Richard P. Dearden

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SCIENTIFIC EMPLOYMENT & EDUCATION

Dec 2022-present: **Postdoctoral Fellow at Naturalis, Leiden, Netherlands**
DEADSharks: Divergence times, Evolution, and Anatomy Deciphered in early Sharks.
Hosted by Dr Martin Rücklin in the Vertebrate Evolution, Development, and Ecology group. Project aims to integrate information from Mesozoic shark body fossils with the anatomy and genomes of living sharks to better understand the timings of major events in elasmobranch evolution.

2021-2022: **Postdoctoral Researcher at the University of Birmingham, UK**
Feeding without jaws: innovations in early vertebrates.
Working in the School of Geography, Environmental, and Earth Sciences with Ivan Sansom, Sam Giles, Stephan Lautenschlager, and Zerina Johanson (Natural History Museum, London). Aimed to characterise the form and function of the mouthparts in jawless fishes using computed tomography; led collection, processing and interpretation of fossil data as well as coordinating between the team.

2019-2021: **Postdoctoral Researcher at the Muséum national d'histoire naturelle (MNHN), Paris, France**
Form and function in the early chondrichthyan pharynx.
Worked in MNHN's CR2P lab group with Alan Pradel. Research focused on the **evolution of the pharynx and feeding** in early shark-relatives. Did a digital dissection of skeleton and muscles in two living chondrichthyans (Dearden *et al.* 2021 *Journal of Anatomy*). Used this data with phylogenetic and functional morphological methods to investigate functional morphology of the pharyngeal skeleton in stem-group chondrichthyan *Acanthodes* and the stem-group holocephalan *Iniopera* (Dearden *et al.* 2023, *PNAS*).

2014-2018: **PhD.** Awarded with minor corrections (awarded Aug. 1 2019). Imperial College London, UK.
Thesis: *The anatomy and evolution of "acanthodian" stem-chondrichthyans*
In Department of Life Sciences with Martin Brazeau. Focused on the anatomy and evolution of stem-group chondrichthyans, in particular using **tomographic methods to visualise their often poorly-preserved fossils** (e.g. Dearden *et al.* 2019, *Nature Commun.*). Used this data to construct and analyse a phylogenetic dataset, and drew conclusions about the morphological evolution of chondrichthyans, in particular the gill skeleton.

2013-2014: **MSc in Palaeobiology**. Awarded with Distinction. University of Bristol, UK.
Dissertation: *Exploring vertebrate evolution: jaws and genome duplications*
Investigated the tempo and mode of early jawed vertebrate morphological evolution. **Assembled a morphological supermatrix of stem-gnathostome taxa, including heterostracans**, by combining existing morphological matrices and by studying specimens in museums. Tested their relationships, morphological disparity, and the rate of evolution in the group.

2010-2013: **MA in Natural Sciences (Zoology)**. Awarded with Honours (2.1). University of Cambridge, UK.
Part II palaeo. Modules: Topics in vertebrate evolution, Mammalian evolution and faunal history,

OTHER RELEVANT EMPLOYMENT

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 on a variety of biology undergraduate and masters courses: details below under Skills

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 AND GRANTS

I have been awarded a number of grants based on applications I have written and co-written, both for fellowships and competitive experimental time. The total value of these grants amounts to approximately €512000. A full list of these is given in the accompanying document.

SCIENTIFIC PUBLICATIONS

I have published in a range of cross-disciplinary and field-specific journals. A full list of my scientific publications is given in the accompanying document.

PRESENTATIONS AT INTERNATIONAL CONFERENCES

2022: *Poster*: **Palaeontological Association annual meeting** - Dublin, Ireland
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] View via Googledrive
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 crassisimus*

2018: *Talk*: **Symposium of Vertebrate Palaeontology and Comparative Anatomy** - Manchester, UK
A third "acanthodian" endoskeleton in a uniquely well-preserved specimen of *Diplacanthus crassisimus*

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** - Chęciny, Poland
Articulated branchial skeletons in the "acanthodian" stem-chondrichthyans *Ptomacanthus anglicus* and *Diplacanthus crassisimus*

PROFESSIONAL SERVICE

Invited talks:
November 2022: University of Birmingham, invited by Lapworth Museum to give Lapworth Lecture. Talked to department and general public about my work on Palaeozoic jawless fishes
July 2022: Uppsala University, Sweden, invited by Sophie Sanchez. Talked to department about my work on feeding in Palaeozoic jawless fishes.
March 2021: Millersville University Pennsylvania, invited by Dominique Didier. Talked to Vertebrate Anatomy undergraduates on my work on fossil holocephalans.

Departmental services:
2022 Workshop on 3D software Blender for members of the department in Birmingham
2017: Contributor to Silwood Park Social Seminar Series: Talks on PhD research
2017: Contributor to Silwood Park Computer Skills workshop: Introduction to Inkscape
2015-16: President of the Silwood Park Student Union: Chaired student committee

Academic memberships:
2015-present: Member of the Systematics Association
2014-present: Member of the Society of Vertebrate Palaeontology
2013-present: Member of the Palaeontological Association

Conferences: 2020: Palaeontological Association Annual Meeting Science Committee member

Peer review: *Palaeontology*, *Proceedings of the Academy of Natural Sciences of Philadelphia*, *Acta Geologica Polonica*, *Palaeontologica Electronica*,*Scottish Journal of Geology*, *PeerJ*, *Cladistics*, *eLife*, *Journal of Vertebrate Paleontology*, *Swiss Journal of Palaeontology*.

SKILLS

Anatomy: Broad grounding in vertebrate anatomy from undergraduate and masters. Specific expertise in the **anatomy of chondrichthyans** and **Palaeozoic jawless vertebrates including heterostracans**, based in literature and museum collections work. Knowledge of living vertebrates' anatomy rooted in published 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 these models in **Blender**.

