Yuriy Pichugin

Theoretical biologist

Research interests

Primary research topic

Evolution of multicellular life cycles.

Major evolutionary transitions, eco-evolutionary dynamics, evolutionary game theory, mathematical oncology.

Research experience

2021 - present **Postdoctoral researcher**, *Princeton University, Ecology and Evolutionary Biology department*, Princeton, USA.
Supervisor: Prof. Dr. Corina Tarnita

2016 - 2021 **Postdoctoral researcher**, *Max Planck Institute for Evolutionary Biology, Evolutionary Theory Department*, Ploen, Germany.
Supervisor: Prof. Dr. Arne Traulsen

2011 - 2015 **PhD student**, *Massey University, Rainey lab*, Auckland, New Zealand.
Thesis title: Theoretical investigation into the origins of multicellularity. Supervisor: Prof. Dr. Paul B. Rainey

2008 - 2010 **Master research project**, *Institute of Chemical Kinetics and Combustion, Laboratory of cytometry and biokinetics*, Novosibirsk, Russia.
Thesis title: Research of cellular cycle taking account of cells distribution function in accordance with division rate. Supervisor: Dr. Andrey V. Chernyshev

2006 - 2008 **Bachelor research project**, *Institute of Chemical Kinetics and Combustion, Laboratory of cytometry and biokinetics*, Novosibirsk, Russia.
Thesis title: Abilities of the spectral approach in the analysis of light scattering indicatrices of mononuclear cells. Supervisor: Dr. Maxim A. Yurkin

Education

2011–2015 **PhD in Theoretical Biology**, *Massey University*, Auckland, New Zealand.

2008–2010 **Master in Physics**, *Novosibirsk State University*, Novosibirsk, Russia.

2004–2008 **Bachelor in Physics**, *Novosibirsk State University*, Novosibirsk, Russia.

Grants and Awards

2020 Marie Curie Individual Fellowship, EU (grant respectfully declined to accept position at Princeton), EUR 200'000

2015 DAAD short-term research grant, Germany, EUR 9'000

2012 Sir Neil Waters scholarship, New Zealand, NZD 5'000

2010 Schlumberger scholarship, Russia, RUB 50'000

2010 Master diploma with excellence. Average score 5.0 out of 5.0, Russia

2009 Kovalsky award, Russia

2008 Bachelor diploma with excellence. Average score 5.0 out of 5.0, Russia

2004 President award for school graduates, Russia

Organisational experience

Sep. 2019 **Co-organiser of the workshop "Evolution of interacting populations"**, Max Planck Institute for Evolutionary Biology, Ploen, Germany.

Jul. 2019 **Organiser of the mini-symposium "Evolution of multicellular life cycles"**, part of the conference MMEE-2019, Lyon, France.

2018 - 2019 **Initiator and coordinator of the peer study group "Machine learning"**, Max Planck Institute for Evolutionary Biology, Ploen, Germany.

Teaching and mentoring experience

2017 - 2021 **Co-supervisor of the PhD student**, Yuanxiao Gao, University of Luebeck, Germany.
Thesis title: Evolution of life cycles of heterogeneous cell groups.

Apr. - Oct. 2019 **Co-supervisor of the master student**, Vanessa Ress, University of Luebeck, Germany.
Thesis title: Eco-evolutionary dynamics of simple life cycles.

2018 - 2019 **Rotating lecturer in the peer study group "Machine learning"**, based on the book "Pattern Recognition and Machine Learning" by Bishop, Ploen, Germany.

2017 - 2018 **Rotating lecturer in the peer study group "Statistical physics"**, based on the book "A Kinetic View of Statistical Physics" by Krapivsky, Redner, and Ben-Amin, Ploen, Germany.

2008 - 2010 **Teacher of physics**, Specialized Scientific Study Center (high school), Novosibirsk, Russia.

Aug. 2006, Aug. 2007, Aug. 2008 **Teacher of physics**, Summer school at Specialized Scientific Study Center (high school), Novosibirsk, Russia.

Industry experience

2010 - 2011 **Internship**, *Schlumberger*, Novosibirsk Technological Center, Novosibirsk, Russia.

Peer-reviewed publications

2021 Y.Gao, H.J.Park, A. Traulsen, **Y.Pichugin**✉, Evolution of irreversible somatic differentiation, *eLife, in press. preprint: https://www.biorxiv.org/content/10.1101/2021.01.18.427219v1*.

