Communicatie bij dieren:
vogelzang als modelsysteem in de biologieonderwijs

Marc Naguib
Department of Animal Sciences
Behavioural Ecology Group
marc.naguib@wur.nl

WAGENINGEN UR
For quality of life

Behavioural Ecology and Applied Animal Behaviour Science

WAGENINGEN UR
For quality of life

- Inleiding communicatie bij dieren

- Voorbeeld vogelzang
  - diversiteit
  - hoe vogels zingen (mechanismen)
  - leren van zang
  - waaroom vogels zingen

- Vragen/Discussie

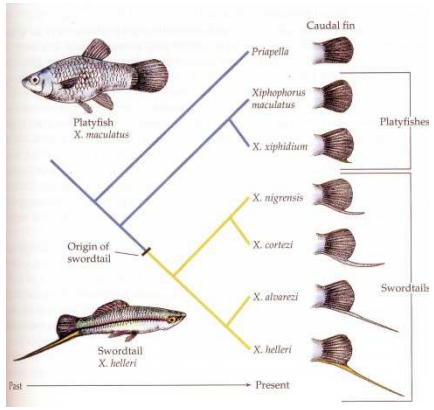
Biological questions

Development

Mechanisms

Function

Phylogeny



Animal communication

alarm calling

Parent-offspring

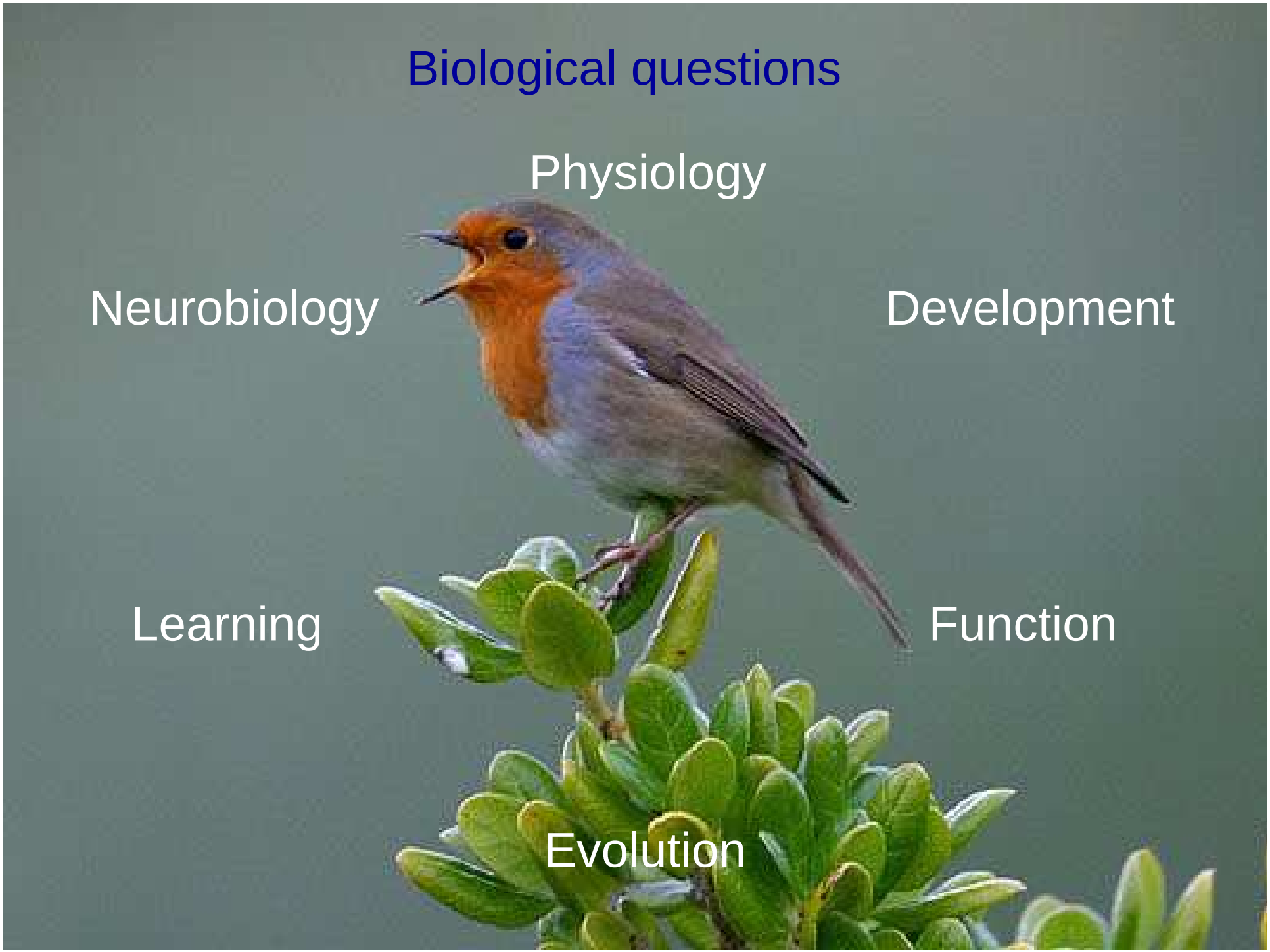
advertisement

Pair coordination

Evolution of communication

signals of quality and/or motivation

Why study birdsong?


Biological questions
Physiology
Neurobiology
Development
Learning
Function
Evolution

- *Long range signal*
- *Learned*
- *Sexually selected*
- *Fitness relevant*

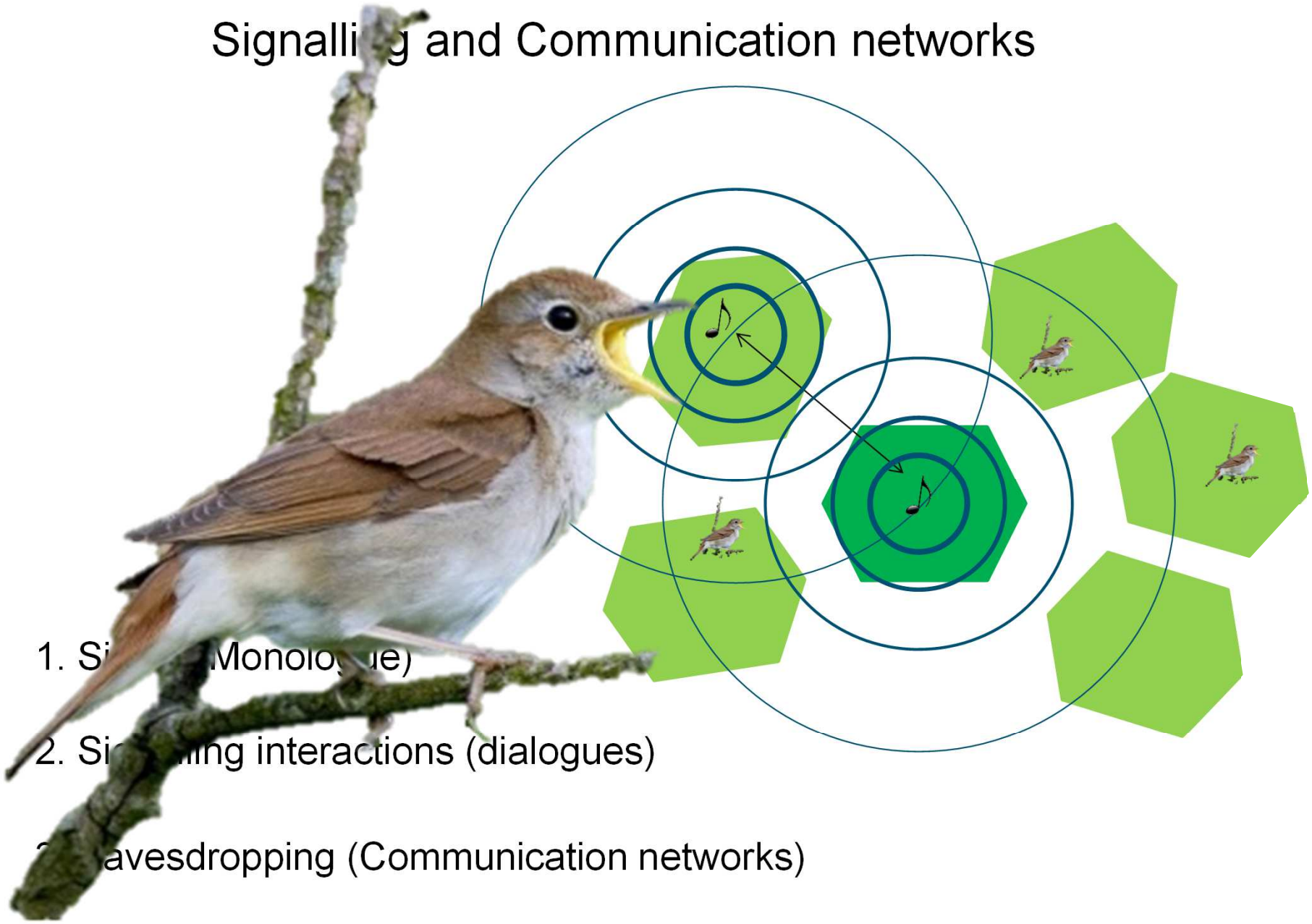
WAGENINGEN UR
For quality of life

Song repertoire
Production quality
Song rate
Total amount of singing

Quality
Motivation
Immune competence
Developmental history
Personality

WAGENINGEN UR
For quality of life

Signalli g and Communication networks



1. Si Monolo ue)

2. Si ling interactions (dialogues)

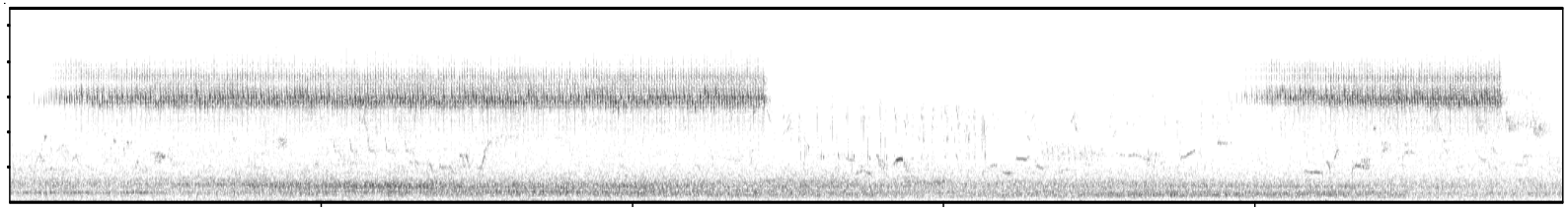
3. avesdropping (Communication networks)

WAGENINGEN UR
For quality of life

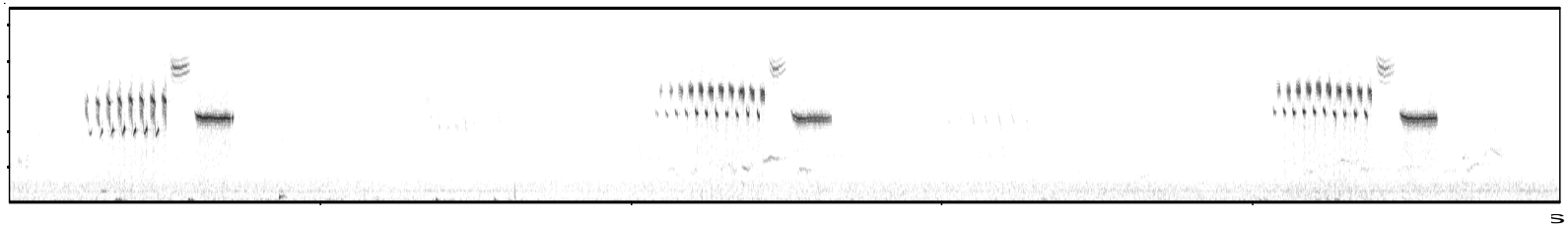
How do birds sing?

