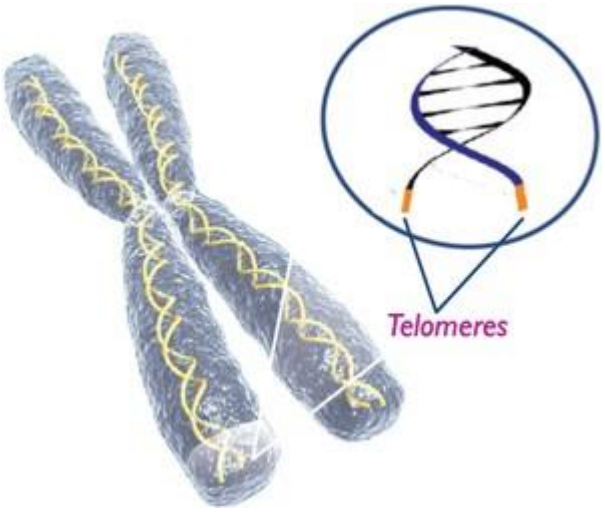
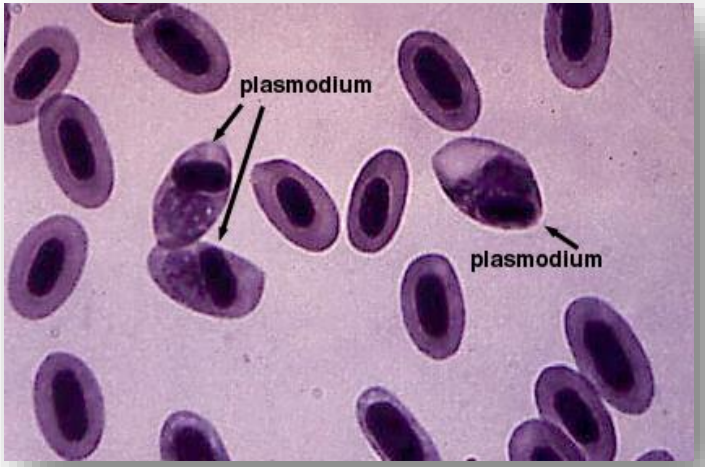
Altruism, infidelity and telomeres

David S Richardson
Lewis Spurgin

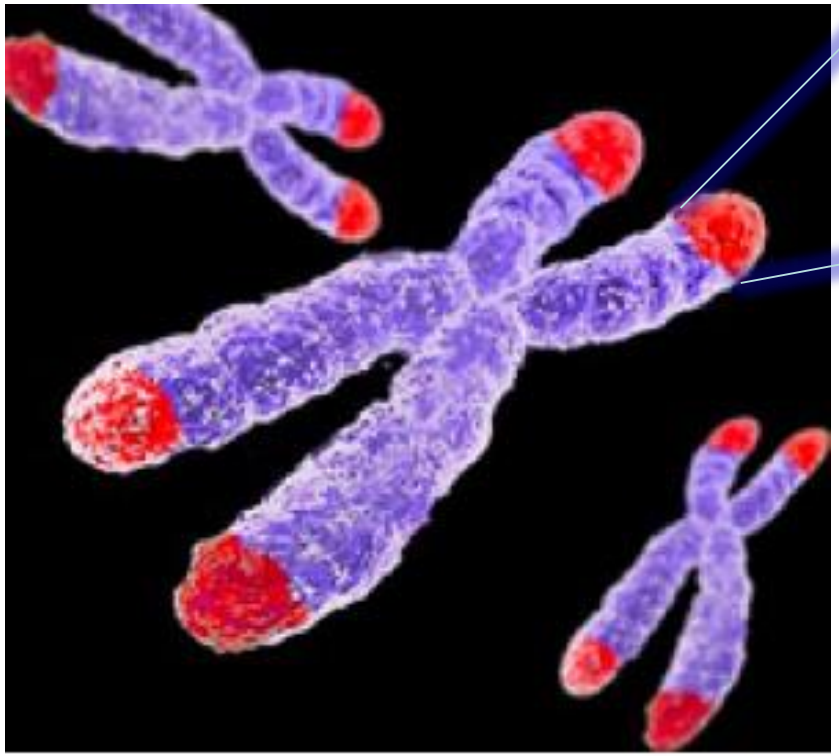


Cost and trade-offs in the struggle to survive and reproduce



Cost and trade-offs in the struggle to survive and reproduce

Telomeres



…TTAGGGTTAGGGTTAGGGTTAGGG…
…AATCCCAAT CCCAATCCC AATCCC…

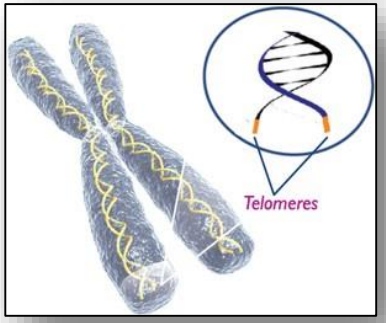
$(TTAGGG)_n$
in vertebrates

1. **Inheritance**
2. **Replication History (age)**
3. **Oxidative Damage**

Telomeres as biomarkers of cost and quality in a wild population

Telomeres as biomarkers of cost and quality in a wild population

If you measure telomere length in individuals and control for chronological age:



Telomeres as biomarkers of cost and quality in a wild population

If you measure telomere length in individuals and control for chronological age:

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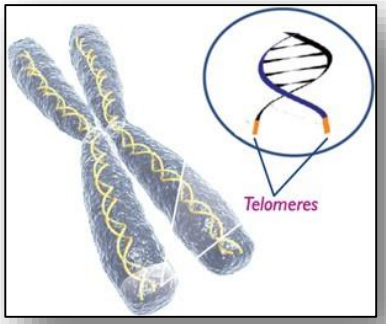

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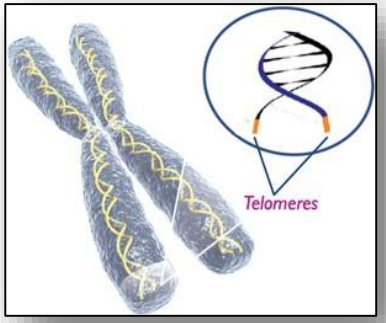

If you isolate telomere shortening during specific experiences:

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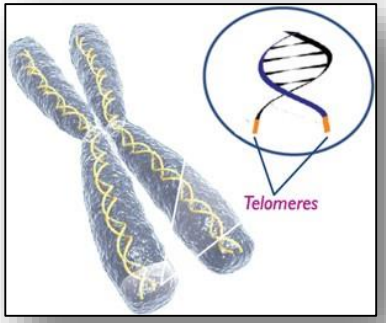
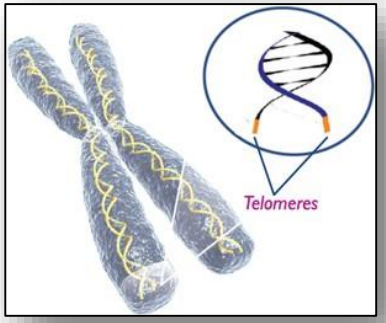


If you isolate telomere shortening during specific experiences:

= Biomarker of the costs of such experiences

Telomeres as biomarkers of cost and quality in a wild population



If you measure telomere length in individuals and control for chronological age:

= Marker of biological ageing

If you isolate telomere shortening during specific experiences:

= Biomarker of the costs of such experiences

If you control for age and telomere shortening factors:

