Module BIO-M1-S06 “Evolutionary ecology”

Introduction: ecology ↔ evolution

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Semaine 1	lundi	mardi	mercredi	jeudi	vendredi
	02/11/2015	03/11/2015	04/11/2015	05/11/2015	06/11/2015
9h30-12h30	*intro, competition*	*Ecology and evolution of symbiosis*	*Sexual selection*	*Sexual selection*	*Ecology and evolution of symbiosis*
	David Claessen	Marc-André Selosse	David Laloi	David Laloi	Marc-Andre Selosse
14h-17h	*Optimisation. Optimal foraging. Life history theory.*	*The adaptive evolution of social traits*	*TP*	*(sport)*	*Host-parasite interactions*
	David Claessen	Jean-Francois Le Galliard	David Claessen		Sylvain Gandon

Semaine 2	lundi	mardi	mercredi	jeudi	vendredi
	09/11/2015	10/11/2015	11/11/2015	12/11/2015	13/11/2015
9h30-12h30	*Spatial structure*	*Invasion, replacement. Adaptive dynamics*	*(11 novembre)*	*(UE Stats)*	*Presentations TP articles, projets à spécifier au début de l'UE*
	Sebastien Lion	David Claessen			David Claessen++
14h-17h	*TP*	*Constraints*	*(11 novembre)*	*(sport)*	*suite et fin*
	David Claessen	Tom van Dooren			David Claessen++

What you already know

- ENS M1S1: E1
  - Population genetics
  - Genetic diversity,
  - Genotype-phenotype interactions
  - Genome diversity -> trait diversity
  - Quantitative characters
    - Genetic determinism
    - Evolution
  - Coalescence
  - Pop genetics of human populations
  - Evolution of sex & death
  - The selfish gene

What you already know

- ENS L3 S1, UE « Ecologie, génétique, évolution »
  1. Population & community ecology
  2. Ecosystem functioning
  3. Evolutionary genetics

  4. In more detail:
     - Species, ecological niche
     - Community patterns/processes
     - Population processes
     - Adaptation processes
     - Data analysis
     - Applications

What you already know

- In more detail:
  - Species, ecological niche:
    - Abundance, distribution, body size energetics, community assembly, speciation, extinction
  - Community patterns/processes:
    - Competition, predation, mutualism, functional response, LV model, cycles, bistability,
  - Population processes
    - Life history traits→pop, density dependence, pop cycles, stochasticity, dispersal, metapopulations
  - Adaptation processes
    - Fitness, selection, trade-offs, feedback, r-K, bet-hedging, plasticity, polymorphism, speciation
  - Data analysis
  - Applications

