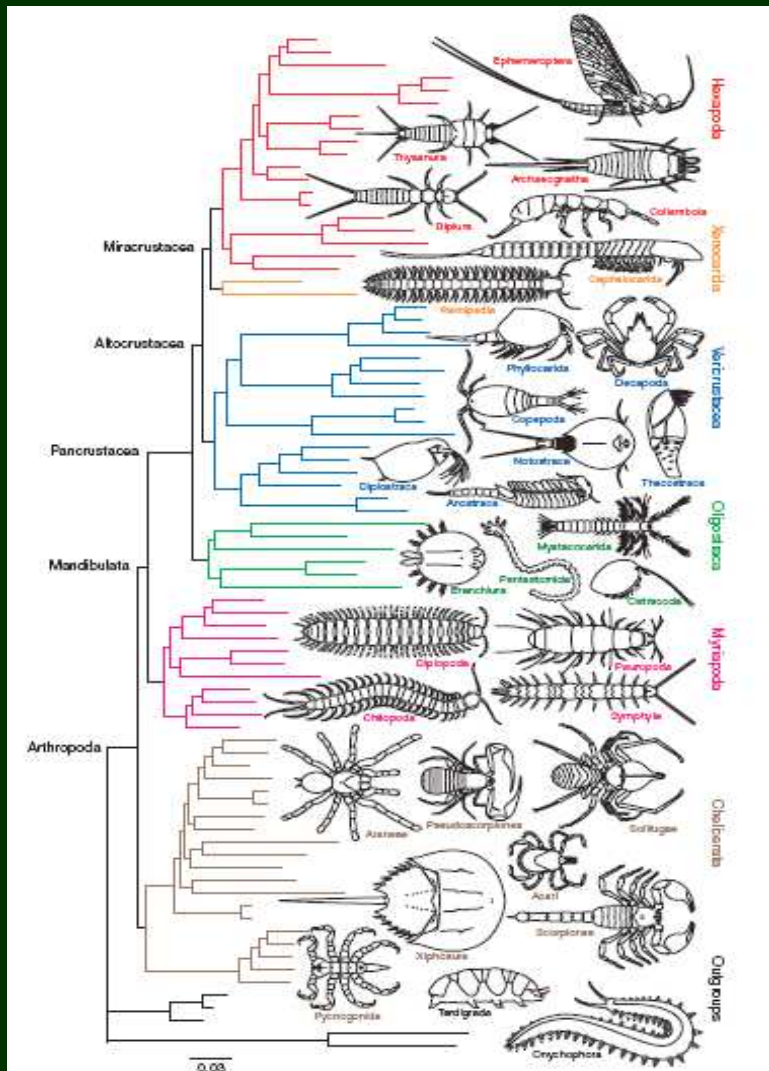
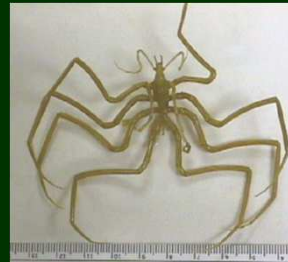


Arthropoda



Arthropoda

- recentní skupiny
- Pycnogonida
- Euchelicerata
- Myriapoda (?)
- Crustacea (???)
- Hexapoda (?)



