

# Richard P. Dearden

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## SCIENTIFIC EMPLOYMENT

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*Dec 2022 - present* **Marie Skłodowska-Curie Postdoctoral Fellow, Naturalis Biodiversity Center, Leiden**

- Hosted by Dr Martin Rücklin in the Vertebrate Evolution, Development, and Ecology group.
- Aiming to better understand evolutionary timings in sharks + kin by using 3D imaging to incorporate fossils into phylogenetic datasets with morphological and genomic data from living sharks.

*Dec 2021 - Nov 2022* **Postdoctoral Research Fellow at the University of Birmingham**

- Led research on Leverhulme trust grant *Feeding without jaws: innovations in early vertebrates*
- Used 3D imaging to understand the mouthparts of the earliest vertebrates and how they fed
- Resulted in 2 publications to date (*Nature*, *Proceedings B*) and ongoing involvement as collaborator.

*Oct 2019 - Jan 2021* **Postdoctoral Researcher at the Muséum national d'histoire naturelle, Paris**

- Awarded DIM-MAP grant for project '*Form and function in the early chondrichthyan pharynx*'.
- Used 3D imaging to understand the functional morphology of gill skeleton in early shark relatives
- Resulted in 2 publications (*J.Morph.*, *PNAS*), 1 in review (*Zoo. Jour. Linn. Soc.*).

## EDUCATION

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*2014-2019* **PhD. Imperial College London, UK. Awarded with minor corrections (awarded Aug. 1 2019).**

- Thesis '*The anatomy and evolution of "acanthodian" stem-chondrichthyans*' was supervised by Dr Martin Brazeau in the Department of Life Sciences (Silwood Park Campus)
- Used 3D and traditional methods to reassess anatomy of key early shark relatives in a bid to better understand the phylogenetic relationships and ultimately the evolution of living sharks and rays.
- Resulted in 3 publications (*Nature Comms*, *Nature Ecology & Evolution*, *Papers in Palaeontology*)

*2013-2014* **MSc in Palaeobiology. University of Bristol, UK. Awarded with Distinction.**

- Dissertation *Exploring vertebrate evolution: jaws and genome duplications*, supervised by Prof. Phil Donoghue.
- Assembled a morphological supermatrix of stem-gnathostome taxa, and used it to investigate the tempo and mode of early jawed vertebrate morphological evolution.
- Data integrated into genomic study, resulting in one publication (*Nature Ecology & Evolution*)

*2010-2013* **MA in Natural Sciences (Zoology). University of Cambridge, UK. Awarded with Honours (2.1).**

- Relevant final year palaeontology modules: Topics in vertebrate evolution, Mammalian evolution and faunal history.

## OTHER RELEVANT EMPLOYMENT

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*2019-2022* **Freelance Scientific Consultant for DK**

- Consulting for republished books, checking that information is up-to-date and suggesting updates.

*2018-2019* **Freelance Specialist Editor at Cactus Communications**

- Ensured geoscience manuscripts met a high standard of scientific English and conformed with subject matter conventions.

*2015-2019* **Teaching Assistant at Imperial College London:**

- Demonstrating biology undergraduate and masters courses: details under Teaching Experience

2016-2017 Assistant Librarian at Silwood Park Library, Imperial College London

- Responsible for the library in the evening, dealing with out of hours requests and closing up.

## AWARDS & GRANTS (~ signifies estimated value for synchrotron time)

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2023 European Synchrotron Radiation Facility beamline time ~€36,000

- Award ES-1458 “Construction of the head and mouth in the earliest jawed vertebrates”, with Ivan Sansom, Sam Giles, Agnese Lanzetti.

2022 Horizon Europe Marie Curie-Skłodowska postdoctoral fellowship €187,624

- *DEADsharks: Divergence times, evolution, and anatomy deciphered in early sharks*, awarded with host institution Naturalis Biodiversity Center, Netherlands.