Telomeres as biomarkers of cost and quality in a wild population

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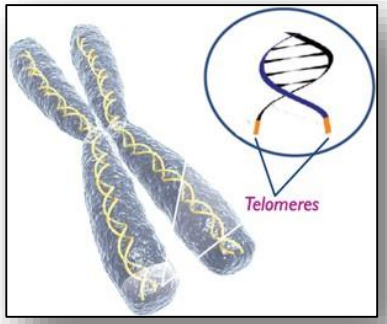
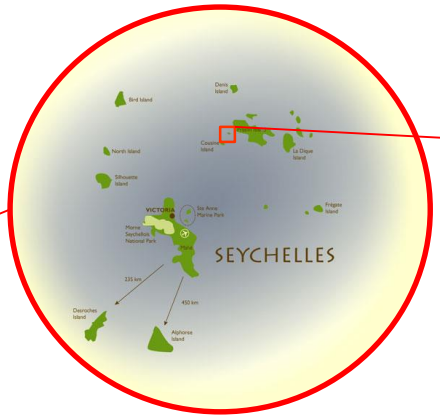


If you isolate telomere shortening during specific experiences:

= Biomarker of the costs of such experiences

If you control for age and telomere shortening factors:

= Measure of individual quality



Seychelles Warbler

Acrocephalus sechellensis

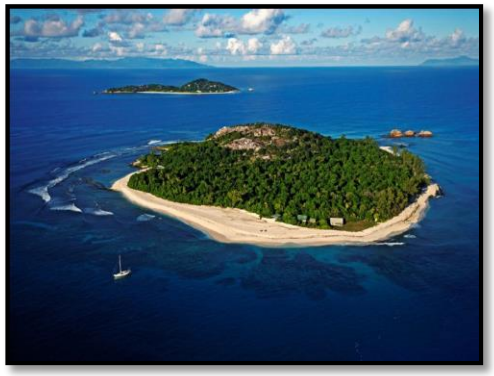
ICBP

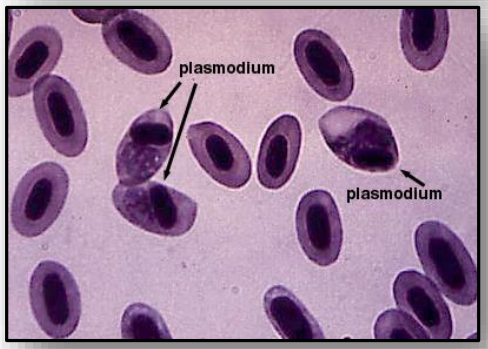
BirdLife INTERNATIONAL

NATURE SEYCHELLES

RSPB

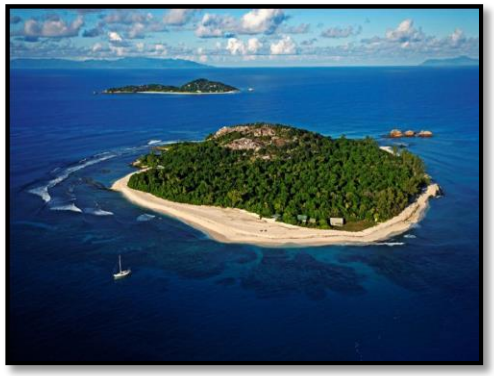
The SW system: a closed population

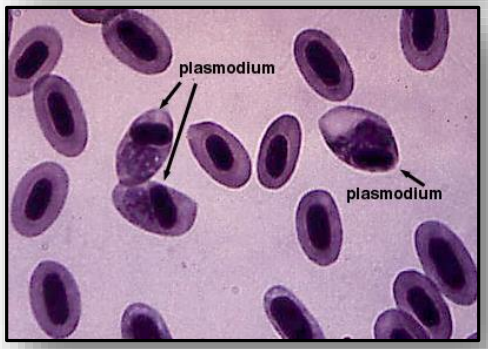




- Cousin island (studied since 1985)

The SW system: a closed population





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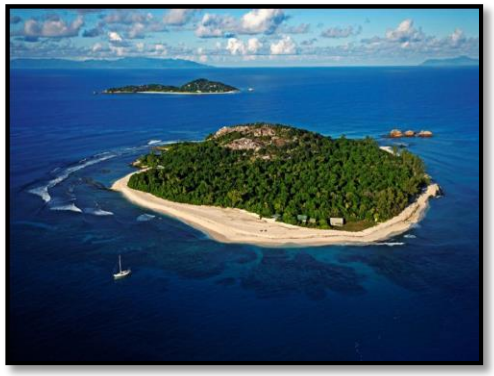

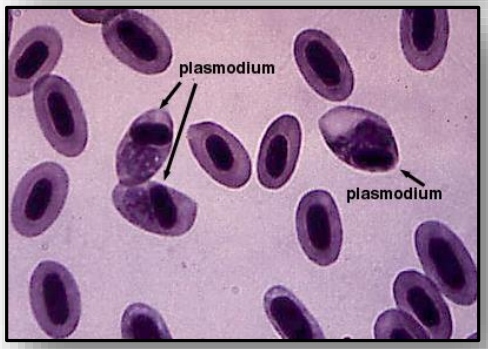

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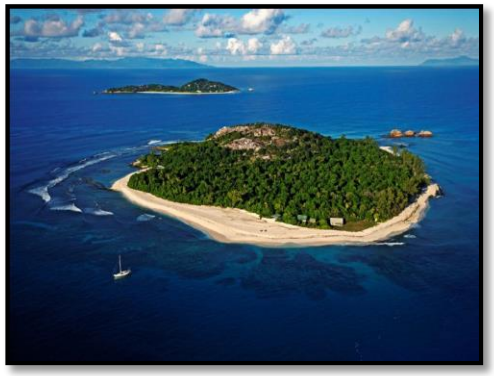

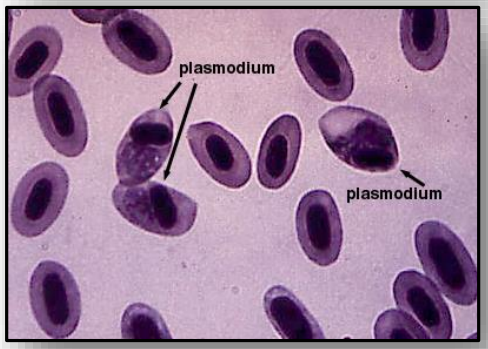

- Cousin island (studied since 1985)
- Small, isolated and enclosed population
- > 97% birds colour ringed
- **Repeatedly blood sampled since 1994**
- Exact chronological age known
- 18 year pedigree being completed
- Life history parameters known
- Other experiences – e.g. malaria infection

The SW system: mostly intrinsic mortality

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Understanding fundamental biological questions

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Altruism

The evolution of cooperative breeding

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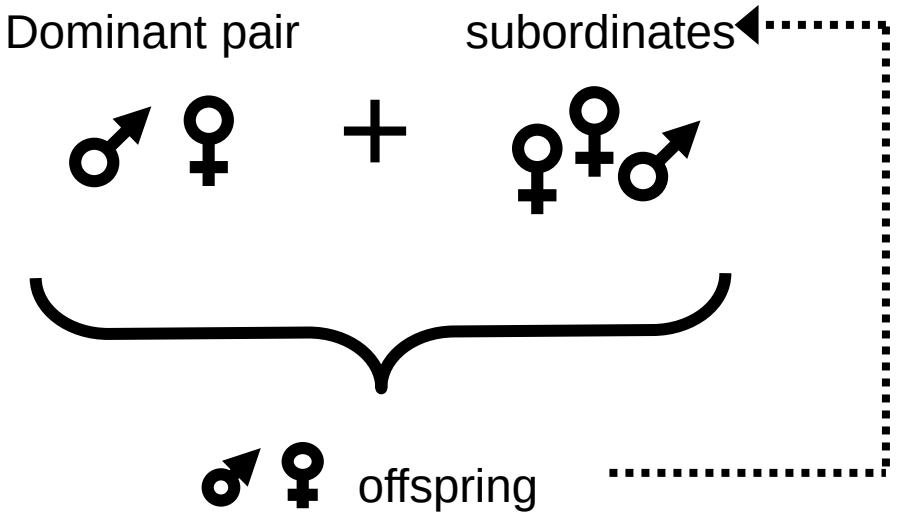

