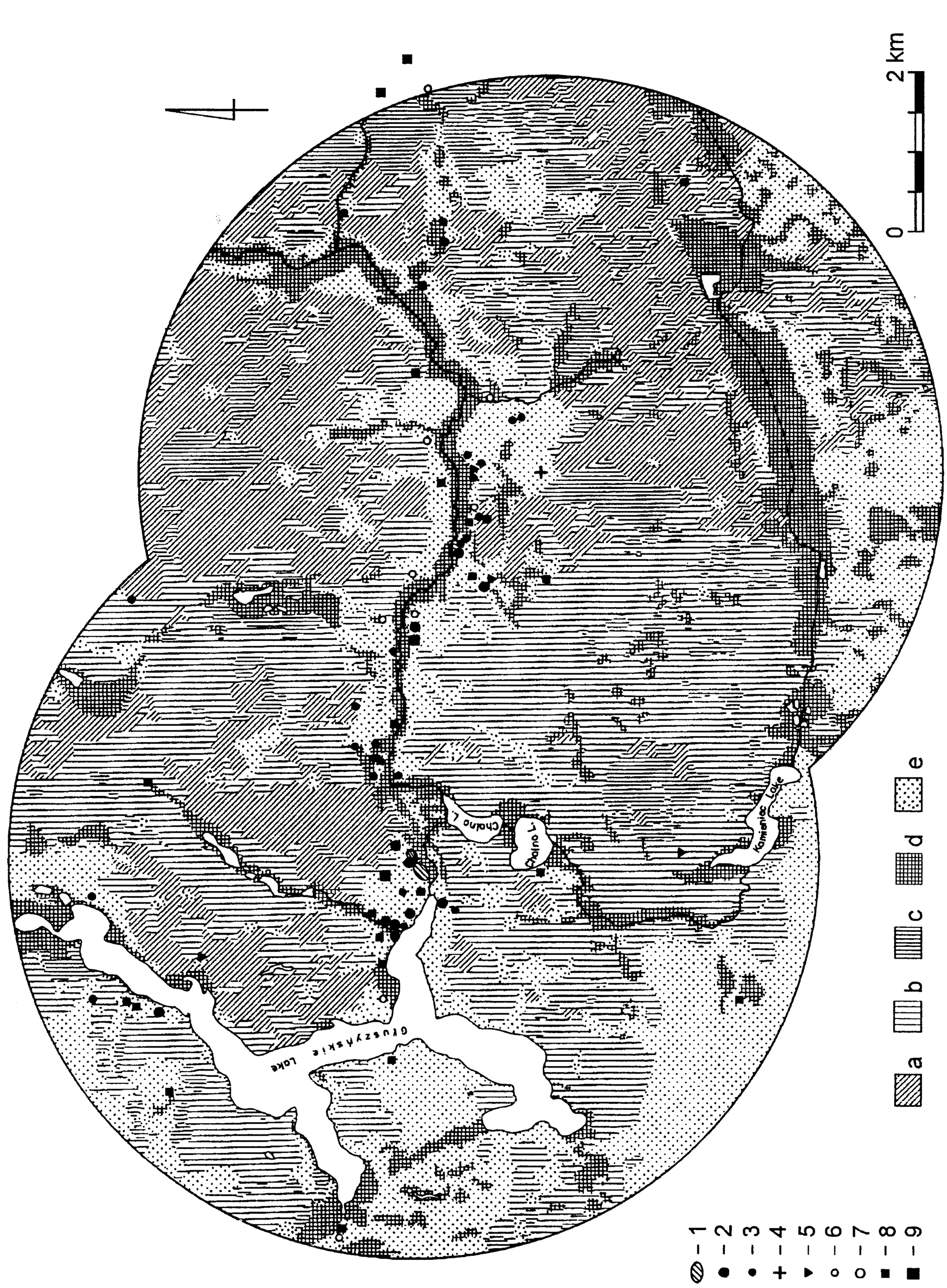


Fig. 2. Location of sites with regard to soil cover: test areas A (western equidistance) and B (eastern equidistance). Area A: a – podzol on clay; b – brown soil; c – black soil; d – hydrogenic soil; e – sand; 1 – TH 2 central settlement at Rybiny, site 17 and Rybiny, site 14; TH 2 stage site; 3 – TH 2 penetration trace; 4 – TH 2 cemetery; 5 – "flint" EBA penetration trace; 6 – TH stage site; 8 – CWC 3,4 – TH 2 penetration trace; 9 – CWC 3,4 – TH 2 stage site. Area B: 4 – TH 2 cemetery ("central point" at Sarnowo, site 2); other items as above.