2022 ANR AAPG grant (French national research agency, generic call for proposals) €149,040

- *MACHER: Mechanical adaptation to crushing in the holocephalan evolutionary lineage*, awarded to Alan Pradel, Anthony Herrel, and Quentin Grimal with me as named scientific partner.

2022 European Synchrotron Radiation Facility beamline time ~€24,000

- Award LS-3110 “Evolution of the head in early cartilaginous fish”, with Alan Pradel

2021 Institut de l’Océan postdoctoral grant €53,200 (unable to accept)

- *MACHER: Mechanical adaptation to crushing in the holocephalan evolutionary lineage*, awarded with Alan Pradel and Anthony Herrel. Unable to accept due to conflict with UoB postdoc.

2021 European Synchrotron Radiation Facility beamline time ~€36,000

- Award LS-3021 “Cartilage in the earliest sharks”, with Sophie Sanchez and Jake Leyhr

2019 DIM Heritage and Ancient Materials Postdoctoral grant €50,000

- “PHARE. Pharyngeal evolution: illuminating its form and function in early jawed vertebrates”, awarded by the Île-de-France research network with Alan Pradel and Anthony Herrel

2016 European Synchrotron Radiation Facility beamline time ~€12000

- Award LS-2541 “Endoskeletal bone in a shark-like early vertebrate”, with Martin Brazeau

2014 Bristol Alumni Foundation travel grant £120

- Awarded for travel and accommodation to present a poster at Progressive Palaeontology

## ONGOING EXTERNAL COLLABORATIONS

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**Feeding in early vertebrates** *Ivan Sansom and colleagues, University of Birmingham*

I was employed as a postdoc on this ongoing project, which aims to understand how the earliest vertebrates fed. I continue to be involved by lending my expertise to the project, e.g. recently (March 2024) travelling to the European Synchrotron Radiation Facility with collaborators to collect additional data.

**Evolutionary timings in chimaeras** *Chase Brownstein, Yale University*

I was contacted by Chase due to my expertise on fossil chimaeras (elephant sharks): we are now writing a paper together combining evidence from the fossil record and genomics to try and understand timings in the evolution of chimaeras. My role is to provide expertise on the anatomy of extinct and living chimaeras.

**The evolution of durophagy in chimaeras** *Alan Pradel & Anthony Herrel, MNHN Paris*

This project is based on funding we obtained from the French National Research Agency (Grant: *MACHER*) which aims to understand the evolution of the extreme anatomical specialisations to durophagy in chimaeras. My role is to provide expertise on 3D methods and the anatomy of Palaeozoic chondrichthyans

**Cartilaginous tissues in sharks** *Sophie Sanchez, Hannah Byrne, Jake Leyhr, University of Uppsala*

This project is based in a grant for time at the European Synchrotron Radiation Facility and aims to understand how the tessellate cartilaginous tissues of sharks and rays evolved using the fossil record. I am lending my expertise on extinct chondrichthyans and helped select taxa/fossil specimens for analysis.

## PROFESSIONAL SERVICE

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- 2024-present **Council member and Trustee of the Palaeontological Association (role: Reviews Editor)**  
Attend and vote at council meetings and commission reviews for the PalAss newsletter.
- 2024-present **Liaison between lab group and the Naturalis IT Governance group**  
Attend biweekly meetings to discuss solutions to issues with IT provision to our group
- 2022-24 **Ran workshops on 3D software Blender at Naturalis and University of Birmingham**  
Designed and gave introductory workshop to varied people working with 3D data
- 2020 **Palaeontological Association Annual Meeting Science Committee member**  
Reviewed abstracts for the meeting on the basis of their scientific merit
- 2017 **Contributor to Silwood Park Computer Skills workshop: Introduction to Inkscape**  
Designed and gave introductory workshop to varied people working with 3D data
- 2015-6 **President of the Silwood Park Student Union**  
Chaired local student committee on satellite campus