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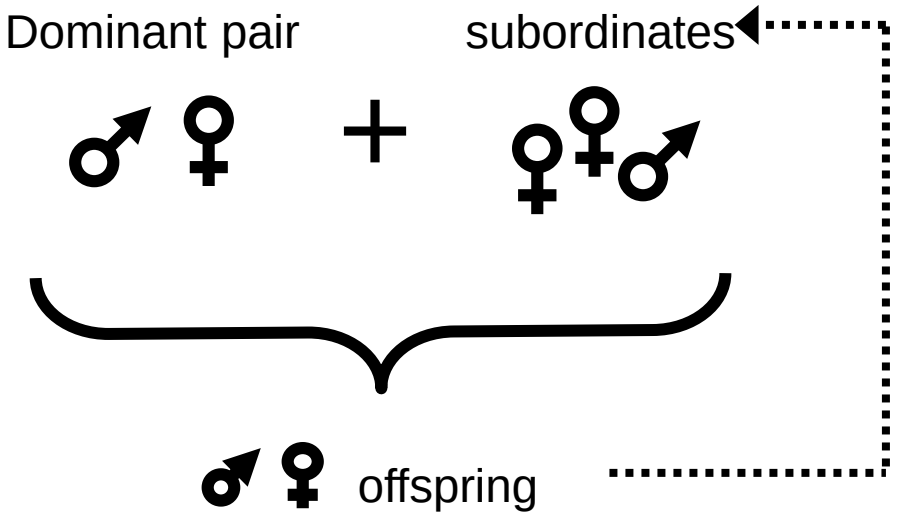
Altruism

The evolution of cooperative breeding



letters to nature

Nature **358**, 493 - 495 (06 August 1992); doi:10.1038/358493a0

Importance of habitat saturation and territory quality for evolution of cooperative breeding in the Seychelles warbler

JAN KOMDEUR*

Understanding fundamental biological questions

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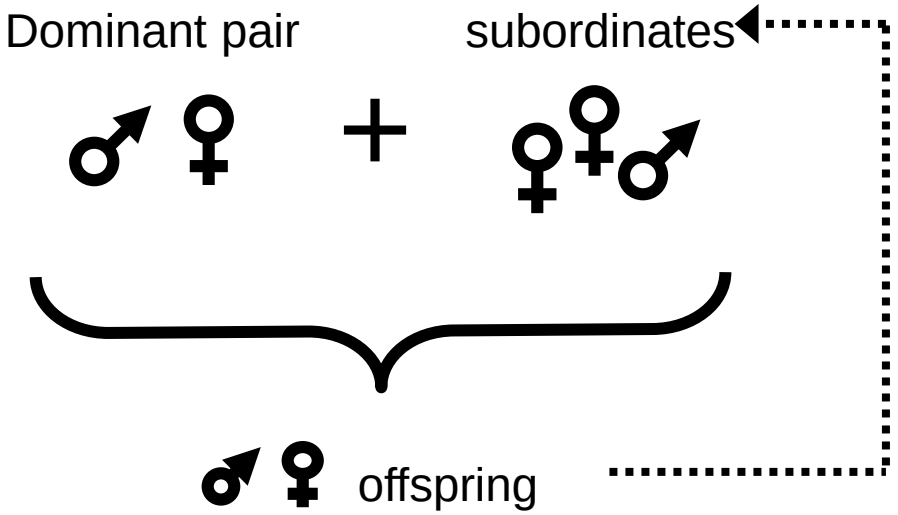

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Extreme adaptive modification in sex ratio of the Seychelles warbler's eggs

JAN KOMDEUR*†‡, SERGE DAAN*, JOOST TINBERGEN* & CHRISTA MATEMAN§

Understanding fundamental biological questions

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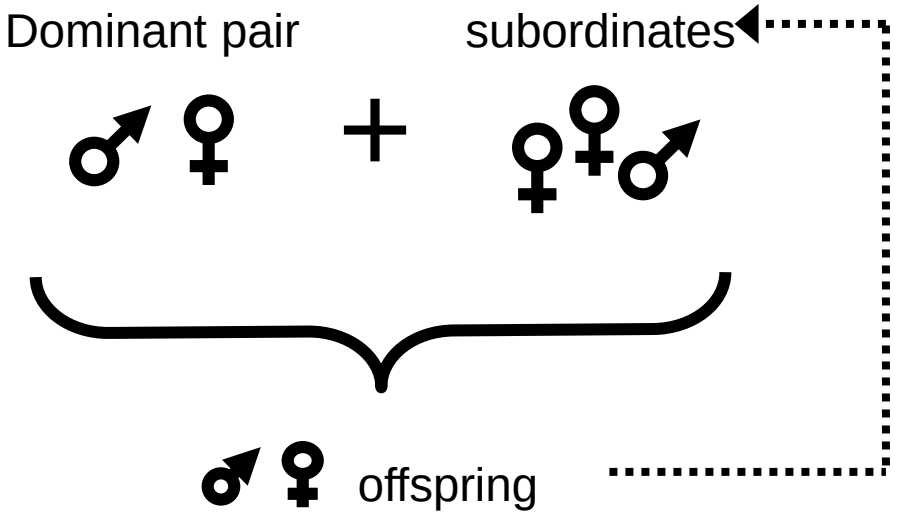

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Evolution, 56(11), 2002, pp. 2313–2321

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DAVID S. RICHARDSON,[1,2] TERRY BURKE[1,3] AND JAN KOMDEUR[4]

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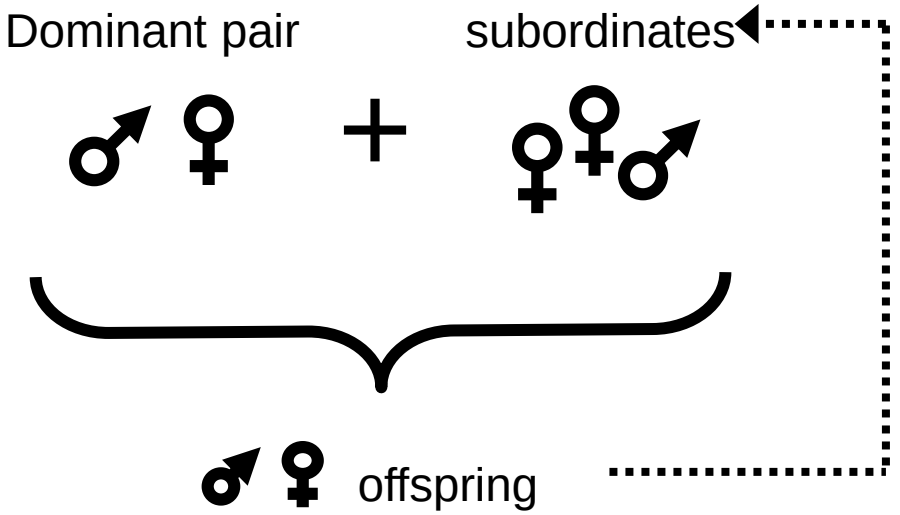

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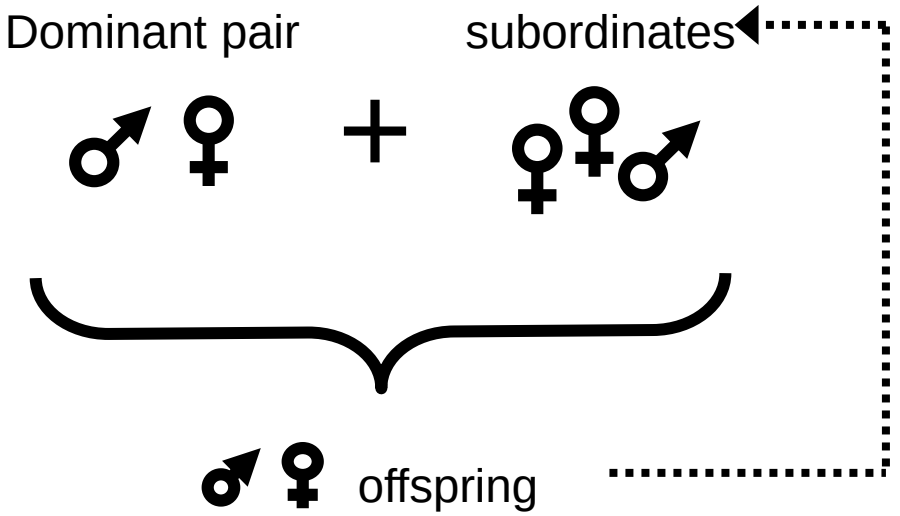

