nature portfolio

Corresponding author(s): Tihomir Simin

Last updated by author(s): Dec 14, 2025

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
☐	☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒ The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☒	☐ A description of all covariates tested
☐	☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☐	☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Code from the SOLCAST database was used to obtain the Air temperature and light conditions in the field (www.solcast.com)
Data analysis	All data were analysed using IBM SPSS Statistics software (v.29.0.2.0 (20); The International Business Machines Corporation, Armonk, NY, USA).

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

The dataset is uploaded to the Zenodo online depository at the following address: https://doi.org/10.5281/zenodo.17911209

Research involving human participants, their data, or biological material

Policy information about studies with human participants or human data. See also policy information about sex, gender (identity/presentation), and sexual orientation and race, ethnicity and racism.

Reporting on sex and gender	Not relevant to the study.
Reporting on race, ethnicity, or other socially relevant groupings	Not relevant to the study.
Population characteristics	Not relevant to the study.
Recruitment	Not relevant to the study.
Ethics oversight	Not relevant to the study.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	The study was conducted in the Free-Air Diesel and Ozone Enrichment (FADOE) facility in Sonning, UK. The facility is composed of 12 rings (3 replicates of 4 rings) with treatments of ozone enrichment, diesel enrichment, combined ozone and diesel enrichment and ambient air. In each ring of the facility four containers were placed. In each container four Scots pine seedlings were planted, one in the middle and three in the edges. The central seedling acted as the emitter, while the ones around it were the receivers. Emitters in two of the four containers in each ring were treated to damage by insect herbivores and two were not, so were treated as control. The sampling was done on receiver seedlings before and after direct herbivory.
Research sample	There were 48 containers, each with two receiver trees for sampling in this experiment. Each receiver Scots pine seedling was sampled twice. Once after exposure to herbivore-damaged emitters (or control emitters) and once after 36 hour herbivore treatment. There were 80 repeated samples in total, 24 from Ambient rings, 16 from ozone enrichment rings, 16 from diesel exhaust enrichment rings and 24 from the combined ozone and diesel exhaust enrichment rings.
Sampling strategy	The herbivory consisted of placing three adult weevils on the bark and encolsing them in a mesh bag around the seedling. Herbivory for emitter seedlings lasted 5 days, while the herbivory for receivers lasted for 36 hours. The sampled techniques consisted of the following techniques and in the following order: 1. Quantification of bark damage area - by tracing the damaged area on paper of the size equivalent to the area of the bark exposed to the weevils 2. Volatile Organic Compound Emission - measured by enclosing the whole seedling in a PET bag and getting the air through the adsorbent cartridge filled with Tenax TA 3. Measurement of photosynthesis and stomatal conductance - using the LI6400 portable photosynthesis system by enclosing one of the side branches of the Scots pine seedling
Data collection	At the beginning of the day the instruments were transported from storage to the rings and the collection happened in the order described above. 16 samples were the average number of samples collected in a day. Data was collected by Tihomir Simin and Oliver E. I. Welling. Ozone and NOx levels were measured continuously at the FADOE facility, along with wind speed and direction.
Timing and spatial scale	FADOE facility was established in 2022. Rings 1-4 were sampled first between May 30th and 2nd June, followed by Rings 5-8 between 18th and 21st June and Rings 9-12 between 28th June to 1st July 2023.
Data exclusions	Due to time constraints, two of the three receiver plants were sampled from each container and samples from a single ozone- (ring 2) and diesel enrichment rings (ring 3) were omitted.
Reproducibility	The experiment was not repeated due to time and fund limitations, but the

Randomization	Trees planted in the containers on 4th May 2023 were chosen at random. So were the weevils used for the herbivory treatment.
Blinding	Blinding was not relevant because the study was not done on human participants.

Did the study involve field work? ☒ Yes ☐ No

Field work, collection and transport

Field conditions	The spring and summer of 2023 were warm and sunny. The air temperature was on average 17.5*C and the photosynhtetic photon light density was higher than 1000 for most of the days during the experiment.
Location	51.48, -0.89; 95 m.a.s.l
Access & import/export	The FADOE facility is a part of the University of Reading. Permission to use the weevils was obtained from the Entomology Department, Forest Research UK. No other permissions were needed for this work.
Disturbance	The FADOE is a permanent installation and does not have a long-term impact on the environment.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☐	☒ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Animals and other research organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research, and Sex and Gender in Research

Laboratory animals	No laboratory animals we used.
Wild animals	Large pine weevils (Hylobius abietis) were collected from tree trunks in Scotland in 2022, using traps placed above the tree trunks and kept in captivity by the colleagues at the Entomology Department of the Forest Research, UK. Around 300 weevils were sent to the FADOE facility in Sonning, UK in 2023, kept in the same conditions before being used in the experiment. After the experiment, the weevils were deposited in the freezer, because we did not want to release them into the wild, as they are considered a pest in the UK.
Reporting on sex	An even distribution of male and female insects were used in the experiment.
Field-collected samples	The weevils were kept in captivity at low temperature (16 °C at night and 9 °C during the day) and fed pine and spruce branches regularly.
Ethics oversight	Entomology Department, Forest Research, UK.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Dual use research of concern

Policy information about dual use research of concern

Hazards

Could the accidental, deliberate or reckless misuse of agents or technologies generated in the work, or the application of information presented in the manuscript, pose a threat to:

No	Yes	
☒	☐	Public health
☒	☐	National security
☒	☐	Crops and/or livestock
☒	☐	Ecosystems
☒	☐	Any other significant area

Experiments of concern

Does the work involve any of these experiments of concern:

No	Yes	
☒	☐	Demonstrate how to render a vaccine ineffective
☒	☐	Confer resistance to therapeutically useful antibiotics or antiviral agents
☒	☐	Enhance the virulence of a pathogen or render a nonpathogen virulent
☒	☐	Increase transmissibility of a pathogen
☒	☐	Alter the host range of a pathogen
☒	☐	Enable evasion of diagnostic/detection modalities
☒	☐	Enable the weaponization of a biological agent or toxin
☒	☐	Any other potentially harmful combination of experiments and agents

Plants

Seed stocks	210 of Seedlings of two-year-old Scots pine (Pinus sylvestris) were purchased from Alba trees company Ltd. (https://www.albatrees.co.uk/)
Novel plant genotypes	All seedlings were of the Meggernie provenance.
Authentication	Seeds were collected in the Meggernie Estate area in Scotland and grown from seeds by the company.