ORGANIZĒ L M S P ATBALSTS Latvijas Biozinātņu un tehnoloģiju universitāte LBTU Meža un vides zinātņu fakultāte ZEME VALSTS SILAVA

# MID TO LATE HOLOCENE STORMINESS AND FIRE HISTORY ON THE BALTIC COAST OF LATVIA

COASTAL PEATLAND ARCHIVE
MULTIPROXY RECONSTRUCTION

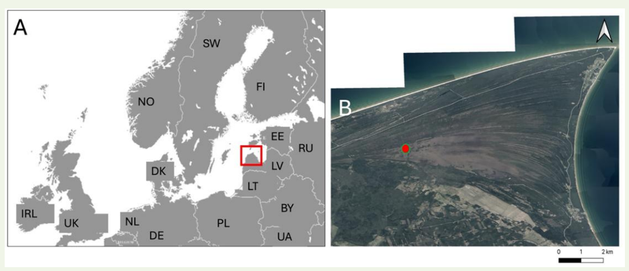
**Normunds Stivrins**

[1] *Latvia University of Life Sciences and Technologies*

**KEY RESULT**

**The 5400-year Bog Bazu record contains 30 fire episodes, 47 enhanced storminess episodes and 16 intervals of partial overlap. The overlaps suggest shared dry or thunderstorm-related conditions, while chronological uncertainty prevents proof of synchronous events.**

## STUDY SITE AND ARCHIVE




*Bog Bazu lies about 3 km inland within Slitere National Park and is surrounded by coastal dune systems.*

| | |
|---|---|
| **330 cm** | CONTINUOUS PEAT SEQUENCE |
| **5400 yr** | APPROXIMATE RECORD LENGTH |
| **6** | AMS RADIOCARBON DATES |
| **15 yr** | MEDIAN TEMPORAL RESOLUTION |
| **0.6 mm** | MEAN PEAT ACCUMULATION PER YEAR |

## MULTIPROXY EVIDENCE

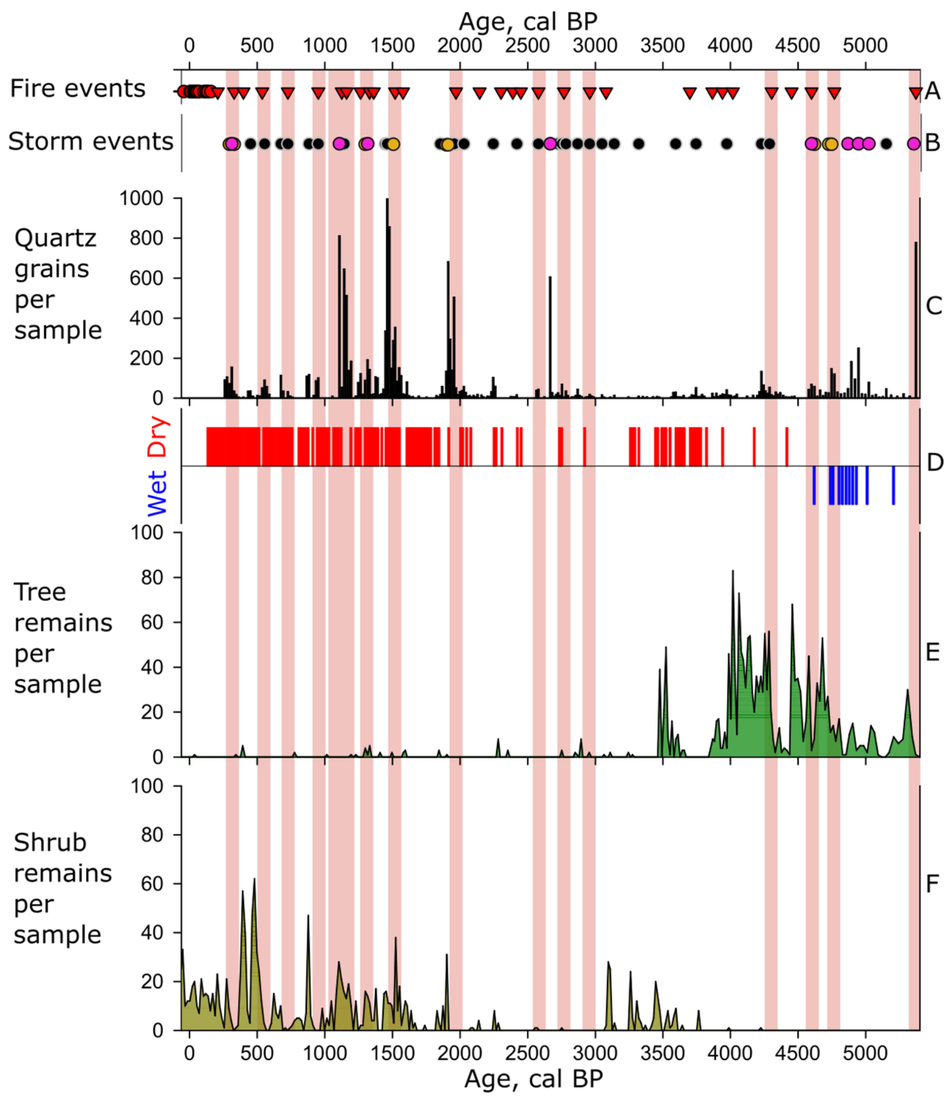
| | |
|---|---|
| **FIRE** | Macroscopic charcoal at contiguous 1 cm intervals. |
| **STORMINESS** | Sand grains retained above a 160 micrometre mesh. |
| **TRANSPORT** | Quartz grain surface characteristics and grain classes. |
| **VEGETATION** | Plant macrofossils used to trace local habitat change. |
| **SEDIMENT** | Loss on ignition measured organic matter content. |