## PEER REVIEW

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*Acta Geologica Polonica, Cladistics, Earth & Environmental Science Transactions of the Royal Society of Edinburgh, eLife, Journal of Vertebrate Paleontology, Palaeontologica Electronica, Palaeontology, PeerJ, Proceedings of the Academy of Natural Sciences of Philadelphia, Scottish Journal of Geology, Swiss Journal of Palaeontology*

## ACADEMIC MEMBERSHIPS

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2013-present: Member of the Palaeontological Association

## TEACHING EXPERIENCE

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- 2022-24 **Daily Supervisor, Masters and Undergraduate theses, Naturalis Biodiversity Center**
- Currently primary supervisor of two masters thesis students using 3D imaging to visualise the anatomy of Cretaceous sharks and understand their relationships and feeding ecology.
  - Supervised two masters thesis students looking at the evolution of the dermal skeleton in early shark relatives. One is currently writing up his project as a manuscript for submission to RSOS.
  - Supervised undergraduate thesis student visualising anatomy of archerfish brains with 3D methods.
- 2023-24 **Lecturer. Paleobiology Masters Course. University of Leiden.**
- Wrote and delivered lectures on modern palaeobiological methods to a group of about 30 students
- 2022-24 **Lecturer. Vertebrate Evolution 3<sup>rd</sup> year undergraduate course, University of Birmingham**
- Wrote and delivered lectures on the radiation of mammals in the Cenozoic and the post-Palaeozoic evolution of sharks and their relatives to a group of about 20 students
- 2023 **Guest-lecturer. Paleobiology Masters course, University of Erlangen.**
- Invited to lead paper discussion on the origin of teeth with a group of about 20 students
- 2022 **Demonstrator. Pembrokeshire field trip for 1<sup>st</sup> year undergraduates. University of Birmingham**
- Helped teach and supervise students on an undergraduate geology field trip
- 2018 **Supervisor, Masters thesis, Imperial College London**
- During PhD co-supervised an MSc student doing a project on the anatomy of early shark relatives
- 2018-19 **Demonstrator. 2nd year undergraduate dissection practical. Imperial College London.**
- Vertebrate Form and Evolution course with 1 wk teaching (phylogenetics) and 2 wk dissection

2016 **Demonstrator. Masters students practical, Imperial College London.**

- Helped students in a practical “Understanding morphological evolution using morphometry”

2015-18 **Demonstrator. 1st year undergraduates: Biology of Organisms. Imperial College London**

- Helped students in a practical using zoological specimens to teach phylogenetics.

## SCIENTIFIC SKILLS

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**Anatomy.** Broad grounding in vertebrate anatomy from undergraduate and masters. Specific expertise in chondrichthyans (sharks, rays, chimaeras) and jawless vertebrates (hagfish, lampreys, and extinct vertebrates) from throughout the Phanerozoic based in literature, museum collections, and research. Knowledge of living vertebrates’ anatomy rooted in digital dissections and helping teach dissection labs.

**3D imaging.** Experience acquiring 3D data from fossils with micro-computed tomography scanning, x-ray synchrotron microtomography, and 3D light scanning. Extensive experience segmenting tomographic data in *Mimics*, and rendering and animating models in *Blender*. Some familiarity with *Avizo* and *Dragonfly*.

**Morphological Phylogenetics.** Experience building morphological character matrices (*Mesquite*), analysing them with parsimony (*PAUP\**, *TNT*) and Bayesian (*MrBayes*, *BEAST2*) methods, and presenting phylogenetic trees in *R* (*ape*, *phangorn*).

**Molecular Phylogenetics.** In MSCA have gained experience finding (*GenBank*), aligning (*aliview*, *clustalw*) and analysing (*BEAST2*, *Tracer*, *FigTree*, *R*) molecular data to build molecular and total evidence time trees. Attended Transmitting Science course *Bayesian Phylogenetic Inference with BEAST2* (2024).

