

Reporting Summary

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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 (<i>n</i>) 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
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ 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. <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> |
| ☒ | ☐ 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 <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	Landmarks were placed and samples scaled using the tpsDIG2 program.
Data analysis	Statistical analyses were performed in RStudio (version 2023.6.1.524), running on R4.1.3 R Core. GPA and mean shapes were computed using the geomorph package (V4.0.3). Model selection and RDA analysis were performed using ordistep and rda function from the vegan package. For other analyses (anova, p.adjust and pr.comp), visualization and figures, packages stats and ggplot2 were used.

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 authors declare that the data generated in this study are provided in the Supplementary Data (Supplementary Data 1). This file contains the main dataset, with all of the landmark coordinates, for all the samples, as well as the characteristics of each sample. Source data for all figures and supplementary material can also be found in the Supplementary Data 1 file. Source code can be found in the Supplementary Code 1 file.

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 Study did not include human participants

Reporting on race, ethnicity, or other socially relevant groupings Study did not include human participants

Population characteristics Study did not include human participants

Recruitment Study did not include human participants

Ethics oversight Study did not include human participants

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](https://www.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

In addition to the reproductive structures themselves, do asexuality inherently alter the shape of traits in animals? While this question has been the subject of many studies, none of them provided a satisfactory answer due to multiple confounding factors. For instance, studies comparing sexual and asexual organisms exclusive to different species, lineages or ploidies, leave the effects of genetic variation intertwined with those of reproductive strategies. Also, sexual selection has been seen to confound results. As parthenogenetic females do not need a mate to reproduce, sexual selection is relieved, leading to changes when compared back to a phylogenetically close sexual species or lineage.

Thus, the inherent shape of reproductive strategies can be elusive and hard to isolate. To our knowledge, no published study conducted in animals had the potential to distinguish whether the observed divergence between asexual and sexual females resulted from their reproductive strategy or from confounding factors. In this paper, we aim to identify whether sexual and asexual gametogeneses are associated with an inherent shape.

Research sample

We performed geometric morphometric analyses in the *Chrosomus eos-neogaeus* fish complex, characterized by the presence of all-female hybrids with distinct reproductive pathways, aiming to identify difference in shape linked to sexual or asexual reproduction. We focused on two groups of triploid hybrids which exhibit both sex and asex and for which the known confounding factors are absent. Therefore, if triploids exhibit shape differences, these are expected to spontaneously result from factors associated with the reproductive strategies.

A total of 193 females were used in the morphometric analysis. They were either from natural conditions (and sexually mature) or from a precedent common garden experiment (where they were 5-month-old). Fish were collected from Desjardins Lake (B-01 lineage; Quebec, Canada; 45.91693, -74.07292) and Halfway Creek (A-11 lineage; Quebec, Canada; 45.04337, -72.36199).

Sampling strategy

No sampling tests were performed - sampling was based on similar study's samplings.

Data collection	Landmarks were placed and samples scaled using the tpsDIG2 program, by a single observer (Joëlle Lafond) to minimize measurement error/variation. Samples were randomly organized to reduce bias in landmarks positioning.
Timing and spatial scale	Samplings were performed in June of 2013, 2019-2021 for the first natural site (where lineage B-01 is found). The other fish were collected in the summer and fall of 2014.
Data exclusions	No data was excluded from the study.
Reproducibility	Measurement error was assessed by positioning the landmarks on 34 randomly selected individuals and their copies, totaling 68 pictures. Then, a linear model was produced with the Individual Identity as predictor. This analysis revealed that 96.1% ($p < 0.0001$) of the variation was detected among individuals, leaving a small amount of within-individual variation.
Randomization	Samples were randomly organized to reduce bias in landmarks positioning.
Blinding	Samples were not identified as to which group they were part of - they only had a sample number, so the observer putting landmarks would not cause bias.

Did the study involve field work? ☒ Yes ☐ No

Field work, collection and transport

Field conditions	Samplings done on day of good weather (not raining).
Location	Samplings performed from the shore of the lake/creek. Sampling done at (B-01 lineage; Quebec, Canada; 45.91693, -74.07292) and (A-11 lineage; Quebec, Canada; 45.04337, -72.36199).
Access & import/export	This research was performed under institutional animal care guidelines (permit #13-084, #19-021, #20-022 and #21-023 issued by the Université de Montréal) and conforms to the mandatory guidelines of the Canadian Council on Animal Care. Sampling permits were provided by the Quebec Ministry of Natural Resources and Wildlife (MRNF).
Disturbance	No disturbance, small number of fish collected

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

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	Some data used by this paper, already published elsewhere, is from a common garden experiment. More details in the aforementioned paper (DOI: 10.7717/peerj.5896)
Wild animals	Chrosomus eos, Chrosomus eos-neogaeus and Chrosomus eos x eos-neogaeus were caught in nature at two locations (Desjardins Lake (B-01 lineage; Quebec, Canada; 45.91693, -74.07292) and Halfway creek (A-11 lineage; Quebec, Canada; 45.04337, -72.36199)). They were sexually mature. Fish were caught by the use of bait traps and euthanized on spot by immersion in a solution of eugenol.
Reporting on sex	Only females were used in this study, as hybrids are only/mostly females.
Field-collected samples	Samples were kept in ethanol at room temperature, in the dark.

Ethics oversight

This research was performed under institutional animal care guidelines (permit #13-084, #19-021, #20-022 and #21-023 issued by the Université de Montréal) and conforms to the mandatory guidelines of the Canadian Council on Animal Care. Sampling permits were provided by the Quebec Ministry of Natural Resources and Wildlife (MRNF).

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

Plants

Seed stocks

Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.

Novel plant genotypes

Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.

Authentication

Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined.