

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
<input checked="" type="checkbox"/>	<input type="checkbox"/> The exact sample size (<i>n</i>) for each experimental group/condition, given as a discrete number and unit of measurement
<input checked="" type="checkbox"/>	<input type="checkbox"/> A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
<input checked="" type="checkbox"/>	<input type="checkbox"/> The statistical test(s) used AND whether they are one- or two-sided <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
<input checked="" type="checkbox"/>	<input type="checkbox"/> A description of all covariates tested
<input checked="" type="checkbox"/>	<input type="checkbox"/> A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
<input checked="" type="checkbox"/>	<input type="checkbox"/> 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)
<input checked="" type="checkbox"/>	<input type="checkbox"/> For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
<input type="checkbox"/>	<input checked="" type="checkbox"/> For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
<input checked="" type="checkbox"/>	<input type="checkbox"/> For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
<input checked="" type="checkbox"/>	<input type="checkbox"/> Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i>), 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	Image stacking was conducted in Helicon Focus 6.7.1 software (https://www.heliconsoft.com/heliconsoft-products/helicon-focus/). Figures were produced using Adobe Photoshop 25.11.0 and CorelDRAW 2022 graphic software.
Data analysis	Phylogenetic analyses were performed in MrBayes 3.2.7a using the Mk-inf + gamma model. The parsimony analyses were conducted using the phylogenetic analysis software PAUP* (v. 4.0a169) with the heuristic search strategies started from 1,000 random addition sequences. The tree bisection and reconnection (TBR) algorithm was employed in PAUP. The apomorphies were calculated in TNT (v.1.6) using a parsimony ratchet and TBR branch swapping with 10,000 replicates, holding 100 trees from each iteration; the apomorphies were optimised computationally using the 'mapping common synapomorphies' function in TNT after estimating the consensus trees.

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 fossil illustrated in this paper is accessioned in the Nanjing Institute of Geology and Palaeontology (catalogue number NIGP206848). Data collected or generated during this study are included in this published article and its supplementary information files. The nomenclature of *J. daohugouensis* gen. et sp. nov. has been registered at ZooBank (LSID: urn:lsid:zoobank.org:act:4F294930-AE20-45E4-A9E2-8FC96919B56B).

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	n/a
Reporting on race, ethnicity, or other socially relevant groupings	n/a
Population characteristics	n/a
Recruitment	n/a
Ethics oversight	n/a

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	Palaeontological study of the first acanthocephalan body fossil collected from the Middle Jurassic Daohugou biota of China.
Research sample	The specimen NIGP206848 studied here comes from the Middle Jurassic Jiulongshan Formation of Daohugou (41°18'N, 119°13'E) in Ningcheng County, Chifeng City, Inner Mongolia, China. The specimen described in this paper is deposited in the Nanjing Institute of Geology and Palaeontology. Its accession number is provided in the manuscript.
Sampling strategy	Sample size is limited to the specimens collected in this study.
Data collection	The specimen described herein was observed under a Zeiss Stemi 508 microscope, equipped with polarizing filters, and photographed both in a dry state and in a wet state under natural and cross-polarised lighting conditions. The photographs were taken with a Zeiss Stereo Discovery V16 microscope system at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS).
Timing and spatial scale	The fossil was collected during 2018 field season. Information on the location of this specimen are described detailed in the Methods.
Data exclusions	No data were excluded.
Reproducibility	All data are contained within the manuscript and Supplementary Information file. The phylogenetic datasets and the commands necessary for executing the MrBayes, PAUP and TNT analyses are included as NEXUS and TNT formatted files in the Supplementary Data 1–3.
Randomization	n/a

Blinding

n/a

Did the study involve field work?



Yes



No

Field work, collection and transport

Field conditions

The field site is located in the temperate zone. Climate is xerothermic in the field season (summer time). The outcrop is well exposed. Excavation was required to remove slabs of fossil specimens.

Location

Ningcheng County, Chifeng City, Inner Mongolia, China (41°18'N, 119°13'E).

Access & import/export

Collection of fossil specimens was carried out in a responsible manner and in compliance with the local, national and international laws. The specimen is publicly accessible in the Nanjing Institute of Geology and Palaeontology, China, with accession number provided in the manuscript.

Disturbance

Disturbance was limited to small excavations typical of field palaeontology research. All sites were cleaned and reclaimed following excavation.

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

Methods

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

n/a

Involved in the study



ChIP-seq



Flow cytometry



MRI-based neuroimaging

Palaeontology and Archaeology

Specimen provenance

Middle Jurassic Jiulongshan Formation of Daohugou (41°18'N, 119°13'E) in Ningcheng County, Chifeng City, Inner Mongolia, China.

Specimen deposition

The specimen is publicly accessible in the Nanjing Institute of Geology and Palaeontology, China, with accession number provided in the manuscript.

Dating methods

No new dates were performed.



Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.

Ethics oversight

No ethical approval or guidance was required because our study is based on previously collected fossil specimens.

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

Plants

Seed stocks

n/a

Novel plant genotypes

n/a

Authentication

n/a