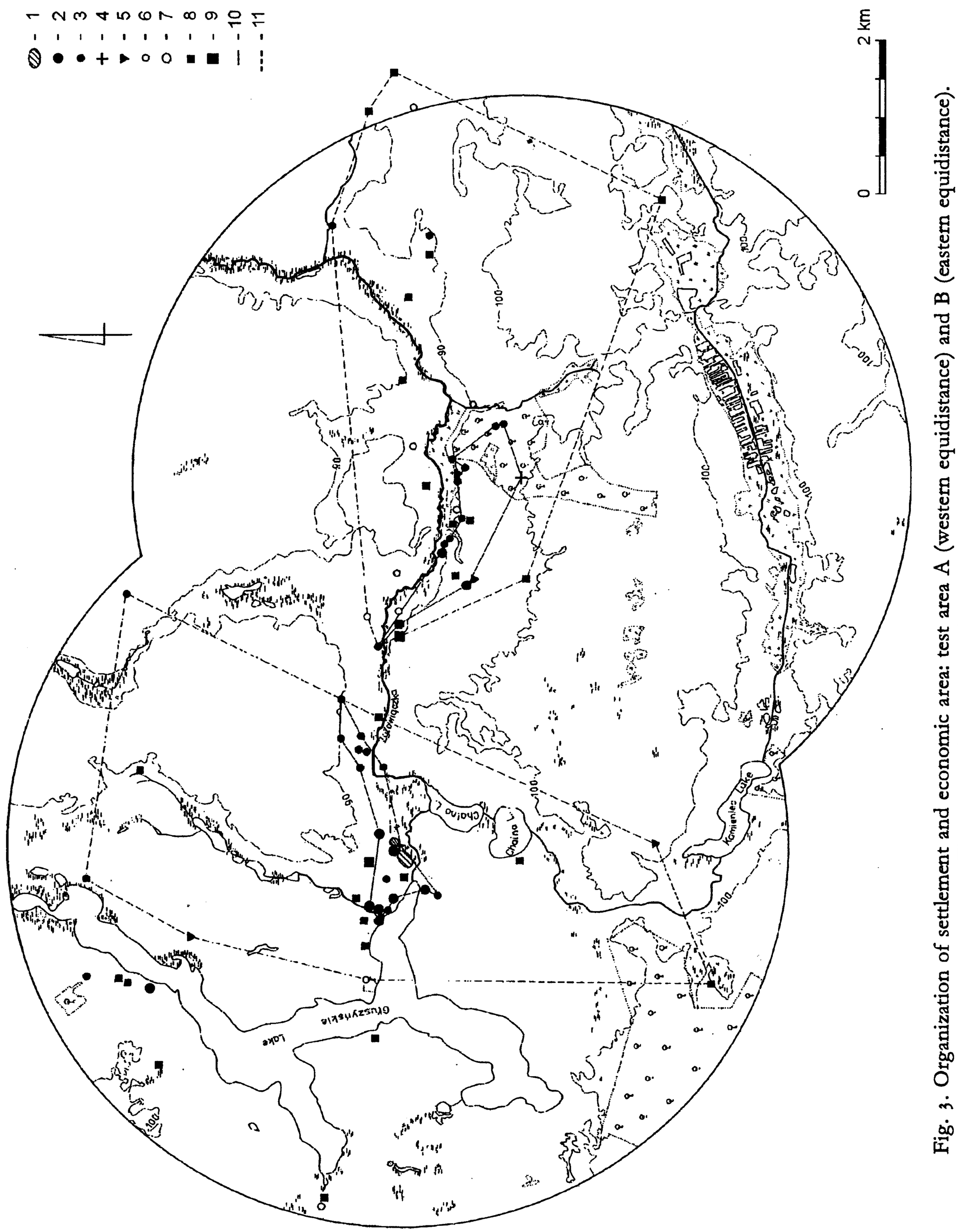
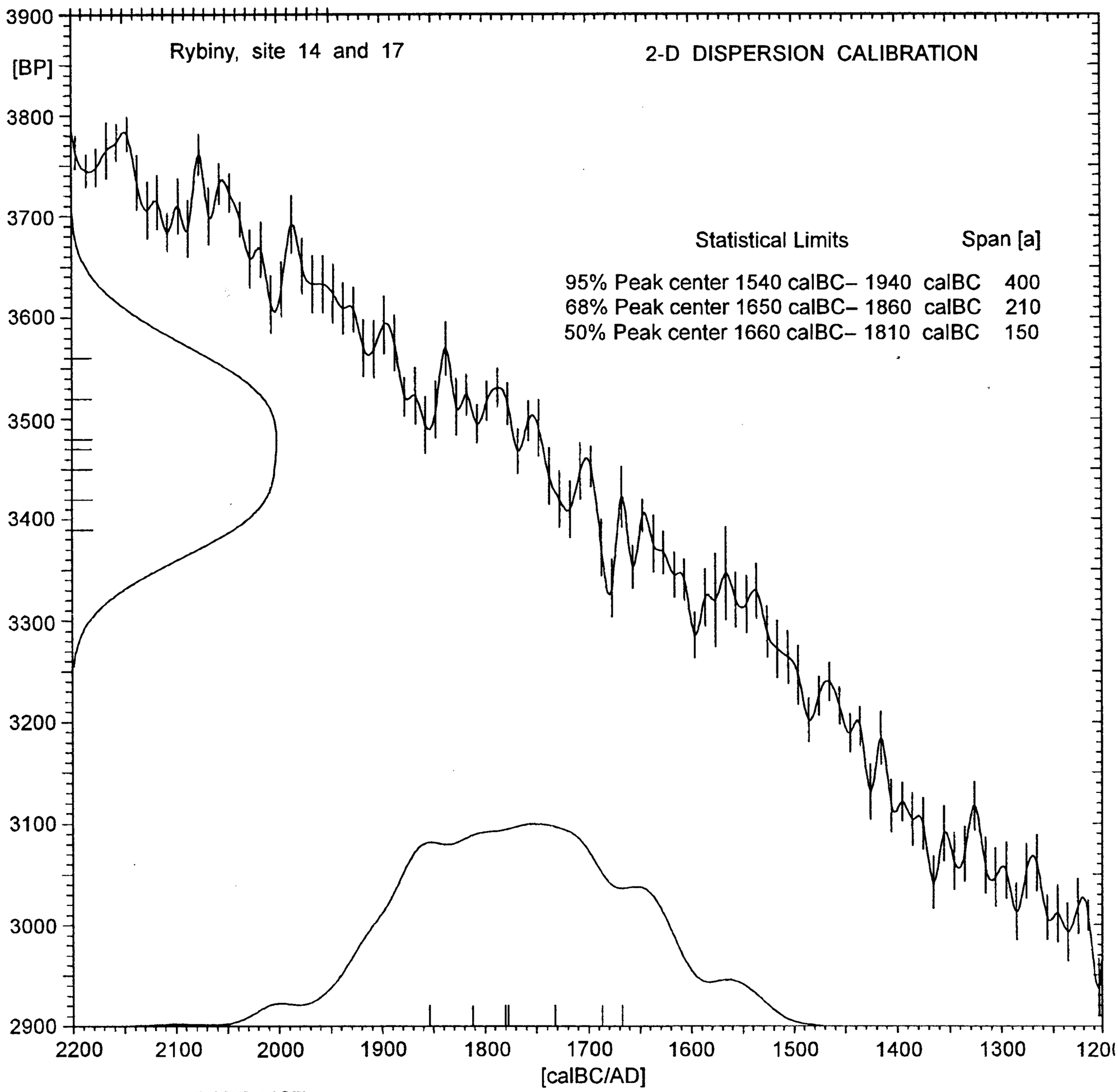


Fig. 3. Organization of settlement and economic area: test area A (western equidistance) and B (eastern equidistance). 1–9 – see Fig. 2; 10 – intensive exploitation zone; 11 – penetration zone.



DATE LIST

Lab. Number	Date Std	calBC/- AD	Reservoir (BP)
Ki-5589	3560 ± 50	1854 ± 77	
Ki-5125	3520 ± 45	1812 ± 63	
Ki-5190	3480 ± 60	1780 ± 81	
Ki-5128	3450 ± 60	1732 ± 90	
Ki-5127	3420 ± 55	1686 ± 76	
Ki-5126	3390 ± 45	1667 ± 63	
Gd-2297	3470 ± 80	1777 ± 105	

Fig. 4. Sum of probability distribution of all calibrated dates for the settlement complex at Rybiny, site 14 and site 17 (*Oxcal v. 3.0* by Christopher Bronk Ramsey).

inhabitants were economically particularly active (Vita-Finzi and Higgs 1970; 1972; Kobyliński 1986; Kadrow 1995; Makarowicz 1998). A similar circle was drawn around the cemetery of the TH2 population at Sarnowo, site 2 (Figs 2–3 – eastern equidistant – *test area B*) representing culture-wise the same society

which inhabited both settlements at Rybiny. Taking the cemetery to be the *central point* followed from the difficulties that were encountered while penetrating this area. Specifically, the forest which covers the area prevented us from precisely locating the settlement, the inhabitants of which used the burial ground. As in the case of Rybiny, the settlement must have been close to the cemetery. Within both equidistants, there are located practically all settlement points which are relics of economic, settlement and ritual activities of people representing two TH2 communities that existed concurrently.

Within *test area A*, within a radius of 1 km from the *central point* (settlement at Rybiny, site 17), *i.e.*, in the zone believed to be the best for field location, sandy soil (35%), hydrogenous and brown soil (25% each) prevailed. Sites identified as TH2 were located mainly on sand (73%). In the case of test area B, within 1 km from the *central point* (cemetery at Sarnowo 2) the domination of podzolic soil formed on clay, brown soil (29% each) and "sandy" soil (17%) was noted. TH2 settlement points were located almost exclusively on sand (94%).