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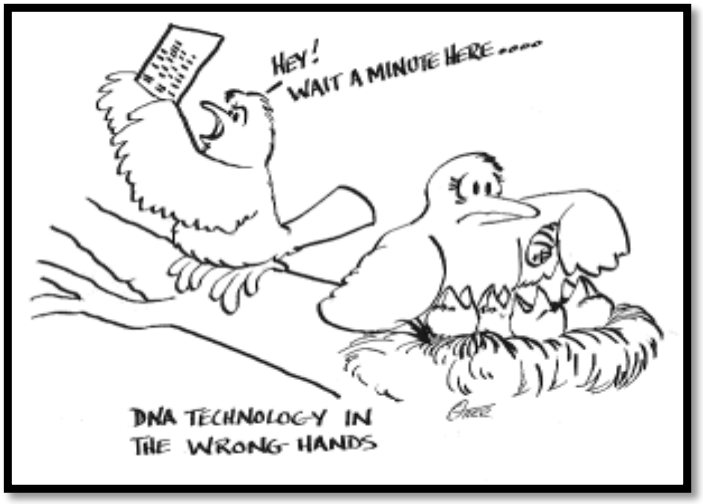
Costs and Benefits

Understanding fundamental biological questions

Infidelity

The benefits of (extra-pair) mate choice



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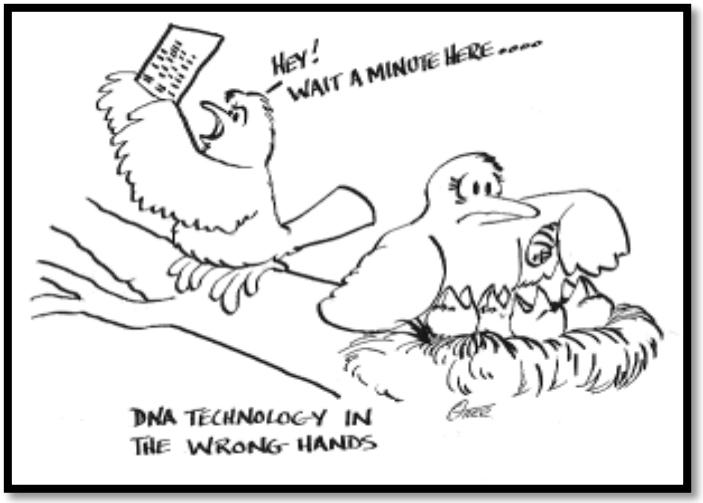

Nature **422**, 580 (10 April 2003) | doi:10.1038/422580a

Avian behaviour: Altruism and infidelity among warblers

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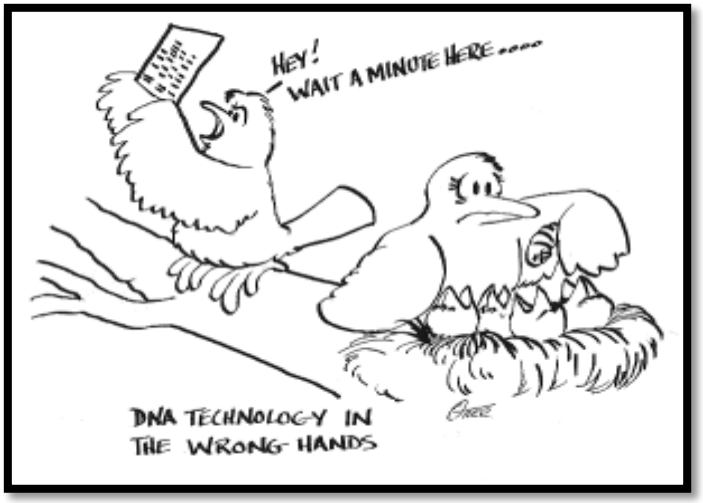

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PROCEEDINGS OF THE ROYAL SOCIETY B

Proc. R. Soc. B (2005) **272**, 759–767
doi:10.1098/rspb.2004.3028
Published online 5 April 2005

MHC-based patterns of social and extra-pair mate choice in the Seychelles warbler

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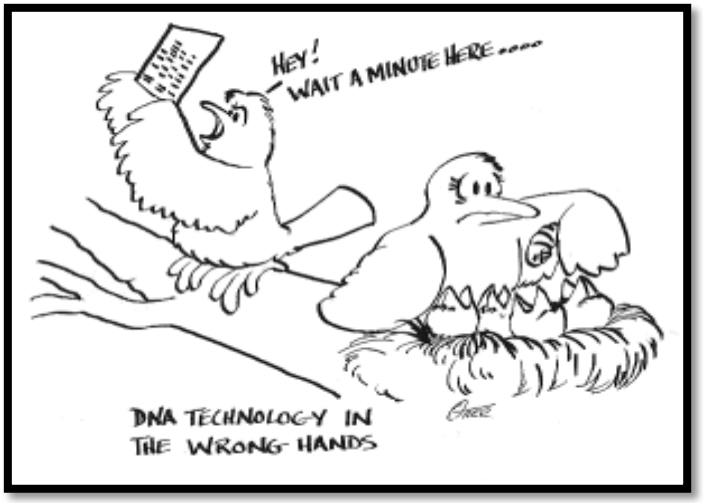

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MOLECULAR ECOLOGY

Molecular Ecology (2010) 19, 3444–3455 doi: 10.1111/j.1365-294X.2010.04750.x

MHC-dependent survival in a wild population: evidence for hidden genetic benefits gained through extra-pair fertilizations

LYANNE BROUWER,*†‡ IAIN BARR,* MARTIJN VAN DE POL,‡ TERRY BURKE,§ JAN KOMDEUR¶ and DAVID S. RICHARDSON***

Overall Aims

Assess **individual variation in telomere length/shortening**

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1. Are telomere dynamics linked to survival / longevity (**Biological ageing)**

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Overall Aims

Assess **individual variation in telomere length/shortening**

1. Are telomere dynamics linked to survival / longevity (**Biological ageing)**
2. How strategies/experiences affect telomere shortening (**Generic currency**)
3. If individuals differ in response to these factors (**Individual quality**)

Results: adult telomere length

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- **Adult telomeres shorten with age**

  Age: $t_{1,211.6}$ =-3.88, P<0.0001

  REML model with bird identity as random effect, R^2 =0.26

  Loss = 120b ± 30.1 SE per year

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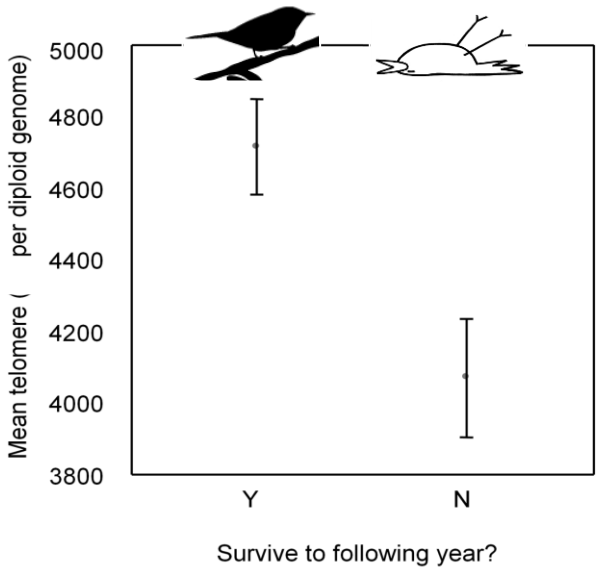
  Independent of their age

