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FRESHWATER SHELLFISH AS ARCHIVES IN RECONSTRUCTING SUBSBISTENCE STRATEGIES OF NEOLITHIC COMMUNITIES AND LOCAL, REGIONAL ENDOWMENTS OF THE RIPARIAN ENVIRONMENT IN THE CARPATHIAN BASIN

THESES OF DOCTORAL DISSERTATION

by

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Introduction, research aims

Foraging is among the most ancient subsistence forms characterizing human communities before 10 kys in general. However, the introduction of farming and herding by no means meant a complete disappearance of this lifestyle among the very first food-producing societies. Foraging must have remained an important part of daily subsistence, probably because flexible opportunistic agricultural systems, like reliance on multiple resources aimed at diversifying landscape capital, offers an advantage of greater economic security if there are fluctuations in the weather, water supply, or during periodic die-offs of crop yields. Fluctuations in available food sources are most likely the result of a complex interplay of various environmental (climatic) and social (behavioral) factors. Rapid or sudden deterioration in natural endowments may put forth an increased reliance on second-line resources in subsistence like foraging or hunting. The nature of responses deployed to these is dependent on the level of resilience or vulnerability of the given society seen in its ability to face changes. This is mainly determined by cultural and productive experiences gained and stored in the collective living memory of society and passed on from generation to generation. It entails the knowledge of local endowments and the distribution of potentially available subsistence resources including second-line resources, which can easily be brought online in case of a socio-economic crisis. It also determines whether or not environmental perturbations are less harmful perhaps even advantageous, or devastating for social development. In case of a more conservative group, a long-term addiction

to cultural roots and subsistence patterns not quite suited to the new environment renders less flexibility in adaptation, and as such major perturbations may be devastating. The introduction of second-line resources like freshwater mollusks may refer to a response given to such perturbations.

According to the archeology, exploitation of riparian environments, including hunting-fishing-gathering, was a characteristic subsistence form in Hungary during the entire Neolithic, probably because freshwater fish and shellfish was a relatively constantly and easily available source of protein for communities settling on the alluvial plain of the Tisza. Freshwater mollusks collected by humans characterize the quality of the water body from which they derive. Furthermore, they are also an excellent marker of socioeconomic response to environmental stress as alternative food sources.

The major aim of our work was to elucidate the local endowments of riparian environment along the River Tisza and its major tributaries for the Neolithic via the analysis of freshwater mollusks retrieved from some Early and Late Neolithic archeological sites. These results then were regionally extended via the comparison of data gained for the individual sites of the same period. Finally, where sampling allowed, potential temporal transformations in the local and regional alluvial environment was also assessed. The observed pattern in the gained proxies expressing the endowments of the riparian environment on the one hand, and the role of freshwater shellfish in subsistence and other social, economic activities was used to interpret the role of second-line aquatic resources in

the lives of the referred agricultural groups. Furthermore, an attempt was made to elucidate how the observed temporal fluctuations in the physical and chemical properties of fluvial and floodplain environments influenced the settlement and subsistence strategies of Neolithic communities in the Carpathian Basin on a local and regional scale.

According to the available archeological and paleoenvironmental data, the period of the Middle Holocene, generally known as the Holocene Hypsythermal or Holocene Climatic Optimum, was characterized by several minor climatic perturbations. These perturbations have been correlated with cultural transformations in several parts of the world. Similar cultural, developmental transformations were documented for communities of the Early Neolithic Körös culture and Late Neolithic Tisza culture of the Carpathian Basin. Another question to test was whether or not the potentially observed transformations in the riparian environment can be linked to the cultural transformation of the first farming groups with Mediterranean roots in the Carpathian Basin. Or the economic and cultural development as well as transformations in the settlement pattern of the Late Neolithic Tisza culture. Finally, if these transformations in the local and regional endowments of the floodplain of the Tisza River are attributable to major climatic, environmental perturbations observable at the scale of the entire basin or the entire continent.

Materials and method

Three Körös sites, located along the boundary of the culture's northern distribution, where signs of cultural transformation had been observed, was subjected to analysis: Nagykörü-Gyümölcsös, Tiszapüspöki-Karancspart-Háromág, Ecsegfalva 23B. The first site is of outstanding importance regading our research work as sampling allowed for studying conditions during the first settlement phase and the assumed period of cultural transformation. The final site dated to the period of cultural transformation enabled us to elucidate patterns observable on a regional scale along with potential background sources. Similar studies were implemented in two Late Neolithic Tisza culture tell sites from the SE Great Hungarian Plains (Hódmezővásárhely-Gorzsa, Szegvár-Tűzköves), which entailed the entire period of cultural development from its birth to the transition to the Early Copper Age.

Faunal changes observable in the archeological material must be attributed to various factors, if we appreciate the human or cultural context of the material. Abundance of certain faunal elements in our freshwater shellfish material is the outcome of the complex interplay of various biotic (predation including humans) and abiotic ecological components (substrate conditions, hydraulic parameters, water temperature, pH, bioproduction, sediment accumulation etc). Thus changes observable in faunal abundances can indicate subsistence change and resource selection resulting from increased foraging pressure on the one hand. On the other hand, environmental change can also reduce the abundance of certain faunal elements independent of human predation.

Thus to resolve issues of temporal change observable in the studied archeofauna a complex analysis of several lines of information is needed. To achieve this goal a new multi-proxy paleoecological analytical method was developed based on the collective handling of faunal taxonomic and demographic data as well as the geochemistry of the shells along with information on taphonomic bias and role of shellfish in both subsistence and other type social, behavioral activities. As a first step the main physical and chemical properties of fluvial and floodplain aquatic habitats (substrate conditions, hydraulic parameters, water temperature, pH, bioproduction, sediment accumulation) surrounding the site was reconstructed based on the analysis of faunal abundance, ecological and geochemical data. Then a local and regional reconstruction of the riparian environment was given highlighting potential regional differences, temporal transformations as well as background causes. The received pattern was then interpreted in the light of cultural, economic and human behavioral patterns gleaned partly from the archeology of the sites and proxies gained via the analysis of taxonomic and demographic composition of the studied faunas reflecting foraging strategies. Finally, potential alterations inferred for the local natural shellfish population as a result of foraging strategies employed was also assessed.

Thesis points highlighting the most important results

1. Via the introduction of a multi-proxy quantitative analysis of freshwater mollusks retrieved from archeological sites a new paleoecological model for reconstructing the endowments of the riparian environment was developed.
2. For the construction of the referred model, quantitative and taphonomic parameters adopted for the first time in Hungarian archeomalacological research from the international literature were introduced. It was complemented by a multivariate statistical analytical method enabling the retrieval of proxies describing the most important ecological parameters of aquatic habitats hosting the studied freshwater mollusks.
3. The role of second-line aquatic resources such as freshwater shellfish along with foraging strategies employed was interpreted in the framework of foraging models adopted from human ecology. According to my findings, the referred resources gained increased importance in the subsistence of the referred Neolithic communities parallel with the inferred transformations in the local riparian environment around the study sites.
4. In order to gain a better picture on foraging strategies employed and assess the dietary contribution of freshwater shellfish targeted a new biometrical method was deployed enabling the introduction of fragmentary shells into the statistical evaluation. Shell fragments, which generally give the major part of our study material, were previously left out of quantitative analysis due to the lack of adequate regression models.

5. The newly gained proxies describing the physical properties of aquatic habitats hosting the targeted shellfish fauna on the floodplain were used to identify major flood cycles during the Early and Late Neolithic in the local and regional watershed of the Tisza river.
6. A new analytical method based on the recording of selected trace elements used as proxies for describing the chemical properties of freshwater environments in freshwater mollusk shells, previously not applied in paleoecological and environmental historical analysis in Hungary was introduced. A comparison of the gained results between our study sites of similar endowments and with those available for the modern fauna from the literature enabled us to accurately assess the past chemical properties of the studied aquatic habitats. This type of approach also enabled the exact determination of the source habitats in a setting of multiple ecotones characterizing floodplains, regardless of location and foraging strategy employed. The pattern and fluctuations expressed in the inferred chemical parameters or proxies were identical with those gained for the physical properties of freshwater habitats. This way influences of major flood cycles identified previously could have been corroborated independently.
7. The inferred transformations of the referred riparian environment around the sites were correlated with data on the archeology and zooarcheology of the studied Early and Late Neolithic sites. According to my findings, these changes must have significantly contributed to the social and economic development, as well as local and regional environmental adaptation of the studied Early and Late Neolithic communities besides other social, cultural factors.