part 1: singing styles

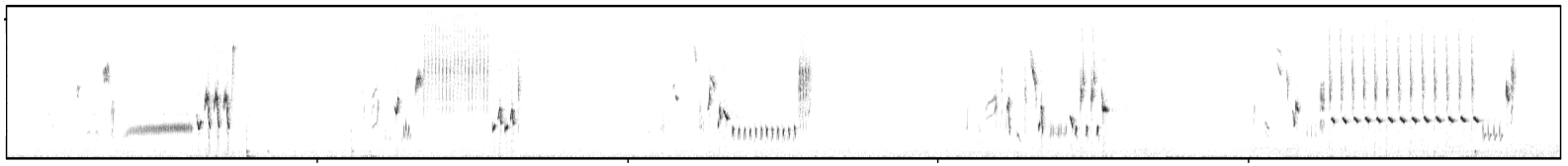
Grasshopper warbler



Yellowhammer

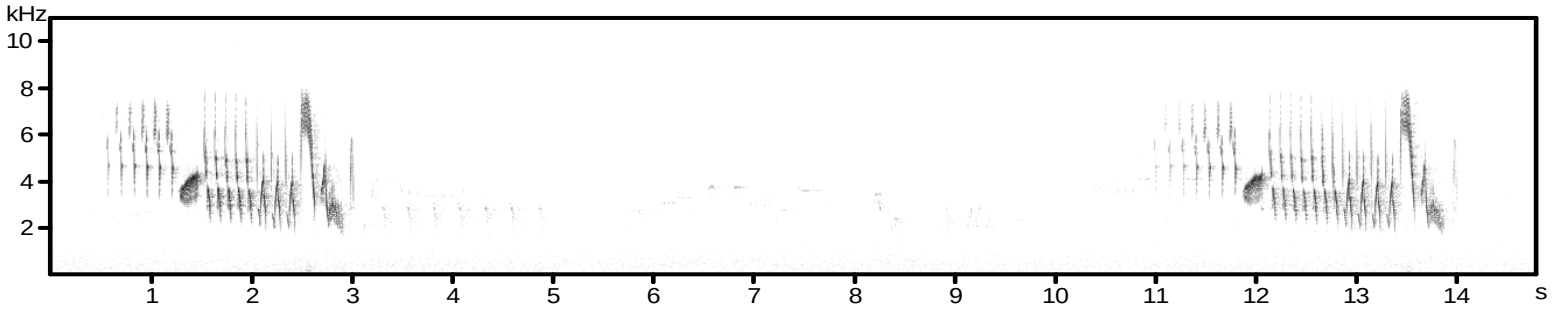


Nightingale



WAGENINGEN UR
For quality of life

Discontinuous singers, small song repertoire:
Mode: A A A A B B B B B C C C C C
(eventual variety)

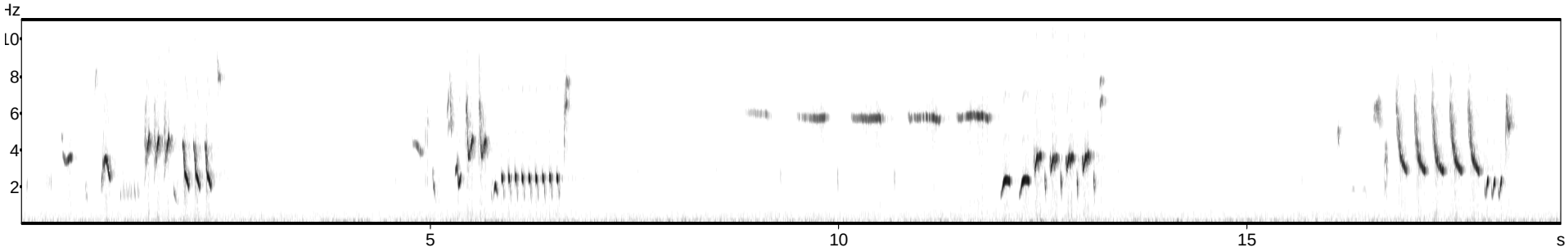


Great tit

Chaffinch

WAGENINGEN UR
For quality of life

Discontinuous singers, large song repertoire:
Mode: A B C D E F G H I J A D F B
(immediate variety)

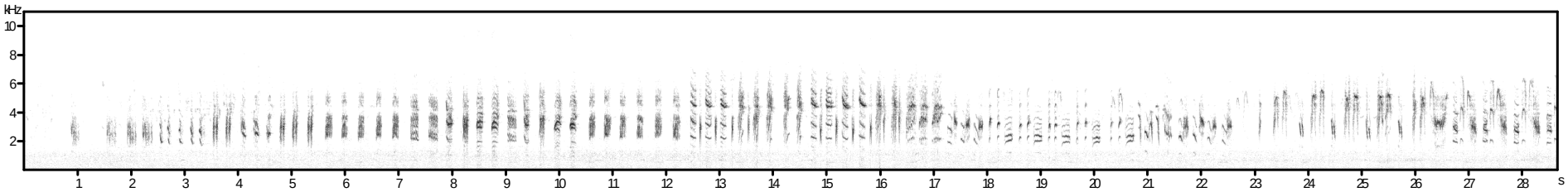


Blackbird

Nightingale

WAGENINGEN UR
For quality of life

Continuous singers:



Starling

Reed warbler

WAGENINGEN UR
For quality of life

Memory game

Who is who?


1


7


13


19


2


8


14


20


3


9


15


21


4


10


16


22


5


11


17


23


6

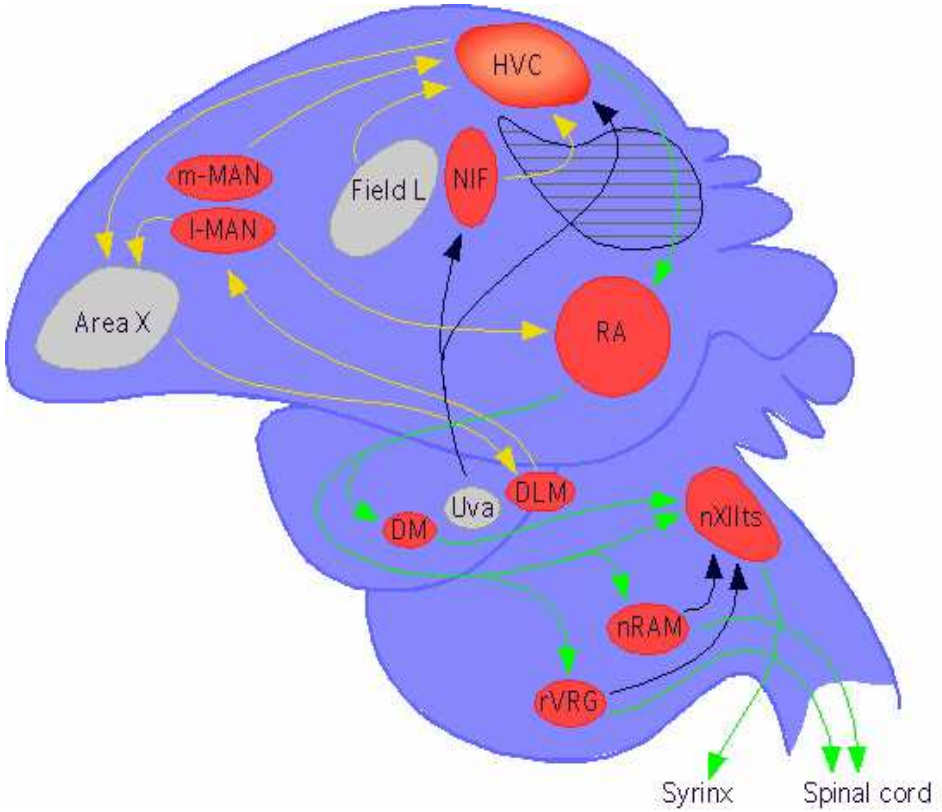

12


18

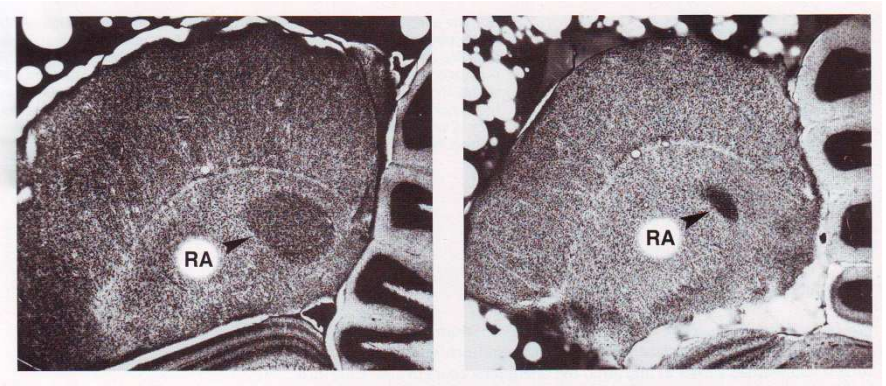

24

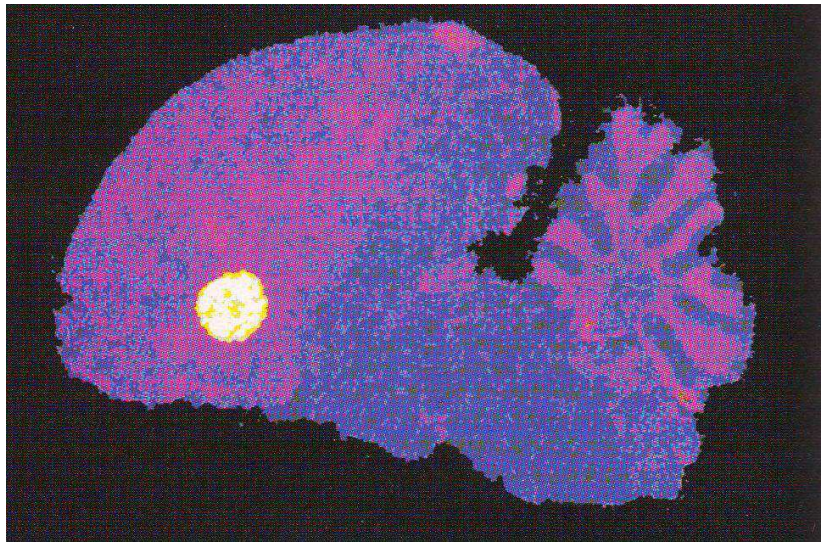
How do birds sing?

