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Remains of the Peipsi *lodi* near Kuru village

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INTRODUCTION

In December 2017, the remains of a wooden clinker built ship with a flat bottom identified as Peipsi *lodi* had been cast ashore by recent storms on the northern shore of Lake Peipsi near Kuru village. Parts of the wreck had been strewn along a two kilometres long stretch of the coast (Fig. 1). In order to protect the remains of the vessel from waves and avoid them being carried back into deeper water, the parts were lifted out of the water to a higher section of the shore by the local people. During the summer of 2018, a compact detail of planking of the same wreck was exposed on Kuru beach. Documentation of the finds using photographic recording and photogrammetry, and taking samples of wood for dendrochronological analysis took place in 2017–2018 by the National Heritage Board.

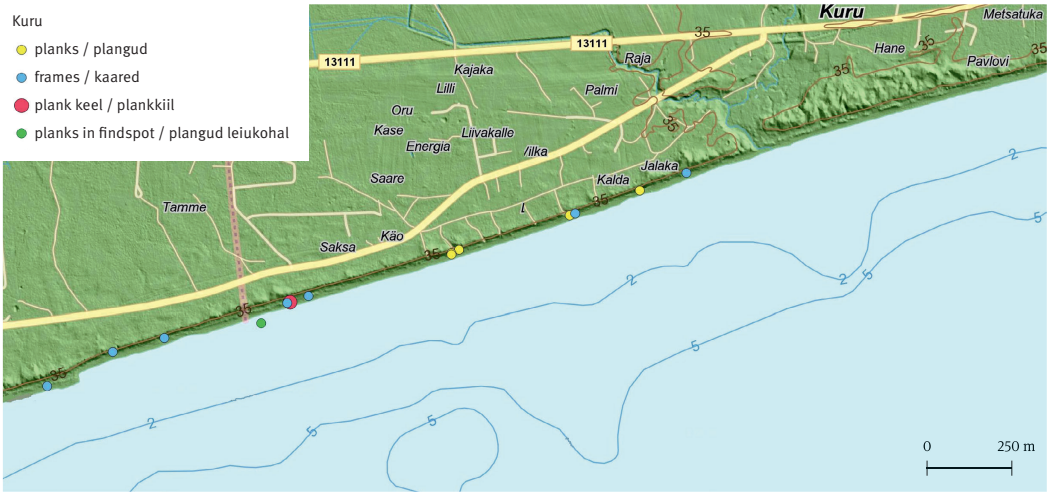

Fig. 1. *Location of the wreck parts.*
Jn 1. *Vrakiosade leiukoha plaan.*
Base map / Aluskaart: Estonian Land Board / Maa-amet, täiendused / additions: Maili Roio

Fig. 2. *Transportation of the wreck remains from the site of discovery to Rannapungerja harbour.*
Jn 2. *Laevajäänuste transport leiukohast Rannapungerja sadamasse.*
Photo / Foto: Maili Roio

Fig. 3. *The bottom part with a plank keel.*
Jn 3. *Plankkiiluga põhjaosa.*
Photo / Foto: Maili Roio

Fig. 4. *Planking of the Peipsi lodi.*
Jn 4. *Peipsi lodja plangutus.*
Photo / Foto: Maili Roio

Most of the wreck was taken to Tartu Lodjakoda – a boatyard for historic ships and barges – in the spring of 2018. The part discovered in 2018, however, although alternately exposed to weather and under sand and water, has thus far been left as it is in its findspot. Transportation of the wreck remains from the site of discovery to Tartu Lodjakoda turned out to be difficult due to lack of access from land with heavy machinery. Larger parts of the wreck had to be transported by water to the closest fishing harbour in Rannapungerja, this was carried out by Tuukritööde OÜ. Winches were used to pull the fragments onto pontoons, which were then towed to the harbour (Fig. 2). In the harbour a special frame was built, which offered structural support to the remains during the lifting and transporting operations.

The exposition of the remains is planned as part of the new building of the Lodjakoda in Tartu, due to open in spring 2020.

REMAINS OF THE *LODI*

The remains discovered in 2017–2018 comprise six larger pieces of planks, 11 frames and a plank keel. The largest piece is a fragment of the ship's bottom together with the plank keel (made of one single log) measuring 22.5 × 1.35 metres (Fig. 3). The planks still connected to each other measure 17.76–17.89 metres in length. The average width of the planks is 30 cm and average thickness 3.5 cm. Planks are joined together by clinker planking, plank seams are caulked with tarred oakum and covered with wooden laths that are attached using iron clamps, the so-called *sintels*. In addition, double-bent iron nails have been used. The nails are located relatively sparsely and irregularly 50 cm to one metre from one another (Fig. 4). The preserved frames are up to 8.80 m long, with a thickness of 21–30 cm. Still attached to the frames are treenails about 5 cm in diameter. The long period of use is evident by the fixes that have preserved on several parts of the ship – again, *sintels* were used for patching.