Fig. 3 shows hypothetical *intensive exploitation* and *penetration zones* for the said communities (Makarowicz 1998). The *intensive exploitation zones* were formed by joining adjacent (or the closest) settlement points of the same chronology as the *central points* (settlement at Rybiny and burial ground at Sarnowo). The *penetration zones* were marked out by joining settlement points which had been culturally and chronologically identified, albeit laxly ("roughly" – TH and EBA), with the activities of the TH2 population. In both cases, a majority of settlement forms (*stage points, penetration traces and two cemeteries*) were recorded within a 2 km radius from the central points. They concentrated mainly along the edges and on the higher terraces of the Zgłowiączka Valley as well as on valley slopes of smaller watercourses. In both cases the *zones* of *intensive exploitation* were similar in size (1.03 sq. km – Rybiny; 1.48 sq. km – Sarnowo); the same was true for penetration zones (23.9 sq. km – Rybiny; 20.5 sq. km – Sarnowo). On the basis of these figures it may be tentatively assumed that the population of both village communities was similar.

More information on the settlement and economy of the TH2 population which is at our disposal concerns *test area A* (Fig. 5). In a chronologically earlier settlement at site 14, located about 300–350 m east of the arm of Lake Głuszyńskie along the NW-SE axis, a single post house in the shape resembling a rectangle was recorded. Around the building there were located features with economic functions (Fig. 6). A later settlement at site 17 is located about 200 m east of the edge of site 14. It consisted of a single living feature (semidugout) and very likely of a number of shelters which did not leave any permanent traces in the ground (Fig. 7). Their existence is evidenced by clusters of large fragments of pisé (pugging) with visible post- and stake-molds. Around the building, in particular W

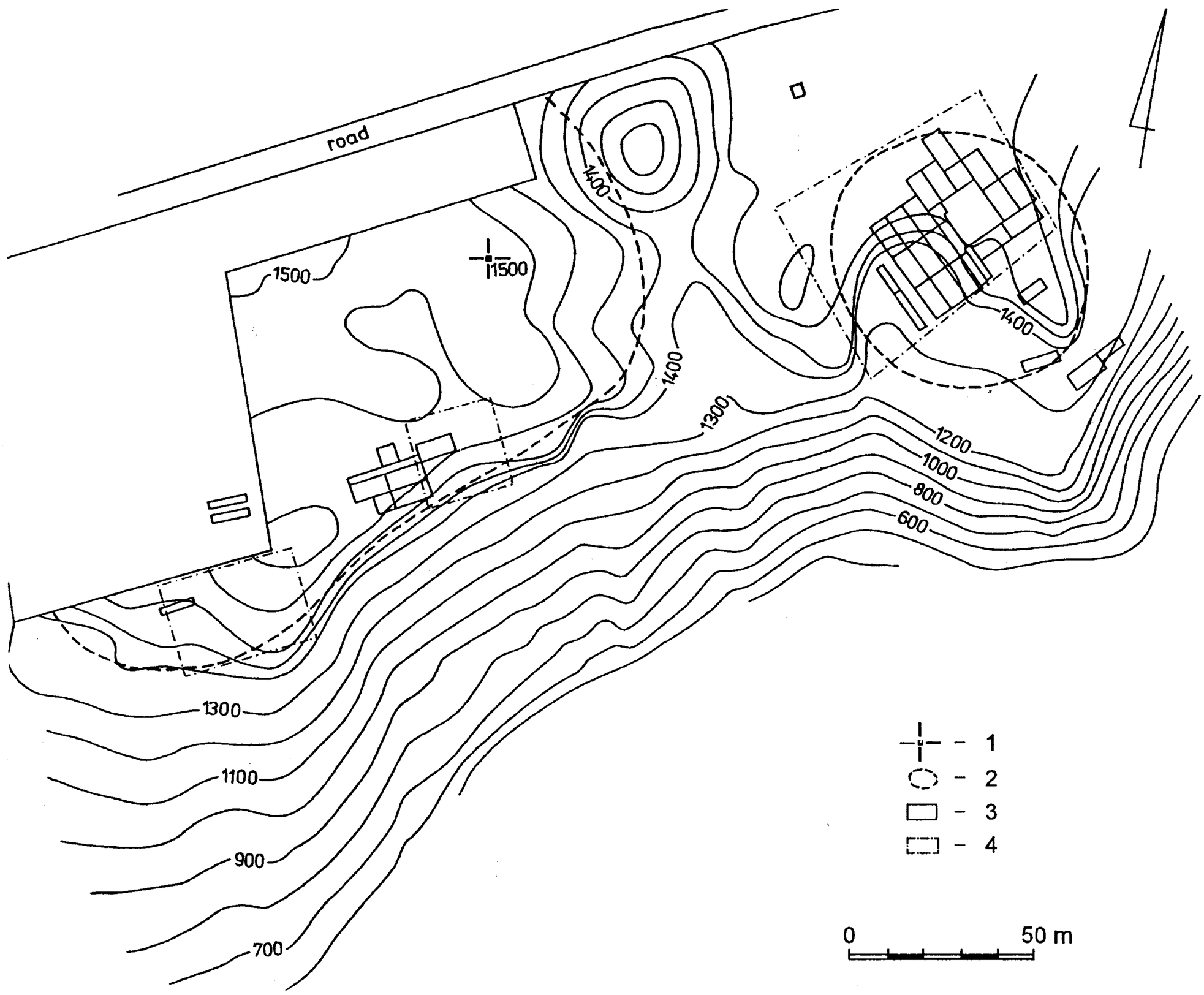


Fig. 5. Location and elevation map of TH 2 settlement at Rybiny, site 14 (west) and Rybiny, site 17 (east). 1 – bench mark; 2 – settlement ranges; 3 – excavations; 4 – area of detailed surface studies.

and SW of it, features fulfilling economic functions were recorded. It follows from analyses that the settlement at site 17 was inhabited at a maximum by 4 to 5 elementary families (16–25 people – Makarowicz 1998). The other settlement may have been less populous.

The most recent studies of the economy of TCC populations on the Polish Lowlands have shown that they used different strategies of obtaining food. The main one was animal raising supplemented by plant crops and assimilating economy, mainly fishing and hunting (Makarowicz 1998).

In the deposits from the settlement at site 14 at Rybiny, only a small number of animal bones, burnt beyond the possibility of species identification, was recorded. Whereas in the contents of a living feature from Rybiny, site 17, there were recorded a large number of postconsumption animal bones, mainly of domestic animals. The group of mammals was dominated by cattle (52.7%), followed by the sheep/goat (31.9%), pig (24.1%), deer and roe-deer (0.9% each)