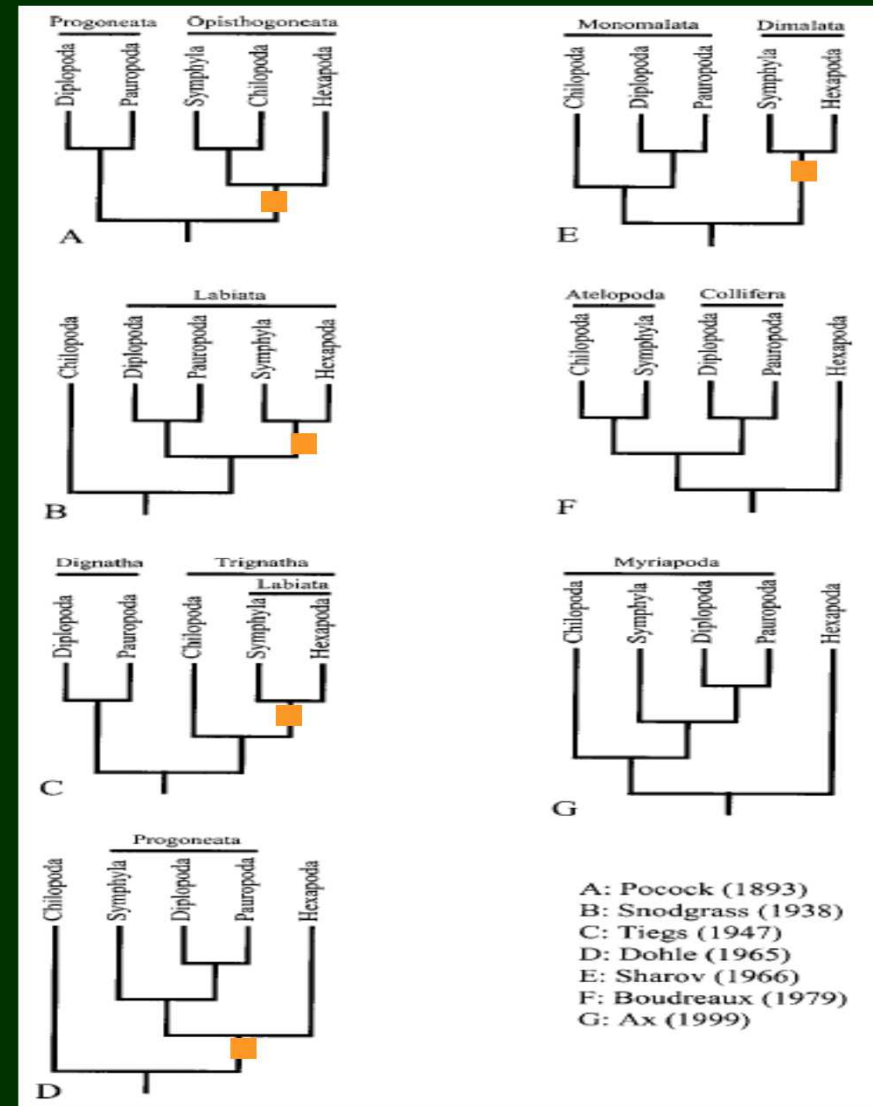
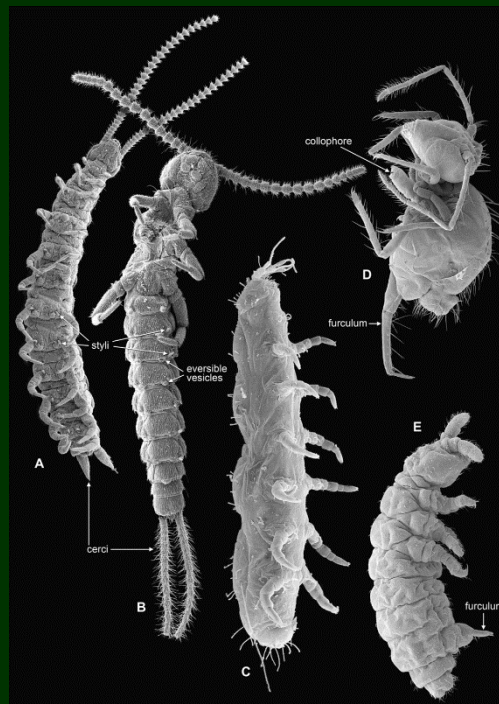
Arthropoda

- klasická morfologická hypotéza
- 1. **Chelicerata** s.lat. (Cheliceromorpha, Arachnata, Arachnomorpha, Lamellipedia)
 - Pycnogonida (Pantopoda)
 - Euchelicerata (Chelicerata s.str.)
- 2. **Mandibulata**
 - Crustacea
 - Tracheata (Atelocerata, Uniramia s.str.)
 - Myriapoda
 - Hexapoda



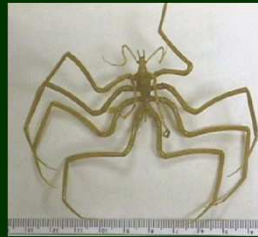
- redukce tritocerebrálního článku (a AN2)
- kusadla bez palců
- jednoduchá stavba pretarsu
- tentorium
- postantenální orgány
- malpighické trubice
- vzdušnice