## RECONSTRUCTION METHODS

Chronology used an rbacon age-depth model with IntCal20. CharAnalysis identified fire peaks above the 95th percentile and tested signal quality with the signal-to-noise index. Statistically significant sand influx peaks provided the storminess proxy. Surface textures supported interpretation of high-energy transport.

**Only two radiocarbon dates constrain the last 3000 years. The record identifies broad disturbance intervals but cannot resolve precise storm and fire synchrony.**

## INTEGRATED DISTURBANCE RECORD




*Red shading marks intervals where fire and storm peaks partly overlap. The event symbols and ecological proxies share one age scale.*

## DISTURBANCE STATISTICS

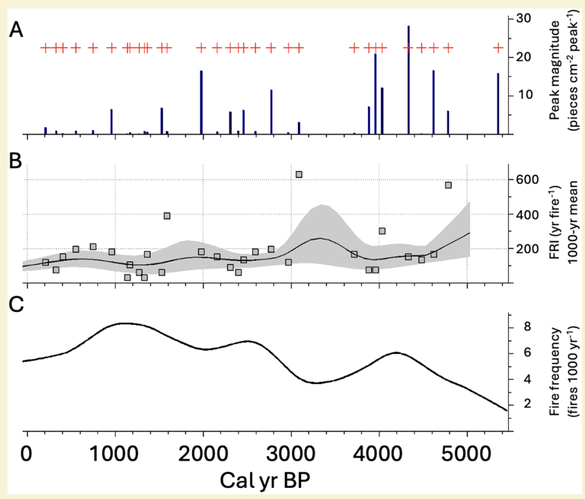
| 30 | 47 | 16 |
|---|---|---|
| FIRE EPISODES MEAN RETURN 170 YEARS | STORMINESS EPISODES MEAN RETURN 145 YEARS | PARTIAL FIRE AND STORM OVERLAPS |

## TIMING OF HIGH ACTIVITY

| | |
|---|---|
| **FIRE** | Highest frequencies occurred at 4500-3900 and 3000-800 cal yr BP, reaching 6-8 fires per 1000 years. |
| **STORMS** | Distinct enhanced phases occurred around 5000-4700, 2665, 1950, 1500-1110 and 310 cal yr BP. |
| **OVERLAP** | Coincident intervals appear more plausible during dry phases when peat was fire-prone and strong winds could transport coastal sand. |

**The record supports occasional coupling through shared hydroclimatic conditions. It does not show that every storm caused a fire.**

## FIRE HISTORY




*The charcoal signal remained robust for most of the sequence. Woody charcoal types dominated the record.*

## PEATLAND DEVELOPMENT

| | |
|---|---|
| **5400-4200** | Aquatic and fen taxa indicate high water tables during early peat formation. |
| **AFTER 4200** | Sphagnum and other bog taxa mark transition to ombrotrophic conditions. |
| **AROUND 3500** | Pine declined while ericaceous shrubs expanded, increasing flammable surface fuels. |
| **AFTER 2750** | Tree macrofossils became rare near the coring site. |

## STORM EVIDENCE

Cracked quartz grains reached 82% during major sand influx peaks. Transport of grains larger than 160 micrometres from coastal dunes about 3 km away likely required strong winds above 62 km h-1. Winter wind transport and limited human disturbance remain alternative explanations for some deposits.

## INTERPRETATION LIMITS

| | |
|---|---|
| **CHRONOLOGY** | Six radiocarbon dates constrain the full record, with only two in the last 3000 years. |
| **RESOLUTION** | Peat proxies integrate time and cannot identify every individual event. |
| **PROXIES** | No charcoal does not prove no fire, and sand influx does not measure storm intensity directly. |

**Use the overlaps as evidence of shared disturbance periods, not exact event matching.**

**CORRESPONDENCE** stivrins@lbtu.lv

Frontiers in Ecology and Evolution 14:1727897 doi:10.3389/fevo.2026.1727897 Estonian Research Council PRG1993 and TK215