part 2: song learning



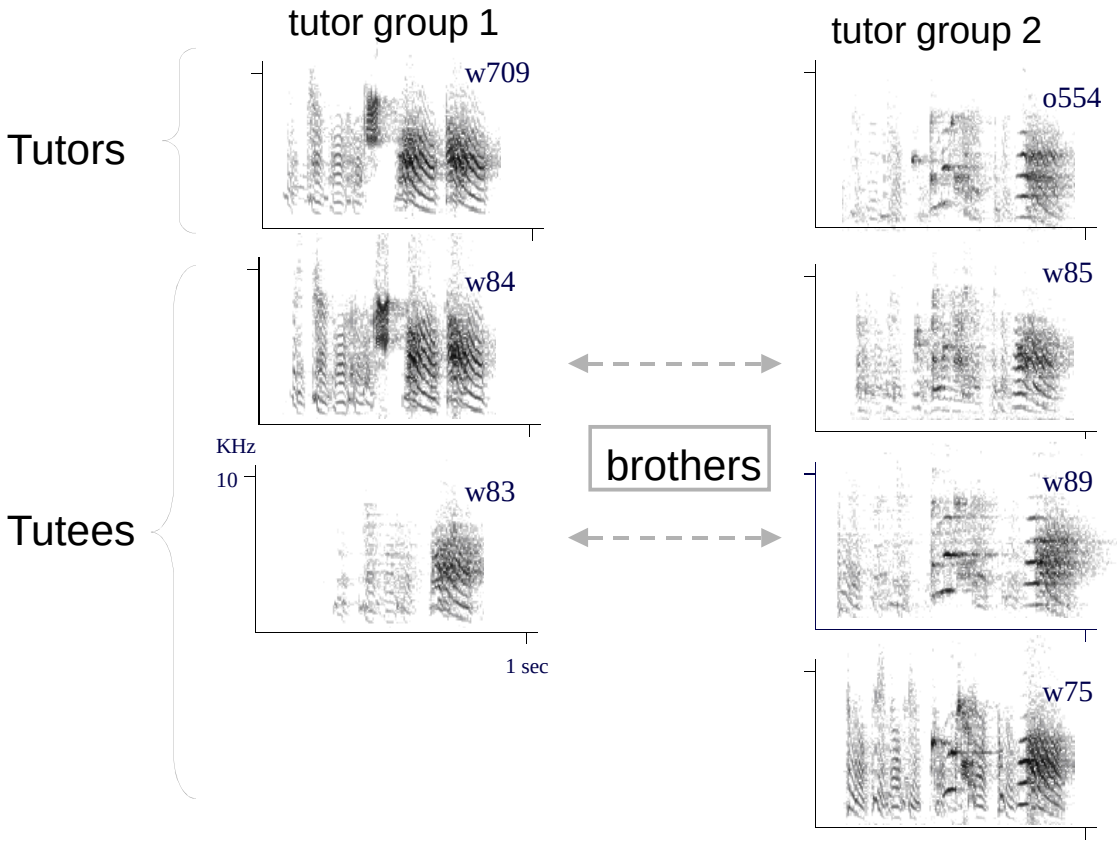
male female



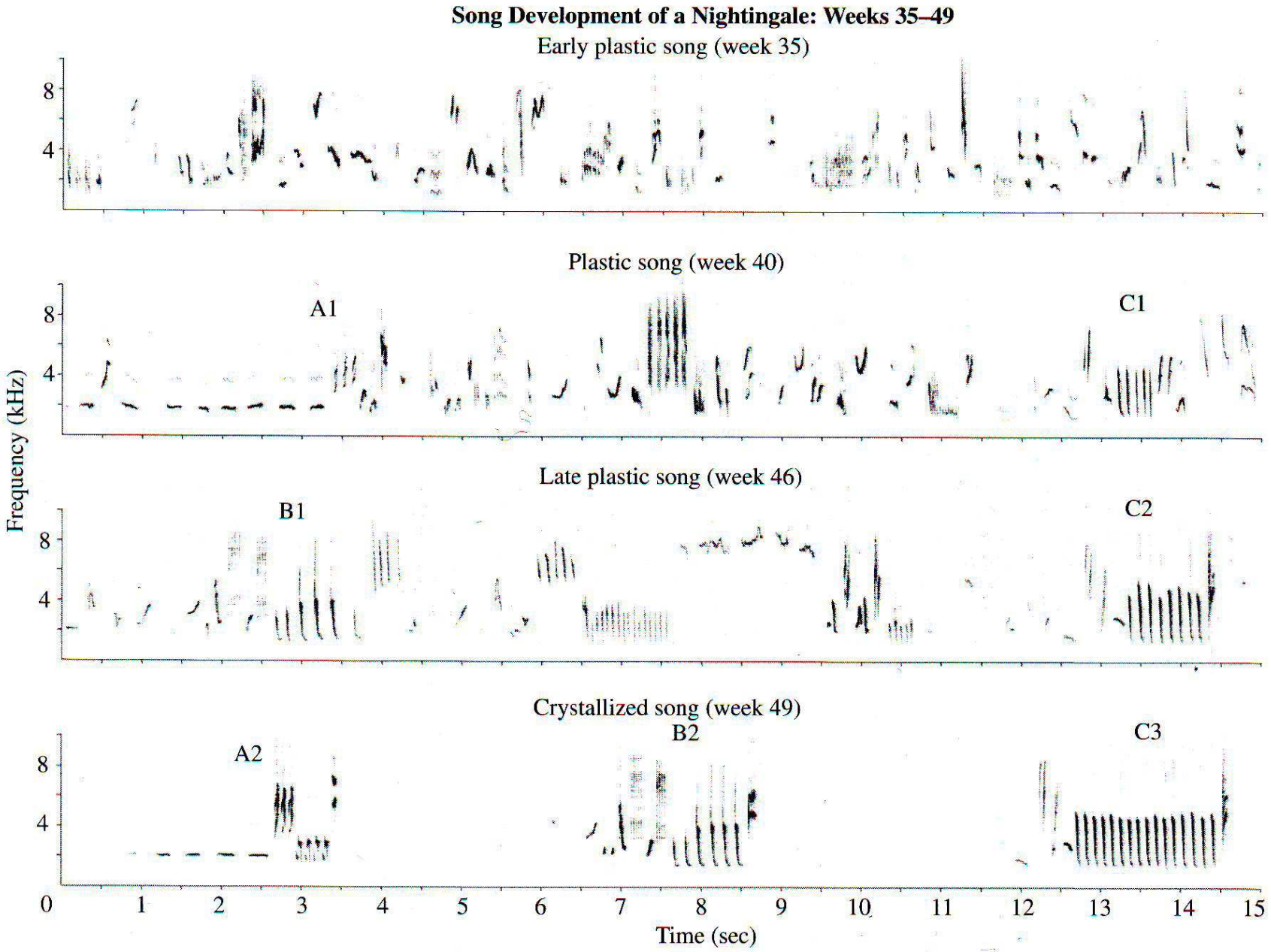


WAGENINGEN UR
For quality of life

Song learning



WAGENINGEN UR
For quality of life



WAGENINGEN UR
For quality of life

from: Hultsch and Todt 2005, In: Nature's music

Serial learning

Wolke...Gabel....Brille...Tulpe...Straße....Sessel...Jacke...Hammer...Seife...Fenster...Tafel...Grube...Birne...Flasche...Pinsel

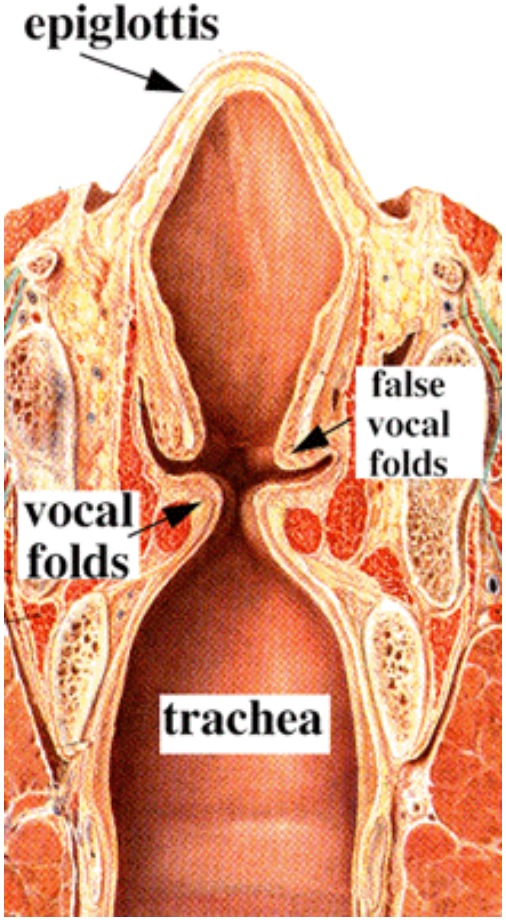
‚primacy‘ and ‚recency‘ effects

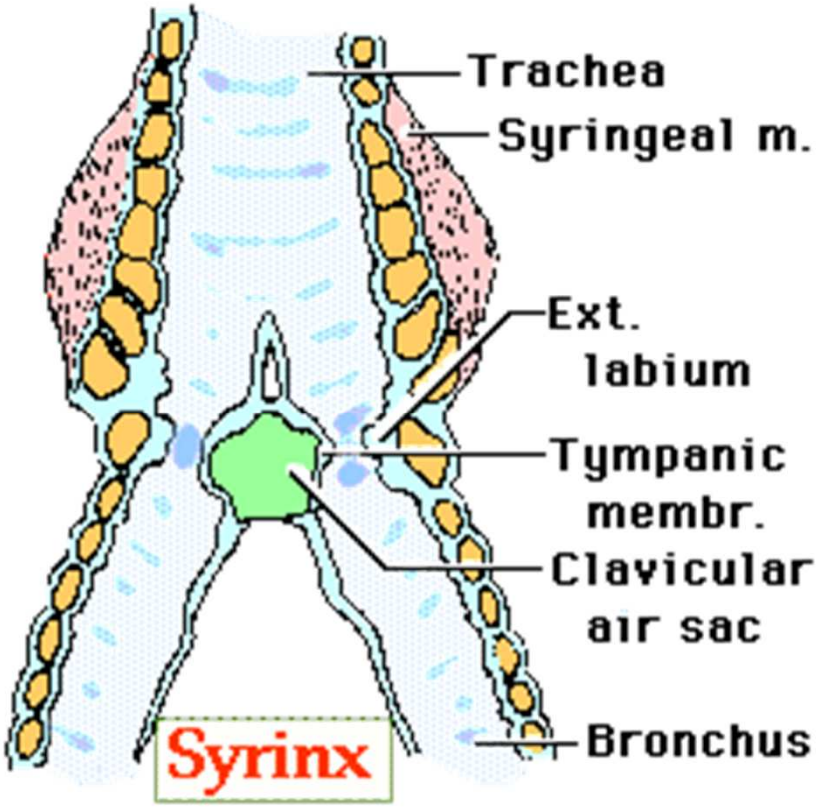

from: David Attenborough, The Life of birds, BBC

How do birds sing?

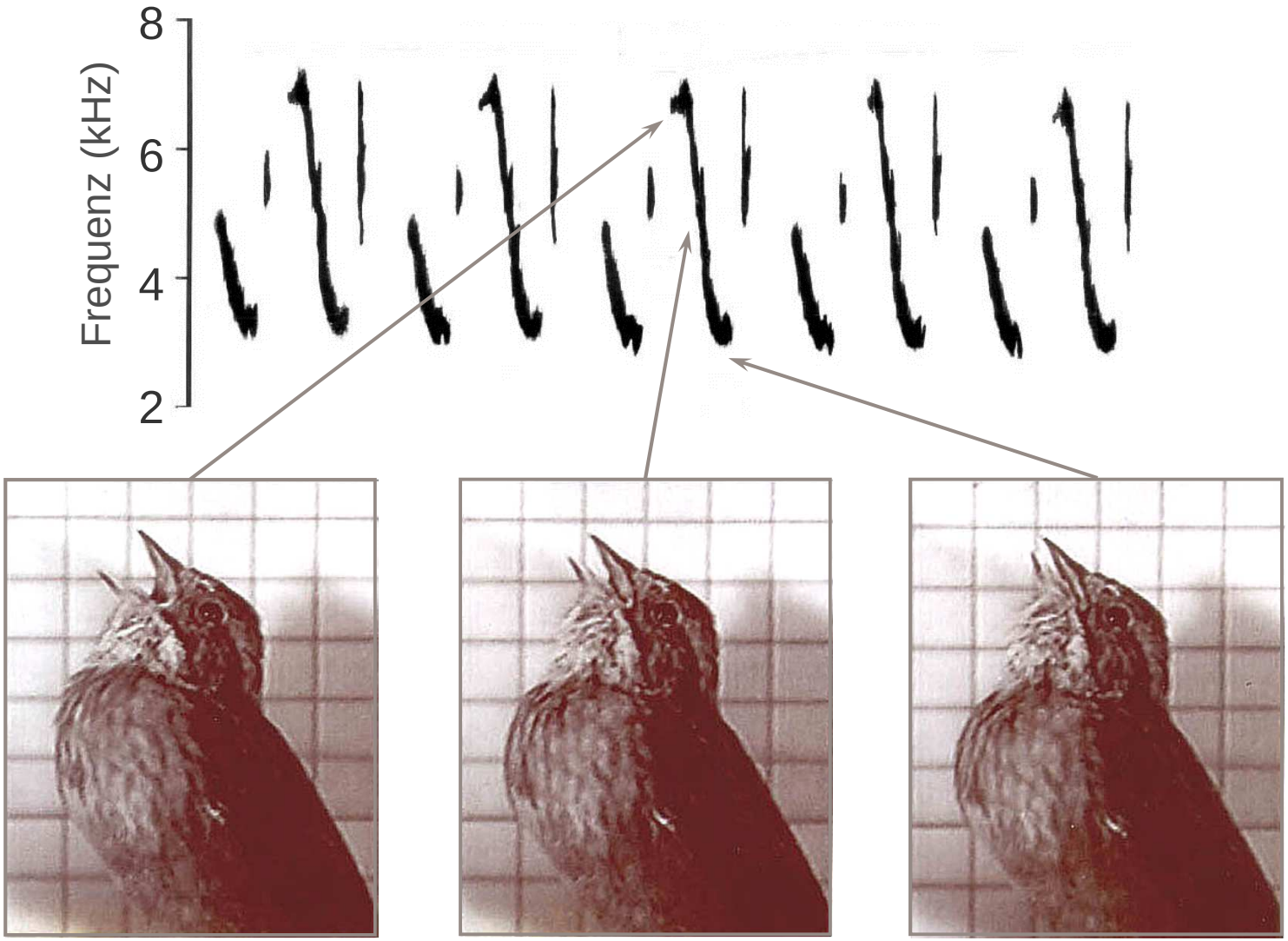
part 3: song production

Human vocal tract (larynx) Bird vocal tract (syrinx)