What we're going to do here

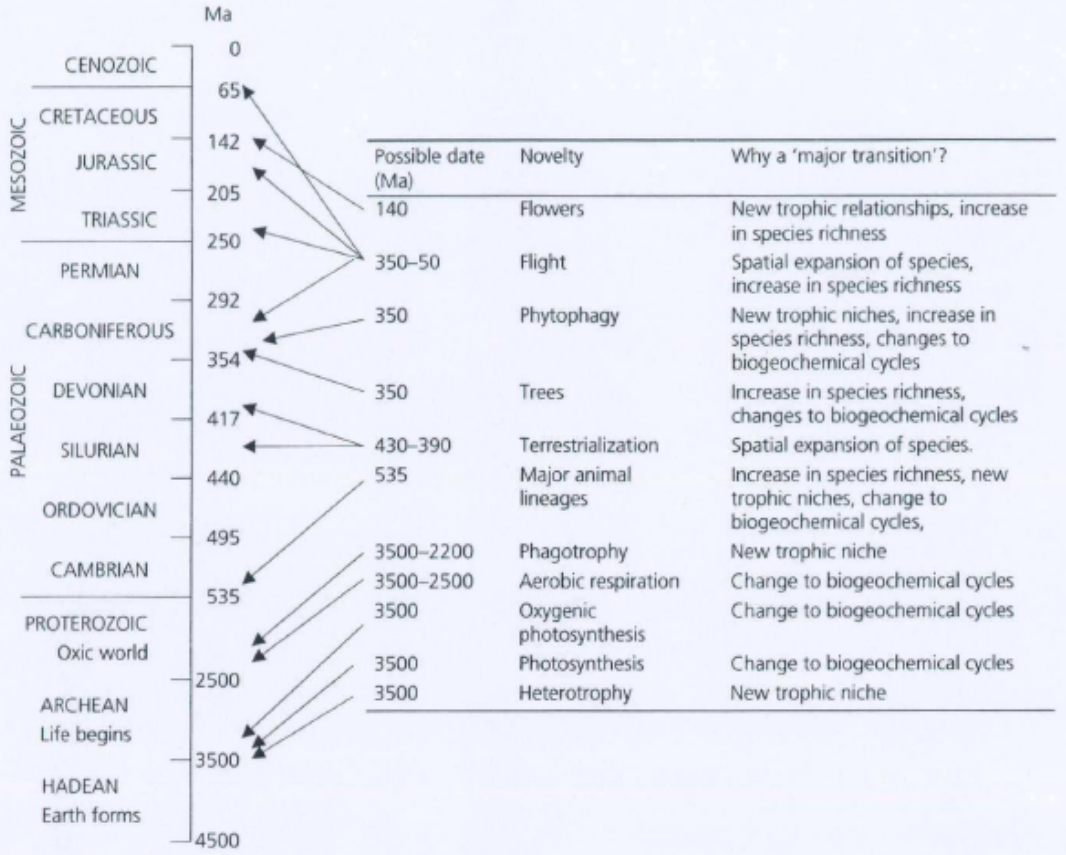
- Remember L3:
  - Species, ecological niche:
    - Abundance, distribution, body size energetics, community assembly, speciation, extinction
  - Community patterns/processes:
    - Competition, predation, mutualism, functional response, LV model, cycles, bistability,
  - Population processes
    - Life history traits→pop, density dependence, pop cycles, stochasticity, dispersal, metapopulations
  - Adaptation processes
    - Fitness, selection, trade-offs, feedback, r-K, bet-hedging, plasticity, polymorphism, speciation
  - Data analysis
  - Applications

+ more …

Programme of E2

- General introduction
  - Interplay « behaviour, ecology & evolution » (DC)
- Intraspecific interactions,
  - Social traits: insect societies (MM)
  - Social traits, life history, dispersal (JFlG)
  - Sexual selection, life history evolution (DL)
  - Evolution of human cooperation (JBA)
- Interspecific interaction,
  - Competition & coexistence (DC)
  - Ecology & evolution of symbiosis (MAS)
- Method: molecular ecology (MR)
- Application: evol. ecology, biogeochemical cycling (MF)

Interplay ecology ↔evolution



Possible date (Ma)	Novelty	Why a 'major transition'?
140	Flowers	New trophic relationships, increase in species richness
350–50	Flight	Spatial expansion of species, increase in species richness
350	Phytophagy	New trophic niches, increase in species richness, changes to biogeochemical cycles
350	Trees	Increase in species richness, changes to biogeochemical cycles
430–390	Terrestrialization	Spatial expansion of species.
535	Major animal lineages	Increase in species richness, new trophic niches, change to biogeochemical cycles,
3500–2200	Phagotrophy	New trophic niche
3500–2500	Aerobic respiration	Change to biogeochemical cycles
3500	Oxygenic photosynthesis	Change to biogeochemical cycles
3500	Photosynthesis	Change to biogeochemical cycles
3500	Heterotrophy	New trophic niche

Fig. 3.1 Some major transitions in ecology resulting from evolutionary novelty, and when they occurred.

- Evolution has increased the complexity of planetary ecology
- Increased richness of
  - species
  - habitats
  - functional groups
  - geochemical cycles
- How and why did these changes occur?

