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Paleoparasitological analysis of soil samples from the Kikki-Akki burial ground of the 17th–19th centuries in West Siberia, Russia

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ABSTRACT

This paper presents paleoparasitological results from the Kikki-Akki burial ground dating from 17th to the early 19th centuries. Examination of sacrum projection and sacral foramina samples revealed helminth eggs of *Diphyllobothrium latum*. It proves that the Taz Selkups consumed thermally untreated or slightly treated fish. A high rate of Diphyllobothriasis in the contemporaneity Selkup group in the area under study points to a continuation of the same dietary habits.

This study estimated parasite prevalence rate in the Taz Selkup population who used the Kikki-Akki burial ground, and attempted to reconstruct early humans' dietary habits and health status. Presence of helminth alternate hosts in different geographical locations allowed us to reconstruct human migration paths in West Siberia.

1. Introduction

The objective of this paper is to present the paleoparasitological analysis of the soil samples collected from the Selkup archaeological site Kikki-Akki. We determine helminth infection sources and infer the Taz Selkups dietary habits and health status, as well as likely migration patterns of the Taz Selkup population.

The soil samples analyzed in this paper were collected from the human burials excavated from Kikki-Akki archaeological site, located in the north-east of West Siberia (Tyumen Oblast, Yamalo-Nenets Autonomous Okrug, Krasnoselkupsky District) (Fig 1). Excavation of this site in 2013 revealed six bone chambers with 10 human bodies. Burial type and funerary inventory suggest of excavation in 2014 suggests that the burial ground dates from the late 17th to the first half of the 19th centuries. The funeral garments and goods indicate that the buried individuals belonged to the Taz (northern) Selkup group (Poshekhonova, 2013).

The Selkups are a small ethnic group living in West Siberia. They are considered to be descendants of the Kulayskaya archaeological culture which existed in the Middle Priobye region from 500 BC to AD 500 (Chindina, 1984, 1991; Vasiliev, 1994). The successors of the latter one were the Ryolkinskaya archaeological culture of the 6th–8th centuries. Many aspects of the Kulayskaya material culture are similar to those in the modern Selkup group. Along with the Nenets, Enets and Nganasan, the Selkup language belongs to the Samoyedic language group that falls within the Uralic language family.

The contemporary Selkups are divided into southern (Narym) Selkups and northern (Taz-Turukhan) Selkups. The first group inhabit Middle Priobye region. The second one is considered to be descended from the southern Selkups who migrated to the Taz and Turukhan river basin in the 17th–18th centuries. The Selkup subsistence activities include all-year-round fishing, elk and deer hunting, fur and feather hunting, deer farming, herding of up to 15 deer during summer, as well as wild berry and pine nut gathering (Golovnev, 1993).

The Taz Selkup ethnic group has not been well studied by archeologists and paleoparasitologists. The Kikki-Akki burial ground hitherto remains the single archaeological site that may broaden our knowledge about the Taz Selkup group. Paleoparasitological analysis of early human populations allows us to reconstruct paleodiet, subsistence strategies, household activities, sanitary condition, and health status. Upon the investigation results we may estimate parasitic infection frequency in human populations and trace human migration patterns in different historical periods (Reinhard and Araújo, 2008, Reinhard, 1992, Bouchet et al., 2003, Araújo et al., 1998, Honcalves et al., 2003, Sianto et al., 2009).

Paleoparasitological investigation of burial grounds and archaeological sites is rarely conducted in Russia (Fig. 1). Savinetsky and Khrustalev in 1992 presented a paleoparasitological review of the parasites found in the dung depositions in Mongolia (Yaroldzykhtyn Grotto, Yaroldzykhtyn Cave, Dzotol Cave), Middle Asia (Turkmenistan, Kashanka Cave), North Caucasus, and Central Russia (Zamostye 1, Voymezhnoe), dating from as early as 38,000 BC to modern times. Their study showed the presence of the helminth eggs from genera *Nematodirus* sp., Oxyurid (Oxyurida), *Fasciola* sp., *Dicrocoelium* sp.,

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Fig. 1. Location of Paleoparasitological investigations. 1, South Mongolia Yaroldzykhtyn Grotto and Cave; 2, East Mongolia, Dariganga Plateau, Dzotol Cave; 3, Central Mongolia, Unzhulcave; 4, Middle Asia, Turkmenistan, Kashanka Cave; and 5, North Caucasus dung deposits. Archeological sites in the Moscow region. 6, Zamostye 1, 2; 7, Voymezhnoe analyzed (Savinetsky and Khrustalev, 2013) and Kikki-Akki.