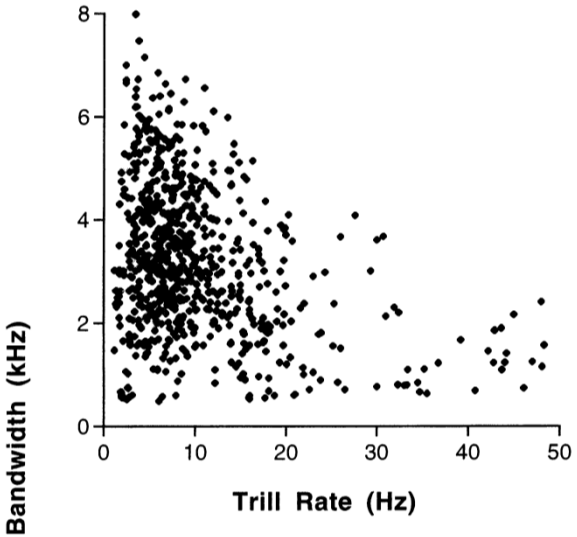


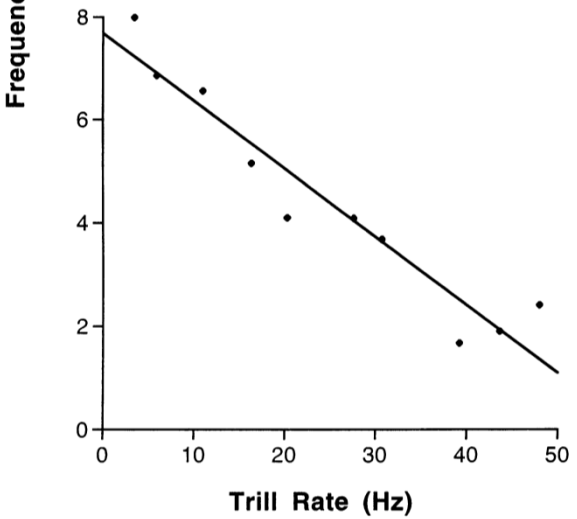
Beak movements and song frequency

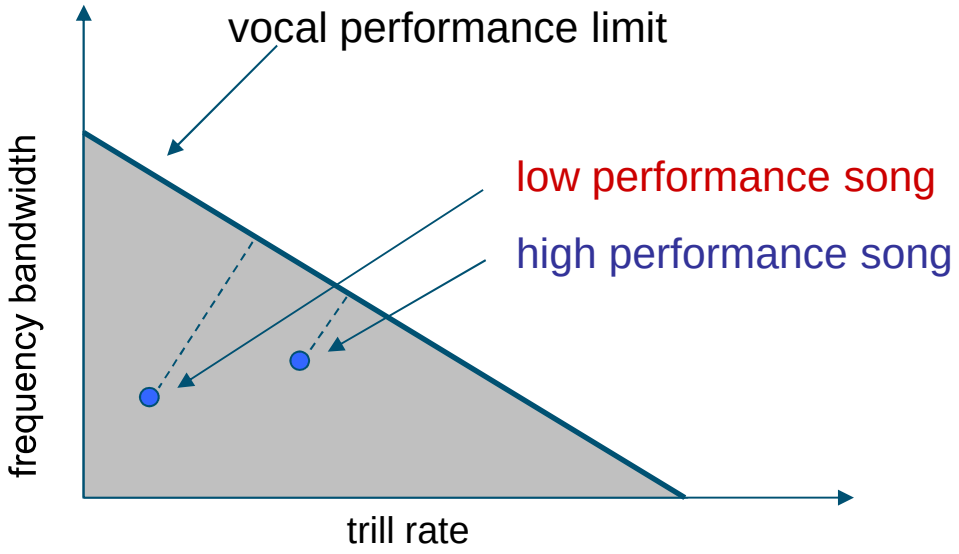


WAGENINGEN UR
For quality of life

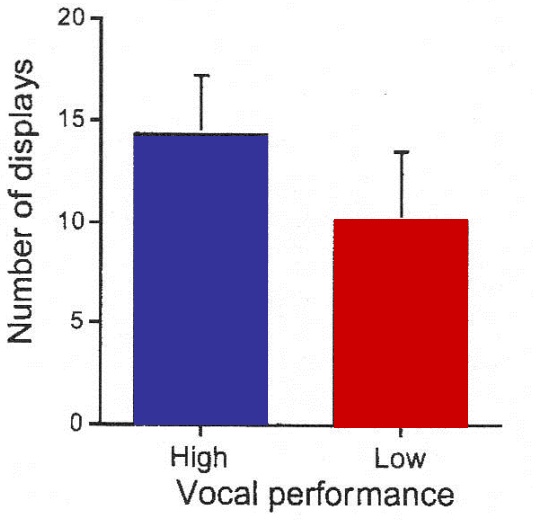
after: Westneat, Long, Hoese & Nowicki, J. Exp. Biol., 1993







Female responsiveness

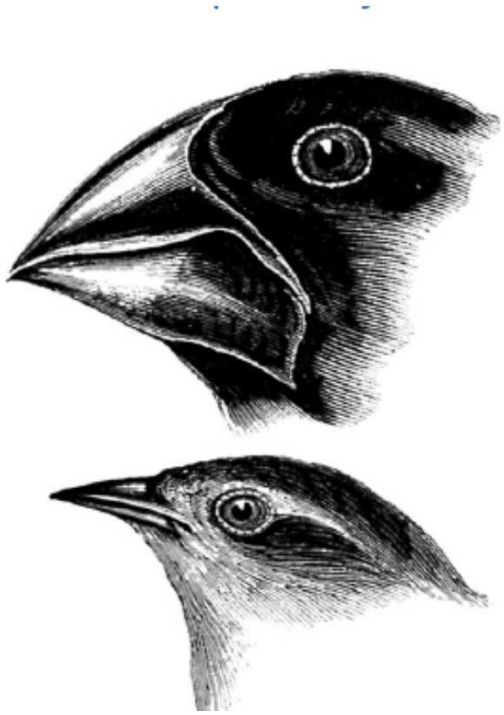


from Podos (1997) Evolution

Bill movements and trill production

Hoese et al, J Exp Biol 2000

Bill size, song and speciation

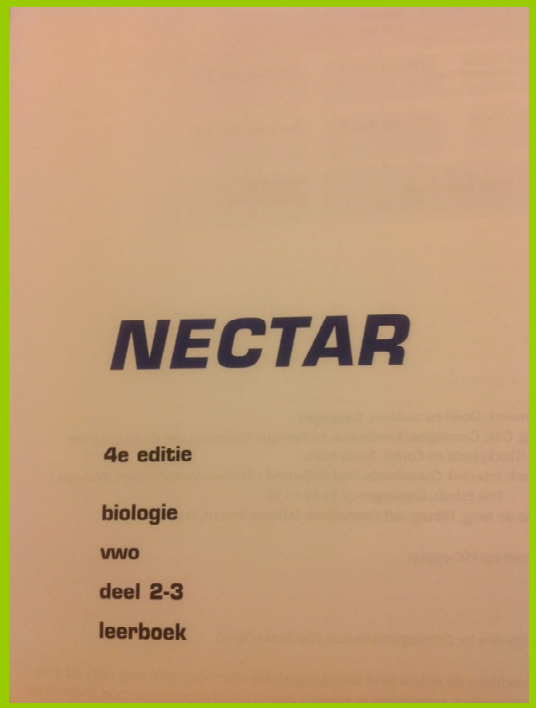


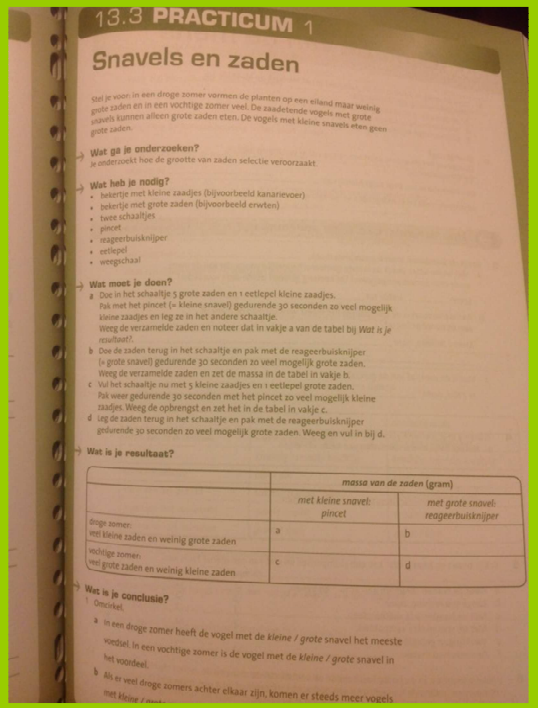
Podos, Nature 2001

WAGENINGEN UR
For quality of life

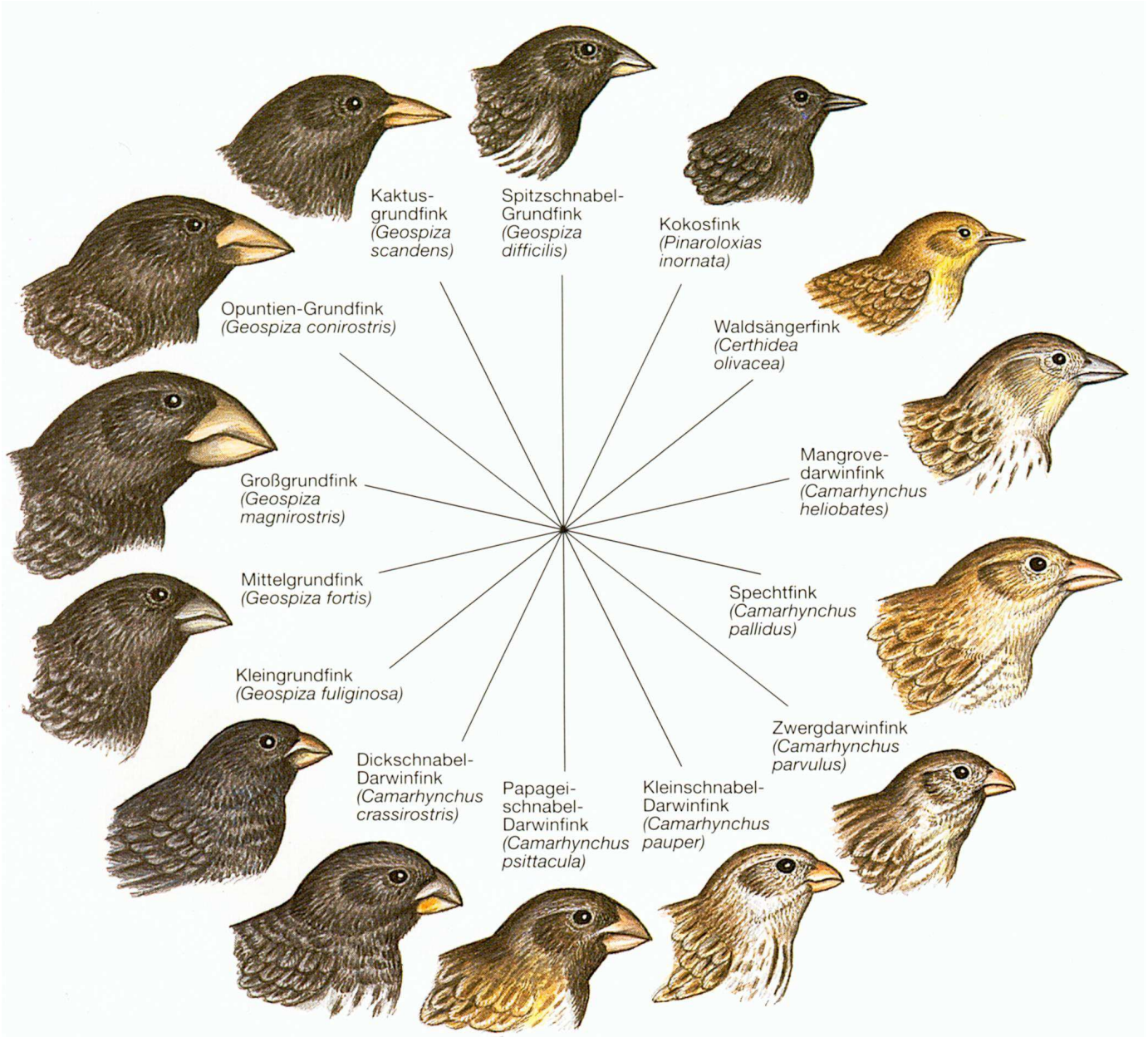
Bird song, speciation and foraging ecology

- How does selection on beak size for foraging affect song?
- Which role can the trade-off between beak size and trill production play in speciation processes?

