

**EHSAN KAYAL, Evolutionary Biologist**

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**SUMMARY**

I am an **evolutionary biologist** interested in the **genomics of marine organisms**, with a focus on **organelles**. I have expertise in an array of **data analysis** methods such as **genetics** and **genomics**, **phylogeny**, and **bioinformatics**. Recently, I have been looking at how the **holobiont concept** could explain the **evolution and diversification of organelles**.

**PROFESSIONAL EXPERIENCE**

- Research Engineer**, Stat. Biol. de Roscoff (France) Jan. 2019-Dec. 2020  
Genomics of brown macro-algae [**Phaeoexplorer project**]
- Postdoc/Res. Engineer**, Station Biologique de Roscoff (France) Sep. 2016-Dec. 2018  
Genomics of parasitic dinoflagellates [**HAPAR project**]
- Postdoctoral Fellow**, NMNH Smithsonian Institution (USA) Sep. 2014-Aug. 2016  
Medusozoan genomes; Cnidarian phylogenomics [**personal project**]
- Laboratory Technician**, NMNH Smithsonian Institution (USA) Sept. 2012-June 2014  
Contractor at the Laboratory of Analytical Biology [**Barcode of Life Project**]
- Predoctoral Fellow**, NMNH Smithsonian Institution (USA) Sep. 2011-Feb. 2012  
Evolution of the mtDNA in Hydrozoa and phylomitogenomics [**personal project**]
- Teaching Assistant**, Iowa State University (USA)  
Fundamentals of Human Anatomy Laboratory Fall 2009 & 2010  
(BIOL 255L Undergrad-level class)  
Fundamentals of Human Physiology Laboratory Spring 2010 & 2011  
(BIOL 255L Undergrad-level class)  
Molecular Phylogenetic Spring 2009  
(EEOB 563 Graduate-level class)
- Visiting Researcher**, Iowa State University (USA) July-Sep. 2007  
Sequencing the mitochondrial genome of the brown hydra *Hydra oligactis*
- Laboratory internship**, NIOO-KNAW (the Netherlands) Aug. 2005-June 2006  
Stable C and N isotope labelling experiments on the opportunistic deposit feeder *Capitella capitata*
- Research Assistant**, ISMER (Qc, Canada) Feb.-June 2005  
Effect of contaminated sediments on steroids concentration in the blue mussel *Mytilus edulis*
- Technician**, Oceanographic vessel N/O Thalassa II (France) September 2004  
Sampling, identification and preservation of zoo-planktonic organisms

## Curriculum vita

**Laboratory internship**, CNRS UMR 7138, Univ. P. et M. Curie Jan.-July 2003  
Molecular and morphological phylogeny of European species of the calcareous sponge *Sycon*

### OTHER POSITIONS HELD

**Scientific observer**, La Rochelle (France) April-May 2007  
Experimental fishing of anchovy off French coasts to evaluate its stock

**Technician**, Enviro-Conseil Travaux (France) Jan., Mars, June 2007  
Supervision and expertise of polluted soil from construction sites

**Scientific mediator**, Association ASTS (France) September 2006  
Increasing people awareness about environmental problems and sustainable development

**Technician**, CNRS UMR 7093, Obs. Océan. Villefranche (France) July 2004  
CHN analysis of algae cultures

**Tutor**, Acadomia (France) 2002-2003  
Tutoring middle- and high-school students in Biology, Chemistry, Physics, and Mathematics

### AWARDS, GRANTS AND FELLOWSHIPS:

2015 Smithsonian Institution Scientific Team Engaging Young Minds Award  
2014 Smithsonian Institution Peter Buck Postdoctoral Fellowship  
2011 Smithsonian Institution Peter Buck Predoctoral Fellowship  
2011 Travel Grant, Graduate College, Iowa State University

### PROFESSIONAL ACTIVITY

**Referee:** Genome Biology and Evolution, Molecular Biology and Evolution, Molecular Phylogeny and Evolution, Coral Reefs, Gene, BMC Genomics, Harmful Algae

**Miscellaneous:** Contributed to the Smithsonian NMNH Dept. of Invertebrate Zoology News - No Bones blog; contributed to the *Compendium of Scientific and Practical Findings Supporting Eco-Restoration to Address Global Warming* vol. 5(1); co-organiser of the 11<sup>th</sup> Young Researchers Day (JJC 2019) conference at the SBR.

### SKILLS AND LANGUAGES

English (Bilingual), Farsi (Bilingual), French (Bilingual)  
Informatics: proficiency in Unix/Linux and computer clusters, elementary in R and Python.  
Diving: PADI Rescue Diver, CMAS II

### EDUCATION

Station Biologique de Roscoff (France), 3-14 June 2013  
Marine Genomics 4 Users (MG4U): workshop on marine genomics

**PhD**, Iowa State University (USA) Dept. Ecology, Evolution, and Organismal Biology, August 4<sup>th</sup> 2012

- Evolution of mitochondrial genomes in Calcarea and Cnidaria  
Bocas del Toro Research Station, STRI (Panama), July 2010  
NSF-AToL: workshop on Taxonomy, Systematics, and Ecology of Sponges
- MS** Sorbonne University (France) Dept. Ecology, Biodiversity, Evolution, June 2005  
Dynamics and genetics of marine pop., evol. of life cycle, etc
- Observatoire Océanologique de Villefranche-sur-Mer (France), July 2004  
Data processing in Marine Ecology
- Maîtrise** Sorbonne University (France) Dept. Marine Biology, June 2004  
Oceanography and marine biology
- Station Biologique de Roscoff (France), August 2003  
Summer course marine fauna diversity
- BA** Sorbonne University (France) Dept. Organismal and Population Biology, June 2002  
Evology and organismal biology, pop. genetic, etc.

## LIST OF PUBLICATIONS

24. Kayal M, Ballard J, **Kayal E**. 2021. Towards a more sustainable academic publishing system. *arXiv*: 2101.06834.
23. Macher JN, **Kayal E**, Duijm E, van der Hoorn B, Montano S, Speksnijder A. The mitochondrial genome of *Nemalecium lighti* (Hydrozoa, Leptothecata). *Mitochondrial DNA Part B: Resources* (*in press*).
22. Klompen AML, **Kayal E**, Collins AG, Cartwright P. 2021. Phylogenetic and selection analysis of an expanded family of putatively pore-forming jellyfish toxins (Cnidaria: Medusozoa). *Genome Biology and Evolution* 13(6): evab081.
21. **Kayal E**, Smith DR. 2021. Is the dinoflagellate *Amoebophrya* really missing a mtDNA? *Molecular Biology and Evolution*, 38(6): 2493–2496.
20. Dittami SM, Arboleda E, Auguet J-C, Bigalke A, Briand E, Cárdenas P, Cardini U, Decelle J, Engelen A, Eveillard D, Gachon CMM, Griffiths S, Harder T, **Kayal E**, Kazamia E, Lallier FH, Media M, Marzinelli EM, Morganti T, Pons LN, Prado S, Pintado J, Saha M, Selosse M-A, Skillings D, Stock W, Sunagawa S, Toulza E, Vorobev A, Leblanc C, Not F. 2021. A community perspective on the concept of marine holobionts: state-of-the-art, challenges, and future directions. *PeerJ*, 9: e10911. DOI: 10.7717/peerj.10911.
19. Farhat S\*, Lec P\*, **Kayal E\***, Noel B\*, Bigeard E, Corre E, Maumus F, Florent I, Alberti A, Aury J-M, Barbeyron T, Cai R, Da Silva C, Istace B, Labadie K, Marie D, Mercier J, Rukwavu T, Jeremy Szymczak J, Tonon T, Alves-de-Souza C, Rouzé P, Van de Peer Y, Wincker P, Rombauts S, Porcel BM, Guillou L. (\*co-first author). 2021. Rapid protein evolution, organellar reductions, and invasive intronic elements in the marine aerobic parasite dinoflagellate *Amoebophrya* spp. *BMC Biology*, 19: 1. DOI: 10.1186/s12915-020-00927-9.
18. **Kayal E**, Alves-de-Souza C, Farhat S, Velo-Suarez L, Monjol J, Szymczak J, Bigeard E, Marie D, Noel, Porcel BM, Corre E, Six C, Guillou L. 2020. Dinoflagellate host chloroplasts and mitochondria remain functional during *Amoebophrya* infection. *Frontiers in Microbiology*, 11: 600823. DOI: 10.3389/fmicb.2020.600823.

17. Cai R, **Kayal E**, Alves-de-Souza C, Bigeard E, Corre E, Jeanthon C, Marie D, Porcel BM, Siano R, Szymczak J, Wolf M, Guillou L. 2020. Cryptic species in the parasitic *Amoebophrya* species complex revealed by a polyphasic approach. *Scientific Reports*, 10: 2531. DOI: 10.1038/s41598-020-59524-z.
16. Ohdera A, Ames CL, Dikow RB, **Kayal E**, Chiodin M, Busby B, La S, Pirro S, Collins AG, Medina M, Ryan JF. 2019. Box, stalked, and upside-down? Draft genomes from diverse jellyfish (Cnidaria, Acraspeda) lineages: *Alatina alata* (Cubozoa), *Calvadosia cruxmelitensis* (Staurozoa), and *Cassiopea xamachana* (Scyphozoa). *GigaScience*, 8(7): giz069. DOI: 10.1093/gigascience/giz069.
15. Kayal M, Lewis H, Ballard J, **Kayal E**. 2019. Humanity and the 21st century's resource gauntlet: a commentary on Ripple et al.'s article "World scientists' warning to humanity: a second notice". *Rethinking Ecology*, 4: 21-30. DOI: 10.3897/rethinkingecology.4.32116.
14. Farhat S, Florent I, Noel B, **Kayal E**, Da Silva C, Bigeard E, Alberti A, Labadie K, Corre E, Aury J-M, Rombauts S, Wincker P, Guillou L, Porcel BM. 2018. Comparative time-scale gene expression analysis highlights the infection processes of two *Amoebophrya* strains. *Frontiers in Microbiology*, 9: 2251. DOI: 10.3389/fmicb.2018.02251.
13. **Kayal E**, Bentlage B, Pankey MS, Ohdera AH, Medina M, Plachetzki D, Collins AG, Ryan JF. 2018. Phylogenomics provides a robust topology of the major cnidarian lineages and insights on the origins of key organismal traits. *BMC Evolutionary Biology*, 18: 68. DOI: 10.1186/s12862-018-1142-0.
12. Kayal M, **Kayal E**. 2017. Colonies of the fire coral *Millepora platyphylla* constitute scleractinian survival oases during *Acanthaster* outbreaks in French Polynesia. *Marine Biodiversity*, 47(1): 255-258. DOI: 10.1007/s12526-016-0465-6.
11. González VL, **Kayal E**, Halloran M, Shrestha Y, Harasewych MG. 2016. The complete mitochondrial genome of the land snail *Cerion incanum* (Gastropoda: Stylommatophora) and the phylogenetic relationships of Cerionidae within Panpulmonata. *Journal of Molluscan Studies*, 82(4): 525-533. DOI: 10.1093/mollus/eyw017.
10. Lawley JW, Ames CA, Bentlage B, Yanagihara A, Goodwill R, **Kayal E**, Hurwitz K, Collins AG. 2016. Box Jellyfish *Alatina alata* Has a Circumtropical Distribution. *The Biological Bulletin*, 231(2): 152-169. DOI: 10.1086/690095.
9. **Kayal E**, Bentlage B, Collins AG. 2016. Insights into the transcriptional and translational mechanisms of linear organellar chromosomes in the box jellyfish *Alatina alata* (Cnidaria: Medusozoa: Cubozoa). *RNA Biology*, 13(9): 799-809. DOI: 10.1080/15476286.2016.1194161.
8. **Kayal E**, Bentlage B, Cartwright P, Yanagihara A, Lindsay DJ, Hopcroft RR, Collins AG. 2015. Phylogenetic analysis of higher-level relationships within Hydroidolina (Cnidaria: Hydrozoa) using mitochondrial genome data and insight into their mitochondrial transcription. *PeerJ* 3: e1403. DOI: 10.7717/peerj.1403.
7. Redmond NE, Morrow CC, Thacker RW, Diaz MC, Boury-Esnault N, Cárdenas P, Hajdu E, Lôbo-Hajdu G, Picton BE, Pomponi SA, **Kayal E**, Collins AG. 2013. Phylogeny and Systematics of Demospongiae in Light of New Small-Subunit Ribosomal DNA (18S) Sequences. *Integrative and Comparative Biology*, 53(3): 388-415. DOI: 10.1093/icb/ict078.

6. **Kayal E**, Roure B, Philippe H, Collins AG, Lavrov DV. 2013. Cnidarian phylogenetic relationships as revealed by mitogenomics. *BMC Evolutionary Biology*, 13: 5. DOI: 10.1186/1471-2148-13-5.
5. Lavrov DV, Pett W, Voigt O, Worheide G, Forget L, Lang BF, **Kayal E**. 2013. Mitochondrial DNA of *Clathrina clathrus* (Calcarea, Calcinea): six linear chromosomes, fragmented rRNAs, tRNA editing, and a novel genetic code. *Molecular Biology and Evolution*, 30(4): 865-880. DOI: 10.1093/molbev/mss274.
4. Smith DR, **Kayal E**, Yanagihara A, Collins AG, Pirro S, Keeling P. 2012. First complete mitochondrial genome sequence from a box jellyfish reveals a highly fragmented, linear architecture and insights into telomere evolution. *Genome Biology and Evolution*, 4(1): 52-58. DOI: 10.1093/gbe/evr127.
3. **Kayal E**, Bentlage B, Collins AG, Kayal M, Pirro S, Lavrov DV. 2012. Evolution of linear mitochondrial genomes in medusozoan cnidarians. *Genome Biology and Evolution*, 4(1): 1-12. DOI: 10.1093/gbe/evr123.
2. Rota-Stabelli O, **Kayal E**, Gleeson D, Daub J, Boore J, Pisani D, Telford M, Blaxter M, Lavrov DV, 2010. Ecdysozoan Mitogenomics: Evidence for a Common Origin of the Legged Invertebrates, the Panarthropoda. *Genome Biology and Evolution*, 2: 425-440. DOI: 10.1093/gbe/evq030.
1. **Kayal E**, Lavrov DV, 2008. The mitochondrial genome of *Hydra oligactis* (Cnidaria, Hydrozoa) sheds new light on animal mtDNA evolution and cnidarian phylogeny. *Gene* 410: 177-186. DOI: 10.1016/j.gene.2007.12.002.

## INTERNATIONAL SYMPOSIA

**Kayal E** & Smith DR. The missing mtDNA of *Amoebophrya* sp. (Syndiniales, Alveolata). *Virtual Evolution*. June 21-25 2021 (oral presentation).

**Kayal E**, Sarah F, Six C, Noel B, Porcel B, Guillou L, Corre E. The syndiniales parasite *Amoebophrya* depends upon its host organelles. *ISEAG International Symposium on Environmental and Agricultural Genomics*. November 5-7 2018. Paris, France (poster).

Szymczak J, Corre E, Alves-de-Souza C, Guillou L, **Kayal E**. Evolution of the Oxidative phosphorylation pathway in Dinoflagellates and sister taxa. *18<sup>th</sup> International conference on Harmful Algae*. October 21-26 2018. Nantes, France (poster).

**Kayal E**, Velo-Suarez L, Sarah F, Bigeard E, Marie D, Six C, Noel B, Porcel B, Alves-de-Souza C, Guillou L, Corre E. Is the intracellular parasite *Amoebophrya* (Syndiniales) mining its host organelles during infection? *EMBO Workshop Comparative genomics of eukaryotic microbes: Dissecting sources of evolutionary diversity*. October 14-19 2017. Sant Feliu de Guíxols, Spain (poster).

Chiodin M, **Kayal E**, Ohdera A, Medina M, Plachetski DC, Collins AG, Ryan JF. You gain some, you lose some: Hox genes in the early history of Cnidaria and Bilateria. *SICB*. January 4-8 2017. New Orleans, LA, USA (oral presentation). *Integrative and Comparative Biology* 57: E224.

Klompfen A, **Kayal E**, Collins AG. Survey of CaTX-like Toxin Genes in Various Cnidarian Species. *IMBC*. August 29-September 2<sup>nd</sup> 2016. Baltimore, MD, USA (poster).

**Kayal E**, Redmond NE, Collins AG. Shallow-depth sequencing of the genome of several sponges using advanced multiplexing. *IXth World Sponge Conference*. November 4-8 2013. Fremantle, Australia (oral presentation).

**Kayal E**, Roure B, Smith D, Pirro S, Yanagihara A, Kayal M, Bentlage B, Philippe H, Collins A, Lavrov DV. Mitogenomic of medusozoans provides insights on the evolution of linear mtDNA in the group. *12th International Coral Reef Symposium (ICRS 2012)*. July 9-13 2012. Cairns, Australia (oral presentation).

**Kayal E**, Bentlage B, Collins AG, Kayal M, Pirro S, Lavrov DV. 2011. Evolution of linear mitochondrial genomes in medusozoan cnidarians. *SMBE*. July 26-30 2011. Kyoto, Japan (poster).

**Kayal E**, Voigt O, Wörheide G, Lavrov DV. Mitochondrial sequences from calcareous sponges redefine the limits of mtDNA evolution in the animal kingdom. *SMBE*. July 26-30 2011. Kyoto, Japan (poster).

**Kayal E**, Voigt O, Wörheide G, Lavrov DV. Mitochondrial sequences from calcareous sponges redefine the limits of mtDNA evolution in the animal kingdom. *VIIIth World Sponge Conference*. September 20-24, 2010. Girona, Spain (oral presentation).

**Kayal E**, Lavrov DV. Cnidarian tree of life based on mitochondrial genomic data. *SICB*. January 3-7, 2010. Seattle, USA (poster).

Pett W, **Kayal E**, Lavrov D. 2010. Mitochondrial genome rearrangements in animals: An update with perspectives on computational tractability. *SICB*. January 3-7, 2010. Seattle, USA (oral presentation). *Integrative and Comparative Biology* 50: E136.

**Kayal E**, Lavrov DV. Evolution of linear mitochondrial DNA in Cnidaria. *SMBE*. June 3-7 2009. Iowa City, USA (oral presentation).

Lavrov DV, Haen K, **Kayal E**, Wang X. Key transitions in animal evolution: a mtDNA perspective. *ICREA Conference on Origin and Early Evolution of Metazoans*. 24-25 October 2008, Barcelona, Spain (poster).

Vandewiele S, **Kayal E**, van Oevelen D, Middelburg JJ, 2007. An isotope dilution approach to assess the nutritional value of detritus (oral presentation). In: Mees, J. et al. (Ed.) (2007). *VLIZ Young Scientists' Day, Brugge, Belgium 2 March 2007: book of abstracts*. VLIZ Special Publication 39: 67.

## LOCAL SYMPOSIA

**Kayal E**. Functional organelles in zombie dinoflagellate? December 9-10<sup>th</sup> 2019. *SYMSYM*. Station Biologique de Roscoff, Roscoff, France (oral presentation).

**Kayal E**. Why scientists don't care about climate change. December 7<sup>th</sup> 2018. *JJC*. Station Biologique de Roscoff, Roscoff, France (oral presentation).

**Kayal E**. Organellar activity of zombie dinoflagellate *Scrippsiella acuminata* during infection by parasitoid syndiniale *Amoebophrya* sp. June 25<sup>th</sup> 2018. *Interactions Biotiques Marines 2*. Observatoire Océanologique de Banyuls, France (orale presentation).

Szymczak J, Corre E, Guillou L, **Kayal E**. Caractérisation et étude de l'évolution d'une voie mitochondriale chez les Alvéolés. March 14<sup>th</sup> 2018. **GEN2BIO** 2018. Rennes, France (poster).

Vandewiele S, **Kayal E**, van Oevelen D, Middelburg JJ, 2007. An isotope dilution approach to assess the nutritional value of detritus. **VLIZ Young Scientists' Day**. March 2<sup>nd</sup> 2007, Brugge, Belgium.

**ACTIVE COLLABORATORS:**

Allen G. Collins (NOAA's National Marine Fisheries Service, USA), Bastian Bentlage (University of Guam, USA), Mohsen Kayal (IRD U227 CoReUs, New Caledonia), Erwan Corre (Station Biologique de Roscoff, France), Laure Guillou (Station Biologique de Roscoff, France), Mark Cock (Station Biologique de Roscoff, France).

**GRADUATE ADVISOR:** Dennis V. Lavrov (Iowa State University)

**POSTDOCTORAL ADVISOR:** Allen G. Collins (NOAA's National Marine Fisheries Service, USA) Erwan Corre (Station Biologique de Roscoff, France), Laure Guillou (Station Biologique de Roscoff, France), Mark Cock (Station Biologique de Roscoff, France).

**STUDENTS ADVISED/MONITORED:**

**High school:** Maximillian Quinn Morgan (Senior from DeMatha Catholic High School, Maryland, USA; YES! program),

**Undergraduates:** Elizabeth Grace Reardon (Junior at High Point University, North Carolina, USA; NHRE program), Courtney Ellen Klatt (Indiana University, Indiana, USA), Anna Marie Louisa Klompen (The College of William and Marie, Virginia, USA; NOAA CED program),

**Master:** Mathilde Scheifler (Sorbonne University, France), Jeremy Szymczak (Sorbonne University, France).

**Ph.D.:** Ruibo Cai (Sorbonne University, France).