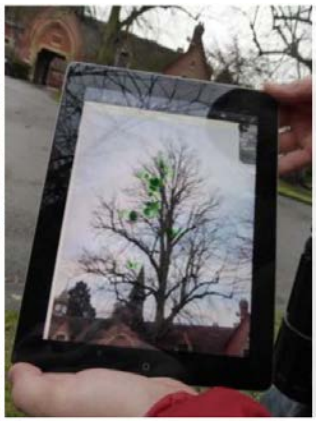
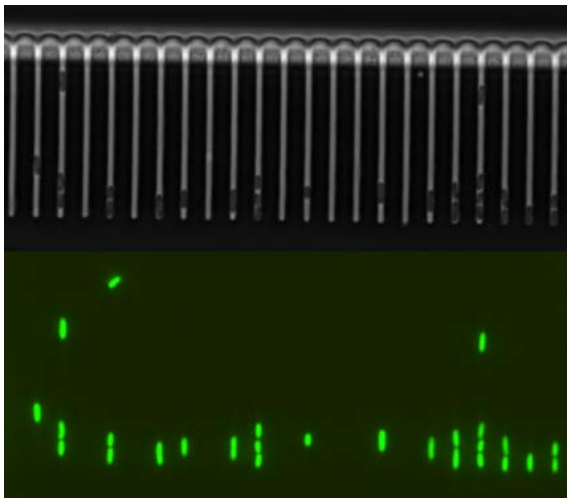
UNIVERSITY OF SOUTHERN DENMARK

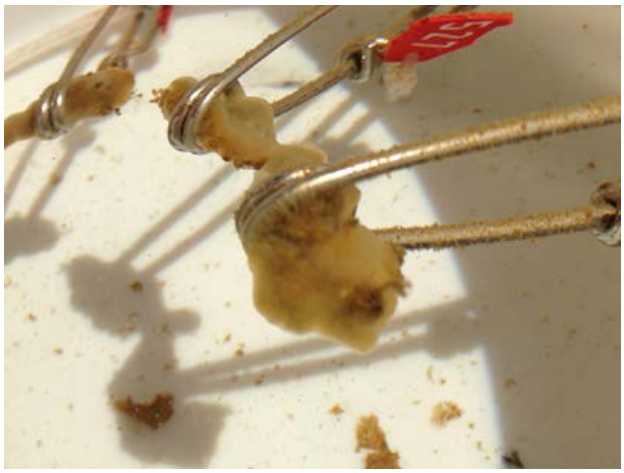
MaxO Max-Planck Odense Center on the Biodemography of Aging

MAX-PLANCK-GESELLSCHAFT

Report on MaxO Activities in 2013







Max-Planck Odense Center on the Biodemography of Aging, University of Southern Denmark,
Campusvej 55, 5230 Odense M, Denmark

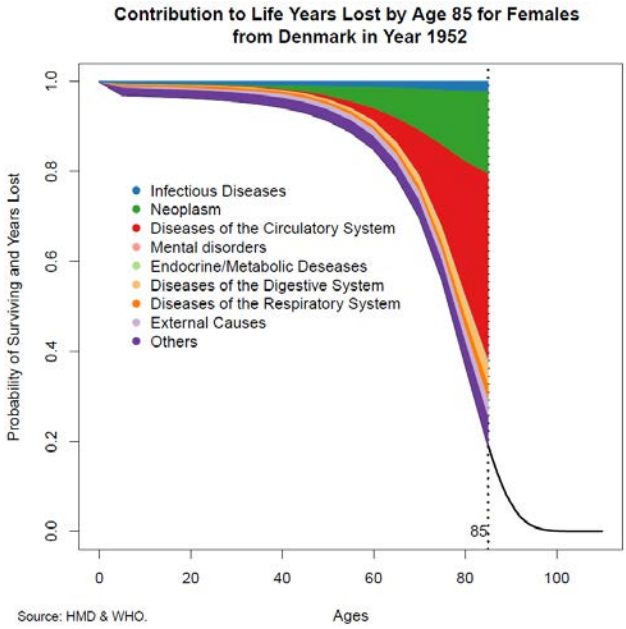
Table of Contents

Projects

Vladimir Canudas-Romo (Associate Professor)

Analysis of causes of death

We studied a measure of the number of life years lost due to specific causes of death. This measure is based on the cumulative incidence of death, it does not require "independence" of causes, and it satisfies simple balance equations: "total number of life years lost = sum of cause-specific life years lost", and "total number of life years lost before age x + temporary life expectancy between birth and age x = x". Manuscript published in Demographic Research 2013.



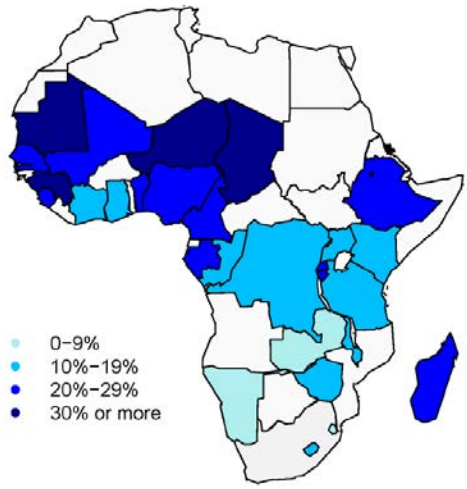


Figure 2. Relative proportional increase in female reproductive-aged life expectancy when eliminating maternal mortality, selected countries in Sub-Saharan Africa, 2000–2011. Source: based on DHS data, author's calculations included in the column of proportion of total change in Table 1.
doi:10.1371/journal.pone.0086694.g002

Analysis of causes of death: Maternal mortality

We assessed the change over time in the contribution of maternal mortality to a life expectancy calculated between ages 15 and 49, or Reproductive-Aged Life Expectancy (RALE). Our goal was to estimate the increase in RALE in developed countries over the twentieth century and the hypothetical gains in African countries today by eliminating maternal mortality. Manuscript published in PlosOne 2014.

Fernando Colchero (Assistant Professor)

Bayesian Survival Trajectory Analysis (BaSTA).

In collaboration with Owen Jones and Maren Rebke (Max Planck Institute for Demographic Research), Felix Zajistcheck and Alexei Maklakov (Uppsala

University), Francisco Villavicencio (Max Plank Institute for Demographic Research), Ana Cabré (Universidad Autonoma de Barcelona).

Understanding age-specific survival in wild animal populations is crucial to the study of population dynamics and is therefore an essential component of several fields including evolution, management and conservation. We have developed the open source R package BaSTA, which allows users to analyse age patterns of survival in long-term studies with mark-capture-recapture data where recapture probabilities may be low, and where birth and death times and age are unknown. We have extended these methods to understand diet effects on mortality in male and female fruit flies (Zajistcheck et al. 2013, Journal of Gerontology A). We have also modify these methods to understand demographic patterns in historical populations in Barcelona, Spain, from marriage records taken between 1575 and 1625.

Methods manuscripts published in 2012. The package is in constant development.

Manuscript published in Journal of Gerontology A.

Bayesian state-space models for animal movement

In collaboration with Dr. Sophie Calmé and Sabrina Plante (University of Sherbrook).

For the last few years, we have statistical models to understand how animals move over the landscape, what triggers their preferences and how different landscape and environmental features affect their movement decisions. Our models combine a state-space approach to handle missing movement records, together with what we have described as Markov Chain Resource Selection (MCRS) functions to determine what features increase the probability of moving to a specific point. We applied these methods to understand the foraging strategy of howler monkeys (Alouatta pigra) in the Mayan Forests of Mexico (Plante et al 2014, Journal of Animal Ecology, 83:116-125).

Manuscripts published in Journal of Animal Ecology.

Ungulate population dynamics and the effects of climate change

In collaboration with Jorge Rabinovich and Maria Zubillaga (CEPAVE, Universidad Nacional de la Plata), David Koons (Utah State University) and Olivier Gimenez (CNRS).

To tease appart the effect environmental perturbations, density dependence and exploitation on animal population growth, we have extended Clark and Bjørnstad's (Clark & Bjørnstad 2004 Ecology, 85: 3140-3150) Bayesian state space model to accomodate extractions and different distrubutions for the process and data models (Colchero et al 2009 Journal of Animal Ecology, 78(3): 666-673). In collaboration with Dr. Jorge Rabinovich and María Zubillaga from the CEPAVE, Universidad Nacional de la Plata, Argentina, we have used these methods to understand the dynamics of a population of Guancos (Lama

guanicoe) and how they are influenced by climatic variables. Also, in collaboration with Dr. David Koons from Utah State University and Dr Olivier Gimenez from the CNRS, we have explored the effects of climate variables on the dynamics of a population of Bison (Bison bison) in Northern USA.

Manuscripts in review in PlosOne and Ecological Modelling.

Age specific trajectories of mortality and fertility in wild and captive populations.

In collaboration with Owen Jones, Dalia Conde, Annette Baudisch, and 27 other collaborators from around the world.

For several decades, researchers have assumed that changes in survival and fertility as a function of age in wild populations are negligible, and that the only necessary distinction in survival should be between juveniles and adults. However, there is increasing evidence that wild populations of birds and mammals exhibit age-patterns of fertility and adult survival, and that neglecting these age-specific trends can result in biased estimates of measures of population performance such as population growth rates. Using new methods developed at the Unit on Ecological and Evolutionary Demography (EED) of MaxO, we have explored age-trajectories of mortality and fertility in a large number of species both in wild and captive environments. We then determined how the assumption that vital rates are age-independent in adults affects the estimation of population growth rates for a large number of life-history strategies. Our results show that simple two stage models can greatly over estimate or under estimate population growth rates under stochastic environments. These results have wide implications for management and conservation and for our understanding of the evolution of the mechanisms of aging.

Manuscript to be submitted to Ecology Letters.

Mortality as a bivariate function of age and size in indeterminate growers.

In collaboration with Ralf Schaible (Max Planck Institute for Demographic Research).

Mortality in organisms that grow indefinitely, known as indeterminate growers, is thought to be driven primarily by size. However, a number of ageing mechanisms also act as functions of age. Thus, to explain mortality in these species, both size and age need to be explicitly modelled. Here we developed a model that treats age- and size-specific mortality as a bivariate process and extended it into a Bayesian framework to allow researchers to test the effect of age and size on mortality. These methods can help to improve the demographic models commonly applied to a vast number of species of commercial and conservation importance such as fish, trees or bivalves, among many other, for which both age and size are relevant. In addition, the application of these methods can help to shed light on the existence of processes such as negative senescence, and contribute to our understanding of the evolutionary mechanisms of senescence in species that do not fit the established theories.

Manuscript submitted to Ecosphere.

Bayesian mortality modeling for species with natal and higher order dispersal

In collaboration with Julia Barthold (University of Oxford and Max Planck Institute for Demographic Research), David Macdonald (University of Oxford), Andrew J. Loveridge (University of Oxford), Craig Packer (University of Minesota), Owen Jones, Dalia A. Conde, Annette Baudisch and James W. Vaupel (MaxO), Susan C. Alberts (Duke University), and Evolutionary Ecology of Primate Life Histories Working Group (National Evolutionary Synthesis Center).

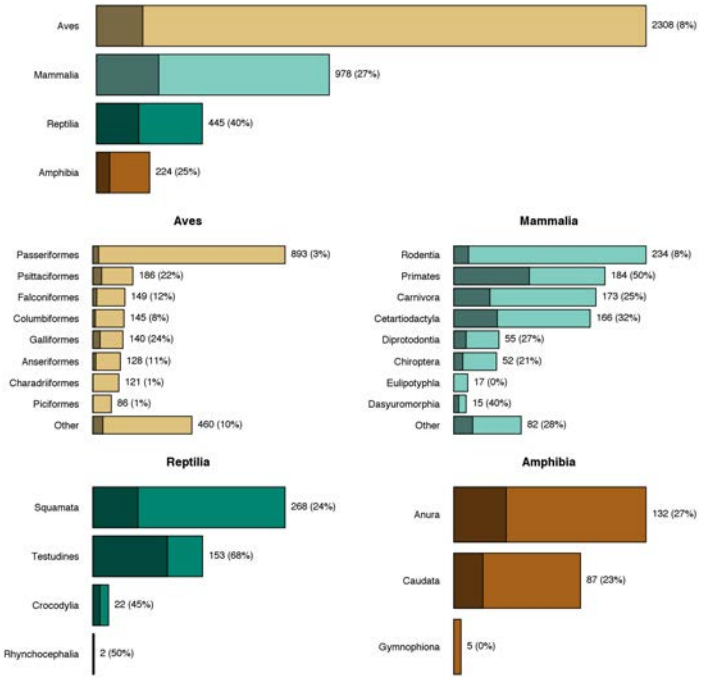
In many species, individuals of one or both sexes disperse after reaching sexual maturity. These individuals that disperse from the study area cannot be detected any longer, and thus their fate is unknown. In these cases researchers cannot know if these individuals died after the last detection or if they dispersed outside the study area. This type of behavior has dramatically hinder researchers' ability to understand mortality in the dispersing sex of species such as lions or baboons, among many others. We have developed a Bayesian model that facilitates to make inference on species with natal and higher order dispersal. We are currently applying these methods to understand sex differences in mortality in lions for populations under different levels of human hunting pressure. We are also applying these methods to understand the evolution of senescence in non-human primates in comparison with historical human populations, hunter gatherers and modern human populations.

Dalia Conde (Assistant Professor)

Zoos through the lens of the IUCN red list

In collaboration with Fernando Colchero, Markus Gusset, Paul Pearce-Kelly, Onnie Byers, Nate Flesness, Robert K. Browne, and Owen R. Jones

Given current extinction trends, the number of species requiring conservation breeding programs (CBPs) is likely to increase dramatically. To inform CBP policies for threatened terrestrial vertebrates, we evaluated the number and representation of threatened vertebrate species on the IUCN Red List held in the ISIS zoo network and estimated the complexity of their management as metapopulations. Our results show that 695 of the 3,955 (23%) terrestrial vertebrate species in ISIS zoos are threatened. Only two of the 59 taxonomic orders show a higher proportion of threatened species in ISIS zoos than would be expected if species were selected at random. In addition, for most taxa, the management of a zoo metapopulation of more than 250 individuals will require the coordination of a cluster of 11 to 24 ISIS zoos within a radius of 2,000 km. Thus, in the zoo network, the representation of species that may require CBPs is currently low and the spatial distribution of these zoo populations makes management difficult. Although the zoo community may have the will and the logistical potential to contribute to conservation actions, including CBPs, to do so will require greater collaboration between zoos and other institutions, alongside the development of international agreements that facilitate cross-border movement of zoo animals. To maximize the effectiveness of integrated conservation actions that include CBPs, it is fundamental that the non-zoo conservation community acknowledges and integrates the expertise and facilities of zoos where it can be helpful.



The representation of terrestrial vertebrate species held in ISIS zoos.The upper panel summarizes the representation of species for each taxonomic class of terrestrial vertebrates while the four lower panels summarize representation at the taxonomic order level within each class. The length of each bar is proportional to the number of species held, and each bar is color-coded by class. The darker shaded region of each bar represents the number of species that fall into the three IUCN Red List threatened categories (Vulnerable, Endangered and Critically Endangered). The number of species in each category is indicated to the right of each bar, and the percentage of these that are threatened is given in parentheses. doi:10.1371/journal.pone.0080311.g001

Carnivora population dynamics are as slow and as fast as those of other mammals: Implications for their conservation

A project led by Eelke Jongejans.

Citation: van de Kerk M, de Kroon H , Conde DA and Jongejans E, Carnivora population dynamics are as slow and as fast as that of other mammals: implication for its conservation. PLOSOne. http://dx.doi.org/10.1371/journal.pone.0070354

Demographic Index of Species Knowledge (DISKo) Phase 1.

Led by Dalia Conde, and in collaboration with a large group of globally distributed researchers.

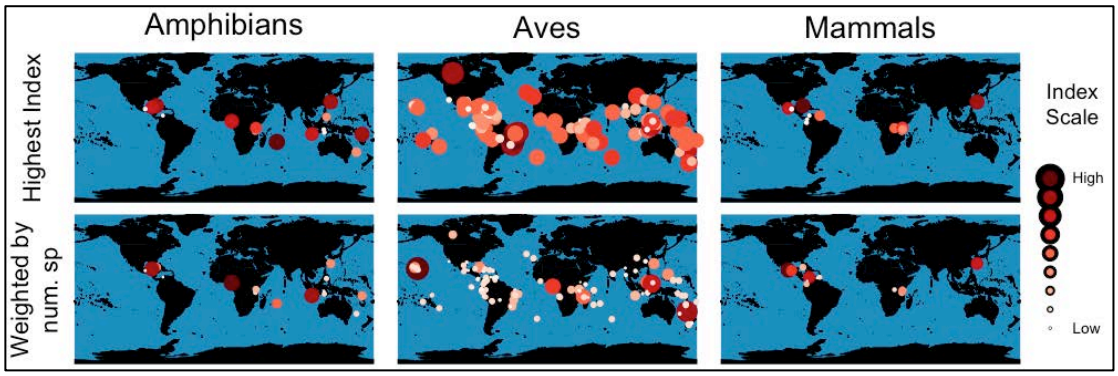
Biodiversity is the foundation of life on earth (IUCN 2012). Five major extinction crises have led major drops in biodiversity and if the current trends of species loss continue, we will head towards a six mass extinction. However, species extinctions are mainly preceded by population declines). Extinction is in essence a demographic process; the result of changes in fertility and mortality that lead to population losses. In this sense, species demographic knowledge (i.e population dynamics) is key to expand our understanding on past population's extinctions and to forecast species loss under different scenarios. However, we still do not have a consistent way to assess how much demographic knowledge

there is across the tree of life. On the other hand we have exponentially expanded our biodiversity knowledge at the genetic level; GeneBank is a compilation of several molecular markers across all terrestrial vertebrates species. While demographic data still is sparse and in many cases it is not even published. Here we develop a Demographic Index of Species Knowledge (DISKo) for the world's vertebrates and explore gaps and opportunities to expand and further develop it together with a Species Demographic Bank

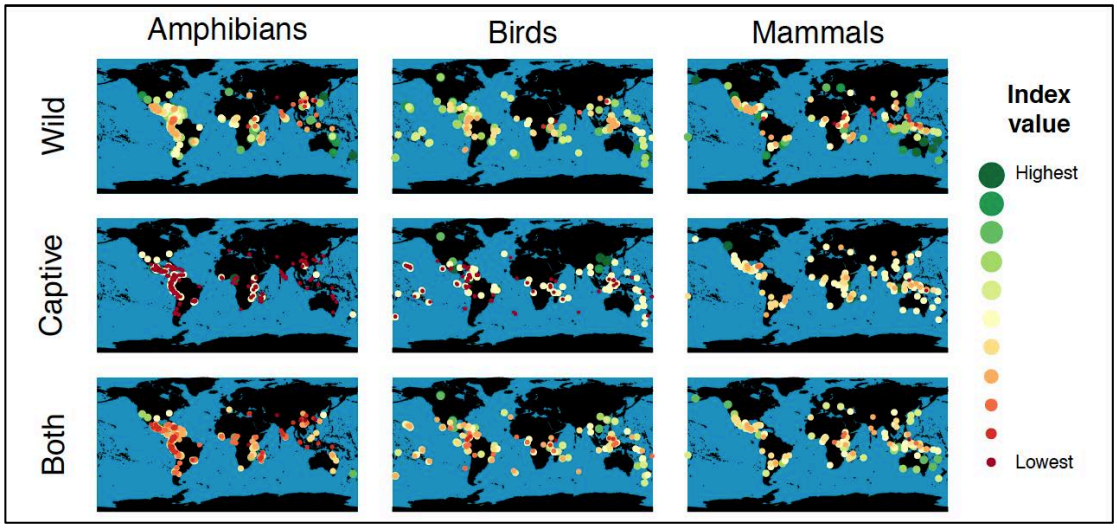
Opportunity index for the management and conservation of AZE populations

Paper being lead by Dalia A. Conde and John E. Fa

The value of the AZE list of sites and species to assist global biodiversity conservation has been recognized by the Convention for Biological Diversity (CBD), with the signing of an agreement between CBD and AZE in 2010. This memorandum of cooperation allows AZE expertise to support implementation of the CBD Strategic Plan, particularly regarding the draft target of halting species extinction. AZE is able to assist the Parties to the Convention in integrating the zero-extinction target into national biodiversity strategies and action plans. AZE provides a tool for nations to comply with their obligations under the Convention, and also a cost-effective way to prioritise sites for conservation. However, for which species we should target conservation programs that will have a higher potential for success? In this paper we tackle this issue considering not just biological factors but other aspects that directly will affect the opportunity to conserve the species, such as: costs of habitat protection, costs for captive breeding, population size in ISIS zoos and level of violence in the country site. Based on this we built and index to inform which species and sites have the highest opportunities for the development of population management plans.



Representation of AZE sites, upper row shows the sites with the highest conservation opportunity index based only on the species with the highest index, the lower row shows those sites that have the highest combined index weighted by the number of species.



A decomposition of the index per species, upper row shows conservation opportunity index for population management in the wild, middle row: for the implementation of captive breeding and population management, and lower row: shows the combined index.

Johan Dahlgren (Assistant Professor)

Projects on age-based plant demography

Demographic senescence has been thought to be universal in organisms and is well documented in many animals, but little is known for plants due to a lack of data. The project addresses this by determining age trajectories of demographic rates for plants, both by using long-term monitoring data and by collecting new data where individual age is determined from anatomical features of roots. Sub-projects were started up in 2013 with several external collaborators. I visited Prof. Fritz Schweingruber at the Swiss Federal Institute for Forest, Snow and Landscape Research to learn methods of age-determination based on root anatomy and to start working on a paper using such data. I started writing a review paper on senescence in plants and planned future projects with Ass. Prof. Deborah Roach from University of Virginia, USA. I also started work on a study on age effects on the demography of a long-lived orchid, using a 32-year monitoring data set together with Ass. Prof. Nina Sletvold, Uppsala University, Sweden.

Ulrich Steiner (Associate Professor) and Lionel Jouvet (Post-doc)

Ageguess.org: A citizen science project on chronological and biological aging in humans

Coordinated by Ulrich Steiner and Dusan Misevic (INSERM, Paris).

With the project AgeGuess we investigate the differences between perceived age (how old you look to other people) and chronological age (how old you actually are) and their potential power as

an aging biomarker. We tailored AgeGuess to several specific scientific questions. Perceived age as a predictor (biomarker) for age at death, or does the perceived age influence mortality rates? Is 60 the new 50? AgeGuess will allow us to quantify how the deviance between perceived and chronological age has changed.

Defoliation and bark harvesting and its effect on life-history traits of a tropical tree

Project in collaboration with Orou Gaou, Carlol Horvitz, Tamara Tickting, Ulrich Steiner and Shripad Tuljapurkar,

Selectively harvesting whole individuals in managed populations (e.g. fisheries, hunting) has substantial effects on life expectancy and age at maturity. Although demographic rates of trees are impacted by recurrent harvest of plant organs (e.g. fruit, leaf, bark) known as non-timber forest products, the effect of such harvesting on life-history traits is less explored. Here, we investigate how different strategies of foliage and bark harvest by local people affect life expectancy and age at maturity of Khaya senegalensis across two climatic regions in West Africa. We compare elasticities of life expectancy to perturbation of vital rates to the elasticities of population growth rate, emphasizing how the two kinds of elasticity address distinct biological issues and management goals.

Evolutionary change in continuous reaction norms

Ulrich Steiner in collaboration with Courtney J. Murren, Heidi J. Maclean, Sarah E. Diamond, Mary A. Heskel, Corey A. Handelsman, Cameron K. Ghalambor, Josh R. Auld, Hilary S. Callahan, David W. Pfennig, Rick A. Relyea, Carl D. Schlichting and Joel Kingsolver.

Understanding the evolution of reaction norms remains a major challenge in ecology and evolution. Investigating evolutionary divergence in reaction norm shapes between populations and closely related species is one approach to provide insights. Here we use a meta-analytic approach to compare evolutionary divergence in reaction norms of closely related species or populations of animals and plants, across types of traits and environments. We quantified mean-standardized differences in overall trait means (Offset) and reaction norm shape (including both Slope and Curvature).

Demographic consequences of genetic, environmental and individual stochastic variability in *Plantago lanceolata*

Ulrich Steiner in collaboration with Deborah Roach (Duke), Shripad Tuljapurkar (Stanford).

Predicting population dynamics requires understanding how individual fitness components are influenced by genetic and environmental parameters. However such a focus often neglects the stochastic events that individuals experience throughout their lives. Here we illustrate, for an experimental population of Plantago lanceolata, that despite substantial fluctuation in the environment, the variation in fitness components among individuals explained by the

environment, the genes, and their interactions was modest compared to the overwhelming unexplained (stochastic) variation in lifespan and reproduction among individuals.

Generation time, net reproductive rate, and growth in stage-age-structured populations

Ulrich Steiner in collaboration with Shripad Tuljapurkar (Stanford) and Tim Coulson (Oxford)

Major insights into the relationship between life-history features and fitness have come from Lotka's proof that population growth rate is determined by the level (expected amount) of reproduction and the average timing of reproduction of an individual. But this classical result is limited to age-structured populations. Here we generalize this result to populations structured by stage and age by providing a new, unique measure of reproductive timing (Tc) that, along with net reproductive rate (R0), has a direct mathematical relationship to and approximates growth rate (r)

Aging and imperfect asymmetric division in bacteria

Ulrich Steiner, in collaboration with Ming Ni and Francois Taddei (INSERM, Paris)

The process of aging is assumed to result from accumulating damage over the lifespan, and such damage finally leads to death. Evolutionary theory predicts that dividing organisms such as bacteria flee from that process at the population level by asymmetric division, that is one cell (presumably the mother cell) takes over more of the damage and the other cell (daughter) is perfectly rejuvenated. To test these arguments and to see whether asymmetric division remains perfect throughout life we conducted experiments on a single cell microfluidic bacteria system to compare demographic parameters of daughter cells that came from young mothers with daughter cells coming from old mothers. Results show that daughters from young mothers have long lifespan and divide more often compared to daughters coming from old mothers. There seem to be no differences in cell growth. Our results suggest that asymmetric division is only perfect early in life of cells but not late in life.

Stochastic variability in bacteria under different environmental conditions

Ulrich Steiner and Lionel Jouvet

Isogenic bacteria under identical environmental condition show large variability in lifespan and reproduction. Such neutral variability has substantial consequences for evolutionary dynamics and demographic change. How does this stochastic variability is influenced by different environments? Preliminary data collected using a microfluidic device suggests that means and variances are scaled to each other in different environments.

Owen Jones (Assistant Professor)

The SDU nest box project

In collaboration with Jennifer Lynch, Thomas Bjørneboe Berg and Ole Naesbye Larsen (SDU Biology).

At the beginning of 2013 we established a breeding population of blue tits (Blåmeise) and great tits (Musvit) in the woodland around the SDU campus. The population is being used as a teaching and research resource. We have 100 nest boxes with around 85% occupancy. We are systematically ring marking the juveniles and adults and intend to follow the population over the next few years. Much of the fieldwork is carried out by a team of dedicated volunteers, most of whom are biology students. Some of them will use the population to carry out project work on population biology, behavior or evolutionary demography.

The demography of parasitic and hemiparasitic plants

In collaboration with Roberto Salguero-Gomez (U. Queensland), Sydne Record (Harvard Forest) and Michael Crawley FRS (Imperial College London).

The demography of parasitic plants is understudied, even though they are excellent models to explore ecological trade-offs. These plants use their hosts for support, and resource provisioning. They thus partially escape several costs that non-parasites endure. We have established a project to explore the significance of this "cheating" strategy using European mistletoe (Viscum album), an iconic species across much of Europe. Like other parasitic species, mistletoe derives much of its nutrients by stealing resources of the trees on which they live. The project is carried out in the Silwood Park campus of Imperial College London where we follow the life course of ~100 mistletoe plants on ~25 trees.

Comparative demography across the tree of life

In collaboration with Alexander Scheuerlein, Roberto Salguero-Gómez, Carlo Giovanni Camarda, Ralf Schaible, Brenda B. Casper, Johan P. Dahlgren, Johan Ehrlén, María B. García, Eric Menges, Pedro F. Quintana-Ascencio, Hal Caswell, Annette Baudisch and James W. Vaupel

The question of whether the human experience of aging, where we deteriorate as we go from maturity into old age, is universal in all living things was the focus of an important piece of work we published in Nature in January (Jones *et al.* 2014 Nature). In the article we looked at the mortality and fertility trajectories of 46 species of animals, plants and an alga. We showed that, contrary to "classical" evolutionary theories of ageing, there is a great diversity of patterns of aging. In some species, such as the desert tortoise, mortality actually declined with age, while in others such as the tiny freshwater hydra, it remained constant. There was just as much diversity in the fertility trajectories, which could be hump-shaped (increasing and then decreasing with age), increasing, decreasing or flat. The shapes of the mortality trajectories were not strongly associated with the lifespan of the species; both short and long-lived species can have increasing, decreasing, or constant mortality rates.

Dan Levitis (Assistant Professor), Paul Dunn (Post-doc), Josephine Goldstein (PhD student), Lars Kumala (PhD student), Kim Lundgren (Research Assistant)

The role of sexual reproduction in offspring inviability

Dan Levitis in collaboration with Anne Pringle and Kolea Zimmerman.

The age-specificity of age-specificity

Dan Levitis

The demography of PIT-tags in sea-stars

Dan Levitis

The sponge farm project—do sponges senesce?

Dan Levitis, Paul Dunn, Kim Lundgreen, Lars Kumala

Ontogenescence in barnacles

Dan Levitis and Paul Dunn

Life-history stages of the moon jellyfish *Aurelia aurita* - towards a demographic understanding of jellyfish blooms

Josephine Goldstein

Ecophysiology and biodemography of aging in sponges.

Lars Kumala

Virginia Zarulli (Post-doc)

Application of matrix population models to demography of health

Virginia Zarulli in collaboration with Hal Caswell

Meetings, conferences etc.

Group

January 31: Grand opening of the Max-Planck Odense Center

February 27: 351st birthday of Demography/welcoming Reception of MaxO

October 6-10: EvoDemo /Evolutionary Demography Society First Annual Meeting -- The Max-Planck Odense Center, in cooperation with the Max Planck Institute for Demographic Research, hosted the first annual meeting of the Evolutionary Demography Society. The meeting was highly successful, with over one hundred scientists, including SDU staff and students, attended, and more that 70 of these presenting original research in evolutionary demography. The society has been given a good launch, with its first bank account and distinguished scholars having agreed to host the next three annual meetings.

Vladimir Canudas-Romo (Associate Professor)

IUSSP 2013 conference, Busan, South Korea, 26-31 August, 2014

The EU 2013 conference Horizons for Social Sciences and Humanities (SSH), Vilnius, Lithuania 23-24 September 2013

Formal demography workshop, Stanford University March 24-25, 2014

Fernando Colchero (Assistant Professor)

Colchero, F., Jones, O.R., Conde, D.A. et al. Assumptions of flat age-specific mortality and fertility can impair estimation of demographic processes. Evolutionary Demography Society first meeting, University of Southern Denmark, Odense, Dk, 2013.

Instructor for First BaSTA workshop (10-11 Nov 2013.). University of Southern Denmark, Odense, DK

Dalia A. Conde (Assistant Professor)

CBSG, Conservation Breeding Specialist Group of the Species Survival Commission of the IUCN. October 2013 in Orlando. Workshop on Zoos and ISIS data

WAZA meeting October 2013. Talk on Zoos and Conservation

Ulrich Steiner (Associate Professor)

Organizer of the ESEB symposium on Evolutionary Demography: Ulrich Steiner & Barbara Pietrzak

ESEB poster Ulrich Steiner, Ming Ni: Aging and imperfect asymmetric division in bacteria

ESEB poster Ulrich Steiner, Dusan Misevic: AgeGuess crowdsourcing human aging research

Philos (SDU-PhD student seminar series): Anti-aging therapies: do they work?

EvoDemo Odense meeting: Ulrich Steiner, Aging and imperfect asymmetric division in bacteria

NordCEE seminar: Ulrich Steiner, Demographics, stochasticity and bacteria

Stanford Demography Workshop: Ulrich Steiner, Stochastic variation in fitness

Linnaeus (SDU undergraduate seminar series): Ulrich Steiner, From individuals to populations: dynamics, climate change, and aging.

Odense Birthday of Demography, Ulrich Steiner, Evolutionary demography: Individual dynamics to population dynamics

Owen Jones (Assistant Professor)

Jones O, et al. (March 2013) Variation in demographic trajectories across the tree of life. Workshop on "Modelling population response to environmental change", University of Amsterdam, Netherlands.

Jones O, et al. (Oct 2013) Demographic trajectories across the tree of life. 1st Annual Evolutionary Demography Society Meeting, Odense. Poster and talk.

Adam Lenart (Post-doc)

Received the Otto-Hahn medal of the Max Planck Society in May, 2013 and participated at the Annual Meeting at the Max Planck Society in Potsdam

His co-author, Trifon Missov presented our poster "Goodness-of-fit tests for the Gompertz distribution" at the Population Association of America (PAA) and the Internation Union for the Scientific Study of Population (IUSSP) meetings in New Orleans and Busan (South Korea), respectively.

Dan Levitis (Assistant Professor), Paul Dunn (Post-doc), Josephine Goldstein (PhD student), Lars Kumala (PhD student), Kim Lundgren (Research Assistant)

Dunn, P. H. and D. A. Levitis (August 2013). Ontogenescence and the Barnacle: an experimental examination of early life mortality in the estuarine barnacle Amphibalanus improvisus. Paper presented at the Congress of the European Society for Evolutionary Biology, Lisbon, Portugal.

Dunn, P. H. and D. A. Levitis (October 2013). Ontogenescence in the Estuarine Barnacle Amphibalanus improvisus. Paper and poster presented at the Evolutionary Demography Society Meeting, Odense, Denmark.

Goldstein J, Levitis D, Riisgård HU (2013) Jellyfish in Kertinge Nor (Denmark) – size, growth and fertility. Poster. First Meeting of the Evolutionary Demography Society 6-10 October 2013, Odense, Denmark.

Goldstein J, Augustin CB, Holst S (2013) A matter of tolerance – potential distribution of sczphozoan polyps in semi-enclosed ecosystems such as the Baltic Sea. Speaker. Fourth International Jellyfish Bloom Symposium 5-7 June 2013, Hiroshima, Japan.

Kumala, L., P. H. Dunn, and D. A. Levitis (October 2013). Biodemography of aging in sponges: How can age be determined? Poster presented at the Evolutionary Demography Society Meeting, Odense, Denmark.

Kumala,L, Hentschel U, Bayer K (November 2013) Investigations on abundance and activity of microbial sponge symbionts using quantitative real-time PCR. Oral Presentation. 9th World Sponge Conference, Fremantle, Western Australia

Levitis, D. A. and P. H. Dunn (October 2013). A proxy-based hypothesis regarding the evolutionary history of metazoan senescence. Paper and poster presented at the Evolutionary Demography Society Meeting, Odense, Denmark.

IPMpack: an R package for Integral Projection Models. 1st Evolutionary Demography Society Meeting, Odense, Denmark (Lars Kumala)

Sponge Classification Workshop. 9th World Sponge Conference, Fremantle, Australia (Lars Kumala)

Virginia Zarulli (Post-doc)

Italian Statistical Society Conference 2013: Advances in Latent Variables - Methods, Models and Applications (Brescia , Italy 19 -21 June 2013) - Zarulli, V., Marinacci, C., Costa, G. and Caselli, G., Mortality by education level at late-adult ages in Turin: a survival analysis using frailty models with period and cohort approaches."

Staff

- James W. Vaupel, Professor, Public Health, Director of MaxO
- Kaare Christensen, Professor, Public Health
- Don Canfield, Professor, Biology

- Vladimir Canudas-Romo, Associate Professor, Public Health
- Hal Caswell, Honorary Professor, Biology
- Fernando Colchero, Assistant Professor, IMADA
- Dalia Amor Conde, Assistant Professor, Biology
- Johan Dahlgren, Assistant Professor, Biology
- Owen Jones, Assistant Professor, Biology
- Daniel Levitis, Assistant Professor, Biology
- Ulrich Steiner, Associate Professor, Biology

- Paul Dunn, Post doc, Biology
- Lionel Jouvet, Post doc, Biology
- Virginia Zarulli, Post doc, Public Health
- Adam Lenart, Post doc, Public Health

- Josephine Goldstein, PhD student, Biology
- Marie-Pier Bergeron Boucher, PhD student, Public Health

- Kim Lundgreen, Academic Research Assistant, Biology
- Vibeke Jensen, Secretary, Biology

Visiting researchers

- Annette Baudisch, Max-Planck Institute for Demographic Research
- Julia Barthold, University of Oxford
- James Carey, University of California, Davis
- John. E. Fa, Durrell Conservation Fund and Imperial College London
- Saskia Hin, University Leuven
- Carol Horvitz, Unviersity of Florida, Miami
- Eelke Jongejans, Univeristy of Neijmegen
- Sean McMahon, Smithonian Tropical Research Insitute
- Corey Merow, Smithsonian Environmental Research Center
- Jessica Metcalf, University of Oxford
- Deborah Roach, Unviersity of Virginia
- Roberto Salguero-Gomez, University of Queensland
- Shripad Tuljapurkar, Stanford University
- Francisco Villavicencio, Max-Planck Institute for Demographic Research

Media coverage

Vladimir Canudas-Romo (Associate Professor)

- Science daily, 25th February 2014

Ulrich Steiner (Associate Professor)

- SciStarter
- Scientific American
- AXA People Protectors (1 million followers facebook page)
- TV2 Fyn: Christmas calendar
- Jyllands posten

Owen Jones (Assistant Professor)

Most media attention concerned our Nature article on "Diversity of aging across the tree of life".

- Radio interviews with BBC World Service, Voice of Russia, Radio Télévision Suisse, The Wire Radio (Australia), Nature Podcast.
- There were more than 100 news articles, including the following;
- Der Spiegel, Süddeutsche Zeitung, Huffington Post, The Times, International Business Times, Scientific American, Science Nordic, The Conversation, Scientific American, National Geographic, I Fucking Love Science, io9, Freakonometrics, Financial Times, Tehran Times, Videnskab.dk, der Standard (Austria), The Daily Star (Bangladesh), Student News (Ireland), Berliner Morgenpost, BBC Newsround, Ekstra Bladet, Die Welt, Hamburger Abendblatt, University Herald, Daily Mail, Malaysia Sun, Vietnam Express, Diario (Portugal), Metro (Nederland), ABC, Charlotte Observer, and many more.
- The article was highlighted in F1000Prime, which publishes recommendations of articles in biology and medicine, as being "exceptional": http://f1000.com/prime/718201299

Adam Lenart (Post-doc)

- Altinget.dk/Sundhed: Otto-Hahn-medaljen er uddelt, 13/06/13
- Nordjyske Stiftstidende Vendsyssel: Medalje for forskning i pensionsalder, 16/06/13

Dan Levitis (Assistant Professor)

- MHV havforskersejlads: Dræbergopler i Limfjorden. 24 September 2013. http://www.hjv.dk/MHV/Nyheder/Sider/DraebergopleriLimfjorden.aspx

Virginia Zarulli (Post doc)

- NeoDemos: http://neodemos.it/index.php?file=onenews&form_id_notizia=722

Teaching

MaxO staff contributed to the following courses and workshops.

Vladimir Canudas-Romo (Associate Professor)

Biostatistics for pharmaceutical students, main lecturer (3-month course), SDU.

BB208: Introduction to Evolutionary Demography; International PhD-level course, SDU.

Mathematical demography, EDSD, Warsow, Poland, 5-9 December, 2013.

Fundamentals of Life Tables. Johns Hopkins University, January 6-17, 2014.

Fernando Colchero (Assistant Professor)

Teaching assistant for ST514 – Multivariate Analysis. Spring semester 2013.

Instructor for NAT501 – First year project: Modeling animal movement. Spring semester 2013.

Instructor for FF506 – Mathematics, Statistics and Physics for Biologists and Pharmacists. Fall semester 2013.

Instructor for ST502 – Statistical Analysis. Spring semester 2014.

Johan Dahlgren (Assistant Professor)

BB531 Planter, protister og svampe, SDU

BB512 Population and evolution, SDU

Ulrich Steiner (Associate Professor)

FF501: First year projects, SDU

BB512: Population and Evolution; 3rd year course, SDU

BB529: Introduction to Biodemography; 4th year course , SDU

BB817/BB206: Planning and evaluation of biological experiments; MSc-level course, SDU

BB208: Introduction to Evolutionary Demography; International PhD-level course, SDU

Owen Jones (Assistant Professor)

BB817/BB206 Planning and evaluation of biological experiments, SDU

BB512 Population and evolution, SDU

BB529 Introduction to biodemography, SDU

Owen also organized the Software Carpentry Workshop, a teaching workshop aimed at providing scientific computing skills to researchers.

Lionel Jouvet (Post-doc)

BB512 Population and evolution, SDU

BB529 Introduction to biodemography, SDU

Adam Lenart (Post doc)

Biostatistics I. , SDU

Mathematical Demography (Barcelona, European Doctoral for Demography)

Dan Levitis (Assistant Professor), Paul Dunn (Post-doc), Josephine Goldstein (PhD student), Lars Kumala (PhD student), Kim Lundgren (Research Assistant)

BB529 Introduction to Biodemography, SDU

BB208 Introduction to Evolutionary Demography, SDU

FF501 First Year Projects, SDU

BB506 Marin- og Brakvandsøkologi, SDU

BB525 Zoologi og Evolution, SDU

BB817/BB206 Planning and evaluation of biological experiments, SDU

MP182 Applied methods of public health and mortality research using R, SDU

BB204 Mathematical environmental modeling 1, SDU

Dalia A. Conde (Assistant Professor)

FF501 First Year Projects, SDU

BB529 Introduction to biodemography, SDU

Funding

University of Southern Denmark

Max-Planck Institute for Demographic Research, Rostock

AXA Dissemination of Research Grant for AgeGuess (8,000 Euros) (Ulrich Steiner)

BioVeL grant for "COMPADRE Data Access Services" (10,000 Euros) (Owen Jones)

SDU "Laeringsrum og undervisningsteknologi" grant for "Innovative teaching of theory and method in evolutionary demography" (100,000 DKK) (Owen Jones).

European Research Council (ERC) Grant (Vladimir Canudas-Romo)

Gerhard und Ellen Zeidler Foundation (20,000 Euros) (Dalia Amor Conde)

Publications

MaxO manuscripts published or accepted for publication in 2013 (MaxO members are highlighted with bold)

PUBLISHED:

1. **Jones, O.R.**, Scheuerlein, A., Salguero-Gómez R., Camarda, C.G., Schaible, R., Casper, B.B., **Dahlgren, J.P.**, Ehrlén, J., García, M.B., Menges, E.S., Quintana-Ascencio, P.F., Caswell, H., Baudisch, A. and **Vaupel, J.W.** (2013) *Diversity of ageing across the tree of life*. ***Nature*** doi:10.1038/nature12789

2. **Christensen, K.**, Thinggaard, M., Oksuzyan, A., Steenstrup, T., Andersen-Ranberg, K., Jeune, B., McGue, M., **Vaupel, J. W.** (2013) Physical and cognitive functioning of people older than 90 years: A comparison of two Danish cohorts born 10 years apart. ***Lancet*** 382: 1507-1513.

3. Missov, T. and **Lenart, A.** (2013) Gompertz-Makeham Life Expectancies: Expressions and Applications. ***Theoretical Population Biology*** 90: 29-35

4. **Zarulli, V.**(2013) The Effect of Mortality Shocks on the Age-Pattern of Adult Mortality. ***Population*** 68: 265-291.

5. **Zarulli, V.**, Marinacci C., Costa G. and Caselli G. (2013) Mortality by education level at late-adult ages in Turin: a survival analysis using frailty models with period and cohort approaches." ***BMJ open*** 3.7.

6. Andersen, P.K., **Canudas-Romo, V.** and Keiding, N. (2013) Cause-specific measures of life years lost. ***Demographic Research*** 29: 1127-1152.

7. Gaoue, O., Horvitz, C. Ticktin, T., **Steiner, U.** and Tuljapurkar, S. (2013) Defoliation and bark harvesting affect life-history traits of a tropical tree. ***Journal of Ecology*** 101: 1563-1571.

8. Beekman, M., Blanché, H. Perola, M., …,**Christensen K., Vaupel, J.W.** *et al.* (2013) Genome-wide linkage analysis for human longevity : Genetics of Healthy Aging Study. ***Aging Cell*** 12: 184-193.

9. van de Kerk, M., de Kroon, H., **Conde, D.A.**, Jongejans, E. (2013) Carnivora population dynamics are as slow and as fast as those of other mammals : implications for their conservation. ***PloS ONE*** 8: e70354.

10. Engberg, H., Jeune, B., Andersen-Ranberg, K., Martinussen, T., **Vaupel, J. W**, **Christensen, K.** (2013) Optimism and survival: Does an optimistic outlook predict better survival at advanced ages? A twelve-year follow-up of Danish nonagenarians. ***Aging Clinical and Experimental Research*** 25: 517-525.

11. Zajitschek, F., Jin, T., **Colchero, F**., Maklakov, A. (2013) The missing female deceleration: diet- and sex-dependent late-life mortality patterns in Drosophila melanogaster. ***Journals of Gerontology. Series A*** doi: 10.1093/gerona/glt158

12. Levitis, D. and Martínez, D. (2013) The two halves of U-shaped mortality. ***Frontiers in Genetics*** 4: 1-6.

13. Levitis, D. and **Goldstein, J.** (2013) The consistent, non-destructive measurement of small proteiform aquatic animals, with application to the size and growth of hydra. ***Marine and Freshwater Research*** 64: 332-339.

14. **Conde, D.A.**, **Colchero, F.**, Pearce-Kelly, P., Gusset, M., Byers, O., Flesness, N., Browne, R.K., **Jones, O.** (2013) Zoos through the lens of the IUCN Red List: a global metapopulation approach to support conservation breeding programs. ***PloS ONE*** 8: e80311.

15. Skytthe, A., Christiansen, L., Kyvik, K.O., Bødker, F. L., Hvidberg, L., Petersen, I., Nielsen, M. M. F., Bingley, P., Hjelmborg, J., Tan, Q., Holm, N. V., **Vaupel, J. W.**, McGue, M., **Christensen, K.** (2013) The Danish Twin Registry: Linking surveys, national registers, and biological information. ***Twin Research and Human Genetics*** 16: 104-111.

16. Baudisch, A., Salguero-Gómez, R. , **Jones, O.** , Wrycza, T., Mbeau-Ache, C., Franco, M. , **Colchero, F.** (2013) The Pace and Shape of Senescence in Angiosperms. ***Journal of Ecology*** 101: 596-606.

17. Oksuzyan, A., Jeune, B., Juel, K., **Vaupel, J. W.**, **Christensen, K.** (2013) Changes in hospitalisation, surgical procedures, and survival among the oldest-old : A follow-up study of the entire Danish 1895 and 1905 cohorts from ages 85 to 99 years. ***Age and Ageing*** 42: 476-481.

18. Canudas-Romo, V., & Engelman, M. (2013). Life expectancy in the United States: international and domestic comparisons by ages and causes of death. Genus, 68(3).

19. **Levitis, D.**, Bingaman Lackey, L. (2013) The Human Postfertile Life Span in Comparative Evolutionary Context. ***Evolutionary Anthropology*** 22(2):66-79.

IN PRESS:

20. **Steiner UK**, Tuljapurkar S, Coulson T (*In press*) Generation Time, Net Reproductive Rate, and Growth in Stage-age Structured Populations. ***American Naturalist***

21. Murren, C.J., Maclean, H. J., Diamond S.E., **Steiner, U.K.** *et al.* (*In press*) Evolutionary change in continuous reaction norms. ***American Naturalist***

22. **Zarulli, V.** *(In press)* Post-war migration flows and disparities in mortality from age 50 on: the case of Turin in Italy. ***Population Space and Place.***

SUBMITTED:

1. **Colchero, F., Jones, O.R., Conde, D.A.**, …, **Baudisch, A.**, *et al.* (*Submitted*) Assumptions of flat age-specific mortality and fertility can impair estimation of demographic processes.

2. **Dahlgren, J.P.**, Östergård, H., Ehrlén, J. (*Submitted*) Local environment and density-dependent feedbacks determine population growth in a forest herb.

3. Harris H, **Lenart, A., Levitis, D.** (*Submitted*) The recent, rapid, resurgence of ravens in the eastern US. 1945-2012. ***The Auk***.

4. Oravecz Z, Faust K, **Levitis D**, Batchelder W. (*Submitted*) Deriving consensus based definitions of core psychological concepts. ***American Journal of Psychology***.

5. **Barthold, J.A.**, Schindler, S, **Jones, O.R.**, Packer, C, Coulson, T (*submitted*) No significant role for paternal inheritance of body size as a mechanism for intersexual frequency dependence in lions. **Ecology**

6. Cohen, A.A., **Jones, O.R.**, Scheuerlein, A, Salguero-Gomez, R (*submitted*) Systemic physiological constraints and the evolution of aging. **Trends in Ecology and Evolution**

7. **Canudas-Romo, V.,** DuGoff, E.H., Wu, A.W., Ahmed, S. and Anderson, G. (*submitted*) "Life Expectancy in 2040: What do Clinical Experts Expect?" PNAS

8. **Canudas-Romo, V.,** Nandita Saikia. (*submitted*) "Sex Gap in Life Expectancy in India and Bigger States during 1970-2006." Genus

9. **Canudas-Romo, V.,** Guillot, M. (*submitted*) "A Measure for Comparing the Mortality History of Cohorts: TCAL" Population

10. Hin, S, **Conde, D. A., Lenart, A.** (submitted) "New light on Roman census papyri through computer-assisted record linkage" Historical Methods

11. **Lenart, A ,** Missov, T. (*revised*) "Goodness-of-fit tests for the Gompertz distribution" Communications in Statistics: Theory and Methods

12. **Zarulli, V.** *(submitted)* "Unobserved Heterogeneity of Frailty in the Analysis of Socioeconomic Differences in Health and Mortality". European Journal of Population.

Activities of James W. Vaupel, Don Canfield and Kaare Christensen

James W. Vaupel

Activities

• EDSD (European Doctoral School of Demography), Scientific Board Meeting, Warsaw/Poland, January 18
• 1st Scientific Working Group Meeting JPI (Joint Programming Initiative "More Years, Better Lives), Berlin/Germany, January 28
• 2nd Scientific Working Group Meeting JPI, Berlin/Germany, March 19
• AXA Scientific Board Meeting, Paris/France, March 21
• SCOR/1st Meeting of the Foundation's Scientific Board, Paris, March 22
• Talk at Max Planck Institute for Biology of Aging ("The Biodemography of Longevity"), Cologne/Germany, March 28
• EDSD (European Doctoral School of Demography) Mathematical Demography course, Barcelona/Spain, April 3-5 and 8-12
• Keynote at PRC (Pension Research Council) conference "Recreating Sustainable Retirement: Solvency and Tail Risk" ("Are We Underestimating Human Longevity? Implications for Retirement Security"), Philadelphia/USA, April 25
• 1st Meeting Search Committee "MPI for Dem. Research", Berlin/Germany, May 14
• Symposium on the occasion of Beatrice Fromm's 75th birthday, Berlin/Germany, May 24
• 3rd Scientific Working Group Meeting JPI, Berlin/Germany, June 3
• PhD Defense Boris Kramer, Mainz/Germany, June 19
• AXA Research Fund Celebration, Paris/France, June 20
• Talk at St John's College Workshop "Population - The Long View" ("Humans as extreme outliers in the Biodemography of ageing"), Oxford/UK, September 16
• Talk at the 9th World Conference on the Future of Science by Fondazione Umberto Veronesi ("The Biodemography of Longevity"), Venice/Italy, September 19 – 21
• EDSD (European Doctoral School of Demography) Course Mathematical Demography + Causes (Mortality), Warsaw/Poland, November 12-15 and 19-22

Publications

Beekman, M., H. Blanché, M. Perola, A. Hervonen, V. Bezrukov, E. Sikora, F. Flachsbart, L. Christiansen, A. J. M. De Craen, T. B. L. Kirkwood, I. M. Rea, M. Poulain, J.-M. Robine, S. Valensin, M. A. Stazi, G. Passarino, L. Deiana, E. S. Gonos, L. Paternoster, T. I. A. Sørensen, Q. Tan, Q. Helmer, E. B. van den Akker, J. Deelen, F. Martella, H. J. Cordell, K. L. Ayers, J. W. Vaupel, O. Törnwall, T. E. Johnson, S. Schreiber, M. Lathrop, A. Skytthe, R. G. J. Westendorp, K. Christensen, J. Gampe, A.

Nebel, J. J. Houwing-Duistermaat, P. E. Slagboom and C. Franceschi: Genome-wide linkage analysis for human longevity: Genetics of Healthy Aging Study. Aging Cell 12(2), 184-193 (2013).

Christensen, K., M. Thinggaard, A. Oksuzyan, T. Steenstrup, K. Andersen-Ranberg, B. Jeune, M. McGue and J. W. Vaupel: Physical and cognitive functioning of people older than 90 years: a comparison of two Danish cohorts born 10 years apart. Lancet 382(9903), 1507-1513 (2013).

Glei, D. A., N. Goldman, V. M. Shkolnikov, D. Jdanov, M. Shkolnikova, J. W. Vaupel and M. Weinstein: Perceived stress and biological risk: is the link stronger in Russians than in Taiwanese and Americans? Stress 16(4), 411-420 (2013) .

Oksuzyan, A., B. Jeune, K. Juel, J. W. Vaupel and K. Christensen: Changes in hospitalisation and surgical procedures among the oldest-old: a follow-up study of the entire Danish 1895 and 1905 cohorts from ages 85 to 99 years. Age and Ageing 42(4), 476-481 (2013).

Rau, R., M. Muszynska and J. W. Vaupel: Europe, the oldest-old continent. In: The demography of Europe: current and future challenges, (Eds.) G. R. Neyer, G. Andersson, H. Kulu, L. Bernardi and C. Bühler. Springer, Dordrecht 2013, 119-137.

Skytthe A, L. Christiansen, K. O. Kyvik, F. L. Bødker, L. Hvidberg, I. Petersen, M. M. F. Nielsen, P. Bingley, J. Hjelmborg, Q. Tan, N. V. Holm, J. W. Vaupel, M. McGue and K. Christensen: The Danish Twin Registry: linking surveys, national registers, and biological information. Twin Research and Human Genetics 16(1), 104-111 (2013).

Sørensen, M., S. Dato, Q. Tan, M. Thinggaard, R. Kleindorp, M. Beekman, H. E. D. Suchiman, R. Jacobsen, M. McGue, T. Stevnsner, V. A. Bohr, A. J. de Craen, R. G. Westendorp, S. Schreiber, P. E. Slagboom, A. Nebel, J. W. Vaupel, K. Christensen and L. Christiansen: Evidence from case-control and longitudinal studies supports associations of genetic variation in APOE, CETP, and IL6 with human longevity. Age 35(2), 487-500 (2013).

Vaupel, J. W. and R. Rau: Research versus rhetoric. Gerontology 59(1), 95-96 (2013).

Vaupel, J. W., T. I. Missov and C. J. E. Metcalf: Optimal semelparity. PLoS ONE 8(2), e57133 (2013).

Don Canfield

Activities

Meeting, ERC Panel, Bruxelles, February 19-21 2013

Meeting, DANFOSS Universe, April 23 2013

Research Meeting, Leeds University, May 6-8 2013

Meeting, ERC Panel, Bruxelles, June 10-13 2013

Research meetings & Fieldwork, China, September 20-30 2013

Evaluation of applications, NORRUSS Call, The Research Council, Oslo, Norway, October 8 2013

Research visit, Princeton University, NJ, USA, November 19-21. Invited talk: Climate Change 1.4 billion Years Ago.

Publications

Canfield DE, Kump LR (2013) Carbon cycle makeover. Science 339: 533-534 (02.13)

Boyle RA, Clark JR, Poulton SW, Shields-Zhou G, Canfield DE, Lenton TM (2013) Nitrogen cycle feedbacks as a control on euxinia in the mid-Proterozoic ocean. Nature Communications 4: 1533. doi: 10.1038/ncomms2511 (02.13)

Frei R, Gaucher C, Stolper D, Canfield D (2013) Fluctuations in late Neoproterozoic atmospheric oxidation – Cr isotope chemostratigraphy and iron speciation of the late Ediacaran lower Arroyo del Soldado Group (Uruguay). Gondwana Research 23: 797-811, doi: 10.1016/j.gr2012.06.004 (03.13)

Glud RN, Wenzhöfer F, Middelboe M, Oguri K, Turnewitsch R, Canfield DE, Kitazato H (2013) High rates of microbial carbon turnover in sediments in the deepest oceanic trench on Earth. Nature Geoscience 6: 284-288 (04.13)

Canfield DE (2013) Sulfur isotopes in coal constrain the evolution of the Phanerozoic sulfur cycle. Proceedings of the National Academy of Sciences of the United States of America 110: 8443-8446. [OA] DOI: www.pnas.org/cgi/doi/10.1073/pnas.1306450110 (05.13)

Crowe SA, Døssing LN, Beukes NJ, Bau M, Kruger SJ, Frei R, Canfield DE (2013) Atmospheric oxygenation three billion years ago. Nature 501: 535-539. doi:10.1038/nature12426 (09.13)

Canfield DE, Ngombi-Pemba L, Hammarlund EU, Bengtson S, Chaussidon M, Gauthier-Lafaye F, Meunier A, Riboulleau A, Rollion-Bard C, Rouxel O, Asael D, Pierson-Wickmann A-C, El Albani A (2013) Oxygen dynamics in the aftermath of the Great Oxidation of Earth's atmosphere. Proceedings of the National Academy of

Sciences of the United States of America 110-16736-16741 [OA] http://www.pnas.org/content/110/42/16736.full.pdf+html (10.13)

Dahl TW, Ruhl M, Hammarlund EU, Canfield DE, Rosing MT, Bjerrum CJ (2013) Tracing euxinia by molybdenum concentrations in sediments using handheld x-ray fluorescence spectroscopy (HHXRF), Chemical Geology 360: 241-251, doi: 10.1016/j.chemgeo.2013.10.022 (10.13)

Canfield DE (2013) Oxygen. A four billion year history. Princeton University Press.

Kaare Christensen

Activities

Invited lectures

Foredrag om tvillingforskning ved symposium i anledning af H.K.H. Kronprinsessens protektion af Dansk Tvilling Register og Australsk Tvilling Register [Lecture on research including twins at the symposium in connection with Her Royal Highness Crown Princess Mary's patronage of the Danish and the Australian Twin Registries], University of Southern Denmark, Odense, Denmark, January 15, 2013.

"Hvad skal der til for at blive 100 år?" [What will it take to become 100 years?], lecture at Dalum Church, Odense, Denmark, January 17, 2013.

"Genetics of aging and longevity", lecture at a Special Seminar at Columbia University Medical Center, G.H. Sergievsky Center/Taub Institute, New York, USA, March 11, 2013.

Foredrag om den nyeste forskning vedrørende ældre patienter og aldring [Lecture on the newest research into aging and the elderly patients]. Theme meeting about the elderly medical patients/citizens, Odense University Hospital, Odense, Denmark, April 16, 2013.

"Hvad skal der til for at blive 100 år?" [What will it take to become 100 years?], lecture at "Forskningens Døgn" [Research Day], Odense Town Hall, Odense, Denmark, May 2, 2013.

"Hvor stor og hvor syg er "den demografiske bombe?" [How big and how sick is "The Demographic Bomb"?], lecture at the annual meeting in Dansk Selskab for Ledelse i Sundhedsvæsenet (DSS) [Danish society for management in the health care sector], Copenhagen, Denmark, May 23, 2013.

"Healthy aging – outreach to society", lecture at the INTERREG4A "Healthy Aging" closing meeting, Hotel Koldingfjord, Kolding, Denmark, June 18, 2013.

"Trivsel i senkarrieren – hvornår er man (for) gammel" [Well-being late in your career – when are you (too) old?], lecture at a course for people aged 50+ years, arranged by the Danish pension fund "PFA Pension", Ebeltoft, Denmark, August 27, 2013.

"Fremtidens seniorer – alderdommen er ikke, hvad den har været" [The future elderly – old age is not what it used to be], lecture at a conference "The future elderly sports – between chair exercise and ironman", arranged by Idrættens Analyseinstitut (Danish sports analysis institute) and DGI (association of sports clubs in Denmark), Vejen, Denmark, September 3, 2013.

"Hvornår er man (for) gammel" [When are you (too) old?], lecture at a course for people aged 50+ years, arranged by the Danish pension fund "PFA Pension", Schackenborg, Denmark, October 1, 2013.

"Hvad skal der til for at blive 100 år?" [What will it take to become 100 years old?], lecture in Paarup Kirke, Odense, Denmark, October 8, 2013.

"Ældre patienter – hvad kan de og vi forvente?" [Elderly patients – what can they and we expect?], lecture at a theme meeting for the heads of the hospital departments at "Hospitalsenheden Vest", Central Denmark Region, Ringkøbing, October 10, 2013.

"Hvorfor ældes kvinder og mænd forskelligt?" [Why do women and men age differently?], lecture at the People's University, Odense, Denmark, October 21, 2013.

"Behandling af de ældste – hvad har vi gang i?" [Treatment of the oldest patients – are we doing good?], lecture at the autumn meeting in the Danish Society of Cardiology, Odense, Denmark, October 31, 2013.

"Activity and function in elderly" and "How much do genes predict our aging and loss in bodily functions?", two lectures at the international symposium on aging and physical training, arranged by Centre for Healthy Aging (University of Copenhagen), La Santa, Lanzarote, Spain, November 2-7, 2014.

"Behandlingen af de ældre – hvad har vi gang i?" [Treatment of the oldest patients – are we doing good?], lecture at a theme meeting about elderly with apoplectic damage in "Hjernesagen" (a Danish national brain injury association), Odense, Denmark, November 28, 2013.

Media appearances

Printed and online

Morten G. Andersen. Supercenter skal forske i alderdommen [Supercenter is going to carry out research into aging]. Politiken, January 30, 2012.

Annette K. Nielsen. Hvad nu, hvis jeg runder 100? [What will happen to me if I turn 100?], Weekendavisen, February 1, 2013.

Interview about the growing number 100 year-olds in Denmark, Nova Magasin, February 14, 2013.

Flere end 1000 er blevet 100 [More than 1,000 people have turned 100]. Interview in Jyllands-Posten, February 15, 2013.

Levealderen stiger med seks timer om dagen [Life expectancy increases by 6 hours per day]. Interview in the teachers' magazine "Lærernes Pension", No. 1, spring 2013, pages 12-13.

Line Holm Nielsen. Tvillinge-boom på retur [Twin birth rate in decline]. Berlingske Tidende, May 26, 2013.

Niels Stoktoft Overgaard. Patienter bliver gamle på meget forskellige måder. [Patients age very differently]. DL Magasinet [Magazine for members of the pension fund for medical secretaries], No. 5, May 2013, pp 9-10.

The paper by Christensen et al. published in Lancet in July 2013 on the physical and cognitive functioning of the 90+ year-olds has received world-wide media attention, among others in The New York Times, USA Today, Daily Mail (UK), BBC, BBB Scotland, Canadian Broadcasting Association, Time.com, Spiegel, La Vanguardia, Le Figaro, Newsmaxhealth.com, Times of Pakistan, Associated Press (US), MDLinx.com, New Old Age (blog on nytimes.com), International Herald Tribune, and Newscientist.com.

Lars Aksel Jakobsen. Vores middellevetid er fordoblet [Our mean life expectancy has doubled]. Interview in "RASK Magasinet" (magazine for patients, relatives and health personnel), No. 9, 2013, pp.32-33.

Vi er blevet bedre til at blive gamle [We are getting better at getting older]. Interview in the health magazine of the Region of Southern Denmark "Sund i Syd", No. 6, 2013, pp. 4-7.

Radio/TV

DR1/P2/Essensen, interview about aging, January 14, 1213.

TV2/Fyn and TV2 News, Visit to the Danish Twin Registry by Her Royal Highness, Crown Princess Mary of Denmark, patron of Danish and the Australian Twin Registries, University of Southern Denmark, Odense, January 15, 2013.

TVFyn, "Fynske Firstmovers": interview about the aging research at the newly established Max Planck Odense Center at the University of Southern Denmark, June 20, 2013.

Publications

International peer-reviewed publications

1. Lindahl-Jacobsen R, Tan Q, Mengel-From J, Christensen K, Nebel A, Christiansen L. Effects of the APOE {varepsilon}2 Allele on Mortality and Cognitive Function in the Oldest Old. The Journals of Gerontology A Biological Sciences and Medical Sciences 2013; 68(4):389-94.

2. Brandt F, Thvilum M, Almind D, Christensen K, Green A, Hegedus L, Brix T. Graves' disease and toxic nodular goiter are both associated with increased mortality but differ with respect to the cause of death. A Danish population-based register study. Thyroid 2013; 23(4):408-13.

3. Tan Q, Jacobsen R, Sørensen M, Christiansen L, Kruse TA, Christensen K. Analyzing age-specific genetic effects on human extreme age survival in cohort-based longitudinal studies. European Journal of Human Genetics 2013; 21(4):451-4.

PMCID: PMC3598313

4. Sørensen M, Dato S, Tan Q, Thinggaard M, Kleindorp R, Beekman M, Suchiman HE, Jacobsen R, McGue M, Stevnsner T, Bohr VA, de Craen AJ, Westendorp RG, Schreiber S, Slagboom PE, Nebel A, Vaupel JW, Christensen K, Christiansen L. Evidence from case-control and longitudinal studies supports associations of genetic variation in APOE, CETP, and IL6 with human longevity. Age (Dordr). 2013; 35(2):487-500.

PMCID: PMC3592963

5. Wulf-Johansson H, Thinggaard M, Tan Q, Johansson SL, Schlosser A, Christensen K, Holmskov U, Sorensen GL. Circulating surfactant protein D is associated to mortality in elderly women: A twin study. Immunobiology 2013; 218(5):712-7.

6. Schupf N, Barral S, Perls T, Newman A, Christensen K, Thyagarajan B, Province M, Rossi WK, Mayeux R. Apolipoprotein E and familial longevity. Neurobiology of Aging 2013;34(4):1287-91.

PMCID: PMC3545094

7. Ekmann A, Petersen I, Mänty M, Christensen K, Avlund K. Fatigue, general health, and ischemic heart disease in older adults. The Journals of Gerontoly, Series A, Biological Sciences and Medical Sciences 2013; 68(3):279-85.

PMCID: PMC3396727

8. McGue M, Christensen K. Growing old but not growing apart: Twin similarity in the latter half of the lifespan. Behavior Genetics 2013; 43(1):1-12.

PMCID: PMC3546153

9. Garm C, Moreno-Villanueva M, Bürkle A, Petersen I, Bohr VA, Christensen K, Stevnsner T. Age and gender effects on DNA strand break repair in peripheral blood mononuclear cells. Aging Cell 2013; 12(1):58-66.

10. Skytthe A, Christiansen L, Kyvik KO, Bødker FL, Hvidberg L, Petersen I, Nielsen MM, Bingley P, Hjelmborg J, Tan Q, Holm NV, Vaupel JW, McGue M, Christensen K. The Danish Twin Registry: Linking Surveys, National Registers, and Biological Information. Twin Research and Human Genetic 2013; 16(1):104-11.

PMCID: PMC3629375

11. Bream EN, Leppellere CR, Cooper ME, Dagle JM, Merrill DC, Christensen K, Simhan HN, Fong CT, Hallman M, Muglia LJ, Marazita ML, Murray JC. Candidate gene linkage approach to identify DNA variants that predispose to preterm birth. Pediatric Research 2013; 73(2):135-41.

PMCID:PMC3740714

12. Christophersen IE, Budtz-Jørgensen E, Olesen MS, Haunsø S, Christensen K, Svendsen JH. Familial atrial fibrillation predicts increased risk of mortality: A study in Danish twins. Circulation, Arrhythmia and Electrophysiology 2013; 6(1):10-5.

13. Bjerregaard-Andersen M, Gomes MA, Joaquím LC, Rodrigues A, Jensen DM, Christensen K, Benn CS, Aaby P, Beck-Nielsen H, Sodemann M. Establishing a Twin Registry in Guinea-Bissau. Twin Research and Human Genetics 2013; 16(1):179-84.

14. Strate LL, Erichsen R, Baron JA, Mortensen J, Pedersen JK, Riis AH, Christensen K, Sørensen HT. Heritability and familial aggregation of diverticular disease: A

population-based study of twins and siblings. Gastroenterology 2013; 144(4):736-742.

15. Frost M, Petersen I, Hegedüs L, Christiansen L, Brix T, Christensen K. Regulation of the pituitary-thyroid axis in adulthood is not related to birth weight: Evidence from extremely birth weight-discordant monozygotic Danish twin pairs. Thyroid 2013; 23(7):785-90.

16. Tan Q, Christiansen L, Thomassen M, Kruse TA, Christensen K. Twins for epigenetic studies of human aging and development. Ageing Research Reviews 2013;12(1):182-7.

PMCID: PMC3509237.

17. Pedersen NL, Christensen K, Dahl AK, Finkel D, Franz CE, Gatz M, Horwitz BN, Johansson B, Johnson W, Kremen WS, Lyons MJ, Malmberg B, McGue M, Neiderhiser JM, Petersen I, Reynolds CA. IGEMS: The Consortium on Interplay of Genes and Environment Across Multiple Studies. Twin Research and Human Genetics 2013;16(1):481-9.

PMCID: PMC3699700

18. Lindahl-Jacobsen R, Hanson HA, Oksuzyan A, Mineau GP, Christensen K, Smith KR. The male-female health-survival paradox and sex differences in cohort life expectancy in Utah, Denmark, and Sweden 1850-1910. Annals of Epidemiology 2013; 23(4):161-6.

PMCID: PMC3651922

19. Hvidtjørn D, Petersen I, Hjelmborg J, Skytthe A, Christensen K, Hvidt NC. Familial Resemblance in Religiousness in a Secular Society: A Twin Study. Twin Research and Human Genetics 2013;16(2):544-53.

20. Steenstrup T, Hjelmborg JV, Mortensen LH, Kimura M, Christensen K, Aviv A. Leukocyte telomere dynamics in the elderly. European Journal of Epidemiology 2013; 28(2):181-7.

PMCID: PMC3604590

21. Thvilum M, Brandt F, Almind D, Christensen K, Hegedüs L, Brix TH. Excess mortality in patients diagnosed with hypothyroidism: A nationwide cohort study of singletons and twins. Journal of Clinical Endocrinology and Metabolism 2013; 98(3):1069-75.

22. Beekman M, Blanché H, Perola M, Hervonen A, Bezrukov V, Sikora E, Flachsbart F, Christiansen L, De Craen AJ, Kirkwood TB, Rea IM, Poulain M, Robine JM,Valensin S, Stazi MA, Passarino G, Deiana L, Gonos ES, Paternoster L, Sørensen TI, Tan Q, Helmer Q, van den Akker EB, Deelen J, Martella F, Cordell HJ, Ayers KL, Vaupel JW, Törnwall O, Johnson TE, Schreiber S, Lathrop M, Skytthe A,Westendorp RG, Christensen K, Gampe J, Nebel A, Houwing-Duistermaat JJ, Slagboom PE, Franceschi C; the GEHA consortium. Genome-wide linkage analysis for human longevity: Genetics of Healthy Aging Study. Aging Cell 2013; 12(2):184-93.