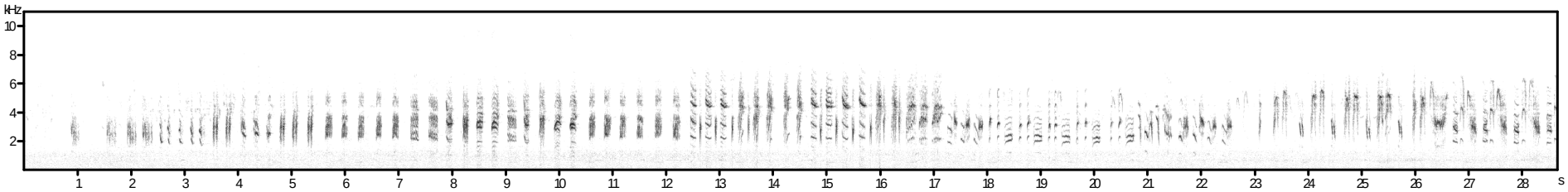




WAGENINGEN UR
For quality of life



Continuous singers:

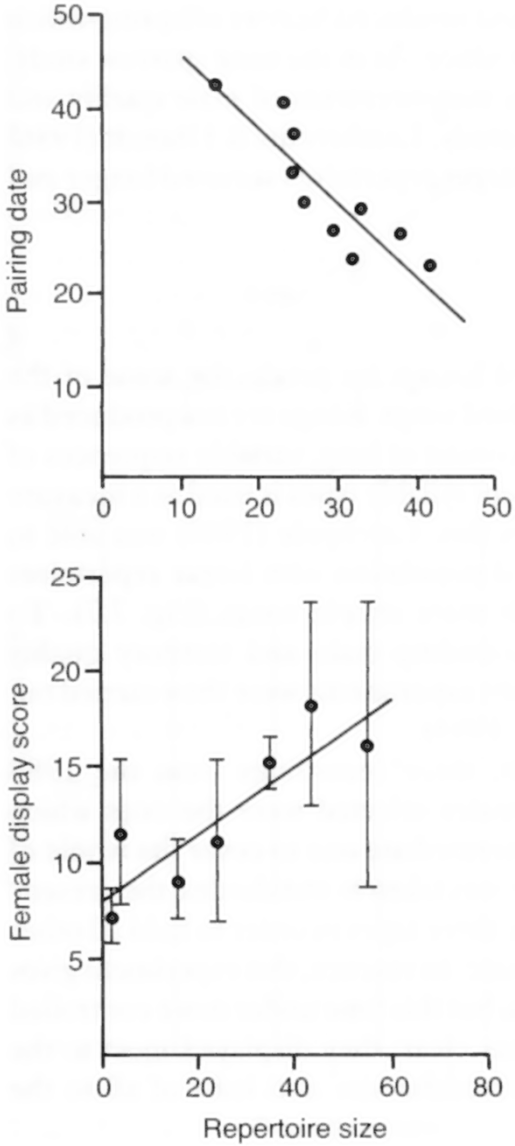


Starling

Reed warbler

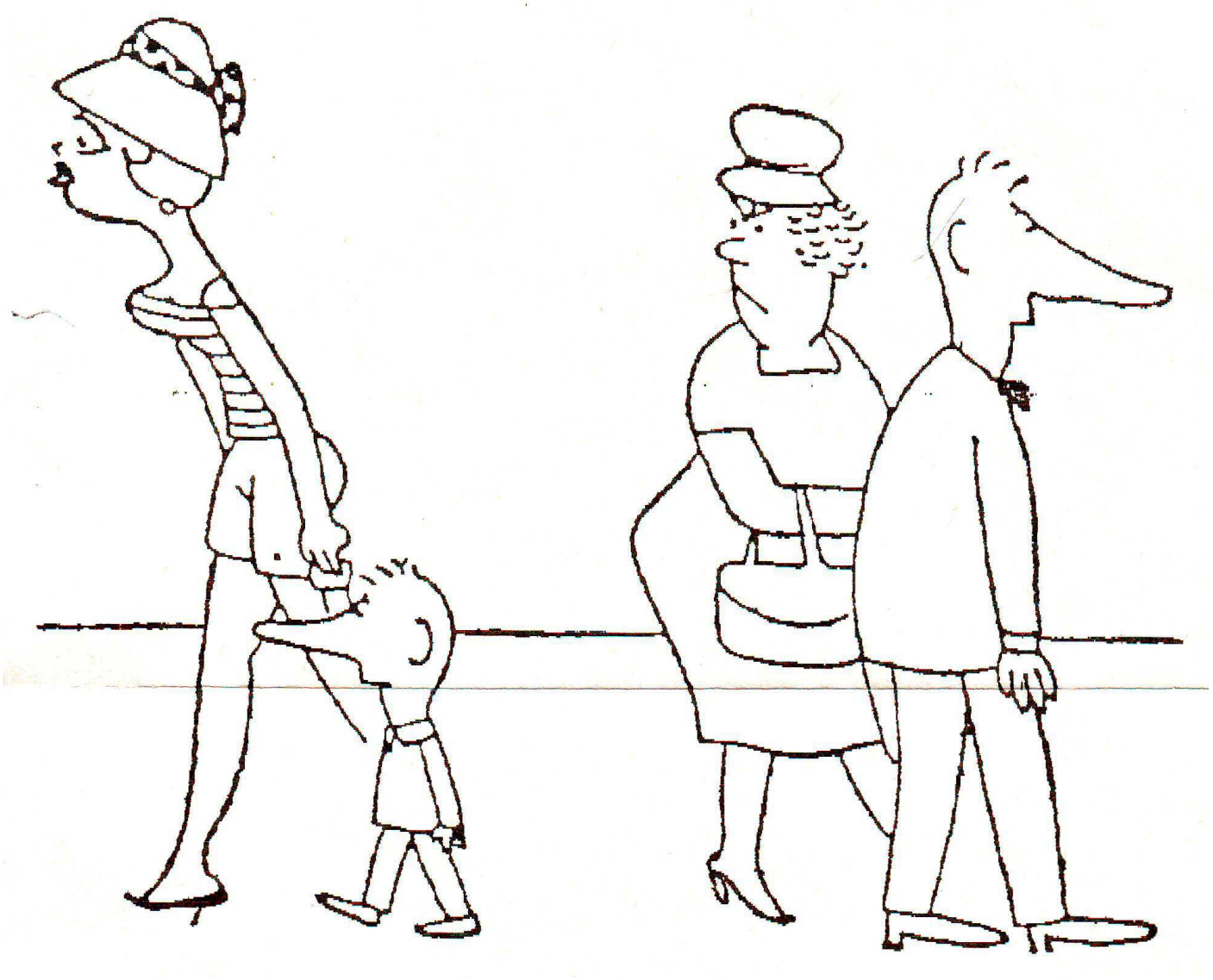
WAGENINGEN UR
For quality of life

Sedge warbler

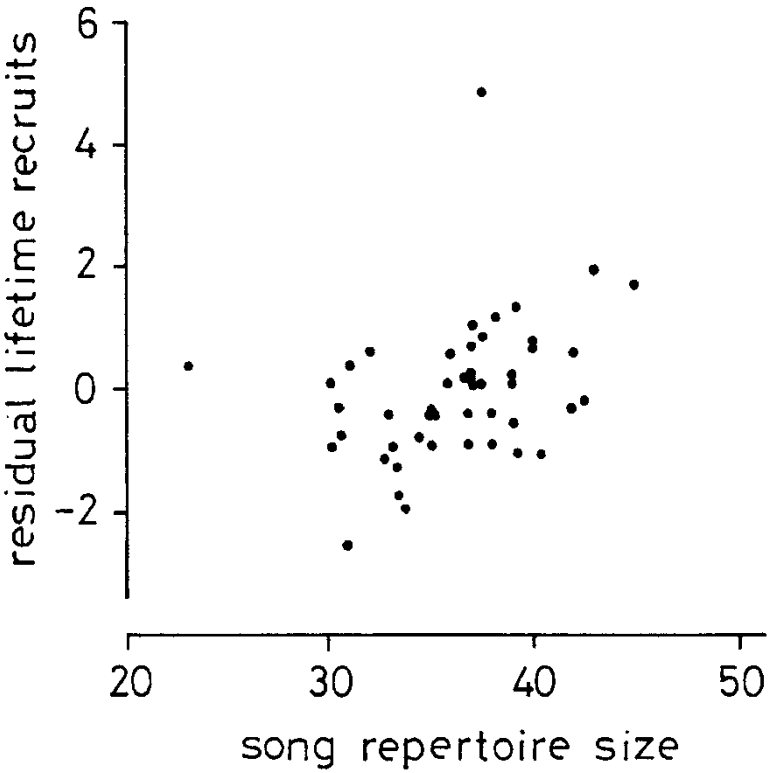


Catchpole et al.

Social monogamy and reproduction



WAGENINGEN UR
For quality of life



- females prefer males with a larger song repertoire
- females engage in extra-pair copulation with males that have a larger song repertoire than their social mate

WAGENINGEN UR
For quality of life

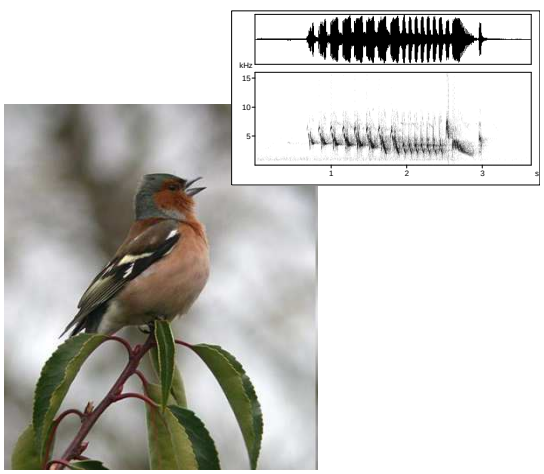
Hasselquist et al, 1996

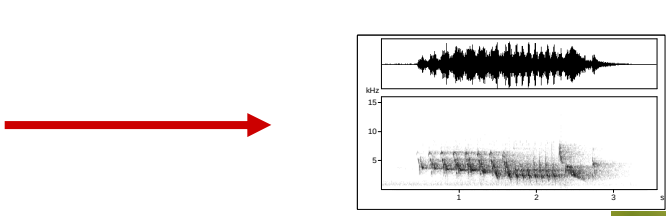
If female prefer males with the best song,
why is there still so much variation?

