

# Sarah Cubaynes

*Evolutionary demography  
Biodiversity conservation  
and Biostatistics*

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## Research interests

Understand and predict species' responses to environmental perturbations -such as climatic factors, diseases, interactions with other species including humans- with a specific interest in how evolutionary and ecological processes interact to shape life histories in free-living birds and mammals. Beyond theoretical interests, I am motivated by using these results to inform conservation actions.

## Current position

since Oct. 2016 **Associate Professor**, Ecole Pratique des Hautes Etudes, PSL Research University  
since 2019 I am now member of the [HAIR team](#), Dynamics and Conservation of Biodiversity department, at the [Center for Functional and Evolutionary Ecology](#) of Montpellier.

I study the eco-evolutionary dynamics of **social species** (humans, wolves, horses and spotted hyenas), **endangered species living in extreme environments** (Svalbard polar bears), and **species interactions in changing environments** (host-parasite and predator-prey systems). My research also involves the use and development of forecasting models.

In parallel, I am teaching population dynamics, life history evolution, wildlife management and statistics to master students at EPHE and University of Montpellier.

2016-2018 Following my recruitment, I was part of the [Longevity and Vitality team of the MMDN lab](#), at the [University of Montpellier](#). My research focused on the impact of environmental variables on human health and longevity (temperatures, pollution, epidemiological factors) in interaction with social factors. After three years there, gaining experience in human demography, I was ready to join the [Human-Animal InteRactions \(HAIR\) team](#) at the [CEFE](#).

## Post-doctorate

2015-2016 **Post-Doctoral Research Associate**, Center for Functional and Evolutionary Biology of Montpellier and Norwegian Polar Institute, Tromso.

Understanding the **ecological and evolutionary drivers of polar bears reproductive strategies**. I am also using polar bears as a study case to understand the evolution of reproductive strategies in extreme environments and evaluate the impact of global warming.

collaborators Olivier Gimenez (Center for Functional and Evolutionary Ecology, Montpellier)  
Jon Aars (Norwegian Polar Institute, Tromso)  
Nigel Yoccoz (The Arctic University of Norway, Tromso)

2012–2015 **Post-Doctoral Research Associate**, University of Oxford (2013 to 2015),  
Imperial College of London (2012).

Understanding the **ecological and evolutionary consequences of environmental change on Yellowstone wolves**. I used wolves as a study case to explore how individual traits (such as body weight, coloration, age, sex) can modulate disease dynamics and predator-prey interactions.

collaborators Tim Coulson (University of Oxford, Oxford)  
Douglas Smith (Yellowstone Wolf Project, Mammoth)  
in close collaboration with several american epidemiologists and geneticists

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## Ph.D. Thesis

2008–2011 **Heterogeneity in capture-recapture models**, University of Montpellier

Development and evaluation of estimation and model selection procedures for capture-recapture mixture models, random effects models, and application of structural equation modeling to capture-recapture data.

Application of these methods to test life history predictions (seabirds and passerines) and for conservation purposes (seabirds and wolves).

supervisors Olivier Gimenez (Center for Functional and Evolutionary Ecology, Montpellier)  
Christian Lavergne (Institute of Mathematics and Modeling, Montpellier)

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## Education

2007–2008 **MSc, 2nd year**, 'Ecology, Evolutionary Biology and Biometry'.  
University Lyon I, Lyon, France

Jan–Jun 2008 Internship: **Demography of elusive species: non-invasive monitoring of French Wolves**.

supervisors Olivier Gimenez (Center for Functional and Evolutionary Ecology, Montpellier),  
Jean-Michel Gaillard (University Lyon 1), Christophe Duchamp and Eric Marboutin  
(French National Game and Wildlife Agency).

2006–2007 **MSc, 1st year**, 'Biostatistics'.  
University of Montpellier, Montpellier, France

Jan–Jun 2007 Internship: **Studying trade-offs in natural populations: influence of environmental conditions on the cost of reproduction in blue tits**.

supervisors Olivier Gimenez, Claire Doutrelant, Philippe Perret (Center for Functional and Evolutionary Ecology, Montpellier),  
and Vladimir Grosbois (CIRAD, Montpellier).