**Macroevolutionary analysis.** Experience using *R* to conduct evolutionary rate and disparity analyses using packages *claddis*, *dispRity*. Attended Transmitting Science course *Introduction to Macroevolutionary Analyses using Phylogenies* (2024)

**Functional Morphology.** Experience using *Blender* and *R* to test functional hypotheses e.g. using Python scripting to estimate maximum muscle extension, mechanical advantage, and changes in volume.

**Computing.** Documents in *LaTeX*, *MSOffice*, and *GoogleDocs*. Can use *R* and *Github*. Maintain a website with *Jekyll*, using *HTML* and *Markdown*. Some experience with *Python* scripting in *Blender*.

**Graphics/video.** Experienced creating publication-quality figures using *Gimp*, *Inkscape*, and *Adobe Illustrator*, including 3D visualisation in *Blender* and videos in *Lightworks* and *Blender*.

**Data collection.** Collected morphological data from fossils in museum collections in the UK, Europe, and N America. Experience with scientific drawing/photography, and with light and scanning electron microscopy.

**Fieldwork.** Organised palaeontological fieldwork in the Northwest Territories, Canada (2016), and in Scotland (2016, 2019), and have participated in fieldwork in Mongolia (2015), and across the UK.

**Scientific writing.** Written specialist scientific research papers (see Scientific Publications) as well as for a more general audience, e.g. for *Nature Ecology & Evolution Community*. Written multiple grant proposals for postdoctoral positions, tomographic scanning bids, and have contributed to larger grant proposals.

## OTHER RELEVANT SKILLS

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**Leadership.** Experience of motivating, helping, and delivering feedback to undergraduate and masters students as supervisor. Attended course *EMBO Lab Leadership Course for Postdocs* (2024)

**Teamwork.** Worked collaboratively as part of several research groups, and maintain a network of relationships with academic collaborators, amateur palaeontologists, and museum colleagues.

**Independence.** Conducted research with several different groups, including without PhD supervisor.

**Organisation.** Experience managing collaborations with colleagues from different institutions, managing project and finances (e.g. MSCA), and taking responsibility for managing students as daily supervisor. Taken on professional roles both within lab group (IT liaison) and outside it (Palaeontological Association).

**Communication.** Presented my research to a variety of audiences including specialist and more general scientific conferences, the general public, and undergraduates.

**Public outreach.** Participated in the Great Scottish Fossil Showdown (Scottish Geology Festival 2021) and Palaeovision Song Contest (2022,24). Interviewee on podcasts Palaeoparty (2020) and Palaeocast (2024). Contributor to the virtual Natural History Museum. Ran annual stand at Silwood Park Bugs Day (2015-2018) on Palaeozoic fossil fishes. Volunteered at schools and science festivals with Bristol Dinosaur Project (2014).

**Driving.** I have a full UK driving license.

## SCIENTIFIC PUBLICATIONS (\*denotes without PhD supervisor)

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\***Dearden, R.P.**, Jones, A.S., Giles, S., Lanzetti, A., Grohgan, M., Johanson, Z., Lautenschlager, S., Randle, E., Donoghue, P.C.J., Sansom, I.J. 2024 The three-dimensionally articulated oral apparatus of a Devonian heterostracan sheds light on feeding in Palaeozoic jawless fishes. *Proceedings of the Royal Society B: Biological Sciences* [doi.org: 10.1098/rspb.2023.2258](https://doi.org/10.1098/rspb.2023.2258)

\*Yu, D., Ren, Y., Uesaka, M. *et al.* (including **Dearden, R.P.**) 2024 Hagfish genome elucidates vertebrate whole genome duplication events and their evolutionary consequences *Nature Ecology & Evolution*. [doi: 10.1038/s41559-023-02299-z](https://doi.org/10.1038/s41559-023-02299-z)