Trichuris sp., *Capillaria* sp., *Diphyllobothrium* sp., *Opisthorchis felineus*, *Alaria alata*, and *Dioctophyma renale*. The diversity of helminths in the animal dung provided insight into the food patterns of the early people in the aforementioned regions. It also revealed information about the early practices of animal farming in those regions (Savinetsky and Khrustalev, 2013).

Paleoparasitological investigations have recently been conducted on soil samples from archaeological sites in West Siberia. Archaeological excavations were carried out in Mangazeya which has been the first Russian settlement in the Arctic Circle from the 17th century. The eggs of *O. felineus*, *Diphillobathrium latum*, *Trichocephalus* sp., *Toxocara canis*, and *Fasciola hepatica* were found in soil and animal coprolites. Not without interest is the fact that the soil and animal coprolites showed a high opisthorchiasis rate (Vizgalov et al., 2013).

Paleoparasitological analysis of dog coprolites from Maray I settlement, located in the forest-steppe zone of West Siberia, Russia, revealed larvae of *Strongyloides papillosus*, *Strongyloides westeri*, and *Strongyloides stercoralis* (Zach et al., 2011). Maray I settlement dates to transition from the Bronze Age to the Iron Age (2645 ± 30 BP) (Tsembalyuk, 2013). Dogs likely contracted these helminthes by eating culled animal hides and cattle viscera. Presence of *Opisthorchis* eggs in the coprolites is evidence that dogs consumed raw Cyprinid fish.

Paleoparasitological study has not yet been performed on archaeological sites left by indigenous Arctic ethnic groups in West Siberia. Here, we introduce paleoparasitological results from the burial ground of the Taz Selkup people.

2. Materials and methods

Soil samples were collected from the pelvic girdle and sacral foramina of human remains from burials 1, 2, 4/1, 4/2, and 5/1 and from an estimated pelvic region of other burials. Since in burials 5/2, 13/1, 13/2, 13/3 the sacrum and hip bones were completely decomposed, the soil samples were collected from where the sacrum must have been located based on position of other bones. Each sample weighed about 50 g and was vacuum-packed in the field. We took a soil control sample from the area between the individuals in burials 13/1 and 13/2. Burial 3 was excluded from the study, since the skeleton had been moved and the soil strata had been shifted during the burial ground pitting in 1998, so that the skeleton position was distorted (Fig 2).

In the laboratory, we placed a dry 8-gram sample into a beaker and added a 3% sodium hydroxide solution till it covered the sample completely. After the sample rehydrated, we removed any plant fragments and sifted it through a 0.5 mm sieve. In an hour and a half, the obtained material was gathered in a plastic centrifuge tube. The tubes were then centrifuged for 7 min, distilled water being added to achieve neutral pH level. After the tubes were decanted, there remained not more than 1/3 residue to which we added a rich sodium nitrate solution (1.38–1.40 g/cm^3). Sample separation was performed in the centrifuge tubes. We poured the float fraction with the supernatant fluid into the beaker, filled it with distilled water, and allowed it to settle. Then we carried out multiple centrifuge process, the float fraction was gathered in the centrifuge tube. After dehydration glycerol was added to the resulting fraction.

Since there were a few floating organic particles in the supernatant fluid, we prepared slides from the supernatant as well.

Microscopic examination was conducted using AxioSkop 40 and MicMed 2 var.2 microscopes under 80× and 400× magnification. For measurement, AxioVision 4.6 and Scope Photo 3.0 software were used.

3. Results

During examination of samples from bodies of two children (burials 13/2 and 13/3) and a young male (burial 1) we found oval light brown eggs, several of them were operculated (Fig. 3.). A small prominence was observed opposite the *operculum*. The egg average diameter was 82, 1–62, 4 μm × 66, 1–37, 8 μm (Table 1). Relying on these morphological characters, we infer that the eggs belong to the fish tapeworm genus