2003–2006 **BSc**, 'Biology of organisms'.  
University of Montpellier, Montpellier, France

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## Teaching experience

- since 2019 Teaching **Evolution of life history traits, Population dynamics, Matrix models**, to master students specialty Biodiversity and Environment at EPHE
- since 2019 Teaching **Wildlife management**, to master students specialty Biodiversity Ecology and Evolution at University of Montpellier
- since 2017 Teaching **Statistics**, EPHE, University of Montpellier  
I am in charge of a module 'Data acquisition and statistical analyses Level 1' (30h) for biology master students and Diplome EPHE. It provides the basics for biological data analyses (theory and R practicals). I also participate to a more advanced course for second year master students.
- since 2017 Teaching **Phylogenetic analyses with program R**, EPHE, University of Montpellier  
I give a course and practical (4h) about analysing genomic and genetic data with R, performing phylogenetic analyses, creating and visualising phylogenetic trees. This is part of 'Bioinformatics' (coordinator C. Lasbleiz). Students were biology and ecology master students and Diplome EPHE.
- since 2017 Teaching **Communication in science**, EPHE, University of Montpellier  
I participate in a module about teaching master students the basic tools for communicating their results (written and oral skills) and analysing papers with a critical view. This is part of 'Communication' (coordinators M.C. Lebart). Students were biology and ecology master students and Diplome EPHE.
- 2012 - 2015 Organisation and teaching of two informal 'training sessions on the use of computer programs E-SURGE and Mark' for demographic analyses of individual-based longitudinal data (8h each) for colleagues at the University of Oxford.
- 2008 - 2011 Teaching in **Statistics, Biostatistics, Applied statistics**, University of Montpellier  
During the 3 years of my PhD, I taught about 300 hours (96h/yr) to undergrad students in biology, chemistry and applied mathematics. My teaching covered descriptive statistics, statistical tests, and linear and generalised regression models. Half of these classes were practicals, in which I taught the use of statistical pieces of softwares (programming in R).

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## Students supervision

- Sept 2021- 2023 Co-supervision with O. Gimenez of Marwan Naciri's PhD project in conservation biology. Understanding and forecasting the population dynamics of Svalbard polar bears (*Ursus maritimus*) in response to climate change.
- Feb-July 2021 Supervision of Juan-Pablo Ramirez-Loza's (Erasmus Mundus Master Programme in Evolutionary Biology) master project in evolutionary biology. Exploring kinship demography using wolf (*Canis lupus*) simulated populations
- Feb-July 2021 Co-supervision with L. Tatin of Nolwenn Le Pioufle's (University Rennes 1) master project in population dynamics. Survival of Przewalski horses (*Equus ferus przewalskii*) before and after translocation : effect of site, demographic and social factors.

- Feb-July 2021 Supervision of Marwan Naciri's master project in Conservation Biology (ENS Lyon). Impacts of environmental changes on Polar bears (*Ursus maritimus*) reproduction.
- 2018 Co-supervision with O. Gimenez of Dorinda Folio's master thesis in Evolutionary ecology (University of Paris Saclay). Influence of maternal traits on Polar bears (*Ursus maritimus*) reproduction.
- 2012 - 2015 Co-supervision with T. Coulson of a PhD thesis in Biostatistics (Jack Massey, University of Oxford). Eco-Evolutionary Dynamics of Social Carnivores.
- 2013 Co-supervision with T. Coulson of a master student in Ecology (Abigael Proctor, Imperial College of London). An analysis of pre- and post-wolf trophic interactions in Yellowstone National Park through the use of pathway analyses with the novel use of a time-lag in model formation.
- 2013 Member of a PhD student transfer's viva advisory committee (Julia Barthold, University of Oxford and Max Planck Institute for demograohic Research, Rostock). Two-sex population dynamics.
- since 2009 Collaborations with several master and PhD students, mainly providing methodological support.

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## Grants and Awards

- 2018-2022 Partner of ANR grant 'Mathematics of Kinship Demography' PI S. Pavard.
- 2012-2015 Natural Environment Research Council (NERC) grant 'Ecological and evolutionary consequences of environmental change on Yellowstone wolves' PI T. Coulson.
- 2010 L'Oreal-Unesco National Prize for Women in Science.
- 2010-2011 CNRS - Royal Society joint grant 'Advanced statistical models for population dynamics' PI O. Gimenez and B. Morgan
- 2008-2011 Ph.D. grant from the Languedoc-Roussillon county and CNRS.
- 2008-2011 ANR grant (NSF equivalent) 'Towards capture-recapture mixed models' PI O. Gimenez
- 2009 France-Berkeley grant 'Integrated population viability analyses' PI O. Gimenez and S. Beissinger

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## Skills

- Analyses Stochastic and two-sexes population models, integral projection models and matrix models, capture-recapture analyses, Bayesian methods, structural equation models, linear and non linear models, mixture models, multivariate analyses.
- Computer R, MATLAB, Nimble, Jags, ADMB, E-SURGE, MARK, U-CARE, PRESENCE.
- Fieldwork Polar bears tracking and collaring. Wolves radio-tracking (aerial and from the ground), behavioral observations, prey necropsy. Birds capture and ringing.

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## Professional activities

- since 2018 **Board member of the Evolutionary Demography Society**, *One meeting is organised in Europe or America each year, I will co-organise the next meeting in 2021 in France with S. Pavard.*
- 2017 **Coordinator of the working group 'The Metrics of Longevity'**, *Working Group gathering French demographers, ecologists and statisticiens to work on the thematic of longevity across the tree of life. Two meetings have occurred in 2016 and 2017. University of Lyon, University of Montpellier, France*
- since 2009 **Reviewer** for *Ecology Letters, Proceedings B, Ecology, Methods in Ecology and Evolution, Biological Conservation, Animal Conservation, Wildlife Biology.*
- 2011 **Evaluating and improving open source software for nonlinear statistical modeling in ecology**, *NCEAS working group.*  
Santa Barbara, California, USA
- 2009 **Modeling of individual histories with state uncertainty**, *Workshop.*  
Center for Functional and Evolutionary Ecology, Montpellier, France
- 2008 **Conservation Genetics**, *Workshop.*  
Liblice Conference Center, Pragues, Czech Republic
- 2008 **Modeling Patterns and Dynamics of Species Occurrence**, *Workshop.*  
Center for Functional and Evolutionary Ecology, Montpellier, France
- 2008 **Ecology and Biodiversity- Understanding patterns and processes**, *Summer School.*  
Mammal Research Institute, Bialowieza, Poland.
- 2008 **Latent variables and Mixture models**, *Meeting of the French Statistical Society.*  
International Center of Mathematical Meetings (CIRMM), Marseille, France.

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## Scientific communications

- 2021 **Demography of the Svalbard polar bear population**, *virtual talk*, Ecology and evolution Group, Montreal, Quebec.
- 2020 **Dynamics of polar bears family units**, *talk*, 7th Evolutionary Demography Society meeting, Roros, Norway.
- 2018 **Modelling the life cycle of species providing extended parental care**, *talk*, 5th Stochastic Modeling Techniques and Data Analysis International Conference, Chania, Greece.
- 2017 **In search of a trade-off between health and longevity: the 5-Country Oldest Old Project (5-COOP)**, *talk*, Human Mortality Database Symposium, Berlin, Germany.
- 2017 **Evolutionary Demography: environmental impacts on populations**, *Invited seminar*, Center for Population Studies, Nihon University, Tokyo, Japan.
- 2017 **Wolf and Human Demography in a changing environment**, *MMDN Seminar*, University of Montpellier, Montpellier, France.

- 2016 **Why grey wolves are not always grey : interaction of disease, mate choice and genetics**, *Invited seminar*, Leibniz Institute for Zoo and Wildlife Research, Berlin, Germany.
- 2016 **Modeling the life cycle of species providing extended parental care**, *talk*, Meeting of the research group of Statistical Ecology, Montpellier, France.
- 2016 **Polar bears reproductive strategies**, *talk*, Norwegian Polar Institute, Tromso, Norway.
- 2014 **Disease Outbreak Frequency Determines Optimal Mate Choice and Col-oration Patterns in wolves**, *talk*, Joint meeting of the British Ecological Society and French Ecological Society, Lille, France.
- 2014 **Integral Projection Models for the study of Trait-Mediated Species Interac-tions**, *talk*, 2nd annual meeting of the Evolutionary Demography Society, Stanford University, USA.
- 2013 **The role of disease in maintaining coat colour polymorphism in wolves**, *talk*, 1st annual meeting of the Evolutionary Demography Society, Max-Planck Odense Center, Odense, Denmark.
- 2013 **Why grey wolves are not always grey**, *poster*, 1st annual meeting of the Evolu-tionary Demography Society, Max-Planck Odense Center, Odense, Denmark.
- 2013 **Exploring the maintenance of coat color polymorphism in wolves using a population projection model**, *talk*, Yellowstone wolf project annual meeting, Yel-lowstone National Park, Mammoth, WY, USA.
- 2012 **Impact of food availability, climate and density-dependence on wolves de-mography**, *talk*, Yellowstone wolf project annual meeting, Yellowstone National Park, Mammoth, WY, USA.
- 2012 **Predicting wolves response to environmental changes**, *talk*, Meeting with Wildlife Conservation Research Unit, University of Oxford, Tubney house, Tubney, UK.
- 2012 **Integrating heterogeneity in capture recapture models: recent developments and applications**, *talk*, Coulson lab meeting, Silwood Park Campus, Imperial College of London, UK.
- 2010 **Structural Equation Modeling of capture-recapture data**, *talk*. Annual meeting of Ph.D. students in ecology, Montpellier, France.
- 2009 **Evolutionary trade-offs using mark-recapture models**, *talk*. EURING, Analytical Meeting and Workshop, Pescara, Italie.
- 2008 **Non-invasive monitoring of elusive species**, *talk*. ESF summer school in Conservation Genetics, Prague, Czech Republic.

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## Publications

- [1] **Cubaynes, S.**, Aars, J., Yoccoz, N., Pradel, R., Wiig, O., Ims, R. and Gimenez, O. 2021. Modeling the demography of species providing extended parental care: A capture-recapture approach with a case study on Polar Bears (*Ursus maritimus*). *Ecology and evolution*. 11(7):3380-92. [link](#)

- [2] Coste CF, Bienvenu F, Ronget V, Ramirez-Loza JP, **Cubaynes, S.**, Pavard S. 2021. The Kinship Matrix: Inferring the Kinship Structure of a Population from its Demography. *In press in Ecology Letters*.
- [3] **Cubaynes, S.**, Galas S., Richaud M., Sanz A., Pradel R., Tavecchia G., Colchero F., Shefferson R., and Camarda C. G. 2021. Survival analyses across the tree of life (book chapter) in *Demographic Methods across the tree of life*, edited by Gamelon M. and Salguero-Gomez R., Oxford University Press.[link](#)
- [4] Deelen, J., Evans, D.S., Arking, D.E. [...], **Cubaynes, S.**, [...], and Murabito J.M. 2019. A meta-analysis of genome-wide association studies identifies novel longevity genes. *Nature Communications* (10) pp. 3669. [link](#)
- [5] Folio, D.M., Aars, J., Gimenez, O., Derocher, A.E., Wiig, O. and **Cubaynes, S.** 2019. How many cubs can a mum nurse? Maternal age and size influence litter size in polar bears. *Biology Letters* 15(5), p.20190070. [link](#)
- [6] Louvrier, J., Duchamp, C., Lauret, V., Marboutin, E., **Cubaynes, S.**, Choquet, R., Miquel, C. and Gimenez, O., 2018. Mapping and explaining wolf recolonization in France using dynamic occupancy models and opportunistic data. *Ecography*, 41(4), pp.647-660. [link](#)
- [7] Herr, M., Jeune, B., Fors, S., Andersen-Ranberg, K., Ankri, J., Arai, Y., **Cubaynes, S.**, Santos-Eggimann, B., Zekry, D., Parker, M. and Saito, Y., 2018. Frailty and associated factors among centenarians in the 5-COOP countries. *Gerontology*, 64(6), pp.521-531. [link](#)
- [8] Deere, J.A., Coulson, T., **Cubaynes, S.** and Smallegange, I.M., 2017. Unsuccessful dispersal affects life history characteristics of natal populations: The role of dispersal related variation in vital rates. *Ecological Modelling*, 366, pp.37-47. [link](#)
- [9] Ripple, W. J., Wolf, C., Newsome, T. M., [...], **Cubaynes, S.**, [...], and 15,364 scientist signatories from 184 countries. (2017). World scientists, warning to humanity: A second notice. *BioScience*, 67(12), 1026-1028. [link](#)
- [10] Robine, J. M., and **Cubaynes, S.** Espérance de vie, espérance de santé : tendances convergentes ou divergentes sur le plan mondial? in: A.M. Guillemard, E. Mascova, S. Moulias ( dir) La Découverte, coll. Recherches, 2017, pp. 37-58
- [11] Robine, J. M., and **Cubaynes, S.** (2017). Worldwide demography of centenarians. *Mechanisms of Ageing and Development*, 165, pp.59-67. [link](#)
- [12] Pozo, R., Schindler, S., **Cubaynes, S.**, Cusack, J., Coulson, T. and Malo, A. (2016). Modeling the impact of selective harvesting on red deer antlers. *The Journal of Wildlife Management*, 80, 978-989. [link](#)
- [13] **Cubaynes, S.**, MacNulty, D. R., Stahler, D. R., Quimby, K. A., Smith, D. W., and Coulson, T. (2014). Density-dependent intraspecific aggression regulates survival in northern Yellowstone wolves (*Canis lupus*). *Journal of Animal Ecology*, 83, 1344-1356. [link](#)
- [14] Desprez, M., Harcourt, R., Hindell, M. A., **Cubaynes, S.**, Gimenez, O., and McMahon, C. R. (2014). Age-specific cost of first reproduction in female southern elephant seals. *Biology Letters*, **10**, 20140264. [link](#)
- [15] **Cubaynes, S.**, Lavergne, C., and O. Gimenez. (2013) Fitting animal survival models with temporal random effects. *Environmental and Ecological Statistics*, 1-12. [link](#)

- [16] Massey, J., **Cubaynes, S.**, and T. Coulson. (2013) Will central Wyoming elk stop migrating to Yellowstone, and should we care? *Ecology*, **94**, 1271-1274. [link](#)
- [17] Bolker, B. M., Gardner, B., Maunder, M., Berg, C. W., Brooks, M., Comita, L., Crone, E., **Cubaynes, S.**, et al. (2013) Strategies for fitting nonlinear ecological models in R, AD Model Builder, and BUGS. *Methods in Ecology and Evolution*, **4**, 501-512. [link](#)
- [18] Gimenez, O., Abadi, F., Barnagaud, J.Y., Blanc, L., Buoro, M., **Cubaynes, S.**, Desprez, M., Gamelon, M., Guilhaumon, F., Lagrange, P., Madon, B., Marescot, L., Papadatou, E., Papaix, J., Peron, G. and S. Servanty (2013). How can quantitative ecology be attractive to young scientists? Balancing computer/desk work with fieldwork. *Animal Conservation*, **16**, 134-136. [link](#)
- [19] **Cubaynes, S.**, Lavergne, C., Marboutin, E., and Gimenez, O. (2012). Assessing individual heterogeneity using model selection criteria: how many mixture components in capture-recapture models? *Methods in Ecology and Evolution*, **3**, 564-573. [link](#)
- [20] **Cubaynes, S.**, Doutrelant, C., Gregoire, A., Perret, P., Faivre, B. and O. Gimenez. (2012) Testing hypotheses in evolutionary ecology with imperfect detection: Structural Equation Modeling of capture-recapture data. *Ecology*, **93**, 248-255. [link](#)
- [21] Caniglia, Romolo, Fabbri, E., **Cubaynes, S.**, Gimenez, O., Lebreton, J. D., and Randi, E. (2012). An improved procedure to estimate wolf abundance using non-invasive genetic sampling and capture-recapture mixture models." *Conservation Genetics*, **13**, 53-64. [link](#)
- [22] **Cubaynes, S.**, Doherty, P.F., Schreiber, E.A., Gimenez, O. (2011) To breed or not to breed: a seabird's response to extreme climatic events. *Biology Letters*, **7**, 303-306. [link](#)
- [23] Marescot, L., Pradel, R., Duchamp, C., **Cubaynes, S.**, Marboutin, E., Choquet, R., Miquel, C. and Gimenez, O. (2011) Capture-recapture population growth rate as a robust tool against detection heterogeneity for population management. *Ecological Applications*, **21**, 2898-2907 [link](#)
- [24] **Cubaynes, S.**, Pradel, R., Choquet, R., Duchamp, C., Gaillard, J-M., Lebreton, J-D., Marboutin, E., Miquel, C., Reboulet, A., Poillot, C., Gimenez, O. (2010) Importance of accounting for detection heterogeneity when estimating abundance: the case of French wolves. *Conservation Biology*, **24**, 621-626. [link](#)
- [25] Papaix, J., **Cubaynes, S.**, Buoro, M., Charmantier, A. Perret, P. and Gimenez, O. (2010) Combining capture-recapture data and pedigree information to assess heritability of demographic parameters in the wild. *Journal of Evolutionary Biology*. **23**, 2176-2184. [link](#)
- [26] Rouan, L., **Cubaynes, S.**, C. Duchamp, C. Miquel, A.-M. Reboulet, O. Gimenez, J.-D. Lebreton, R. Choquet and R. Pradel (2008). Modèles de mélange en Capture-Recapture. *Proceedings of the Meeting of the French Statistical Society*, Marseille, France.