\***Dearden, R.P.**, Lanzetti, A., Giles, S., Johanson, Z., Jones, A.S., Lautenschlager, S., Randle, E., Sansom, I.J. 2023 The oldest three-dimensionally preserved vertebrate neurocranium. *Nature*. [doi:10.1038/s41586-023-06538-y](https://doi.org/10.1038/s41586-023-06538-y)

\***Dearden, R.P.**, Herrel, A., and Pradel, A. 2023 Evidence for high-performance suction feeding in the Pennsylvanian stem-group holocephalan *Iniopera*. *Proceedings of the National Academy of Sciences*. doi: [doi:10.1073/pnas.2207854119](https://doi.org/10.1073/pnas.2207854119)

\*Clements, T., Atterby, J., Cleary, T., **Dearden, R. P.**, and Rossi, V. 2022 The perception of palaeontology in commercial off-the-shelf video games and an assessment of their potential as educational tools. *Geoscience Communication*. [doi:10.5194/gc-5-289-2022](https://doi.org/10.5194/gc-5-289-2022)

\***Dearden, R.P.** and Giles, S. 2021 Diverse stem-chondrichthyan oral structures and evidence for an independently acquired acanthodid dentition. *Royal Society Open Science* [doi:10.1098/rsos.210822](https://doi.org/10.1098/rsos.210822)

\*Pradel, A., **Dearden, R.P.**, Cuckovic, A., Mansuit, R., and Janvier, P.J. 2021 The visceral skeleton and its relation to the head circulatory system of both a fossil, the Carboniferous *Iniopera*, and a modern, *Callorhynchus milii* holocephalan (Chondrichthyes). *Ancient Fishes and their living relatives: a tribute to John G Maisey*

**Dearden, R.P.**, den Blaauwen, J.L., Sansom, I.J., Burrow, C.J., Davidson, R., Newman, M.J., Ko, A., and Brazeau, M.D. 2021 A revision of *Vernicomacanthus* Miles with comments on the characters of stem-group chondrichthyans. *Papers in Palaeontology* [doi:10.1002/spp2.1369](https://doi.org/10.1002/spp2.1369)

\***Dearden, R.P.**, Mansuit, R., Cuckovic, A., Herrel, A., Dominique, D., Tafforeau, P., and Pradel, A. 2021 The morphology and evolution of chondrichthyan cranial muscles: a digital dissection of the elephantfish *Callorhynchus milii* and the catshark *Scyliorhinus canicula*. *Journal of Anatomy* [doi:10.1111/joa.13362](https://doi.org/10.1111/joa.13362)  
Brazeau M.D., Giles, S., **Dearden, R.P.**, Jerve, A., Ariunchimeg, Y.A., Zorig, E., Sansom, R., Guillaume, T., and Castiello, M. 2020 Endochondral bone in an Early Devonian 'placoderm' from Mongolia. *Nature Ecology and Evolution* [doi:10.1038/s41559-020-01290-2](https://doi.org/10.1038/s41559-020-01290-2)

**Dearden, R.P.**, Stockey, C.S., and Brazeau M.D. 2019 The pharynx of the stem-chondrichthyan *Ptomacanthus* and the early evolution of the gnathostome gill skeleton. *Nature Communications* 10, 2050 [doi:10.1038/s41467-019-10032-3](https://doi.org/10.1038/s41467-019-10032-3)

## PREPRINTS IN REVIEW (\*denotes without PhD supervisor)

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\***Dearden, R.P.**, Herrel, A., and Pradel, A. The pharynx of the iconic stem-group chondrichthyan *Acanthodes* (Agassiz, 1833) revisited with micro computed tomography. Minor revisions: *Zoological Journal of the Linnean Society*. Preprint at BioRxiv [doi: 10.1101/2023.08.23.554409](https://doi.org/10.1101/2023.08.23.554409)