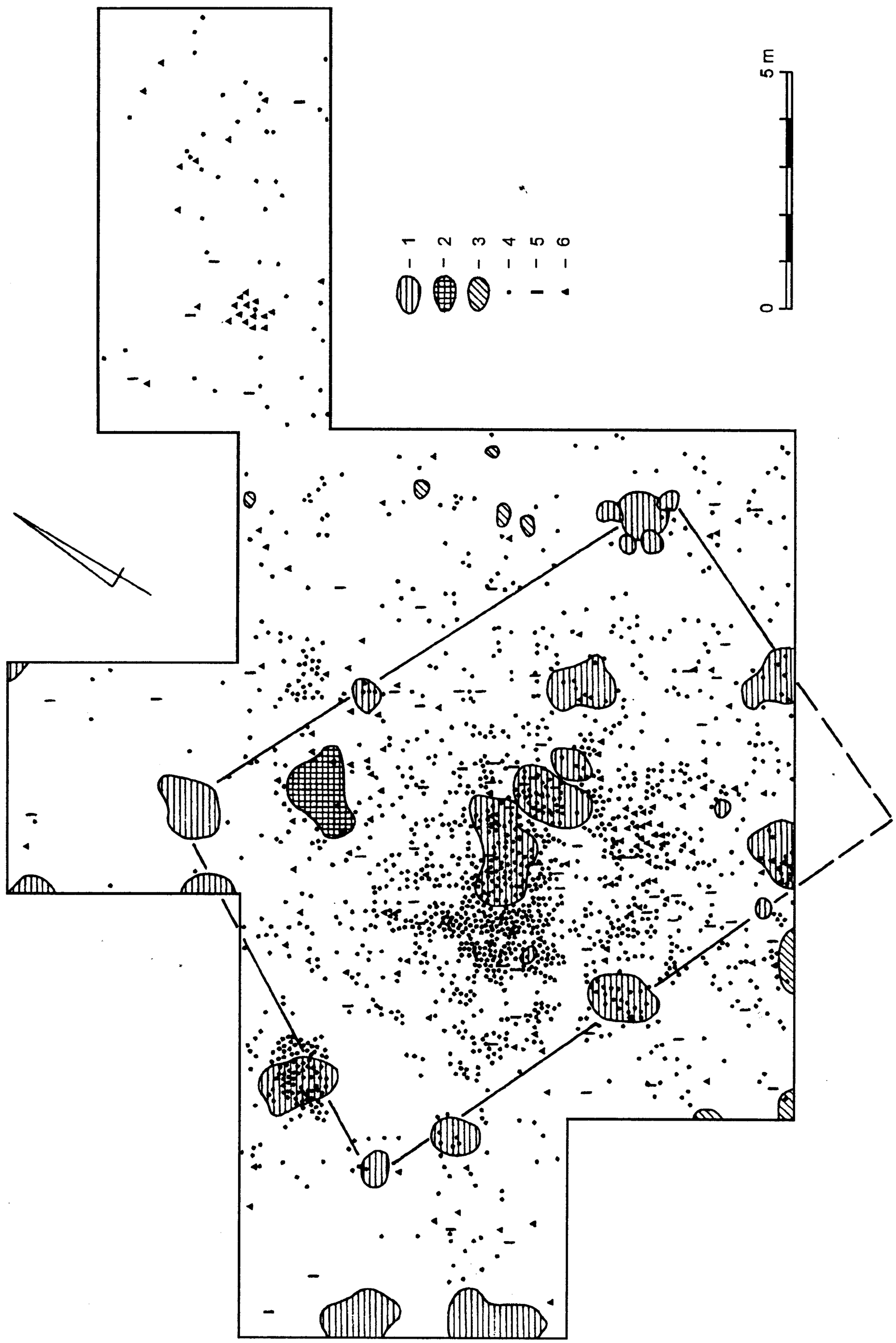


Fig. 6. TH 2 settlement at Rybiny, site 14 (dwelling): 1 – TH 2 feature; 2 – TH 2 hearth; 3 – Neolithic feature; 4 – pottery fragment; 5 – flint artefact; 6 – stone artefact.