Even though the storm had scattered the details of the wreck over a remarkably large area, it is evident that all details belong to the same ship. This is determined by the condition of the wood, dendrochronological analysis, the construction method and similar metal fastenings.

DENDROCHRONOLOGICAL DATING OF THE KURU WRECK

Dendrochronological dating of shipwrecks has some specific features (Bridge 2012). The origin of the ship is often not known. Ship timber is specially selected for its shape that makes it difficult to date. Sapwood is often removed from the wooden parts of a ship. It is often complicated to extract wood samples from a sunken wreck. Nevertheless, dendrochronological dating of shipwreck timbers has become a common practice in Europe (Bridge 2011; Daly 2007; Daly & Nymoen 2008; Daly *et al.* 2017). For example, in Estonia we have successfully dated wrecks found in Kadriorg, Tallinn (Roio *et al.* 2016; 2017).

Dendrochronological samples for dating the wreck were taken from the wreck planks (5) and frames (2). Four wood samples did not have a sufficient number of tree rings (less than 50) to be dendrochronologically dated. The widths of the rest of the three tree ring samples were measured in two radii under the microscope Leica S4E and measurement table Lintab in 0.01 mm units, using program TSAP-Win (Rinntech). Besides, the fourth sample was also measured in spite of its short ring-width sequence (48 rings), to obtain the waney edge, i.e. the outermost tree ring under the bark (Fig. 5). Tree species of the measured samples were determined microscopically at 8 × 10 magnification, using microscope Biolam (Wood anatomy). All the samples are of pine wood (*Pinus* sp.). The length of the three measured tree ring series is 68, 63 and 80 years. By visual assessment all these series extend to the waney edge, but we cannot be entirely sure in it because of

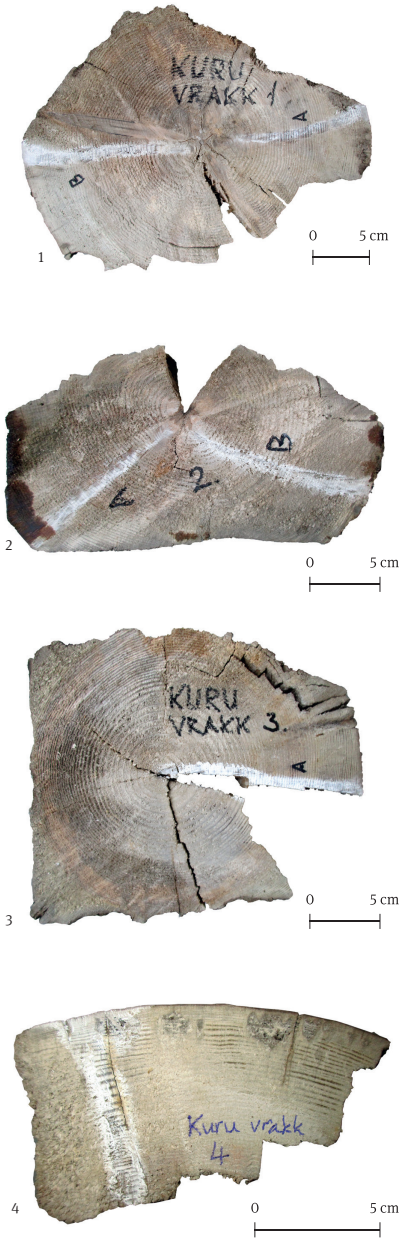

Fig. 5. *Four wood samples from the Kuru wreck. Samples 1–3 were each measured from two radii, A and B. There are 68 tree rings in sample 1, 63 tree rings in sample 2, and 80 tree rings in sample 3. Sample 4 with the waney edge has 48 tree rings.*

Jn 5. *Kuru vraki neli puiduproovi. Proovid 1–3 on mõõdetud kahest vastasraadiusest, A ja B. Proovis nr 1 on 68, nr 2 on 63 ja nr 3 on 80 aastarõngast. Proovil nr 4 koos koorealuse pinnaga on 48 aastarõngast.*

Photo / Foto: Alar Läänelaid

weathering of the wood surface. The presence of the waney edge is essential in determining the exact year of felling the tree (Kaennel & Schweingruber 1995).