  Telomere: χ^2=9.62, P<0.01

  Age: χ^2=0.64, P=0.42



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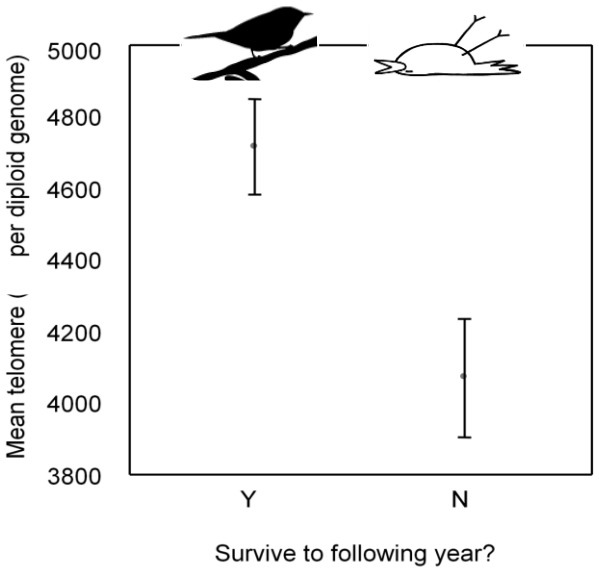
  Age: χ^2=0.64, P=0.42

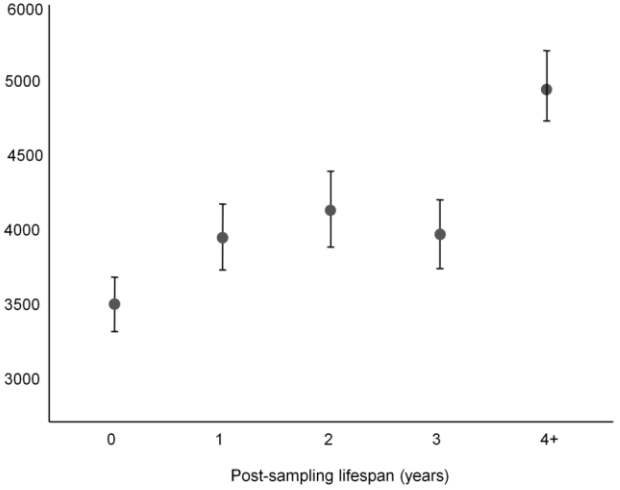
- **Length predicts post sampling lifespan**

  Last sample used for all individuals

  Age χ^2=6.35, P<0.05

  Telomeres χ^2=3.83, P<0.05





Dr Emma Barrett

MOLECULAR ECOLOGY

Molecular Ecology (2013) 22, 249–259 doi: 10.1111/mec.12110

Telomere length and dynamics predict mortality in a wild longitudinal study

EMMA L. B. BARRETT,* TERRY A. BURKE,† MARTIJN HAMMERS,‡ JAN KOMDEUR‡ and DAVID S. RICHARDSON*§

In early life?

Questions

1. Is telomere loss greatest in the first year of life?

2. What factors affect telomere length in early life?

3. What are the consequences of early life telomere dynamics?

Is telomere loss greatest in the first year of life?

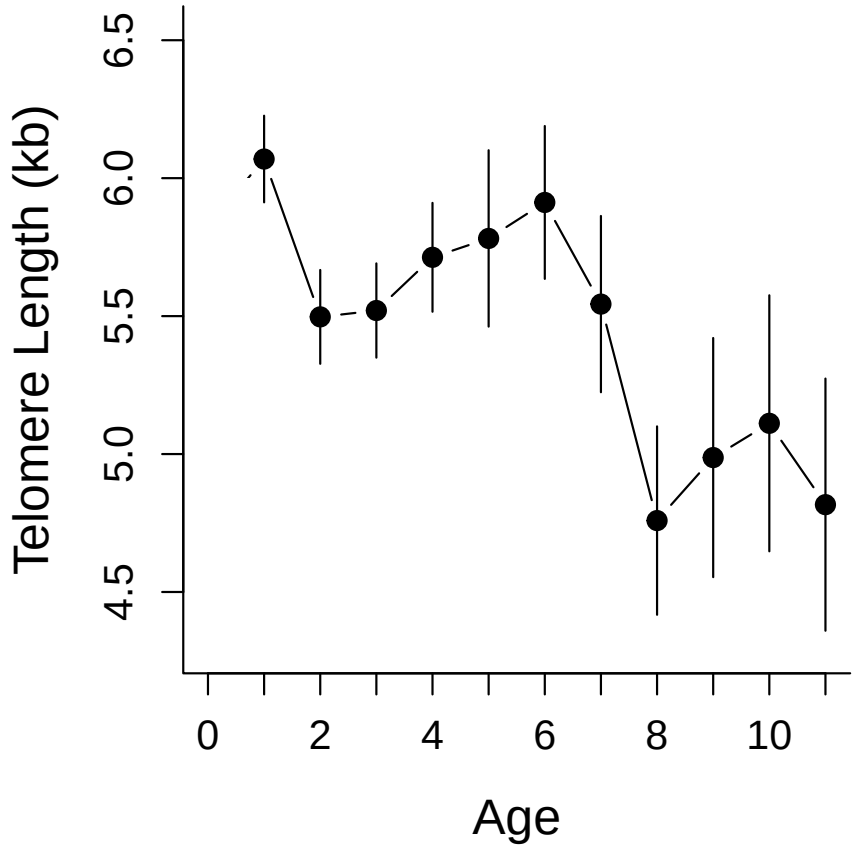
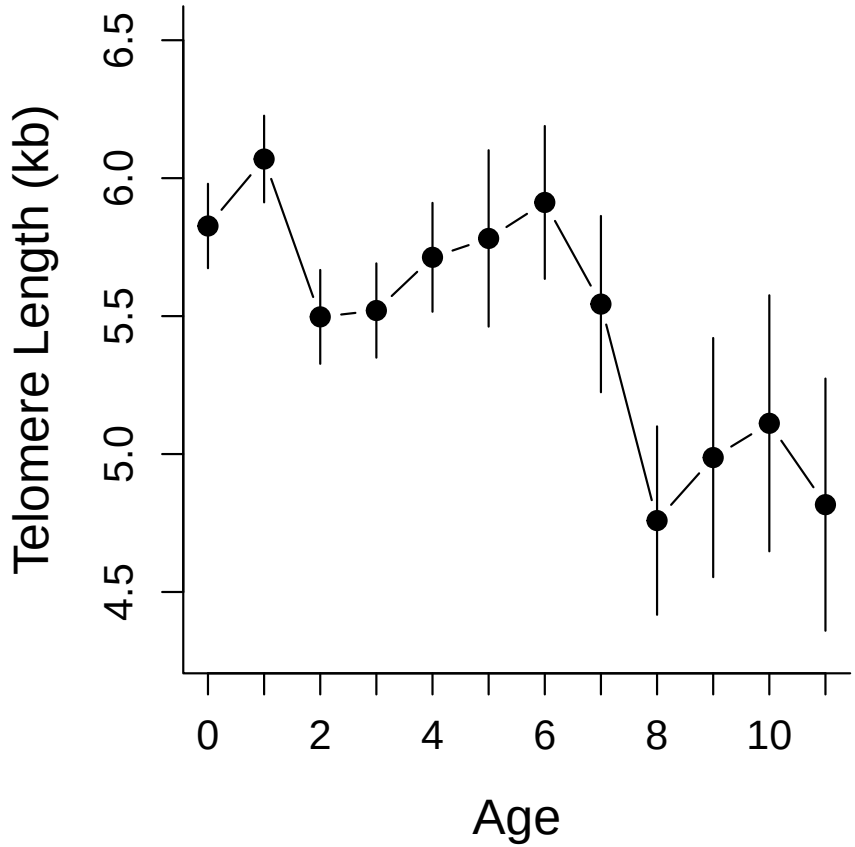


Figure: Telomere length and age

Is telomere loss greatest in the first year of life?