## OTHER PUBLICATIONS

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**Dearden, R.P.**, Herrel, A., and Pradel, A. 2023 3D models related to the publication: Evidence for high-performance suction feeding in the Pennsylvanian stem-group holocephalan *Iniopera*. *Morphomuseum*

Pradel, A. and **Dearden, R.P.** 2022 Un cerveau de chimère fossilisé ! *Paléontologie d'aujourd'hui* Eds. Sylvain Charbonnier and Patrick de Wever, EDP Sciences, Les Ulis

**Dearden, R.P.**, Mansuit, R., Cuckovic, A., Herrel, A., Dominique, D., Tafforeau, P., and Pradel, A. 3D models related to the publication: The morphology and evolution of chondrichthyan cranial muscles: a digital dissection of the elephantfish *Callorhynchus milii* and the catshark *Scyliorhinus canicula*. *Morphomuseum*.

## PRESENTATIONS AT INTERNATIONAL CONFERENCES

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2023 Talk: Palaeontological Association annual meeting - Cambridge, UK

- *An Ordovician vertebrate neurocranium*

2023 Talk: International Symposium on Mesozoic fishes and marine reptiles - Stuttgart, Germany

- *The three-dimensionally fossilised head of a Campanian Synechodus*

2022 Poster: Palaeontological Association annual meeting - Dublin, Ireland

- *Feeding without jaws. Anatomy and function in the mouth of the Lower Devonian heterostracan Rhinopteraspis*

2012 Talk: 16th International Symposium on Early and Lower Vertebrates - Valencia, Spain

- *Feeding without jaws. Anatomy and function in the mouth of the Lower Devonian heterostracan Rhinopteraspis*

2021 Talk: Palaeontological Association annual meeting - Manchester, UK [online]

- *Did Carboniferous chimaeras suck?*

2020 Poster: Palaeontological Association annual meeting - Oxford, UK [online]

- *Addressing ambiguity in Acanthodes: the 3D pharynx of an iconic Permian stem-chondrichthyan revealed by computed tomography*

2019 Poster: Palaeontological Association annual meeting - Valencia, Spain

- *Diverse dentitions in the earliest chondrichthyans*

2018 Talk: Palaeontological Association annual meeting - Bristol, UK

- *A third "acanthodian" endoskeleton in a uniquely well-preserved specimen of Diplacanthus crassissimus*

2018 Talk: Symposium of Vertebrate Palaeontology and Comparative Anatomy - Manchester, UK

- *A third "acanthodian" endoskeleton in a uniquely well-preserved specimen of Diplacanthus crassissimus*

2017 Talk: Palaeontological Association annual meeting - London, UK

- *A chondrichthyan-like shoulder girdle in an "acanthodian" helps tease apart stem-chondrichthyan relationships*

2017 Talk: Society of Vertebrate Palaeontology annual meeting - Calgary, Canada

- *The earliest three-dimensionally preserved chondrichthyan branchial skeleton in the Early Devonian "acanthodian" Ptomacanthus anglicus*

2017 Talk: 14th International Symposium on Early and Lower Vertebrates - Cheċiny, Poland

- *Articulated branchial skeletons in the "acanthodian" stem-chondrichthyans Ptomacanthus anglicus and Diplacanthus crassissimus*

## INVITED TALKS

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- 2024 *Upcoming* Keynote speaker at 17<sup>th</sup> International Symposium on Early & Lower Vertebrates, Canada
- 2023 LiveScience Colloquium Naturalis Biodiversity Center
- 2022 Lapworth Lecture, University of Birmingham, invited by Lapworth Lecture committee
- 2022 Department of Organismal Biology, Uppsala University, Sweden, invited by Dr Sophie Sanchez
- 2021 Millersville University Pennsylvania, invited by Dr Dominique Didier.
- 2017 Contributor to Imperial College London Silwood Park Social Seminar Series

## REFERENCES

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**Dr Martin Rücklin** MSCA host,

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