PMCID: PMC3725963

23. Svendsen AJ, Kyvik KO, Houen G, Junker P, Christensen K, Christiansen L, Nielsen C, Skytthe A, Hjelmborg JV. On the origin of rheumatoid arthritis: the impact of environment and genes-a population based twin study. PLoS One 2013;8(2):e57304.

PMCID: PMC3585362

24. Jagger C, McKee M, Christensen K, Lagiewka K, Nusselder W, Van Oyen H, Cambois E, Jeune B, Robine JM. Mind the gap--reaching the European target of a 2-year increase in healthy life years in the next decade. European Journal of Public Health 2013; 23(5):829-33.

PMCID: PMC3784798

25. Oksuzyan A, Jeune B, Juel K, Vaupel JW, Christensen K. Changes in hospitalisation and surgical procedures among the oldest-old: a follow-up study of the entire Danish 1895 and 1905 cohorts from ages 85 to 99 years. Age and Ageing 2013;42(4):476-81.

PMCID: PMC3693434

26. Ingstrup KG, Liang H, Olsen J, Nohr EA, Bech BH, Wu CS, Christensen K, Li J. Maternal bereavement in the antenatal period and oral cleft in the offspring. Human Reproduction 2013;28(4):1092-9.

27. Nygaard M, Sørensen M, Flachsbart F, Mengel-From J, Tan Q, Schreiber S, Nebel A, Christensen K, Christiansen L. AKT1 fails to replicate as a longevity-associated gene in Danish and German nonagenarians and centenarians. European Journal of Human Genetics 2013; 21(5):574-7.

PMCID: PMC3641374

28. Kulminski AM, Arbeev KG, Christensen K, Stallard E, Miljkovic I, Barmada M, Yashin AI. Biogenetic mechanisms predisposing to complex phenotypes in parents

may function differently in their children. The Journals of Gerontology, Series A, Biological Sciences and Medical Sciences 2013; 68(7):760-8.

PMCID: PMC3674715

29. Hvidtjørn D, Hjelmborg J, Skytthe A, Christensen K, Hvidt NC. Religiousness and religious coping in a secular society: The gender perspective. Journal of Religion and Health 2013 [Epub ahead of print].

30. Tan Q, Sørensen M, Kruse TA, Christensen K, Christiansen L. A novel permutation test for case-only analysis identifies epistatic effects on human longevity in the FOXO gene family. Aging Cell 2013; 12(4):690-4.

PMCID: PMC3714332

31. Benetos A, Kark JD, Susser E, Kimura M, Sinnreich R, Chen W, Steenstrup T, Christensen K, Herbig U, V B Hjelmborg J, Srinivasan SR, Berenson GS, Labat C, Aviv A. Tracking and fixed ranking of leukocyte telomere length across the adult life course. Aging Cell 2013; 12(4):615-21.

PMCID: PMC3798089

32. Andersen PS, Larsen LA, Fowler VG Jr, Stegger M, Skov RL, Christensen K. Risk factors for Staphylococcus aureus nasal colonization in Danish middle-aged and elderly twins. European Journal of Clinical Microbiology and Infectious Diseases 2013; 32(10):1321-6.

PMCID: PMC3775156

33. Elo IT, Mykyta L, Sebastiani P, Christensen K, Glynn NW, Perls T. Age validation in the long life family study through a linkage to early-life census records. The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences 2013;68(4):580-5.

PMCID: PMC3674734

34. Frost M, Petersen I, Andersen T, Langdahl B, Buhl T, Christiansen L, Brixen K, Christensen K. Birth weight and adult bone metabolism are unrelated. Results from birth weight discordant monozygotic twins. Journal of Bone and Mineral Research 2013; 28(12):2561-9.

35. Steenstrup T, Hjelmborg JV, Kark JD, Christensen K, Aviv A. The telomere lengthening conundrum--artifact or biology? Nucleic Acids Research 2013; 41(13):e131.

PMCID: PMC3905906

36. Cosentino S, Schupf N, Christensen K, Andersen SL, Newman A, Mayeux R. Reduced prevalence of cognitive impairment in families with exceptional longevity. JAMA Neurology 2013; 13;70(7):867-874

NIHMS ID: NIHMS508895

37. Christensen K, Hansen TG, Rasmussen LS. Intensive care units and the oldest-old: are we doing good, too little, or too much? Acta Anaesthesiologica Scandinavica 2013;57(6):681-3.

38. Barral S, Cosentino S, Costa R, Andersen SL, Christensen K, Eckfeldt JH, Newman AN, Perls TT, Province MA, Hadley EC, Rossi WK, Mayeux R; for the Long Life Family Study. Exceptional memory performance in the Long Life Family Study. Neurobiology of Aging 2013; 34(11):2445-8.

39. Christensen K, Thinggaard M, Oksuzyan A, Steenstrup T, Andersen-Ranberg K, Jeune B, McGue M, Vaupel JW. Physical and cognitive functioning of people older than 90 years: a comparison of two Danish cohorts born 10 years apart. Lancet 2013;382(9903):1507-13.

PMCID: PMC3818336

40. Garm C, Moreno-Villanueva M, Bürkle A, Larsen LA, Bohr VA, Christensen K, Stevnsner T. Genetic and environmental influence on DNA strand break repair: A twin study. Environmental and Molecular Mutagenesis 2013;54(6):414-20.

41. Brandt F, Thvilum M, Almind D, Christensen K, Green A, Hegedüs L, Brix TH. Morbidity before and after the diagnosis of hyperthyroidism: a nationwide register-based study. PLoS One 2013;8(6):e66711.

PMCID: PMC3688572

42. Hansen TG, Pedersen JK, Henneberg SW, Morton NS, Christensen K. Educational outcome in adolescence following pyloric stenosis repair before 3 months of age: a nationwide cohort study. Paediatric Anaesthesia 2013; 23(10):883-90.

43. Sørensen K, Juul A, Christensen K, Skytthe A, Scheike T, Kold Jensen T. Birth size and age at menarche: a twin perspective. Human Reproduction 2013; 28(10):2865-71.

44. Herskind AM, Almind Pedersen D, Christensen K. Increased prevalence of congenital heart defects in monozygotic and dizygotic twins. Circulation 2013; 128(11):1182-8.

45. Mänty M, Thinggaard M, Christensen K, Avlund K. Musculoskeletal pain and physical functioning in the oldest old. European Journal of Pain 2013 [Epub ahead of print].

PMCID: PMC3933514.

46. Engberg H, Jeune B, Andersen-Ranberg K, Martinussen T, Vaupel JW, Christensen K. Optimism and survival: does an optimistic outlook predict better survival at advanced ages? A twelve-year follow-up of Danish nonagenarians. Aging Clinical and Experimental Research 2013; 25(5):517-25.

PMCID: PMC3844795

47. Bjerregaard-Andersen M, Hansen L, da Silva LI, Joaquím LC, Hennild DE, Christiansen L, Aaby P, Benn CS, Christensen K, Sodemann M, Jensen DM, Beck-Nielsen H. Risk of metabolic syndrome and diabetes mellitus among young twins and singletons in Guinea-Bissau. Diabetes Care 2013; 36(11):3549-56.

48. Thvilum M, Brandt F, Almind D, Christensen K, Brix TH, Hegedüs L. Type and extent of somatic morbidity before and after the diagnosis of hypothyroidism. A nationwide register study. PLoS One 2013;8(9):e75789.

PMCID: PMC3774647

49. Mengel-From J, Thinggaard M, Lindahl-Jacobsen R, McGue M, Christensen K, Christiansen L. CLU genetic variants and cognitive decline among elderly and oldest old. PLoS One. 2013;8(11):e79105.

PMCID:PMC3828341

50. Madsen M, Andersen PK, Gerster M, Andersen AM, Osler M, Christensen K. Are familial factors underlying the association between socioeconomic position and prescription medicine? A register-based study on Danish twins. BMJ Open 2013;3(11):e003292.

PMCID: PMC3831100

51. Raule N, Sevini F, Li S, Barbieri A, Tallaro F, Lomartire L, Vianello D, Montesanto A, Moilanen JS, Bezrukov V, Blanché H, Hervonen A, Christensen K, Deiana L, Gonos ES, Kirkwood TB, Kristensen P, Leon A, Pelicci PG, Poulain M, Rea IM, Remacle J,

Robine JM, Schreiber S, Sikora E, Eline Slagboom P, Spazzafumo L, Antonietta Stazi M, Toussaint O, Vaupel JW, Rose G, Majamaa K, Perola M, Johnson TE, Bolund L, Yang H, Passarino G, Franceschi C. The co-occurrence of mtDNA mutations on different oxidative phosphorylation subunits, not detected by haplogroup analysis, affects human longevity and is population specific. Aging Cell 2013 [Epub ahead of print].

Danish peer-reviewed publications

52. Christensen K, Jeune B, Andersen-Ranberg K, Vaupel JW. Ældre i Danmark: Flere overlever til de højeste aldre og med bedre funktionsevne. Ugeskrift for Læger 2013;175(41):2395-98.

Scientific report

53. National Research Council and Institute of Medicine. U.S. Health in International Perspective: Shorter Lives, Poorer Health. Panel on Understanding Cross-National Health Differences Among High-Income Countries, Steven H. Woolf and Laudan Aron, Eds. Committee on Population, Division of Behavioral and Social Sciences and Education, and Board on Population Health and Public Health Practice, Institute of Medicine. Washington, DC: The National Academies Press, 2013.

(among the Top 10 Most Popular Books of 2013 from the National Academies Press).

Other scientific publications

54. Christensen K, Grosen D. Læbe-ganespalte – arv og miljø [Cleft lip and palate – genes and environment]. In: Læbe-ganespalte [Cleft lip and palate], Pia Hvidsteen Munk (ed.). Landsforeningen Læbe-ganespalte, 2013: pp 15-24.

55. Christensen K, McGue M. Tvillinger og den genetiske hjerne. Den genetiske hjerne. Tommerup N (ed.). Hjerneforum, Copenhagen, 2013. Pp: 15-22.

Text book chapter

56. Christensen K. Aldring. Medicinsk Kompendium. Schaffalitzky de Muckadell OB, Haunsø S, Vilstrup H (eds.). Nyt Nordisk Forlag Arnold Busck, Copenhagen. Vol. 1, 18th edition, 2013:127-135.