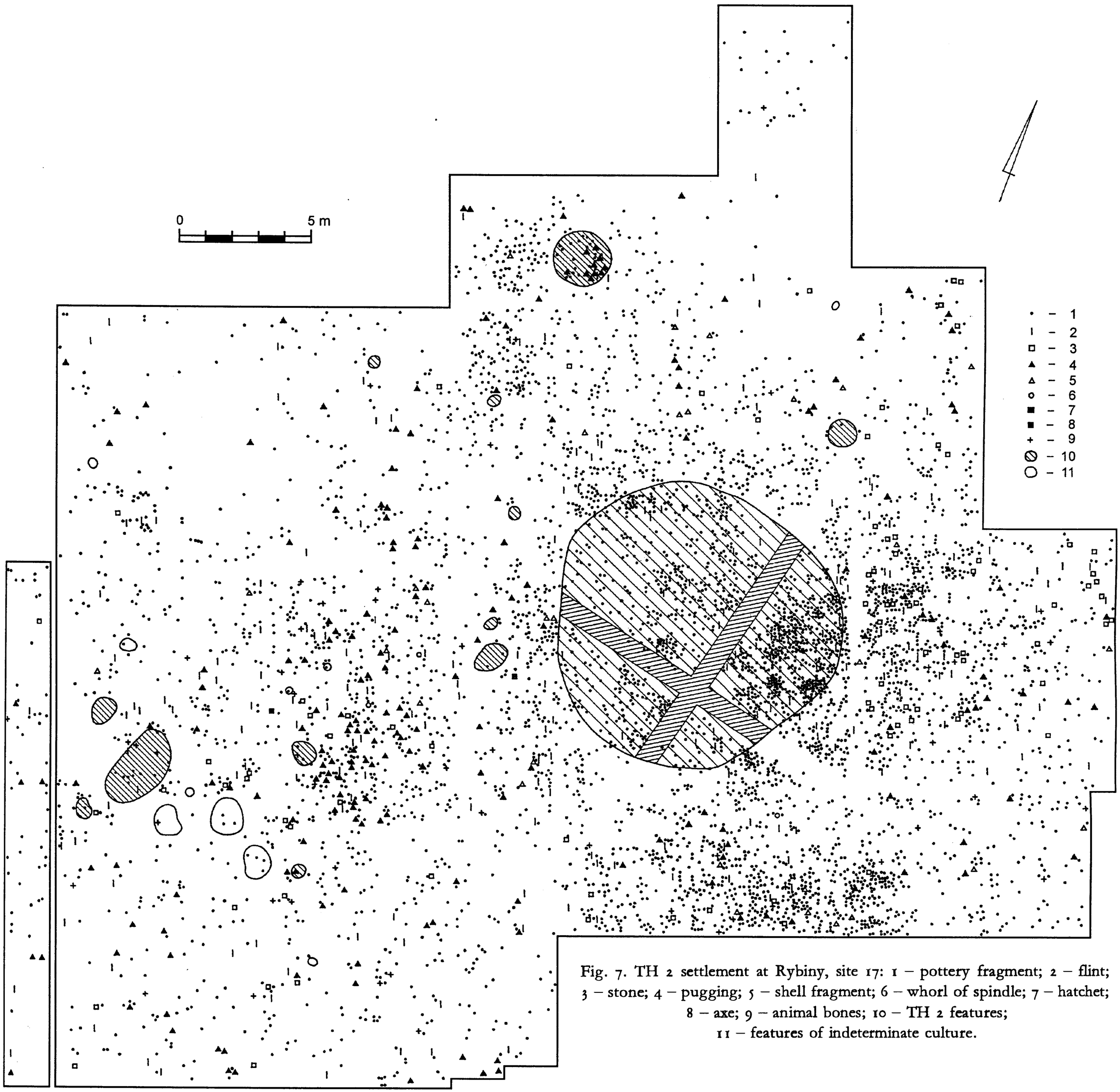


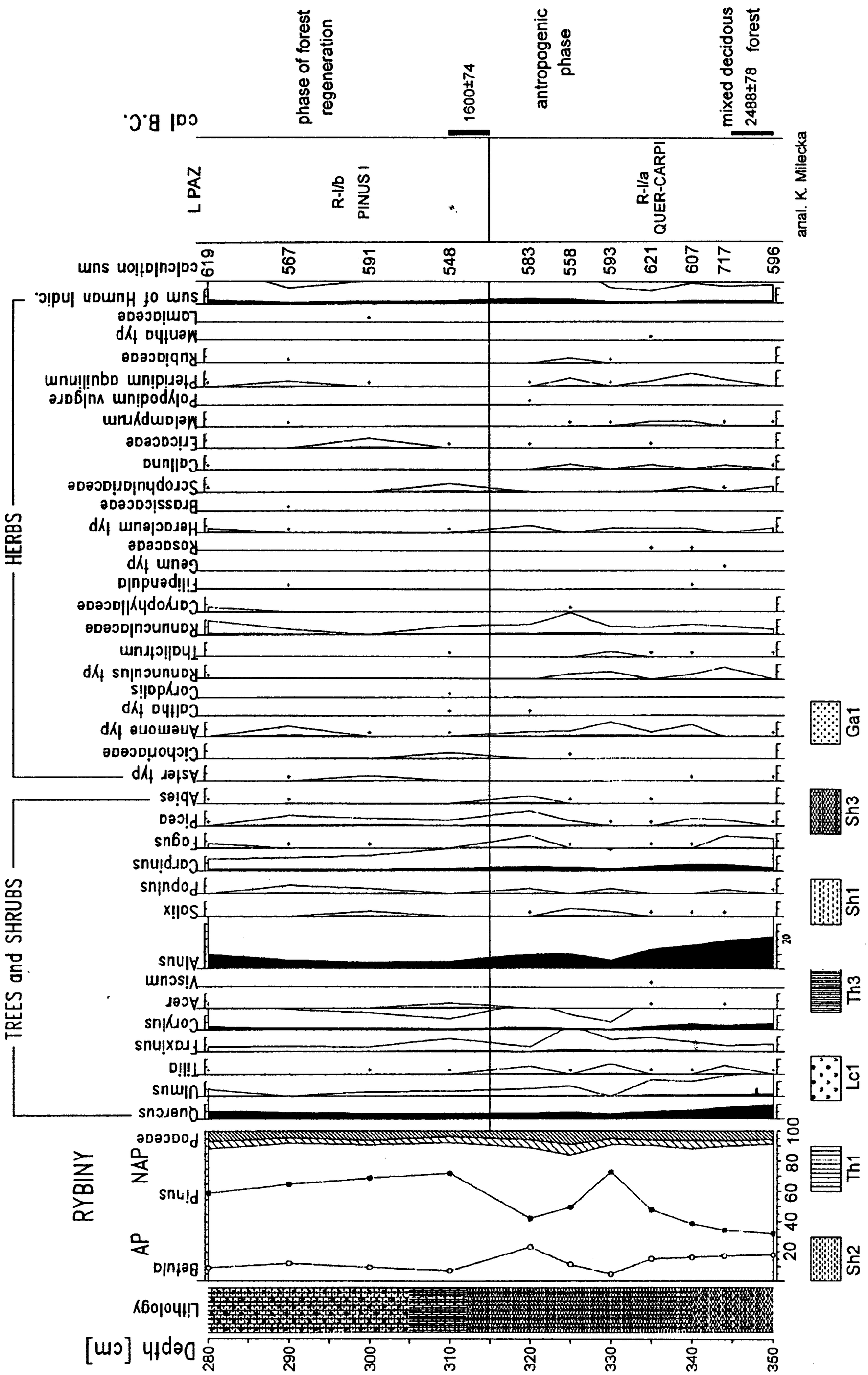
Fig. 7. TH 2 settlement at Rybiny, site 17: 1 – pottery fragment; 2 – flint; 3 – stone; 4 – pugging; 5 – shell fragment; 6 – whorl of spindle; 7 – hatchet; 8 – axe; 9 – animal bones; 10 – TH 2 features; 11 – features of indeterminate culture.

and hare (0.5%). Beside mammal bones postconsumption remains of mollusks, fish and birds were also found. A considerable amount of mollusks and fish indicates intensive exploitation of the water environment (Makarowicz 1998). On the pottery of the TH2 population found at the settlement wheat grains were identified, which may be a proof that the population knew cereal cultivation. This strategy of obtaining food is suggested by inventories of tools made of flint (sickle blades and some arrow points with sickle sheen) and stone (miller's implements – grinders and querns) used by the populations of both settlements. The supplementing role of gathering is evidenced by the debris of hazel nuts and bird eggs recorded in the contents of a living feature from Rybiney, site 17.

Artifacts recorded in both settlements confirm that the populations knew various raw-material related skills such as pottery (beginnings of specialization?), stone- and flint-working (crafts supporting production economy and meeting the needs of assimilating strategies), metallurgy (Rybiny, site 17), weaving and bone-working. From the above description, there emerges an image of a society employing a dual, animal raising and land cultivation economy supplemented with fishing, hunting and gathering.

C. PALYNOLOGICAL PICTURE

The above archaeological data have supplied us with basic knowledge on many aspects of the culture, settlement and economy of the TH2 population inhabiting the valley of the Zgłowiączka and its environs. We have decided to verify the above presented picture of the life of the investigated societies with the pollen analysis method. The method allows one not only to reconstruct the history of vegetation in a specific area, but also to determine the scope and kind of human interference with the natural environment as well as the preferred type of economic and settlement activities. Such activities, reflected in man-induced changes in plant cover, are observable in a pollen diagram. Such a diagram was made for the valley of the Zgłowiączka by analyzing a profile of deposits collected at the foot of a kame, directly behind the settlements of the TH2 communities (Figs 8–9). Individual levels of the three-meter profile were dated using the ^{14}C method. The bottom portion which is of interest to us covers a section of the sub-boreal period between ca 4000 and 3350 bp (*i.e.*, *ca* 2500–1600 BC) in which the settlement of the population in question can be placed (1800–1700 BC, *cf.* Fig. 4). Owing to the obtained datings, it is possible to describe the state of the natural environment prior to the settlement of the said society and after it had left the investigated area. This, in turn, makes it possible to dynamically present the relationships between man and the environment and their impact on one another.


RYBINY
Depth [cm]
Lithology
AP
NAP
Betula
Pinus
Poaceae
TREES and SHRUBS
Quercus
Ulmus
Tilia
Fraxinus
Corylus
Acer
Viscum
Alnus
Salix
Populus
Carpinus
Fagus
Picea
Abies
HERBS
Aster typ
Cichoriaceae
Anemone typ
Calitha typ
Corydalis
Ranunculus typ
Thalictrum
Ranunculaceae
Caryophyllaceae
Filipendula
Geum typ
Rosaceae
Heracleum typ
Brassicaceae
Scrophulariaceae
Calluna
Ericaceae
Melampyrum
Polypodium vulgare
Pteridium aquilinum
Rubiaceae
Mentha typ
Lamiaceae
sum of Human Indic.
calculation sum
L PAZ
R-I/b
PINUS I
R-I/a
QUER-CARPI
cal B.C.
phase of forest regeneration
1600±74
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mixed decidous forest
2488±78
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Ga1
Th1
Sh2