Tracheata

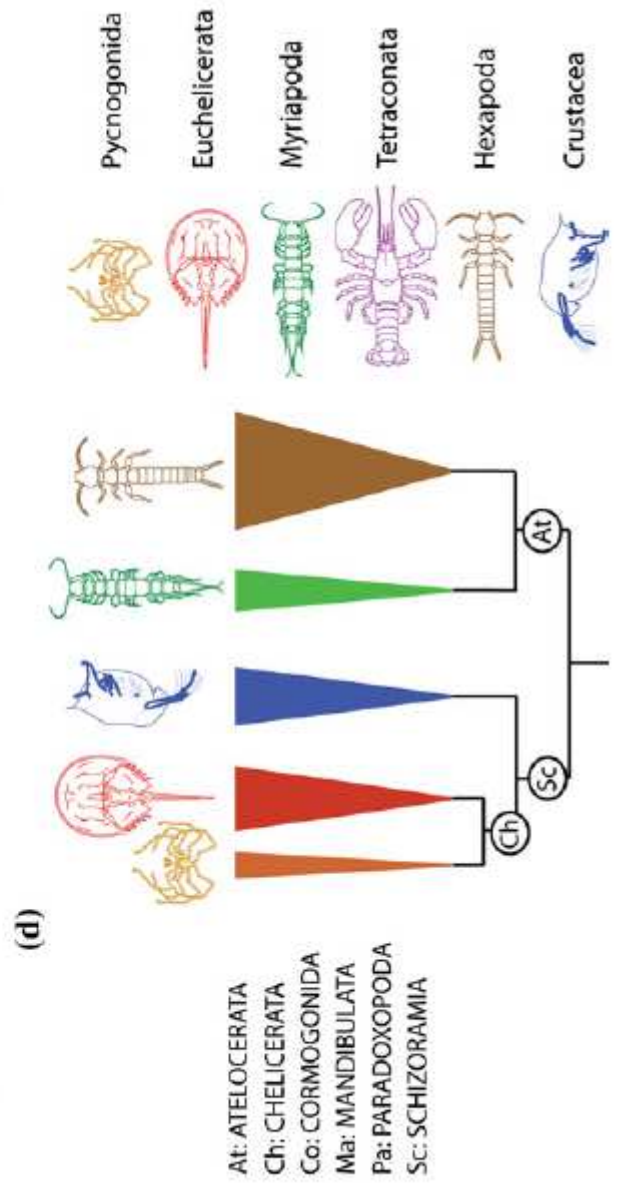
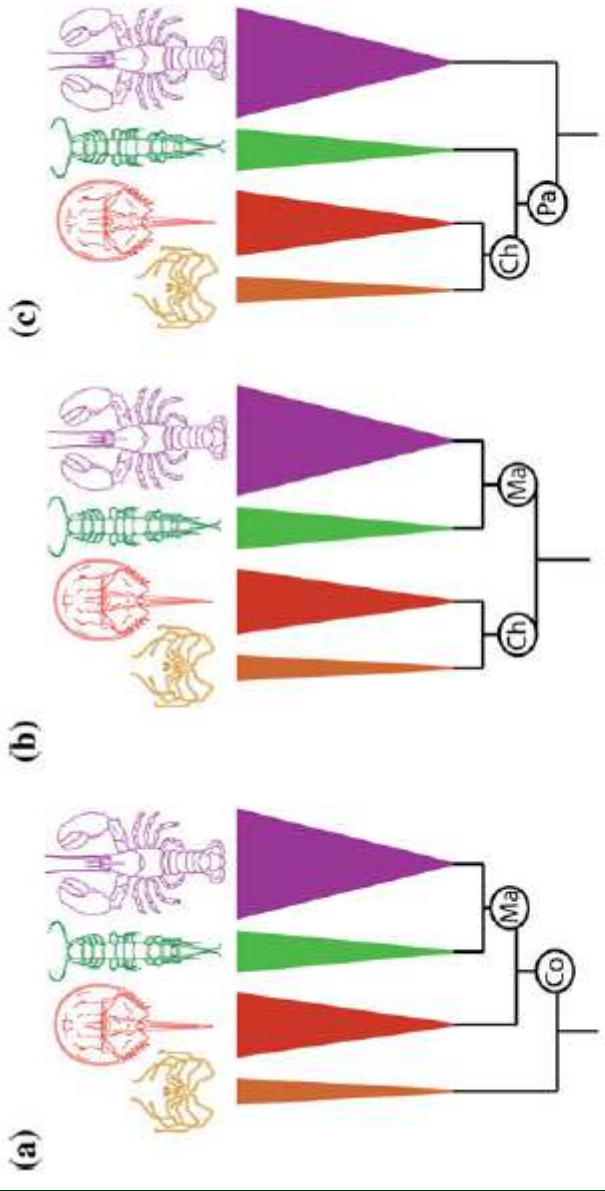