The three tree ring series of the wood samples appeared to be similar with each other so that it was possible to average them into a 80-years long mean series marked with a code *2epkru03*. In averaging it was clear that the last ends of the three series differ by one year from each other (Fig. 6). It means that at least two of the samples have no waney edge, as the outermost tree rings have been weathered off. In this situation it was important to measure the additional fourth sample, hoping to establish the real waney edge. Synchronizing the series of the fourth sample with the rest, it appeared that it had just one more narrow tree ring in the end. As the outer surface of this sample is smoothly curved, is this the true waney edge. Knowing the waney edge is essential to establish the exact felling year of the trees. The felling year in its turn indicates the possible earliest term of use of the wood.

Comparing the average tree ring series of the Kuru wreck, *2epkru03*, with pine chronologies of Estonia and some neighbouring countries (altogether with nearly one hundred reference chronologies) in program TSAP-Win, it appeared that the series of Kuru wreck is most similar to a number of Estonian tree ring chronologies, all showing the last ring of the analysed samples from the Kuru wreck being formed in 1907 (Table 1, Fig. 7). It is noteworthy that the compared Estonian pine chronologies extend back to AD 1111 (Läänelaid & Eckstein 2003; Läänelaid *et al*. 2012). Now, when we take into account the tree ring series of the wood sample no 4, the latest tree ring of the Kuru wreck has to be related to **AD 1908**. This is the dendrochronological date of Kuru wreck samples with the waney edge.

The dendrochronological date indicates the last year when the tree has grown and formed a tree ring before felling. Usually tree cutting was carried out in winter. According to common practice unseasoned (raw) wood was used for buildings in Estonia (Meikar & Nurk 1999). We have no ground to assume a different practice in shipbuilding, as raw wood was much easier to bend and to treat with carpenter tools for ship details than seasoned timber. In this premise the Kuru ship was built of raw timber in the warm season of 1909.

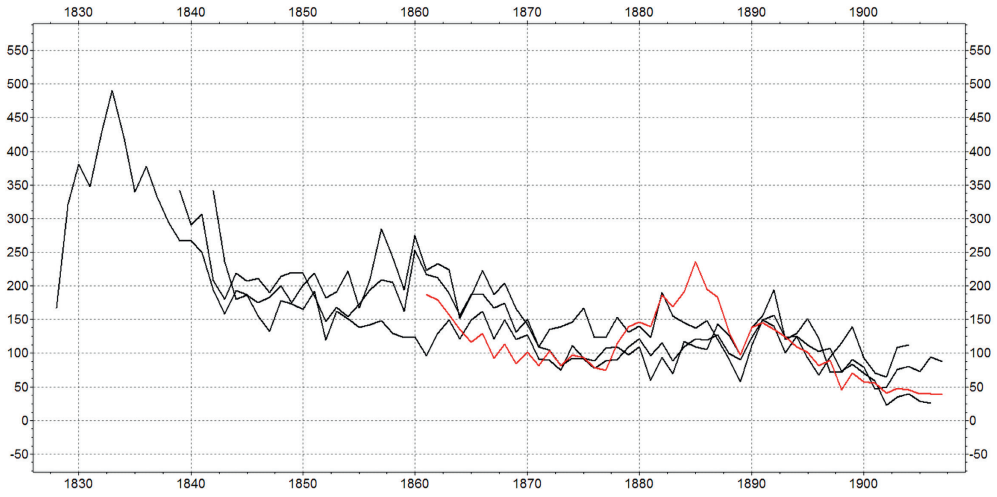

Fig. 6. *Tree ring widths of the four wood samples in synchronous position. The ring-width series of sample 4 is shown in red. Abscissa – calendar years, ordinate – tree ring widths in 0.01 mm units, linear scale.*

Jn 6. *Kuru vraki nelja puiduproovi aastarõngalaiuste read sünkroonselt ajateljel. Punane joon – proov nr 4 aastarõngalaiused, koorealuse puidupinnaga. Rõhtteljel kalendriaastad, püstteljel aastarõngalaiused 0,01 millimeetrites. Drawing / Joonis: Alar Läänelaid*

Table 1. *Cross-dating results of the Kuru wreck series (Sample) with selected references (Ref.) covering the 19th–20th century. OVL = overlap, Glk = Gleichläufigkeit, %CC = cross correlation, TV = t-value, TVBP = t-value Baillie Pilcher, TVH = t-value Hollstein, DateL = left (earlier) end date, DateR = right (later) end date of the sample series (TSAP 1989–1996).*