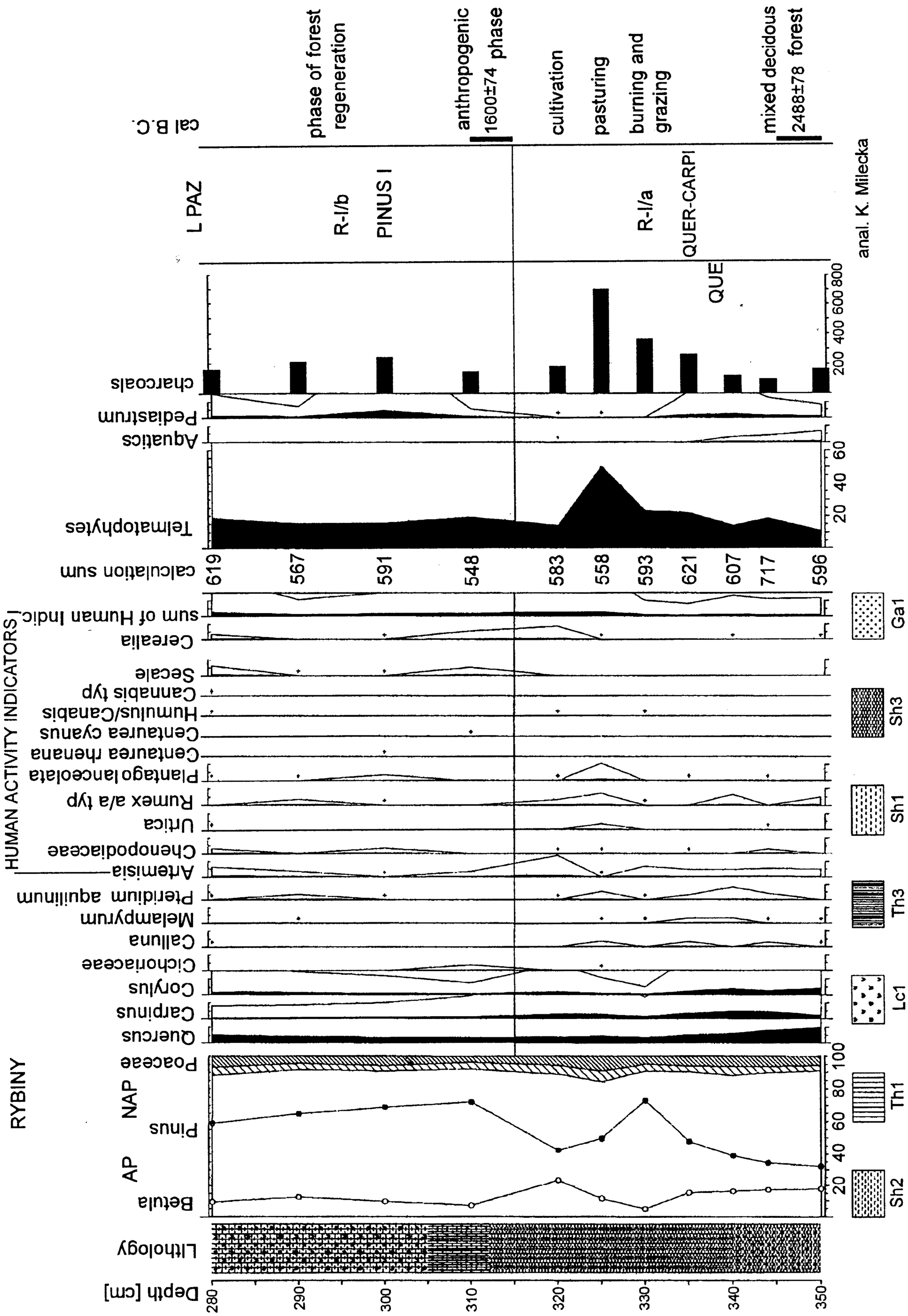

Fig. 8–9. Pollen diagram from the Zgłowiączka valley (test area A).

The pollen diagram was made following percentage calculations based on the sum of pollen grains of trees and shrubs (AP) and herbaceous plants (NAP): AP+NAP=100%.

The analysis of sediment composition suggests that the water level in the river changed in the period. A high degree of decomposition of herbaceous plant debris (Th – *turfa herbacea*) and a high percentage of amorphous substance (Sh – *substantia humosa*) testify to the aeration of peat deposits and a quick decomposition of organic matter. The river banks were alternately flooded and uncovered, which is reflected in the changeable composition of sediments and a different degree of decomposition (humification) of peat. The flow of water and periodical flooding had an impact on the content of mineral substance (Ga – *grana arenosa*) in the studied strata (Tab. 1).

Table 1. Sediment composition of the bottom part of Rybiny core

Depth (cm)	Sediment components	Sediment type
280–305	Sh2, Th1, Lc1, Ga+, D1+, part test (moll)+	fen peat
305–312	Th3, Sh1, Lc+	fen peat
312–340	Sh3, Th1	fen peat
340–350	Sh3, Ga1, Th+, 1f+	fen peat

On the basis of curves representing the content of basic tree species in the pollen profile two local pollen assemblage zones have been distinguished (L PAZ) – Milecka 1998a. The first one (R-I) has been divided, in turn, into six sublevels, a–f. The present paper is concerned only with zone R-I/a and a considerable portion of zone R-I/b.

C.1. PERIOD PRECEDING THE SETTLEMENT OF TRZCINIEC HORIZON SOCIETIES

The bottom part of the core records the state of vegetation before human settlement in the Early Bronze Age. The basic data on the dominant plant formation are provided by the ratio of AP to NAP which defines the degree of woodiness of the area under investigation. Well-known examples from Wielkopolska and other regions point to complete wood coverage in the Neolithic and the Bronze Age. In the diagrams from these areas AP is dominant, *i.e.*, tree pollen grains which account for about 90–95% (Filbrandt-Czaja 1998; Latałowa 1992; Litt, Tobolski 1991; Milecka 1998b; Makohonienko 1991; Miotk-Szpiganowicz 1992). It was only the onset of intensive anthropopressure in the Neolithic – and specifically in the Bronze Age – that upset the natural balance of nature and

consequently distorted the relation: man as an element of the environment – man as a co-creator of the environment. Begun at that time, the more or less conscious interference with the plant cover has continued almost without a break ever since.

In the bottom portion of the studied profile, the degree of woodiness is above 90%, which may reflect a regeneration phase of forests after small man-induced changes in the Late Neolithic (Globular Amphora Culture settlements). The pollen diagram shows a domination of mixed deciduous forests with the oak, hornbeam, elm and hazel prevailing, while the presence of the linden, ash, beech and maple was also detected. There were small amounts of the pine which must have restricted its habitat to areas of less fertile, sandy soil. On meadows and along edges of deciduous forests the photophilous birch was recorded. The ground cover was made of ericaceous plants (*Calluna*, *Ericaceae*), bracken (*Pteridium aquilinum*) and meadow-grass (*Poaceae*). Open communities occurred chiefly in high humidity areas located close to the river. These were fresh and wet meadows including buttercups (*Ranunculaceae*, type *Ranunculus*), umbellifers (type *Heracleum*) and rosaceous plants (type *Geum*) – Fig. 8 (Przybylski 1993).