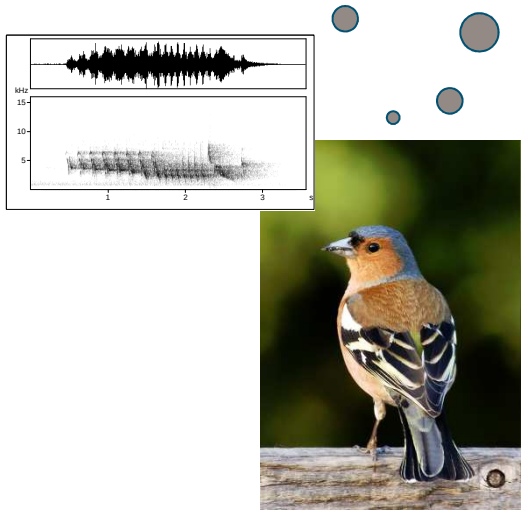
Existing variation


Evolution of song:
the ecology of vocal signalling

Transmission characteristics of the environment







WAGENINGEN UR
For quality of life

1. Sound transmission characteristics

dense

medium

open

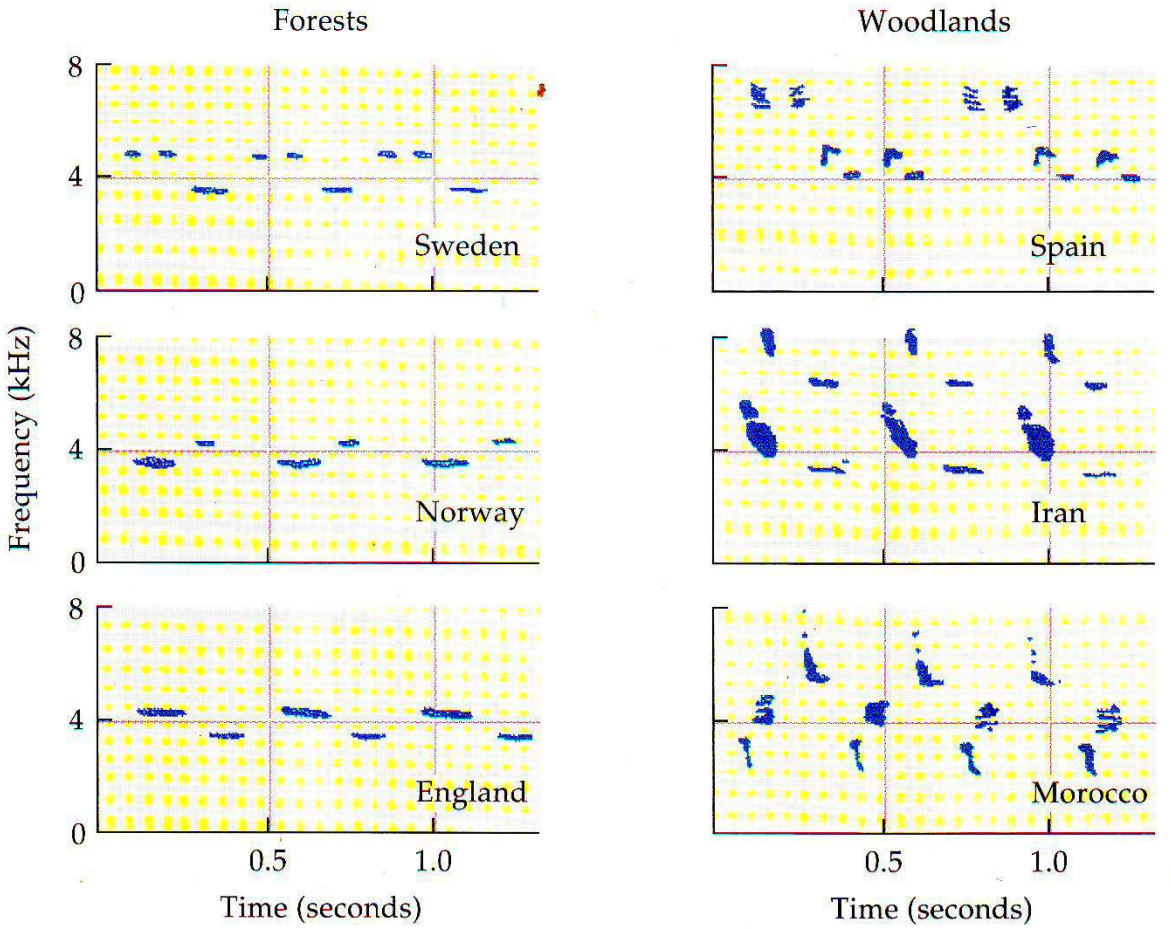
2. Environmental noise

social

natural habitat

anthropomorphic

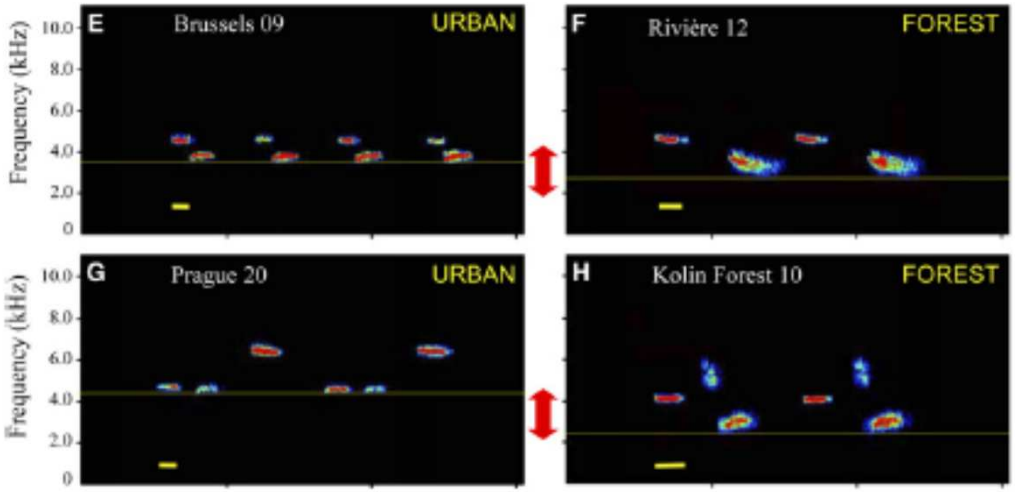
Signals are adapted to the transmission characteristics of the environment

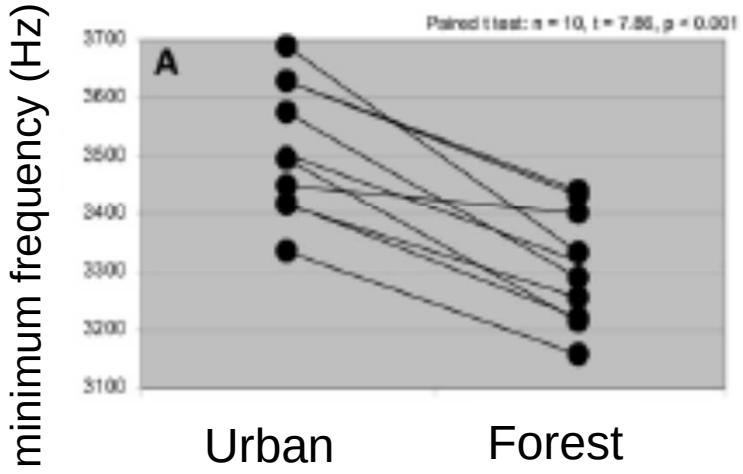


long distance signals in forests: narrow frequency band

WAGENINGEN UR
For quality of life

Survival of the loudest: urban birds change their tune

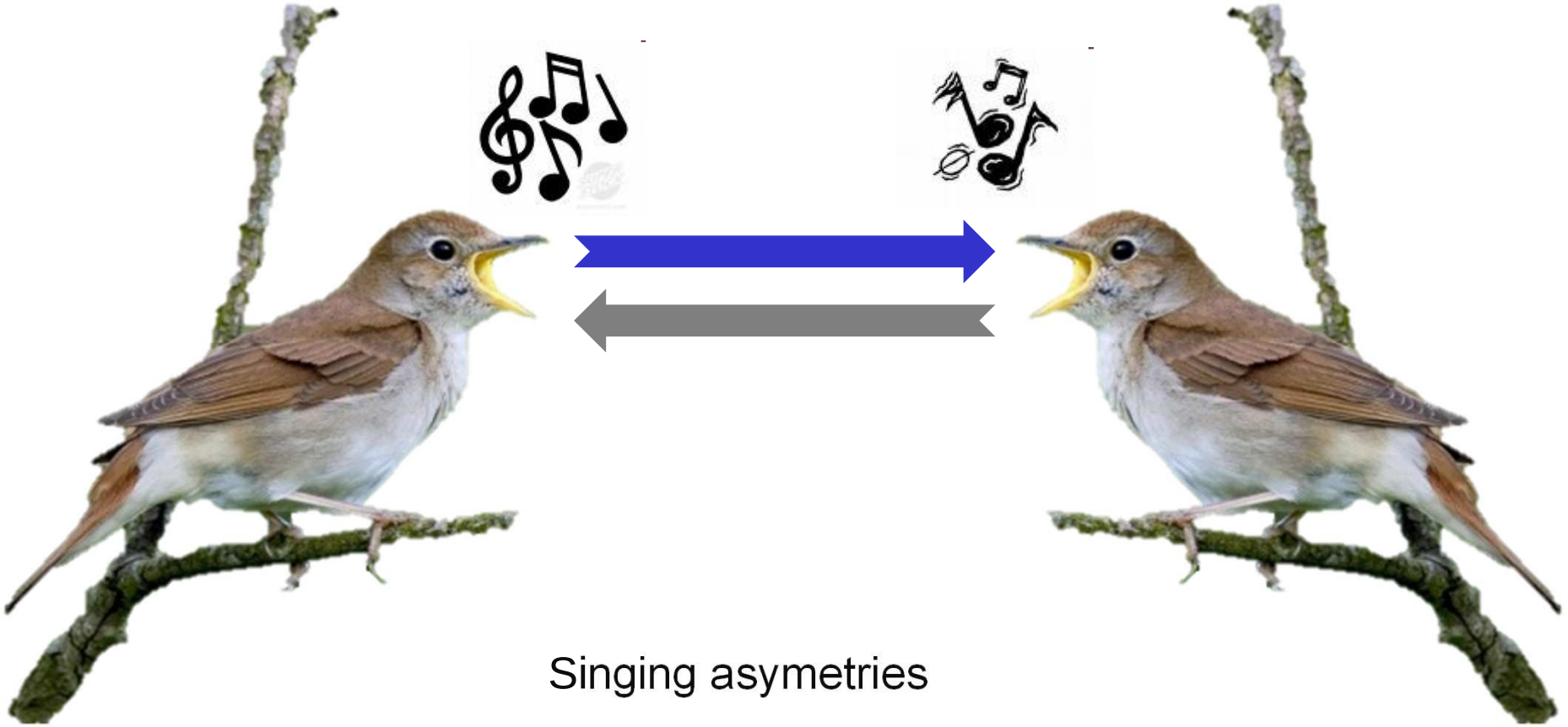




WAGENINGEN UR
For quality of life

from: Slabbekoorn and Peet, Nature 2003 and Slabbekoorn and den Boer-Visser, Curr Biol 2006

2. Dialogues (interactions)



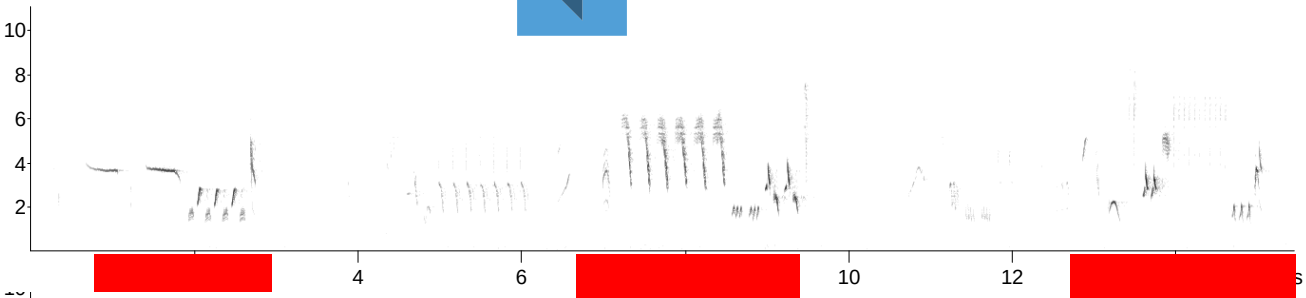
Singing asymetries

- Song rate
- Song matching
- Song timing (song overlapping)