Tabel 1. *Kuru vraki kolme puiduproovi keskmise aastarõngalaiuste rea 2epkru03 kõrgeima sarnasusega positsioonid võrdluskronoloogiatega. Sample – vrakirida, Ref. – võrdlusrida, OVL – ridade kattuvus, Glk – samasuunaliste muutuste protsent, %CC - ristkorrelatsioon, TV – t-väärtus, TVBP – Baillie-Pilcheri t-väärtus, TVH – Hollsteini t-väärtus, DateL – vrakirea varaseima aastarõnga aasta, DateR – vrakirea hiliseima aastarõnga aasta (dendrokronoloogiline dateering).*

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TSAP CROSS-DATING     DATE: 2018.04.06 TIME: 15.27
Check dates of sample and references:
Chrono signature conditions: Density>4 / Internal Glk>75
Results listed for one sample and all references.
List 99 best matches.
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Sample	Ref.	OVL	Glk	%CC	TV	TVBP	TVH	DateL	DateR
2epkru03	3epl2901	69	77	92	18,7	5,6	6,8	1828	1907
2epkru03	3EPMUV02	80	72	91	19,4	5,3	5,7	1828	1907
2epkru03	3EP242AV	80	73	-19	1,7	3,9	5,1	1828	1907
2epkru03	3EP281AV	80	72	-23	2,1	3,8	5,2	1828	1907
2epkru03	3EPRSD02	80	72	8	0,7	3,4	4,7	1828	1907
2epkru03	3EPMUA02	80	72	67	8,0	3,9	4,1	1828	1907
2epkru03	3EP292AV	80	70	-29	2,7	3,4	4,8	1828	1907
2epkru03	3EPRSDCR	80	75	7	0,6	3,0	4,5	1828	1907
2epkru03	3epave02	80	67	-1	0,1	3,4	4,4	1828	1907
2epkru03	3EPALAJA	80	66	-27	2,5	3,3	4,6	1828	1907
2epkru03	3epestcr	80	67	-22	2,0	3,2	4,3	1828	1907
2epkru03	3EP290AV	80	71	-26	2,4	2,8	4,0	1828	1907
2epkru03	3EPVOR01	80	66	70	8,7	3,0	3,5	1828	1907
2epkru03	3EPJAR12	80	62	49	5,0	2,9	4,2	1828	1907
2epkru03	3EPPYH02	68	60	70	8,1	3,4	4,0	1828	1907
2epkru03	3EPTAA06	62	69	77	9,5	2,7	3,5	1828	1907
2epkru03	3EPPYH03	70	63	80	11,2	3,4	3,1	1828	1907
2epkru03	3EPJAR01	80	61	4	0,3	2,7	3,9	1828	1907
2epkru03	3EPMTO01	75	69	48	4,7	2,2	3,1	1828	1907

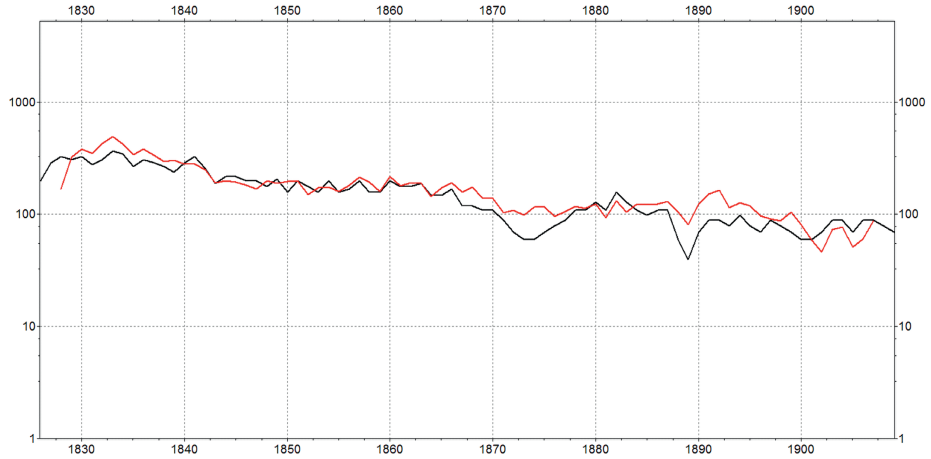

Fig. 7. *Mean tree ring widths (samples 1–3) of Kuru wreck 2epkru02 (red line, AD 1828–1907) in synchronous position with Muike manor (near Palmse) pine chronology 3epmuv02 (AD 1780–1934). Abscissa – calendar years, ordinate – tree ring widths in 0.01 mm units, logarithmic scale.*