C.2. THE PERIOD OF SETTLEMENT OF THE TRZCINIEC HORIZON SOCIETIES

The advent of TH populations in the valley of the Zgłowiączka was reflected in the diagram by a decrease in the percentage of pollen grains of deciduous trees. There was a clear drop of the curves for the oak, hornbeam, ash and hazel. Initially, there was also a decrease in the percentage of birch pollen grains, while the curve for the pine was on the increase. Such pollen picture reflects a shrinking of mixed forests and a thinning of existing tree-stands. Pollen spectra suggest a selective elimination of trees. First, the area covered by deciduous and mixed forests was reduced, which was accompanied by their thinning. Owing to growing open spaces and the thinning of tree-stands, pollen transportation over large distances was facilitated. This explains a clear rise of the curve for the pine in the diagram. Next, the expansion of open areas restricted the share of this tree, too, while the improvement of lighting resulted in a high incidence of the photophilous birch. In the ground cover of mixed forest there were heather (*Calluna vulgaris*), cow-wheat (*Melampyrum*) and bracken (*Pteridium aquilinum*), which often accompanies pines (Przybylski 1993) – Fig. 8. These species need a soil rich in minerals. Their presence over many years was related to the regular burning of wooded areas by men and resulting changes in the habitat of herbaceous plants. There was more light available, the mineral content of soil was growing and hydrological conditions were less stable. The photophilous heather took the greatest advantage

of the thinning of tree-stands on acid soils. Orlica, similarly to cow-wheat (*Melampyrum pratense*, *Melampyrum nemorosum*), grew in open forests, on felling sites and on acid soil with a low calcium content. Therefore, the presence of these species testifies to low forest density, presence of meadows and soil acidity.

Another proof that forest burning was used is a continuous increase in the content of minute particles of coal dust: from 100% in the bottom portion of the profile to about 700% in the period of intensive human economy and visible, man-induced changes in the plant cover (Fig. 9). According to Tolonen (1986), a constant presence of minute coal cinders in deposits cannot be caused by natural reasons since fires rarely break out spontaneously in that part of Europe. The finding of a higher content of burned fragments of plant tissues in the settlement phase, pointed to also by other bioindicators, makes the conclusion about the use of this method of deforestation by the "Trzciniec" populations plausible.

The thinning of tree-stands was also a result of grazing animals on tree and shrub leaves. The trimming of lower branches of trees allowed more light to reach the lowest forest layers while the natural enrichment of soil with nitrogen resulted in the emergence or higher incidence of nitrophilous plants like the motherwort (*Artemisia*) and nettle (*Urtica*). Occasionally, rather close to human dwellings, there appeared the goosefoot (*Chenopodiaceae*), which frequently grows as a weed on soils with a higher nitrogen content.

In the discussed portion of the diagram, the sum of pollen grains of herbaceous plants increases, which can be related to human settlement of the territory. Of considerable importance was animal raising which needed relatively large expanses of land for grazing. In part, as it has been already mentioned, animals were grazed in forests, too. In the first place, however, wet and fresh meadows, of diversified floral composition, were used for grazing. Grazing areas were covered with various species of grass (*Poaceae*): cyperaceous (type *Carex*, *Cyperaceae*), compound (*Cichoriaceae*), ranunculaceous (type *Ranunculus*, *Thalictrum*, *Ranunculaceae*), caryophyllaceous (*Caryophyllaceae*) and umbellifers (type *Heracleum*). The grazing of animals in these areas is confirmed by typical species indicating grazing: the small plantain (*Plantago lanceolata*) and sheep's sorrel (type *Rumex acetosa/acetosella*).

Plantago lanceolata was classified by K.E. Behre (1981) among species growing on fresh meadows and pastures but also on fallow land and less often on dry meadows, grazed forests or in ruderal communities. Each of these possibilities indicates that a higher curve for the small plantain is connected with human presence. Most often, however, this species is believed to be an indicator of grazing areas and a classic bioindicator of animal raising. Studies of contemporary material showed a close correlation between the presence of small plantain pollen grains and mowed areas (Gaillard *et al.* 1992). The sheep's sorrel (*Rumex acetosella*) is believed to be a weed of winter crops despite its occurrence on fallow land and

dry pastures (Behre 1981). The sorrel (*Rumex acetosa*) is chiefly recorded on wet meadows and pastures. In the pollen diagrams only the type of sorrel pollen grains (*Rumex acetosa/acetosella*) is distinguished due to a serious difficulty in differentiating between these two species. An overall interpretation of the presence of this pollen type points to animal grazing on wet or dry meadows. Contemporary studies showed a high correlation between the incidence of the sorrel and animal grazing (Gaillard *et al.* 1992). The incidence was somewhat lower on fallow land. The work mentioned above also pointed to a distinct relationship between the heather (*Calluna vulgaris*) and grazing areas. In grazed forests, the occurrence of bracken (*Pteridium aquilinum*) and the cow-wheat (*Melampyrum pratense*) was recorded. Their pollen grains were found in the discussed portion of the diagram.

The group of human activity indicators comprised single pollen grains of hop/hemp (*Humulus/Cannabis*). Pollen grains of hemp as a cultivated plant occur in pollen diagrams from Central and Western Europe only in the Roman period (Dörfler 1990). Earlier finds of the type *Humulus/Cannabis* can be interpreted as pollen grains of hop, which is an apophyte and grows naturally in forest and meadow complexes and in wet areas (Zarzycki 1984).

The most direct indicator of human economy is the presence of pollen grains of cultivated plants in diagrams. In the layers of deposits synchronized with the Early Bronze Age there are usually not very many of them. Cereal pollen grains (*Cerealia*) are known from single specimens mainly because the species that were cultivated then – wheat and oats – belong to weak pollinifers. A high content of cereal pollen grains can be observed in settlements only in the Roman period due to rye (*Secale*), which is strongly polliniferous. Frequently, its share in a diagram reaches a few percent of the sum of pollen grains of trees, shrubs and herbaceous plants (Behre 1992).

On the basis of palynological indicators it can be claimed that the main strategies of obtaining food by the TH populations inhabiting the settlements at Rybiny were animal raising and cultivation of cereals. Plant products obtained by cultivation were supplemented by the gathering of elder fruit (*Sambucus nigra*) and hazel nuts (*Corylus avellana*).

C.3. REGENERATION OF PLANT COVER AFTER THE "TRZCINIEC" SETTLEMENT PHASE

The abandoning of the microregion by the TH community brought about gradual regeneration changes in the plant cover although the diagram continues to show human activity (Figs 8–9). The share of forest communities increased again. These were mixed deciduous forests with the oak, hornbeam, elm and hazel and

a high incidence of the pine. The birch, as a pioneering and photophilous species, took over the areas that had been abandoned by people, hence a rise of its curve in the diagram. The share of the birch declined soon, however, with the pine taking on a dominant role. *Pinus sylvestris* is believed to be a photophilous species, with modest soil requirements and capable of adapting to a wide range of habitats. It grows on sandy soil and high bogs where habitats are deficient in mineral nutrients. Occupying also fertile stands in mixed forests, the pine grows next to deciduous tree species that have higher edaphic requirements (Przybylski 1993). It is this wide range of ecological adaptation and the facility of pollen grain and seed transportation that make the Scotch pine a pioneering species. In the regeneration phase of tree-stands the pine had invariably a large share with its role gradually declining later (Milecka 1998a).