Phylogenetics: Experience building morphological character matrices using **Mesquite**, analysing them using both parsimony (**PAUP***, **TNT**) and Bayesian (**MrBayes**, **Tracer**) methods, and presenting phylogenetic trees in `R` using `ape,phangorn`

Macroevolutionary analysis: Experience using `R` to conduct evolutionary rate and disparity analyses using packages `claddis,dispRity`.

Functional: morphology Experience using **Blender and** `R` to test functional hypotheses e.g. using Python scripting to test muscle extension, mechanical advantage, and changes in volume in the pharynx.

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** and **Inkscape**, 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. Experienced with scientific drawing, 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 Publications) as well as for a more general audience, e.g. for Nature Ecology & Evolution Community. Have written several grant proposals, for postdoctoral positions, tomographic scanning bids, and have contributed to larger grant proposals for PI.

Presentation: Presented to variety of audiences including scientific conferences (see "Presentations at international conferences"), the general public, and undergraduates.

Public outreach: Contestant on the Great Scottish Fossil Showdown (Scottish Geology Festival 2021). Interviewee on palaeontological podcast Palaeoparty (2020). Contributor to the virtual Natural History Museum. Ran annual stand at Silwood Park Bugs Day(2015-2018), showcasing Palaeozoic fossil fishes. Volunteered in schools and at science festivals with the Bristol Dinosaur Project (2014).

Teaching, supervision, and mentorship:

April 2023:	Invited to lead a paper discussion workshop on the evolution of teeth *Guest-lecturer*. Palaeobiology Masters course, University of Erlangen.
April 2023:	Will give 3 lectures on palaeontological methods as part of palaeobiology course *Lecturer*. Naturalis Biodiversity Center/University of Leiden
Ongoing:	Supervising 2 students at Naturalis (1 undergrad 1 masters) using 3D methods to look at archerfish brains and the Palaeozoic chondrichthyan dermal skeleton respectively.
2023:	Vertebrate evolution course, invited back to give lecture on Shark Evolution *Guest lecturer.* University of Birmingham
2022-3:	Masters student Lars Brakenhoff - *Growth of the dermal skeleton in Silurian chondrichthyans* *Thesis Supervisor.* Masters research project, Naturalis Biodiversity Center
2022:	Staff member helping teach and supervise geology field trip to Pembrokeshire for undergraduates *Staff Member.* University of Birmingham
2022:	Vertebrate evolution course, lectures on Radiation of Mammals and Shark Evolution *Lecturer.* University of Birmingham
2021:	Collaborating with University of Uppsala PhD student Jake Leyhr and (supervisor: Sophie Sanchez) on project examining the origins of gnathostome cartilage
2018:	MSc student Jacob Birkenhead - *Gill arch anatomy in acanthodiform acanthodians* *Thesis Co-supervisor*, Masters research project, Imperial College London
2018-19:	2^{nd} year undergraduates: Vertebrate Form and Evolution (dissections and phylogenetics) *Demonstrator*, 1 wk teaching and 2 wk dissection project, Imperial College London
2016:	Masters students: Understanding morphological evolution using morphometry *Demonstrator*, 4 hrs, Imperial College London
2015-18:	1^{st} year undergraduates: Biology of Organisms (Mammal skulls and phylogenetics) *Demonstrator*, 8 hrs, Imperial College London

REFERENCES

Dr Martin Rücklin	Postdoc host, Vertebrate Evolution, Development, and Ecology, Naturalis Biodiversity Center, Netherlands *Email:* martin.rucklin@naturalis.nl *Tel:* +31 71 751 9247
Dr Ivan Sansom	Postdoc supervisor, Department of Geography, Earth, and Environmental Sciences, University of Birmingham, UK *Email:* i.j.sansom@bham.ac.uk *Tel:* +44 121 41 46147
Dr Alan Pradel	Postdoc Supervisor, UMR 7207 CR2P - MNHN, Paris, France *Email:* alan.pradel@mnhn.fr *Tel:* +33 1 40 79 80 68
Dr Martin Brazeau	PhD supervisor, Department of Life Sciences, Imperial College London, UK *Email:* m.brazeau@imperial.ac.uk *Tel:* +44 20 7594 2254

AWARDS AND GRANTS

2022: **Marie Curie-Skłodowska postdoctoral fellowship €187624**
DEADsharks: Divergence times, evolution, and anatomy deciphered in early sharks, awarded with host institution Naturalis Biodiversity Institute, Netherlands.

2022: **ANR AAPG grant (French national research agency, generic call for proposals) €149040**
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 €24000**
Award LS-3110 "Evolution of the head in early cartilaginous fish", co-awarded with Alan Pradel

2021: **Institut de l'Océan postdoctoral grant €53200 (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 Birmingham job.

2021: **European Synchrotron Radiation Facility beamline time €36000**
Award LS-3021 "Cartilage in the earliest sharks", co-awarded with Sophie Sanchez and Jake Leyhr

2019: **DIM Heritage and Ancient Materials Postdoctoral grant €50000**
"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", co-awarded with Martin Brazeau

2014: **Bristol Alumni Foundation travel grant £120**
Awarded for travel and accommodation to present a poster at Progressive Palaeontology

SCIENTIFIC PUBLICATIONS

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: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

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

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, *Callorhinchus 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

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 *Callorhinchus milii* and the catshark *Scyliorhinus canicula*. *Journal of Anatomy* doi:10.1111/joa.13362

Brazeau M.D., Giles, S., **Dearden, R.P.**, Jerve, A., Ariunchimeg, Y.A., Zorig, E., Sansom, R., Guillerme, 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

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

OTHER PUBLICATIONS

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