2021 O. Yaryhin, J. Klembara, **Y.Pichugin**, M. Kaucka, I. Werneburg, Limb reduction in squamate reptiles correlates with the reduction of the chondrocranium: a case study on serpentiform anguids, *Developmental Dynamics*, 1-18.

2020 **Y.Pichugin**✉, A.Traulsen, Evolution of multicellular life cycles under costly fragmentation, *PLoS Computational Biology*, 16 (11), e1008406.

2020 H.J. Park, **Y.Pichugin**, A.Traulsen, Why is cyclic dominance so rare?, *eLife* 9, e57857.

2020 C.J. Rose, K. Hammerschmidt, **Y.Pichugin**, P.B.Rainey, Meta-population structure and the evolutionary transition to multicellularity, *Ecology Letters* 23 (9), 1380-1390.

2019 **Y.Pichugin**✉, H.J.Park, A.Traulsen, Evolution of simple multicellular life cycles in dynamic environments, *Journal of the Royal Society Interface* 16 (154), 20190054.

2019 H.J.Park, **Y.Pichugin**, W.Huang, A.Traulsen, Population size changes and extinction risk of populations driven by mutant interactors, *Physical Review E* 99 (2), 022305.

2019 Y.Gao, A.Traulsen, **Y.Pichugin**✉, Interacting cells driving the evolution of multicellular life cycles, *PLoS Computational Biology* 15(5), e1006987.

2017 **Y.Pichugin**✉, J.Peña, P.B.Rainey, A.Traulsen, Fragmentation modes and the evolution of life cycles, *PLoS Computational Biology* 13 (11), e1005860.

2015 **Y.Pichugin**✉, C.S.Gokhale, J.Garcia, A.Traulsen, P.B.Rainey, Modes of migration and multilevel selection in evolutionary multiplayer games, *Journal of Theoretical Biology* 387, 144-153.

2012 **Y.G.Pichugin**, K.A.Semiyanov, A.V.Chernyshev, I.G.Palchikova, L.V.Omelyanchyuk, V.P.Maltsev, Peculiarities of cytometrical methods of DNA content determination in the nucleus, *Cell and Tissue Biology* 6 (3), 302-308.

Preprints and manuscripts in preparation

2021 S. Tang^{+}, **Y.Pichugin**$^{+}$, K.Hammerschmidt, Phenotypic plasticity, transient multicellularity, and an environmentally dependent life cycle, *https://www.biorxiv.org/content/10.1101/2021.09.29.462355v1*.

2021 Y.Gao, **Y.Pichugin**, C.S.Gokhale, A. Traulsen, Evolution of reproductive strategies in incipient multicellularity, *https://www.biorxiv.org/content/10.1101/2021.09.13.460035v1*.

2021 J.T.Lange^{+}, C.Y.Chen^{+}, **Y.Pichugin**$^{+}$, *et al*, Principles of ecDNA random inheritance drive rapid genome change and therapy resistance in human cancers, *https://www.biorxiv.org/content/10.1101/2021.06.11.447968v1*.

2019 **Y.Pichugin**, W. Huang, B. Werner, Stochastic dynamics of extra-chromosomal DNA, *https://www.biorxiv.org/content/10.1101/2019.12.15.876714v1*.

Y.Pichugin, A. Traulsen, Mass conservation restricts the possible modes of reproduction, *submitted*.

✉indicates corresponding author
$+$ indicates shared first authorship

Invited talks

2020 **Stochastic dynamics of ecDNA in tumors**, Theory division seminar at Cleveland clinic, Cleveland, USA, *online talk*.

2019 **Evolution of simple multicellular life cycles**, Biomathematics seminar at Harvard University, Boston, USA.

2018 **Evolution of life cycles in early multicellularity**, Complex systems seminar at Queen Mary University of London, UK.

2017 **Fitness correlation metric as a method of detection of the transition in individuality**, Invited talk in Prof. R.Watson group in University of Southampton, UK.

Presentations at the conferences

2021 **Mass conservation restricts the possible modes of microbial reproduction**, SMB-2021: Society of Mathematical Biology annual meeting, online conference (*online talk*).

2020 **Evolution of clonal life cycles: recipes for multicellularity, equal split, and single cell bottleneck**, SMB-2020: Society of Mathematical Biology annual meeting, online conference (*online talk*).

2019 **Evolution of simple multicellular life cycles**, Evolution of interacting populations workshop, Ploen, Germany (*talk*).

2019 **Towards a general theory of reproduction modes evolution**, MMEE-2019: Mathematical models in Ecology and Evolution, Lyon, France (*talk*).

2019 **Evolution of life cycles in early multicellularity**, CCCC-2019: Conflict, Competition, Cooperation and Complexity, Vaals, Netherlands (*talk*).

2018 **Evolution of simple multicellular life cycles in a dynamic environment**, Evolutionary emergence of life cycles workshop, Ploen, Germany (*talk*).

2018 **Evolution of life cycles in early multicellularity**, Evolutionary Models of Structured Populations: Integrating Methods workshop, Ploen, Germany (*talk*).

2018 **Reproduction costs can drive the evolution of groups**, ECMTB-2018: European Conference on Mathematical and Theoretical Biology, Lisbon, Portugal (*talk*).

2018 **Evolution of simple multicellular life cycles in a dynamic environment**, MPDEE-2018: Models in Population Dynamics, Ecology, and Evolution, Leicester, UK (*talk*).

2018 **Evolution of simple multicellular life cycles in a dynamic environment**, DPG-2018: Deutsche Physikalische Gesellschaft meeting, Berlin, Germany (*poster*).

2017 **Fragmentation modes and the evolution of multicellular life cycles**, MMEE-2017: Mathematical models in Ecology and Evolution, London, UK (*talk*).

2017 **Fitness correlation metric as a method of detection of the transition in individuality**, MBE-2017: Modelling Biological Evolution, Leicester, UK (*talk*).

2016 **Fragmentation modes and the evolution of multicellular life cycles**, CCCC-2016: Conflict, Competition, Cooperation and Complexity, Prague, Czech Republic, (*talk*).

2016 **Fragmentation strategies and the evolution of multicellular life cycles**, ECMTB-2016: European Conference on Mathematical and Theoretical Biology, Nottingham, UK (*poster*).

2015 **Modes of migration and multilevel selection in evolutionary multiplayer games**, MMEE-2015: Mathematical models in Ecology and Evolution, Paris, France (*poster*).

Non peer-reviewed publications and outreach activities

2020 **Antibody tests and our return to a more normal life**, *Article in the scientific outreach web-site on the COVID pandemic*, Co-author and translator to Russian, `http://web.evolbio.mpg.de/evoltheo_corona/articles/YP_AntibodyTests/index_EN.html`.

2020 **Exponential virus growth and increasing the capacity of a health-care system**, *Article in the scientific outreach web-site on the COVID pandemic*, Co-author, `http://web.evolbio.mpg.de/evoltheo_corona/articles/AT_CommExpGrowth/01_english/Eng_ExponentiellesWachstum_May.pdf`.

2019 **Was können uns mathematische Modelle über die Evolution von einfachen Lebenszyklen sagen?**, *Chapter in Max Planck Society Year book (in German)*, Co-author, Munich, Germany.

2019 **The game of life cycles**, *The demonstration boardgame presented during European Researcher's Night*, Designer and demonstrator, Ploen, Germany.

2018 **From one to many**, *Popular science article*, Author, New Principia. http://www.newprincipia.com, Pilot issue 001 "Time".

2018 **The game of life cycles**, *The demonstration boardgame presented during Max Planck Institute open day*, Designer and demonstrator, Ploen, Germany.

2018 **Die Evolution von Lebenszyklen**, *Popular science article (in German)*, Co-author, EvolBioMax magazine.

2018 **Write your name with DNA**, *The demonstration at European Researcher's Night*, Demonstrator, Kiel, Germany.

2017 **Write your name with DNA**, *The demonstration at Max Planck Institute open day*, Demonstrator, Ploen, Germany.

Computer skills

Office LaTeX, MS Office (Power Point, Word, Excel), Omnigraffle, Scribus.

Programming Python (numpy, scipy, matplotlib, scikit-learn, seaborn, pandas), R, Mathematica, Matlab.

Other Git, Slurm.

Languages

Russian Native speaker

English Fluent

German Basic

Social media and contact information

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Twitter **@ab_in_**
ORCID **https://orcid.org/0000-0003-3078-2499**