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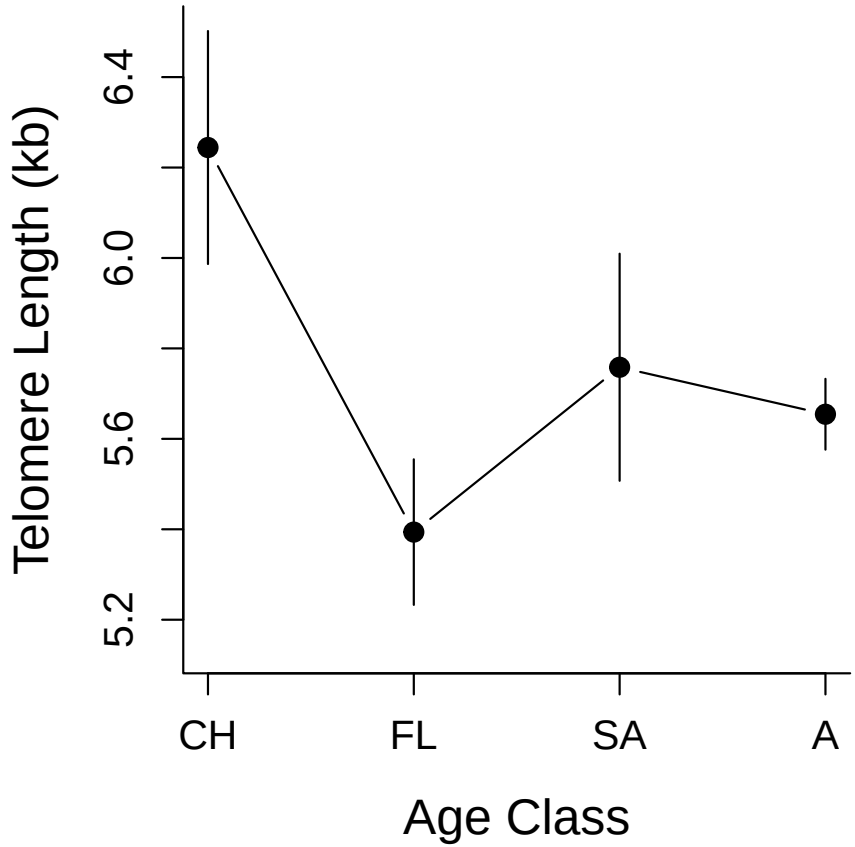


Figure: Telomere length and juvenile age

Questions

1. Is telomere loss greatest in the first year of life?

Yes, but it's lost at a very early stage

2. What factors affect telomere length in early life?

3. What are the consequences of early life telomere dynamics?

What factors affect telomere length in early life?

Model including only juvenile birds ($N = 198$)

```
mymodel <- lm(Telomere_Length ~ Mass +
                                Tarsus_Length +
                                Age_Class +
                                Sex +
                                Territory_Quality +
                                EPP +
                                Helper,
              data = juveniles)
```

What factors affect telomere length in early life?

Key factors:

- Territory Quality
- Age class x Sex
- EPP


What factors affect telomere length in early life?

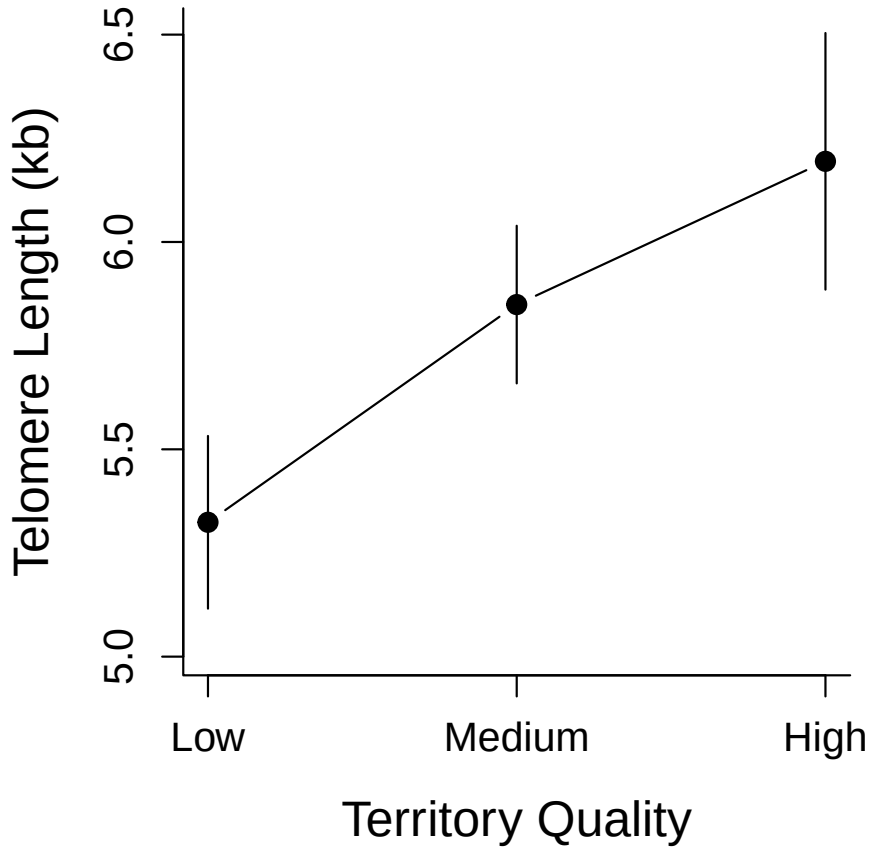


Figure: Telomere length and territory quality

What factors affect telomere length in early life?