Arthropoda

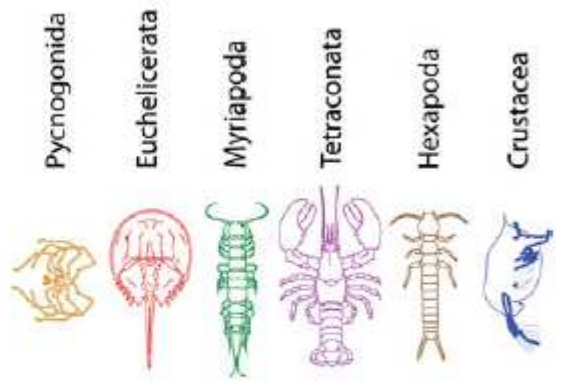
- „molekulární“ hypotéza
- 1. Pycnogonida
- 2. Euchelicerata
- 3. Myriapoda
- 4. Pancrustacea (Tetraconata)



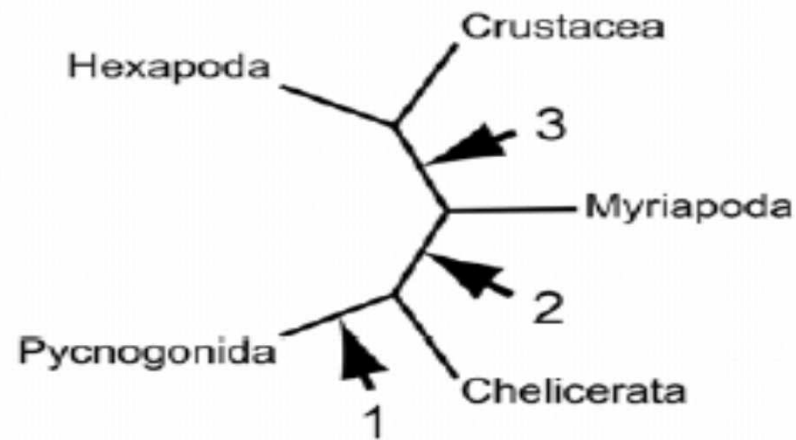
- **2+3+4 = Cormogonida**
- **1+2 = Chelicerata s.lat.**
- **1+2+3 = Myriochelata (Paradoxopoda)**
- **3+4 = Mandibulata**



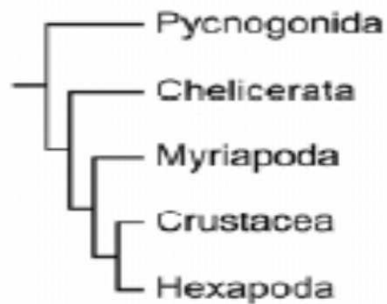
At: ATELOCERATA
 Ch: CHELICERATA
 Co: CORMOGONIDA
 Ma: MANDIBULATA
 Pa: PARADOXOPODA
 Sc: SCHIZORAMIA



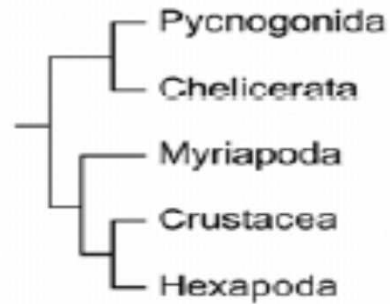
Fylogeneze členovců problém v pozici kořene