The incidence of primary species of deciduous trees (*e.g.*, hornbeam and oak) was relatively low with the linden marking its presence only with single pollen grains. This image is primarily related to the local character of the pollen diagram. It reflects, in the first place, the history of vegetation in the immediate vicinity of the site and the river valley, only to a lesser degree does it illustrate regional vegetation represented by mixed deciduous forests prevailing on the Kujawy Plateau and the Kujawy Lake District. Despite its local character, the diagram captures the main directions of changes and proportions of individual tree species. Besides the already mentioned expansion of the pioneering pine, a further decline of the hornbeam curve is noticeable. This phenomenon may be related to the competition of the hornbeam (*Carpinus betulus*) and the hazel (*Corylus avellana*).

Human activity, although less intensive, continues to be visible in the diagram. Ruderal plants like the motherwort (*Artemisia*) and goosefoot (*Chenopodiaceae*) continue to be recorded albeit in greater dispersion. A decline in the incidence of cereal (*Cerealia*), sheep's sorrel (*Rumex acetosa/acetosella type*) and small plantain (*Plantago lanceolata*) pollen grains is recorded whereas a rise in the share of rye pollen grains (Secale) is noticeable. These indicators of human activity provide evidence of a further penetration of the valley of the Złowiączka by Bronze Age societies (early phase of the Lusatian Culture). In the phase defined as the regeneration stage, settlement was not that intensive but cereal pollen grains and cereal weeds (chenopodiaceous plants, rye, cornflowers) testify to permanent habitation in the valley. There also appear pollen grains of the blue cornflower (*Centaurea cyanus*). This is a common cereal weed occurring in winter crops which is relatively rarely recorded in pollen diagrams from early cultivation periods. It should be remembered, however, that weed communities associated today with a specific crop type have developed with time and the increase in intensity and diversity of crops. Therefore, it is not always possible to directly transfer contemporary relationships to periods going back several thousand years.

In sum, it can be claimed that after the withdrawal of the TH society the area surrounding the site remained partially deforested and due to further, however less intensive, penetration, was slowly undergoing regeneration changes. Consequently, open communities were gradually replaced with mixed tree-stands of increasing density. The process of forest cover regeneration was the quickest in the interior of the Kujawy Plateau and slower in local areas in the valley of the Zgłowiączka. Local communities were subject to stronger man-induced influences as well as the impact of the river (varying water levels). Outside of the river valley, environments abandoned by men were taken over by pioneering species, first the birch and then the pine. Regeneration affected communities of mixed forests with the oak, hornbeam, elm, linden and hazel. However, this re-expansion of such forest communities is poorly reflected in the pollen diagram due to its local character.

D. ATTEMPT AT INTERPRETATION OF CHANGES

While observing the "Trzciniec" settlement phase certain regularities were found concerning the occurrence of indicators of man-induced changes and corresponding types of natural environment exploitation. Initially, only indicators of human presence were found, *i.e.* ruderal plants pointing to penetration and passive use of the environment. Next, there appeared in succession pollen grains indicating a specific type of economy. The presence of the small plantain (*Plantago lanceolata*) and sheep's sorrel (*Rumex acetosa/acetosella*) testifies to annual animal grazing in the river valley. Only a few years' activity of this kind could cause such extensive changes in the floral composition of plant communities. Finally, there appeared cereal pollen grains (*Cerealia*) and field weeds: the blue cornflower (*Centaurea cyanus*) and rye (*Secale*). Successive appearance of specific groups of pollen indicators suggests a definite succession of changes of the economy of the TH2 societies.

The first period when the societies arrived in the river valley and only set out to subdue the area is marked by the presence of ruderal species: the motherwort (*Artemisia*) and chenopodiaceous plants (*Chenopodiaceae*). In our climatic zone these plants, especially? (*Artemisia campestris*), the wormwood (*Artemisia absinthium*) and goosefoot, popularly known as pigweed (*Chenopodium album*) accompany households and crops and grow on fallow land and road sides. In areas affected by human activity, they spread very quickly finding there favorable growing conditions.

The appearance of meadow and pasture plants, namely the sheep's sorrel and small plantain, in the next stage reflects the domination of an economy based on animal raising. It is then that the highest incidence of coal dust can be recorded,

which testifies to increasing deforestation with fire. This may mean that the population inhabiting the river terrace initially occupied themselves with animal raising which met their basic subsistence needs. This phase should be identified with the period of mobile settlement of "Trzciniec" ("proto-Trzciniec" populations – Kośko 1979; Czebreszuk 1996; Makarowicz 1998) preceding the founding of both settlements at Rybiny. The investigated societies must have used specific habitats a number of times. Any chance to stay longer in a given place was offered only by those environments whose potential allowed to effectively supplement the animal raising economy with assimilating methods (hunting, fishing, gathering).

However, due to long-term grazing certain limitations appeared resulting from floral and phyto-sociological changes. They made it necessary to constantly seek new pastures, more and more distant from their settlements and the river valley. On the other hand, the strategic location in a peculiar paleohydrological hub (providing connections to the drainages of the Vistula and Oder), favorable habitat conditions and the abundance of resources along the Zgłowiączka were among the factors that made TH groups stay longer in this region. This peculiar dialectic of wishes and possibilities brought forth a successful attempt at changing to a more settled (less mobile) way of life. What this really meant was at best a few decades' stay in the investigated area owing to a wider use of cereal crops and assimilating methods (chiefly fishing). Only in the phase taking place after the period of the maximum incidence of pasture plants in the diagram is the ever more increasing seeding of cereal plants recorded. It is evidenced by a gradual rise of the curve for pollen grains of cereals and weeds. This innovation was not a simple idea that was implemented in one year. It must have taken many years. Nevertheless, the results must been favorable, therefore encouraging more effort. Animal raising continued to be a substantial source of food but agriculture, specifically sowing of cereals, offered a possibility to further exploit the occupied territory and to use its economic potential more effectively.

As a consequence of these processes, "Trzciniec" populations – next to shack building – began to erect permanent living structures that lasted from a few to a dozen or so years (settlements at Rybiny, site 14 and site 17). A change in the way of life and obtaining subsistence must have resulted in the growth of these populations. The stabilizing of settlement in a natural way encouraged families to combine into larger communities: *village groups* and *microlocal groups*. Thus, the original cause behind the concentration of TH groups was undergoing a modification: besides blood ties the principle of common territory was gaining in importance. This must have been the beginnings of the process of transformation of *kinship* structures into typical *village* and *local groups* as we know them from the development period of the Lusatian Culture. It is hard to say what impact had the said change of settlement and economic customs on the group's ideology. It seems

that the change did not cause any fundamental modifications in mentality. Traditionally *quasipastoral* "Trzciniec" groups continued to live a life dominated by the ideology (ethos) of animal breeders with its extensive symbolism and rich ritual (*e.g.*, tumulus building).

To sum up, it can be said that the described relationships between TH groups and the natural environment caused a gradual transformation of many aspects of their life. These changes are most readily observable in these spheres of human activity that are relatively easily assessable by archaeological means, namely economy and settlement. "Trzciniec" communities, availing themselves of the opportunities offered by the environment, actively contributed to changes in the plant cover and – indirectly – in the whole landscape. Excessive exploitation of the occupied territory with subsistence based solely on animal raising triggered a number of detrimental ecological factors. They, in turn, brought about changes in the way of life and economy of groups of humans. It can be assumed that the ecological values of the microregion on the Zgłowiączka were attractive enough to guide, to a large extent, the "Trzciniec" populations in making specific choices despite an ever increasing number of man-induced changes in the region.

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