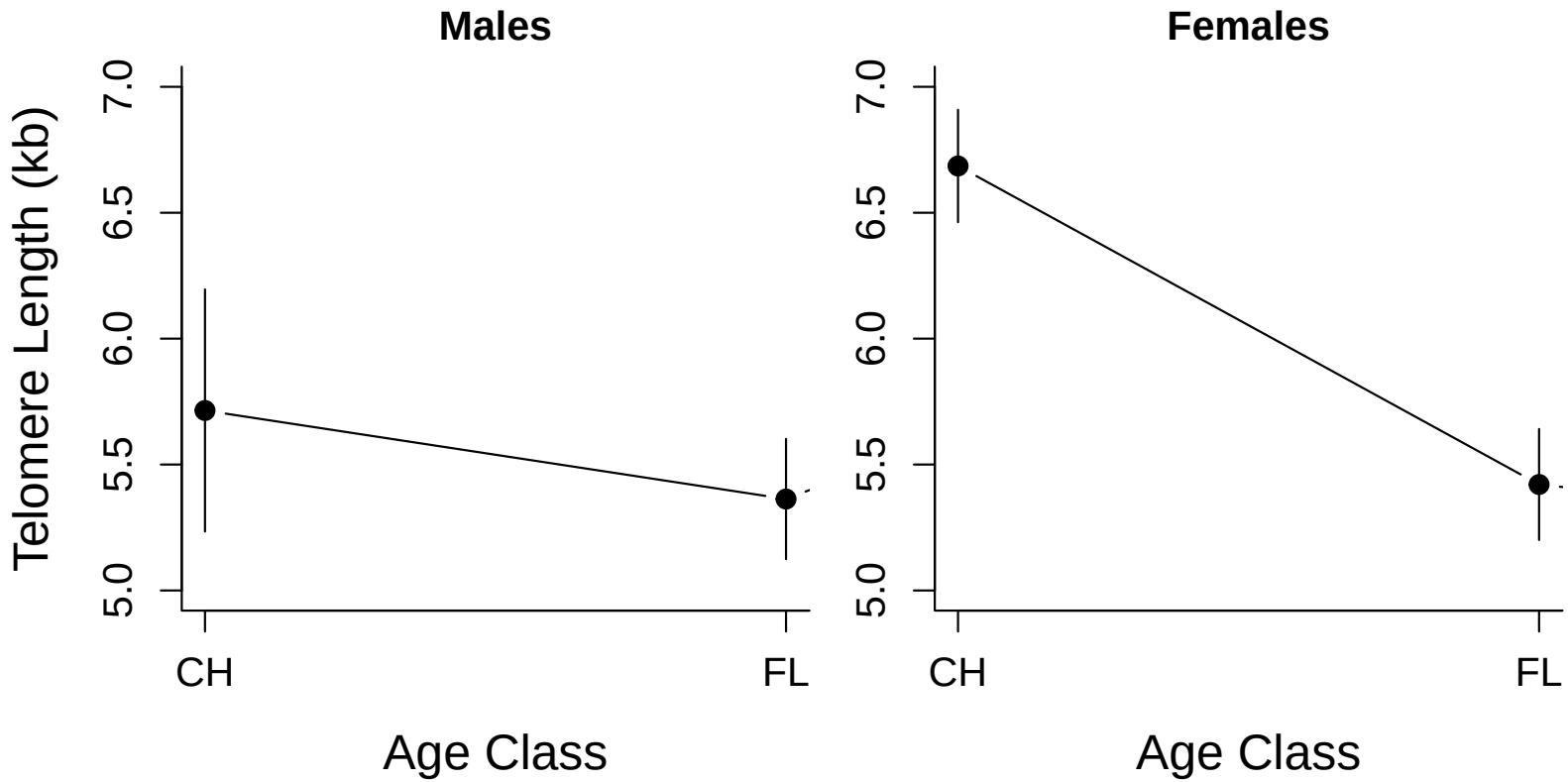


Figure: Telomere length and Sex * Age

What factors affect telomere length in early life?

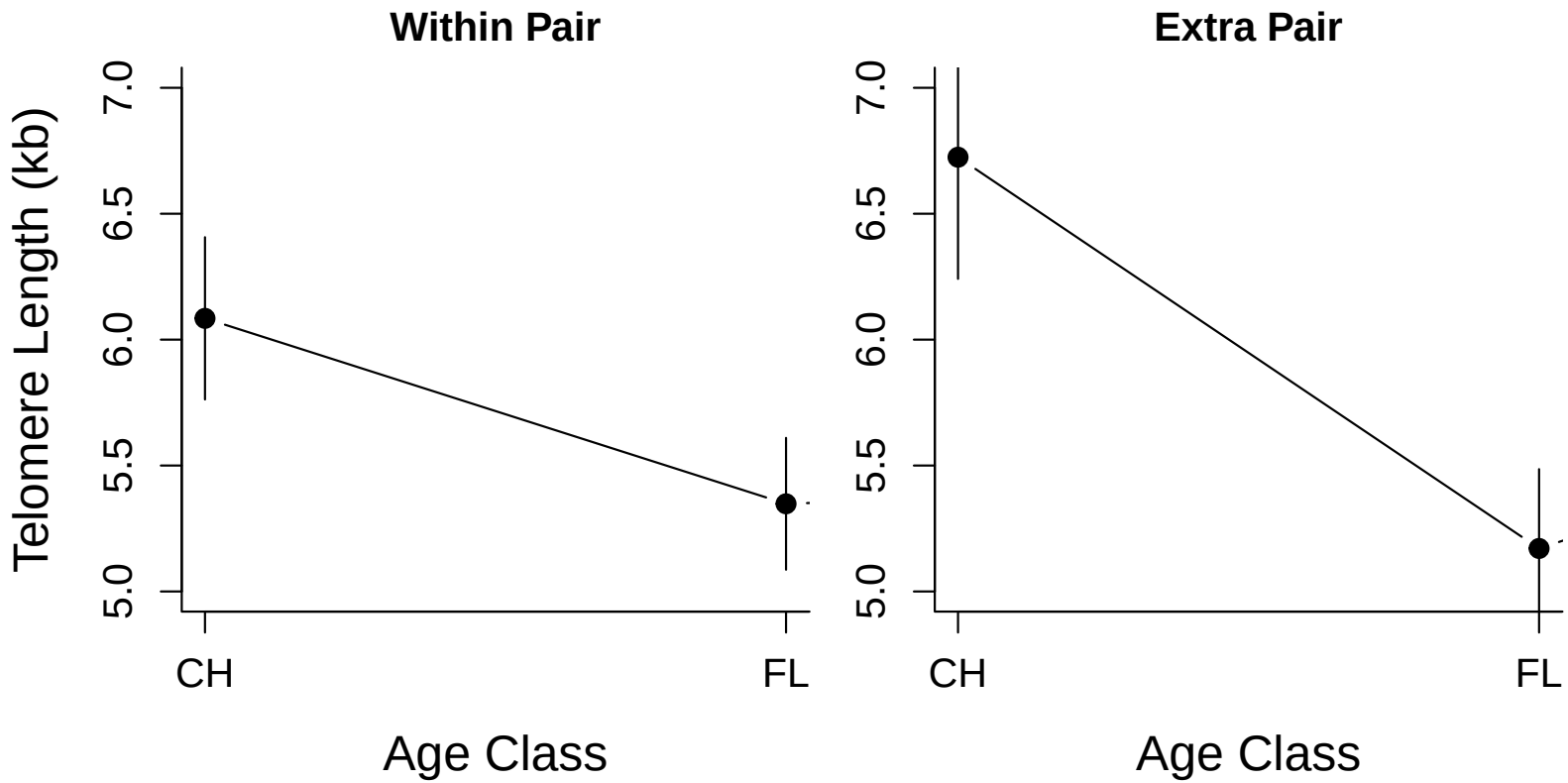


Figure: Telomere length and EPP * Age

Questions

1. Is telomere loss greatest in the first year of life?

Yes, but it's lost at a very early stage

2. What factors affect telomere length in early life?

Age, Sex, Territory Quality and EPP

3. What are the consequences of early life telomere dynamics?

What are the consequences of early life telomere length?