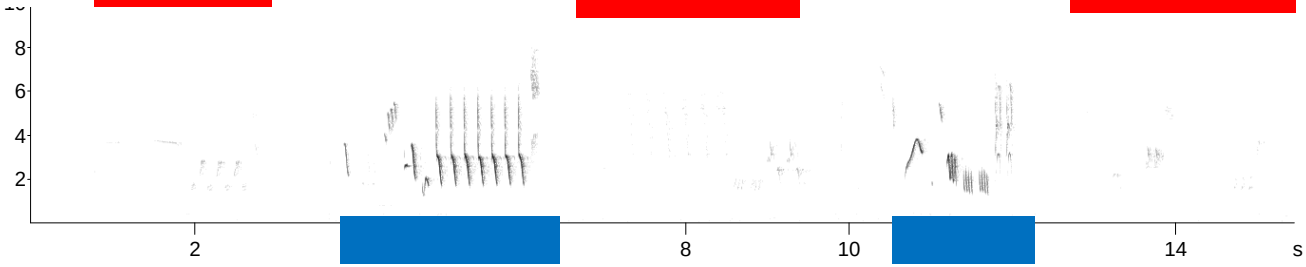
WAGENINGEN UR
For quality of life

song alternating

A

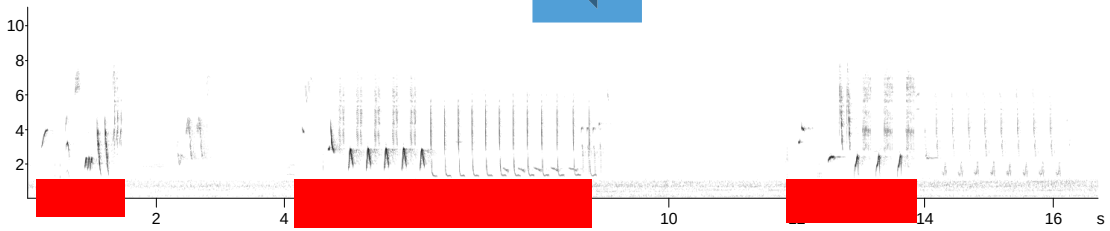


B

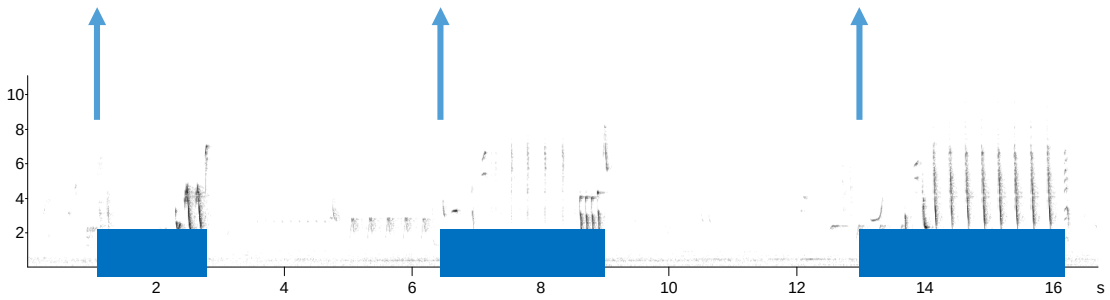


song overlapping

A

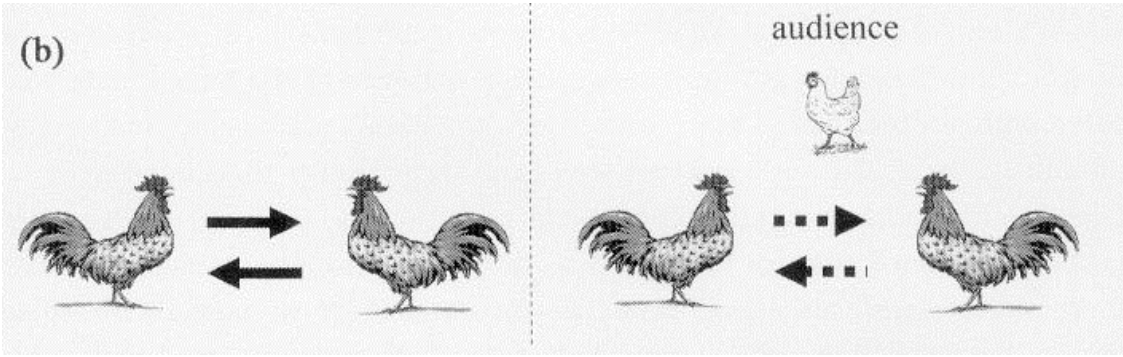


B

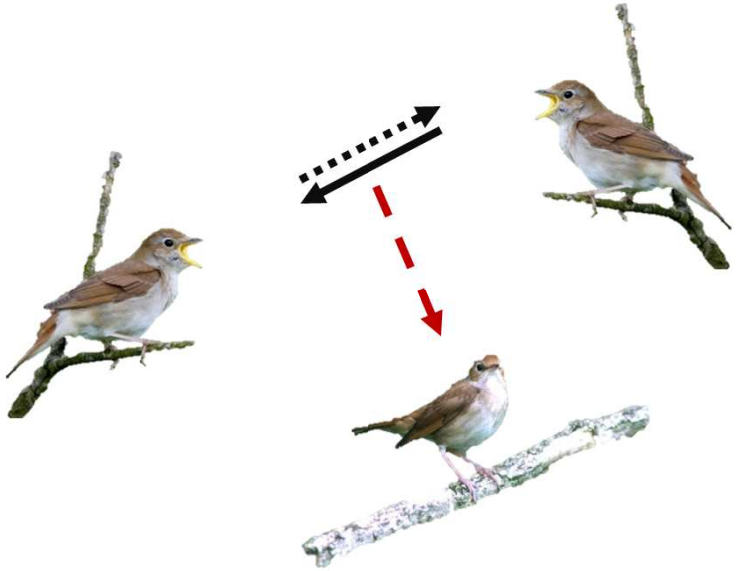


3. Communication networks

Audience effects

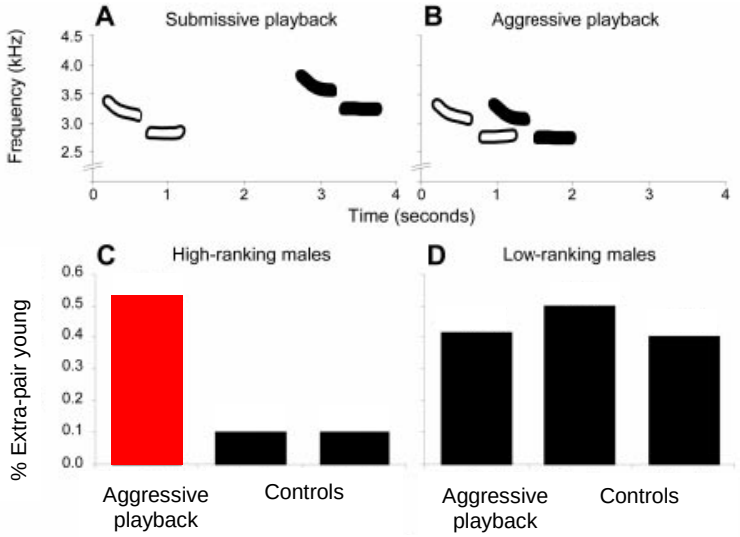


Eavesdropping



WAGENINGEN UR
For quality of life

Song overlapping predicts fitness



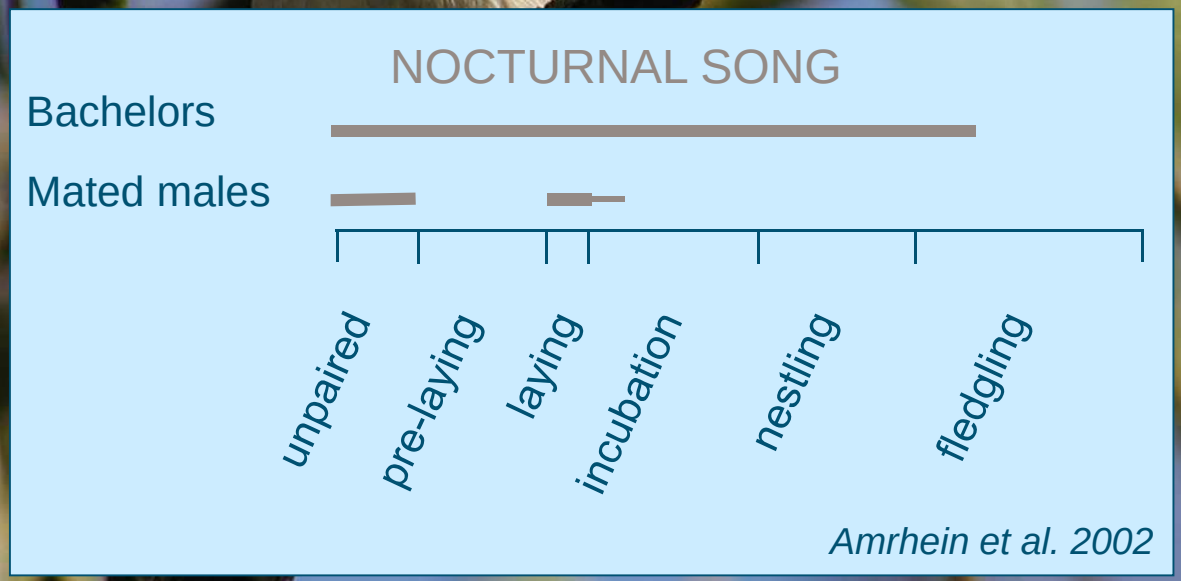
Mennill et al, Science, 2002

Kunc et al. 2006, Schmidt et al. 2006,

WAGENINGEN UR
For quality of life

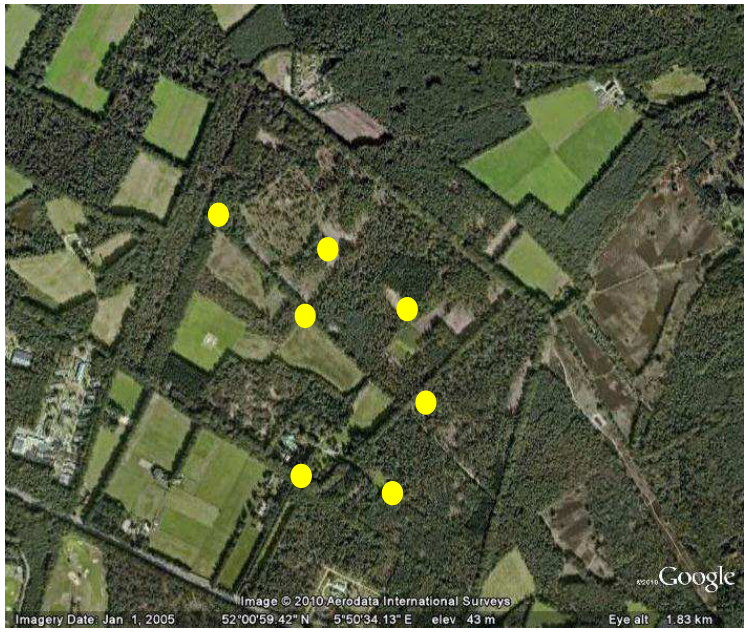
The Nightingale (*Luscinia megarhynchos*)

- diurnal and nocturnal song
- extremely large vocal repertoires



Information availability varies with

Space



Time

Singing activity in nightingales

all males sing

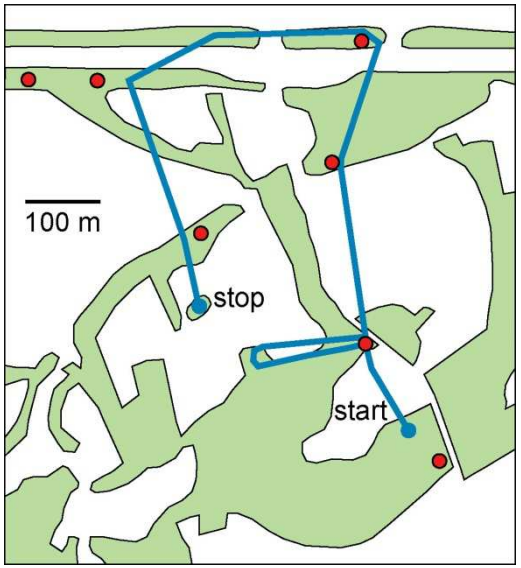
(Amrhein et al 2004, AUK)

unnmated males sing

(Amrhein et al 2002, Anim Behav)