Jn 7. *Kuru vraki kolme puiduproovi keskmistatud aastarõngalaiuste rida 2epkru03 (punane joon) sünkroonses asendis Muike karjamõisa (Palmse) valitsejamaja männikronoloogiaga 3epmuv02. Rõhtteljel kalendriaastad, püstteljel aastarõngalaiused 0,01 mm ühikutes.*

Drawing / Joonis: Alar Läänelaid

As the tree ring curve of the Kuru wreck is most similar with Estonian pine chronologies, it is likely that the ship was built of pine trees from Estonia. The most similar pine chronologies come from the northern part of Estonia including the western islands – Muike (near Palmse), Püha (Saaremaa), Taaliku (Saaremaa) and Vormsi. Such a wide geographical area of similar tree ring patterns does not enable us to delimit the exact point of provenance of the timber used for building this vessel. The usage of timber from nearby Russia is not excluded, but we do not possess Russian pine chronologies from the very vicinity of Lake Peipsi. Comparison of the Kuru wreck curve with pine chronologies of Kivach (Raspopov & Shumilov 2000), Otradnoye and Valaam (Lovelius 2000) showed weaker similarity (t = 3.64). These Russian chronologies are still not very trustful, as the chronologies of Otradnoye and Valaam are identical from 1790 to 1999.

THE ORIGIN OF THE WRECK

In 1923 the total of 93 *lodis* were registered in Estonia, in 1930 the number was 74 and in 1940 – 50 *lodis* (Pärna 2004, 92). After WWI, the *lodi* was gradually replaced by smaller barges that were towed by motor vessels.

Comparing the dimensions of the wreck and the construction time of the vessel to the ship register of the Estonian Maritime Administration only a few possible candidates emerge. The most prominent of these is the two masted barge OAT, which according to the register (Eesti laevade register 1930) was built by Jakob Mahov in 1909[1] in Kasepää parish on the shore of Lake Peipus and measured 23.91 by 13.28 metres. The barge OAT was sunk in October 1931 (Eesti laevade register 1931). According to newspaper Postimees, the barge OAT was taken to Kauksi (between Lohusuu and Vasknarva), where it stayed awaiting a cargo of timber, but was overcome by a storm. First the wind dismasted the vessel and destroyed the superstructure. The two crew members on board were in danger of drowning, so they hoisted the anchors and gave the barge to the mercy of the waves. In the darkness of the night the waves carried the barge about one kilometre away, where it ran ashore. The next day it lay in sand approximately 1 metre deep. The damage to the owner was thought to be around 1000 kroons (Torm maal ja merel 1931).

DISCUSSION

Peipsi *lodi* was a merchant ship with a small draft, a big oval shaped hull, characteristic-looking superstructure, a big steering wheel aft, and one or two masts. These vessels were used to navigate Lake Peipsi, and the rivers flowing into it, mostly the Emajõgi. The *lodi* represents a long tradition in inland shipbuilding in the Peipsi region.

First written sources about using the *lodi* on Peipsi originate from the 14th century. Originally, they were used to transport salt and grain and also various mixed goods. The main article in the 20th century was firewood (Moora 1964, 240; Pärna 2004, 91). Until now, the oldest remains of a *lodi* in Lake Peipsi is the wreck that was found near the inflow of the Narva River and was dated to the 14th–15th century. Only one description from 1911 has remained about the find: pine had been used for building the flat-bottomed *lodi*, the planks had been attached to the frame by using wooden nails, and for connecting the planks iron nails and clamps, which are also used on modern wooden ships in the rivers and lakes in Russia, had been used (Glazov 1911, 3–6).

[1] In the 1923 registry (Eesti kaubalaevastiku register 1923) the building year entered is 1912.

The Peipsi *lodi* featured a number of characteristics that can be associated with Frisian shipbuilding traditions or cog-like vessels like clinkered sides with iron clamps and double-bent nails. At the same time, it is not justified to associate the building tradition of the Peipsi *lodi* with the cog-like type that is used in archaeological literature (see Zwick 2013).

The building and evolution of the Peipsi *lodi* is still an open topic, considering that we only have one find from the 20th century and a short description of a wreck find that can be dated to the 14th–15th century. Both finds have similar characteristics regarding building material and the way of connecting the planks. There are many more pending issues regarding the construction and the answers can be found only by studying other archaeological finds in the Peipsi basin.