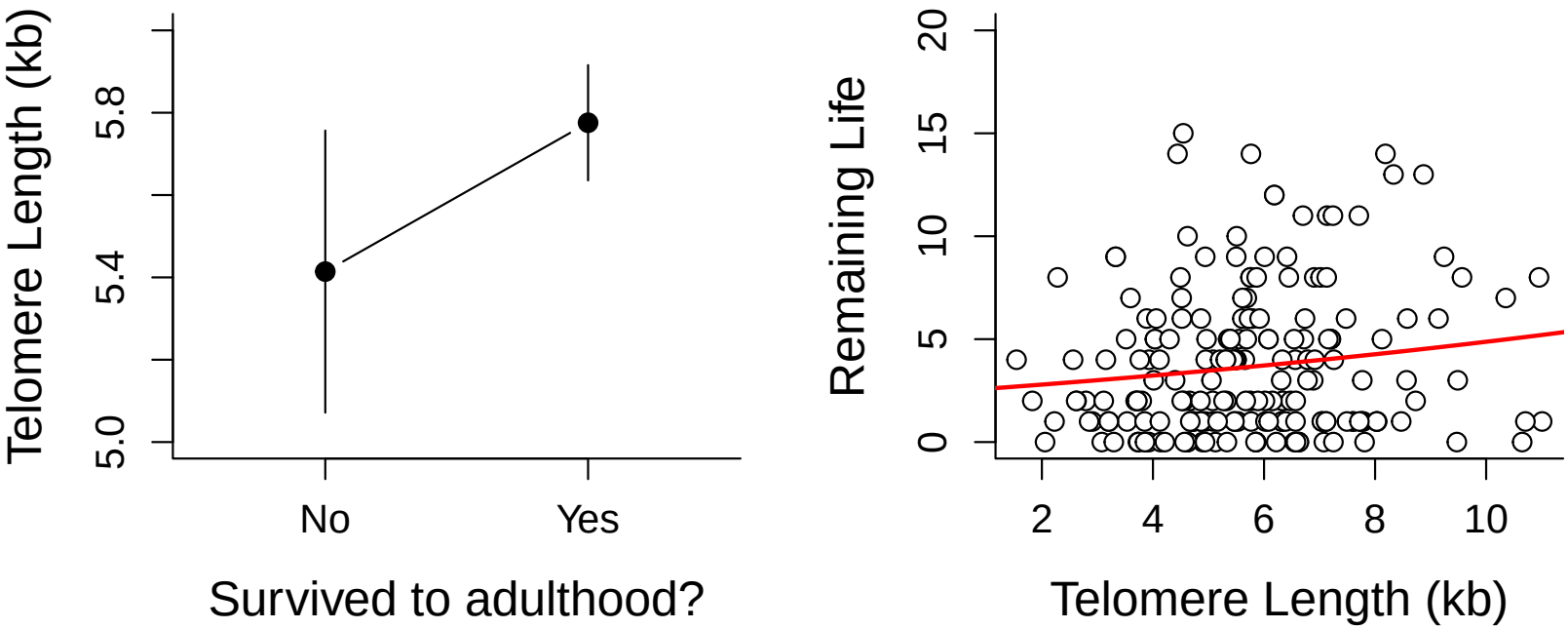


Figure: Telomere length and survival

What are the consequences of early life telomere length?

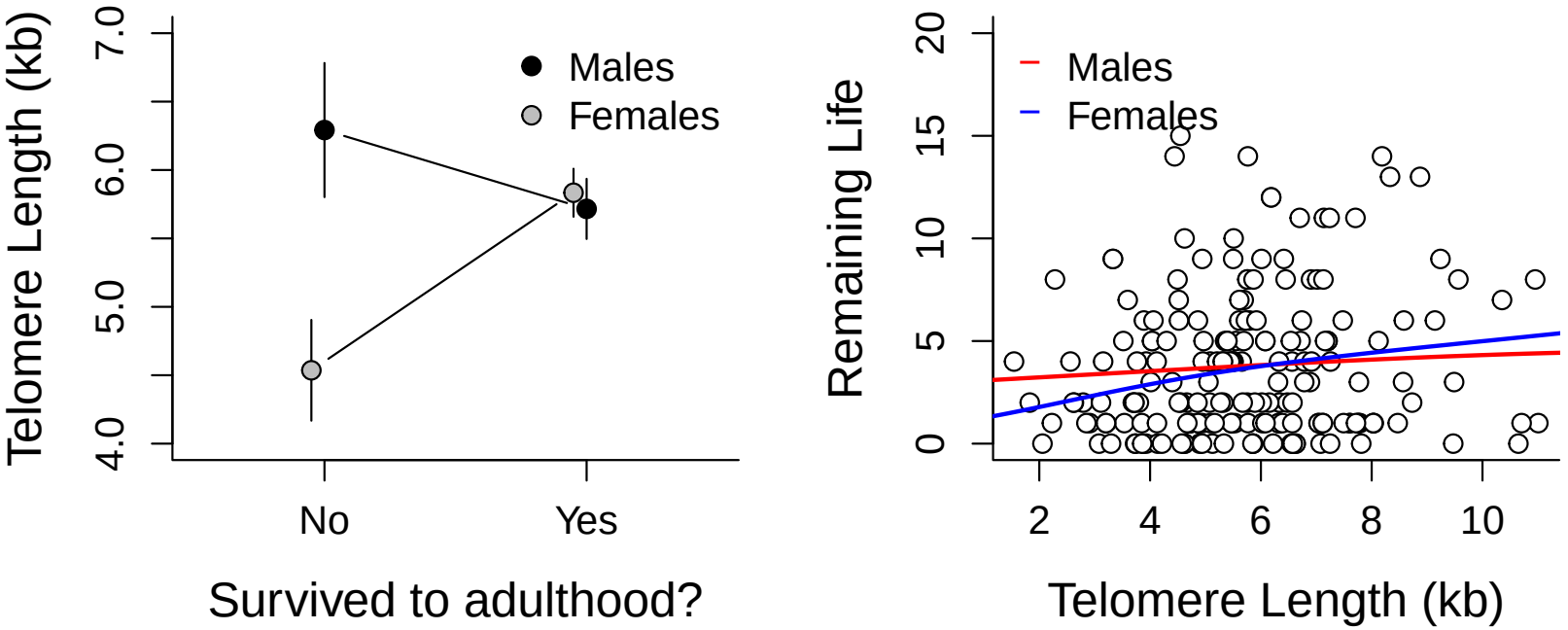
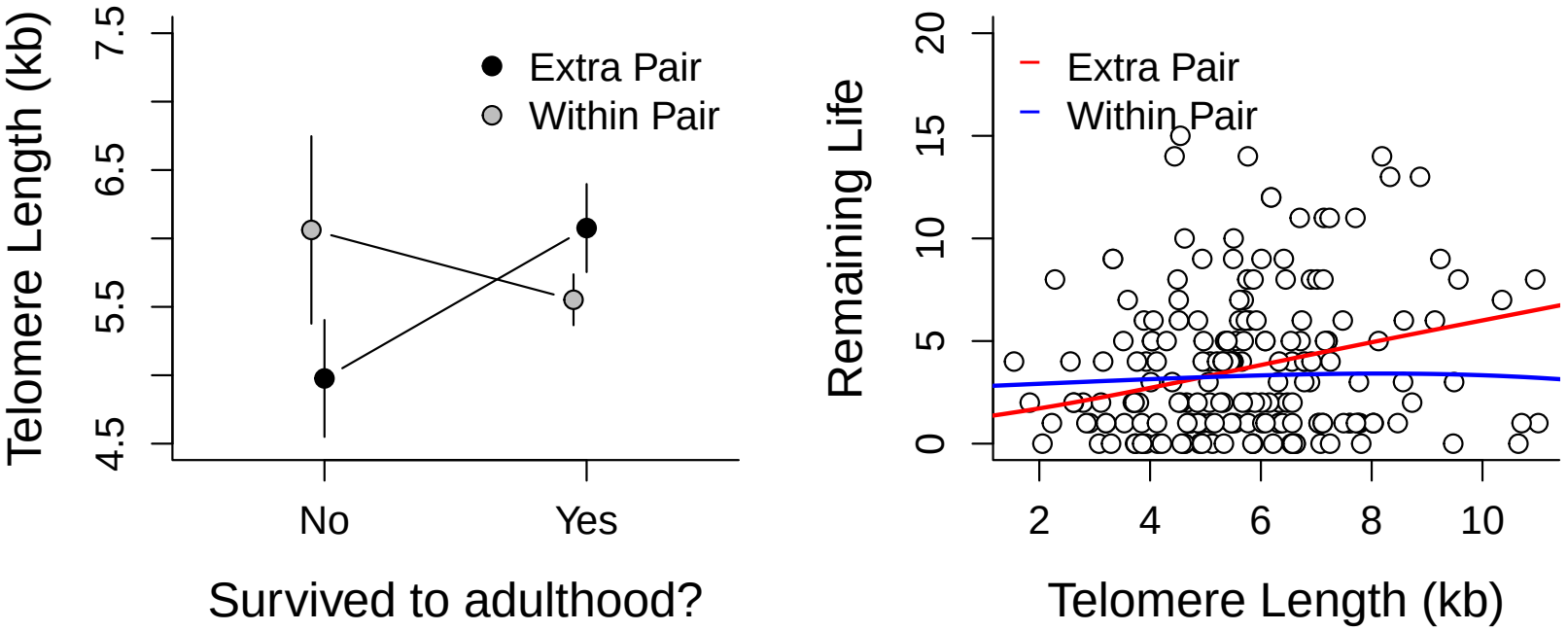


Figure: Telomere length and survival

What are the consequences of early life telomere length?



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Important for survival but dependent on early life conditions

Thanks!

- Pat Monaghan
- Winnie Boner
- Simon Verhulst

Seychelles warbler study group (*Emma Barrett*, Jan Komdeur, Terry Burke and all the other warbler researchers)