From: Mayhem (2006)

Dominance of modern phytoplankton

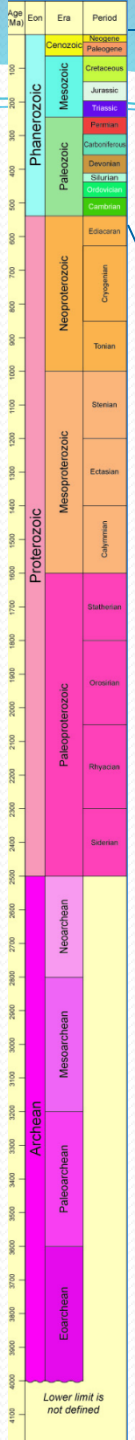
Secondary endosymbiosis (red lineage radiation)

Red algae evolve (>1.2 Ga)

Photosynthetic eukaryotes (>1.5 Ga)

Oxidation of Earth oceans and atmosphere (2.4 Ga)

Photosynthetic « cyanobacteria » (>3.4 Ga)

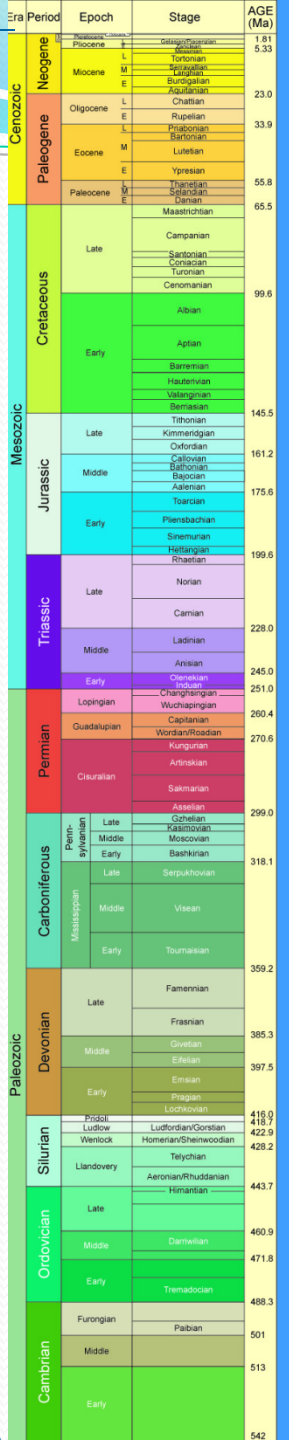


Dominance of modern phytoplankton
- Diatoms
- Coccolithophores
- Dinoflagellates

Rise of modern phytoplankton

Mass extinctions

Dominance of green algae



Falkowski et al 2004

Evolving ecological complexity: evolution of flight

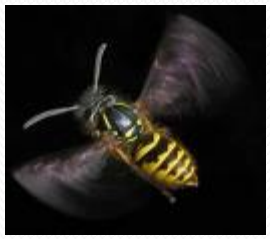


Table 3.1 Hypotheses on the origins of flight

Group	Who changed?	What changed?	Where did it change?	Why did it change?	Controversies
Pterygote insects	Apterygotes with aquatic larvae	Larval gills derived from pleural structures became wing	Newly emerged adults sailing or skimming over the water surface	Improved speed over the water surface	No consensus on the origins of wing structures, or on aquatic apterygote ancestors
Pterosaurs	Unknown basal archosaur	Gliding membrane supported by a finger became wing	Arboreal setting	Improved distance and control of glide	Absence of any fossil ancestors makes this an open question
Birds	Feathered dromeosaurs	Feathered forearm became a wing	Cursorial setting	Flapping aids running speed by providing lift	Primarily about the ecological setting and reasons for change
Bats	Unknown basal eutherian	Gliding membrane supported by fingers became wing	Arboreal setting	Improved distance and control of glide	Absence of any fossil ancestors makes this an open question

From: Mayhem (2006)