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PEIPSI LODJA JÄÄNUSED KURU KÜLA ALT

Maili Roio ja Alar Läänelaid

Detsembri alguses 2017 viskas torm Peipsi põhjakaldale Kuru küla alla laevaosasid. Lainetuse ja ärakandumise vältimiseks tõsteti puitlaeva osad veest välja kõrgemale kaldapervele. Vraki dokumenteerimistööd toimusid 2017–2018. Vraki erinevad osad oli torm laiali paisanud ligikaudu kahe kilomeetrisele lõigule (jn 1). Suurem osa vrakist viidi konserveerimiseks ja hoiustamiseks Tartu Lodjakotta 2018. aasta kevadel (jn 2).

Kokku on säilinud kuus suuremat kompaktset detaili plankudest, 11 kaart ja plankkiil (jn 3–4). Kõige suurem detail oli plankkiil mõõtmetega 22,5 × 1,35 meetrit. Omavahel veel ühenduses plankude pikkused on 17,76 kuni 17,89 meetrit. Ühe plangu laius on keskmiselt 30 cm ja plangu paksus 3,5 cm. Klinkerplangutuses plankude ühenduskohad on tihendatud takuga ja kaetud mõlemalt poolt puitliistudega, mis kinnitatud raudklambritega ehk sinklitega. Lodja säilinud põhjakaared on kuni 8.80 m pikad ja läbimõõduga 21–30 cm. Kaarte küljes on alles veel puidust naaglid läbimõõduga u 5 cm.

Dendrokronoloogiline dateerimine näitas, et Kuru vraki uuritud puiduproovide puude hiliseim aastarõngas (mis on ühtlasi koorealune aastarõngas) on kasvanud 1908. aastal (jn 5–7). Seejärel männid langetati ja puit kasutati laeva ehitamiseks. Kuru vraki puidu aastarõngalaiuste sarnasus Eesti männikronoloogiatega näitab, et ilmselt on kasutatud kohalikku männipuitu. Siiski ei saa välistada, et puit pärineb Venemaa Peipsi-lähedaselt alalt, kuid sealt puuduvad sobivad võrdluskronoloogiad. Kuru vrakiks muutunud laev on toore puidu kasutamise eeldusel ehitatud tõenäoliselt 1909. aastal.

Leitud vraki jäänused võivad pärineda 1931. aastal uppunud lodjalt OAT. See oli kahemastiline purjelodi, mille ehitas Jakob Mahov 1909. aastal Kasepää vallas Peipsi kaldal. Lodja pikkus oli 23,91 ja laius 13,28 meetrit. Lodi OAT uppus oktoobris 1931. Laeva huku kohta kirjutab Postimees, et lodi OAT viidi Kauksi alla (Lohusuu ja Vasknarva vahel), kuhu ta jäi puulaadungi pealevõtuks seisma, sattus seejärel aga tormi võimusesse. Lained kandsid lodja pimedas öös umbes 1 km eemale kaldasse madalikule, kus see umbes meetri sügavuses vees kinni istus.

Peipsi lodi oli madala süvise, suure ovaalse kerega, omanäoliste pealisehitustega, suure ahtris asuva rooliga ja ühe-või kahemastiline kaubapurjekas, mis sõitis Peipsil ja järve suubuvatel jõgedel, eeskätt Emajõel. Seetõttu on alust nimetatud ka Emajõe lodjaks. Esimesed kirjalikud andmed lodja kasutamisest Peipsil pärinevad 14. sajandist. Algselt veeti lotjadega soola ja vilja, samuti mitmesugust segakaupa. 20. sajandil olid peamiseks kaubaartikliks küttepuud.

Seni vanimaks lodja jäänuseks Peipsi järves on 14.–15. sajandisse dateeritud vrakileid Narva jõe sissevoolu lähedalt, millest on alles ainult kirjeldus 1911. aastast.

Peipsi lodja ehitus ja selle evolutsioon on täna veel ebaselge, arvestades et meie kasutada on ainult üks 20. sajandi algusesse dateeritud arheoloogiline leid ja teine, mille kohta on meil lühike kirjeldus ja mis võib pärineda 14.–15. sajandist. Mõlemal leiul on ühiseid jooni. Tunduvalt rohkem on lahtisi ehituslikke küsimusi, millele saavad vastuse anda ainult järgmised arheoloogilised leiud Peipsi vesikonnas.