8. According to my findings, the period of initial settlement of the Körös culture was characterized relatively calm conditions on the floodplain, hydraulically speaking. This was followed by a period of intensified flooding dated to the assumed period of cultural transformation, which was correlable with the so-called Holocene 5.1 climatic perturbation event.
9. Flood cycles identified for the period of the Tisza culture could have been correlated with the emergence of settlement phases, sub-phases and occupation levels as well as peaks of freshwater shellfish harvest. This result further corroborates the statement given in point 7.

Publications presenting the results of the dissertation:

SCI peer-reviewed articles

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2. Kaszaper lelőhely puhatestű faunájának archeomalakológiai vizsgálata. Jelentés a Táncsics Mihály Múzeum, Orosháza részére
3. Gyula-2 lelőhely puhatestű faunájának archeomalakológiai vizsgálata. Jelentés a Táncsics Mihály Múzeum, Orosháza részére
4. Balatonöszöd-Temető-dűlő rézkori lelőhely puhatestű faunájának archeomalakológiai vizsgálata. Jelentés az MTA Régészeti Intézet, Budapest részére

Short film

1. A Kucorgó-halom bronzkori lelőhely édesvízi kagylófaunája, ***DELTA, MTV 1***. ***Magyar Tudomány Napja Különkiadás,*** 2006.11.03. 11.30., rövidfilm Sümegi Pállal közösen

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3. **Sándor Gulyás**- János Geiger- Albert Tóth- Miklós Szónoky- István Cziczer -Mihály Gasparik: The formation of a crevasse-splay and its geological and ecological implications after a major flooding event in river Tisza, Hungary *XVI. INQUA Congress, Reno*, USA, 22-31/07/2003., poster, abstract
4. **Gulyás Sándor** - Tóth Anikó - Sümegi Pál - Horváth Ferenc:Miről mesélhetnek az édesvízi kagylók egy késő neolit tell közösség életéből? A 2004-es zaragozai archeometriai találkozó előadásának bemutatása- *Archeometriai Műhely, Budapest* 21/09/2004, poster presentation

5. **Sándor, Gulyás** – Pál, Sümegi: Studying shellfishing in Neolithic Hungary: an overview of the applied methods and some local examples, *EPOCH ARCHEOLINGUA International Workshop on Archaeological and Cultural Heritage Preservation within the Light of New Technologies, Százhalombatta* 27/09-02/10/2004, invited presentation, abstract
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7. Pál, Sümegi-**Sándor, Gulyás**: Mollusk jewelleries from prehistoric Hungary, *ICAZ Archeomalacology Working Group Meeting, Gainesville*, Florida 17/02-19/02/2005, poster, abstract
8. Miklós Szónoky-**Sándor Gulyás**: Mollusks in Provenance studies of Hungarian building stones and bricks from the SE Great Hungarian Plains *ICAZ Archeomalacology Working Group Meeting, Gainesville*, Florida 17/02-19/02/2005, poster, abstract
9. **Gulyás,Sándor**- Sümegi, Pál: Kagylógyűjtés a neolitkori Magyarországon- az alkalmazott környezetrégészeti célú archeomalakológiai vizsgálatok módszerei és néhány példa, *Magyar Biológiai Társaság Ülése*, Budapest, 04/05/2005, oral presentation
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11. **Gulyás Sándor**: Matematikai-statisztikai módszerek és alkalmazásaik a környezetrégészeti célú archeomalakológiai vizsgálatokban. *VIII. Geomatematikai Ankét , Mórahalom*, 2005. május 20-21. oral presentation, abstract
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17. **Sándor Gulyás**-Pál Sümegi-Róbert Kovács: Procurement of freshwater shellfish during the Late Neolithic: a quantitative archeomalacological study of a tell site from SE Hungary. *13th Annual Meeting of the European Association of Archeologists*, Zadar, Croatia, 2007.09.18-23., poster, abstract
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21. **Gulyás, S**- Sümegi P: Mollusks as environmental archives for the Quaternary- TERRAREACT workshop, Hohenheim University Stuttgart-Germany- invited presentation 2008.11.30-12.03.
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