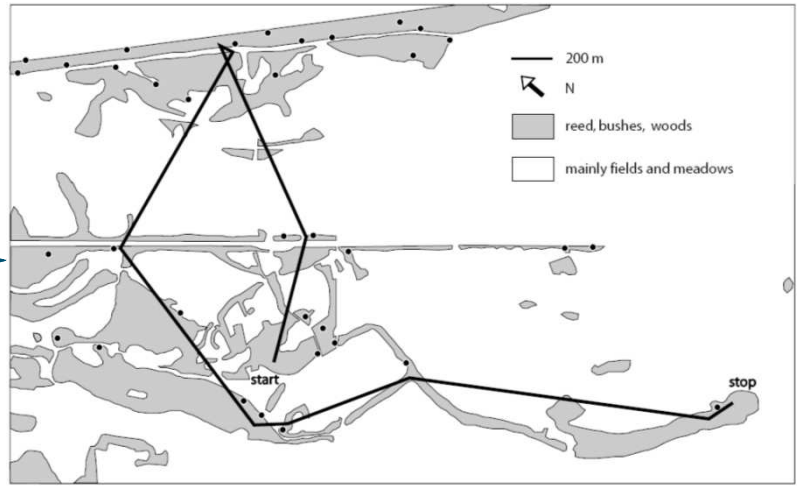
when to explore the area?

males



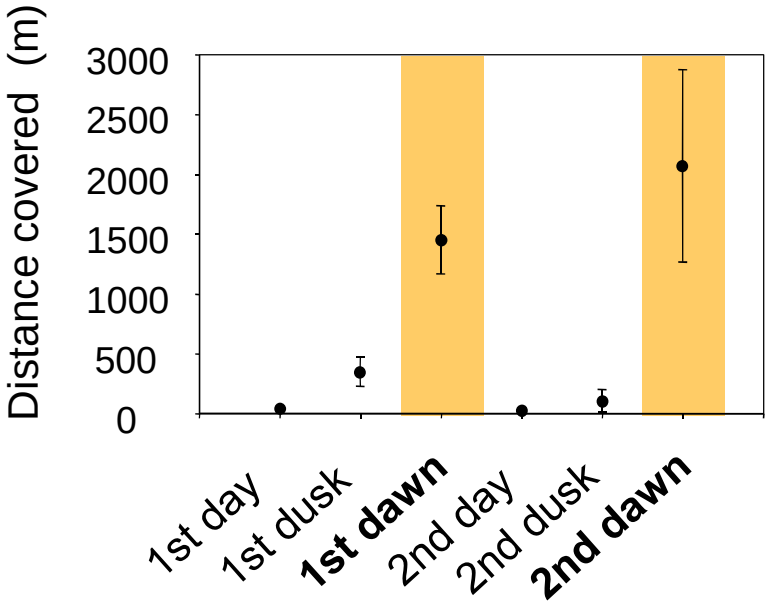
remote site
100 km away)

females



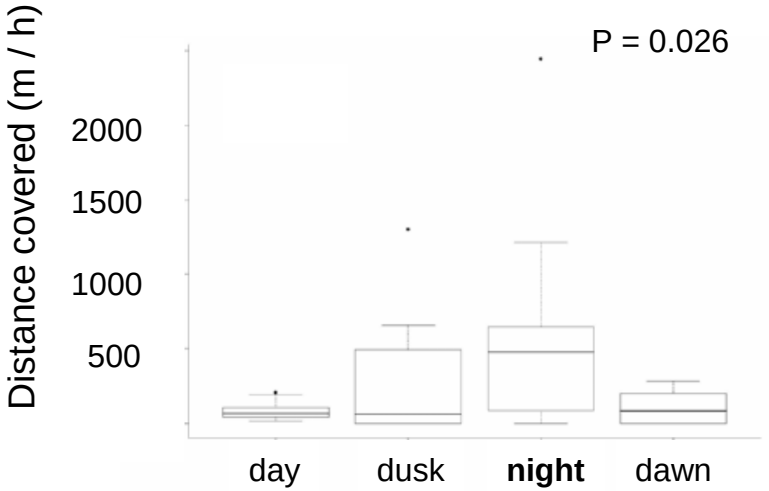
WAGENINGEN UR
For quality of life

Males explore at dawn



Amrhein et al. Proc Royal Soc Lond, 2004

Females explore at night



Roth et al. Proc Royal Soc Lond, 2009

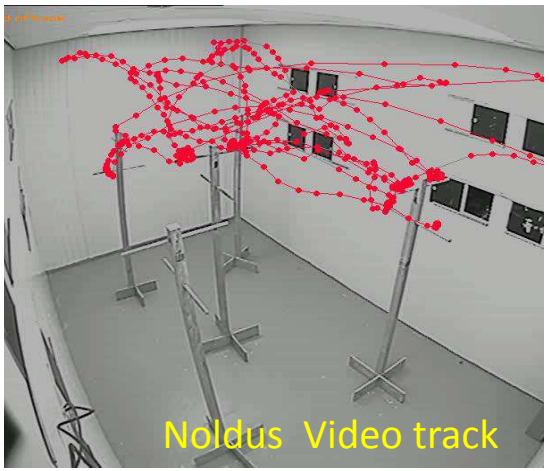
WAGENINGEN UR
For quality of life

Social networks

WAGENINGEN UR
For quality of life

Condition

Digital radiotag



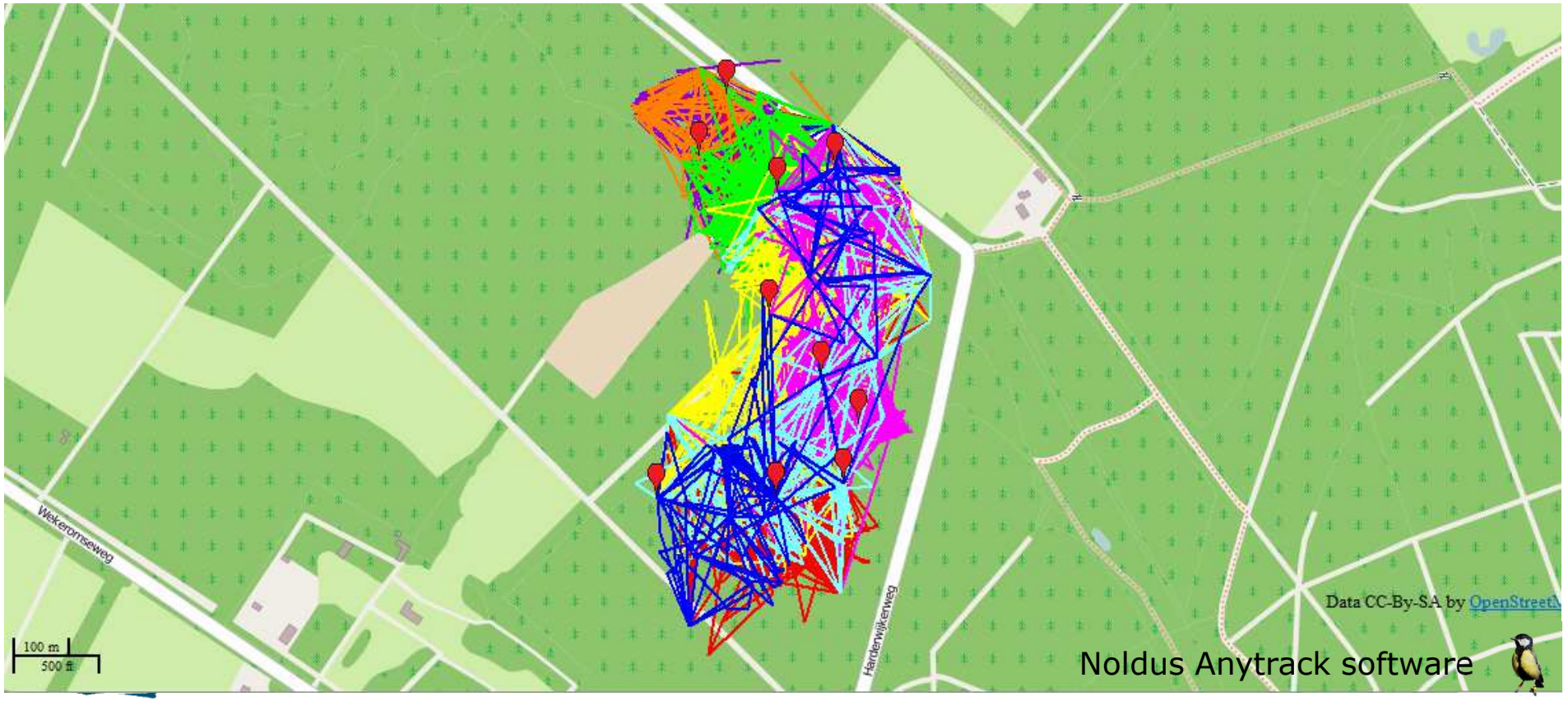
Personality

Male song

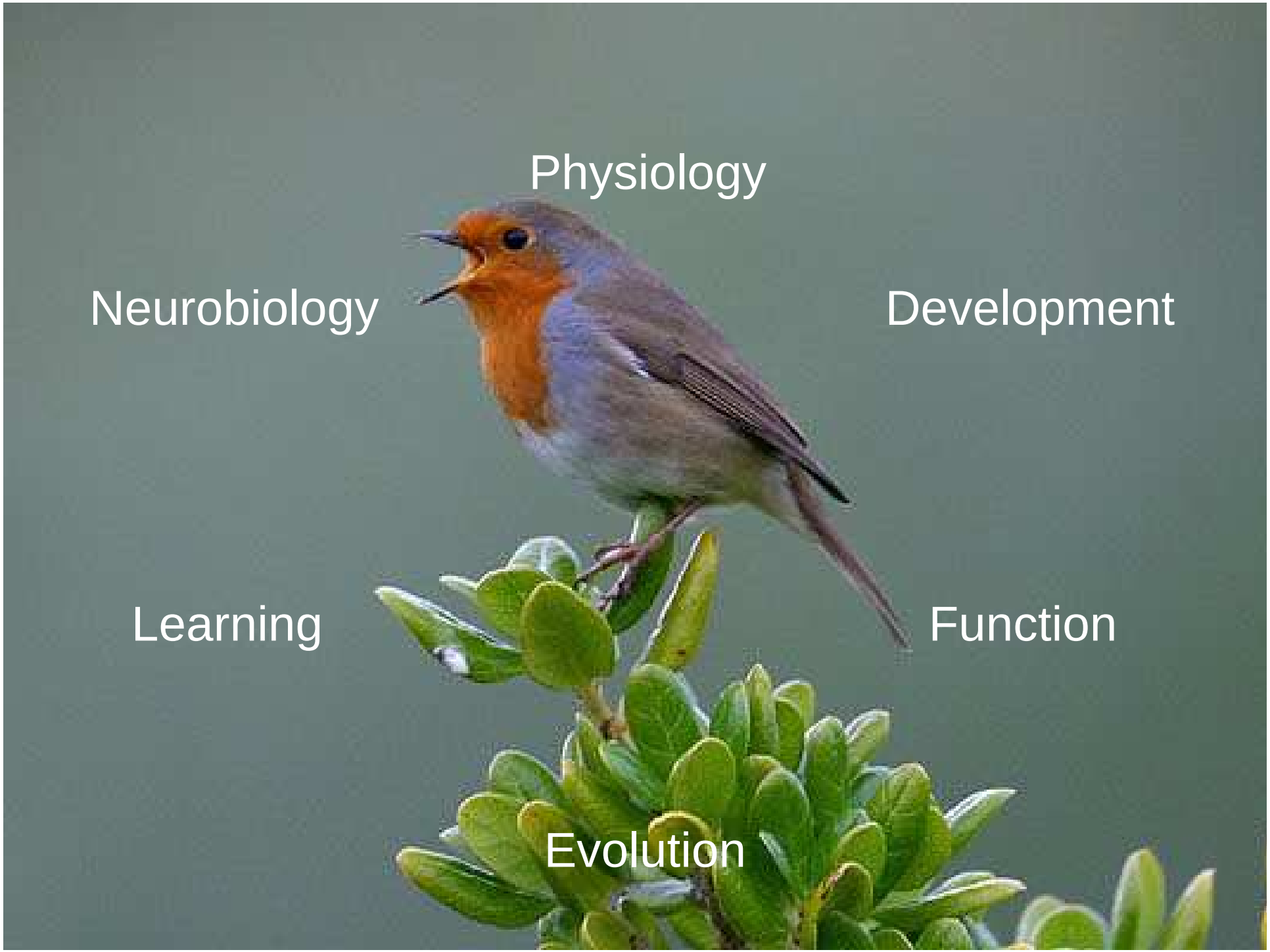
Fitness

Social network tracking

Encounternet base nodes



Noldus Anytrack software


Physiology
Neurobiology
Development
Learning
Function
Evolution