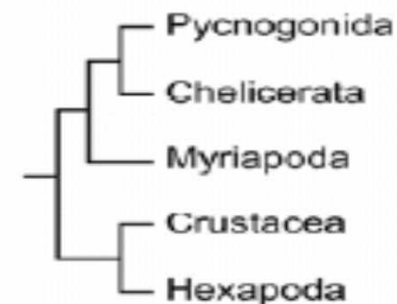
1. Cormogonida



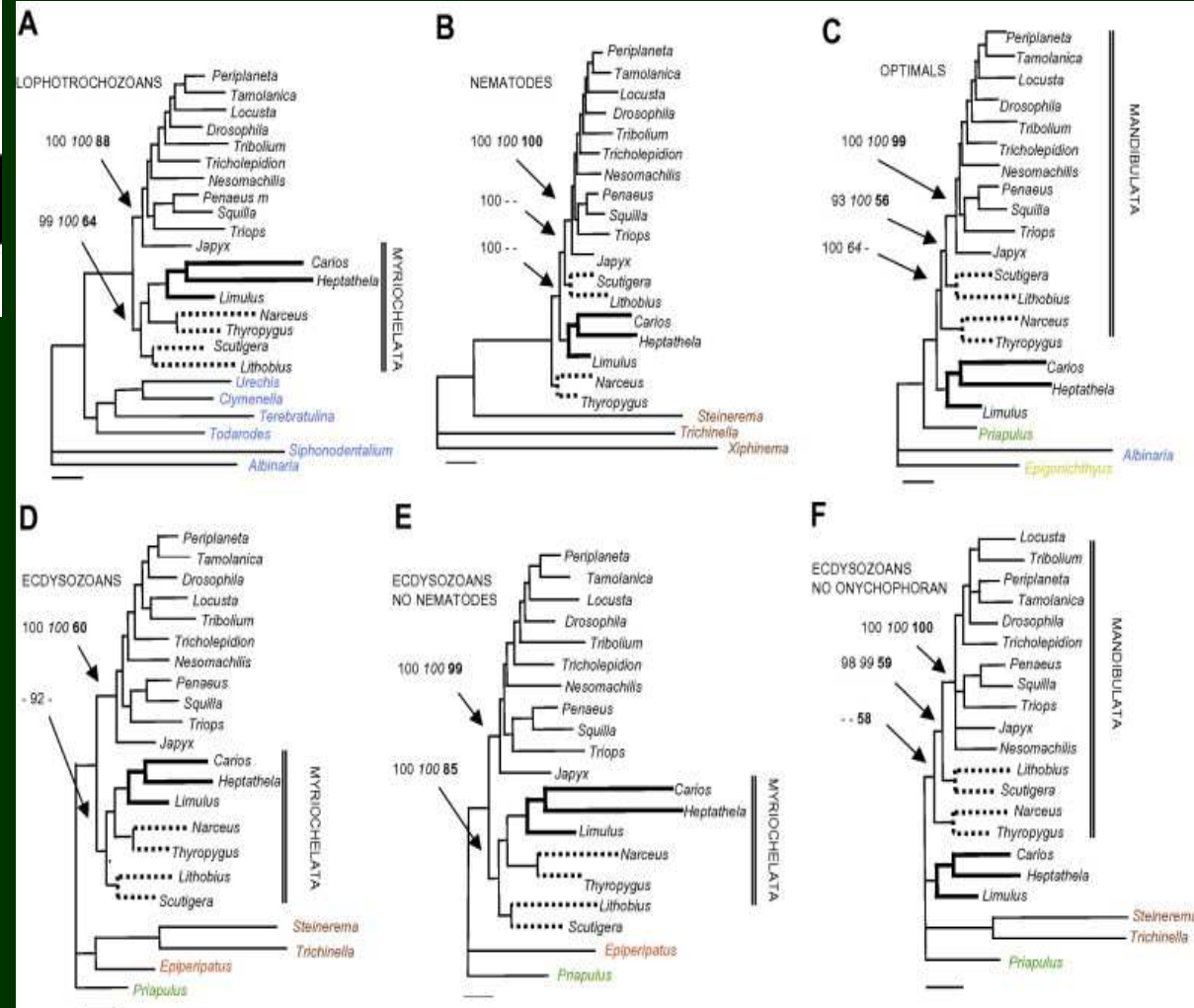
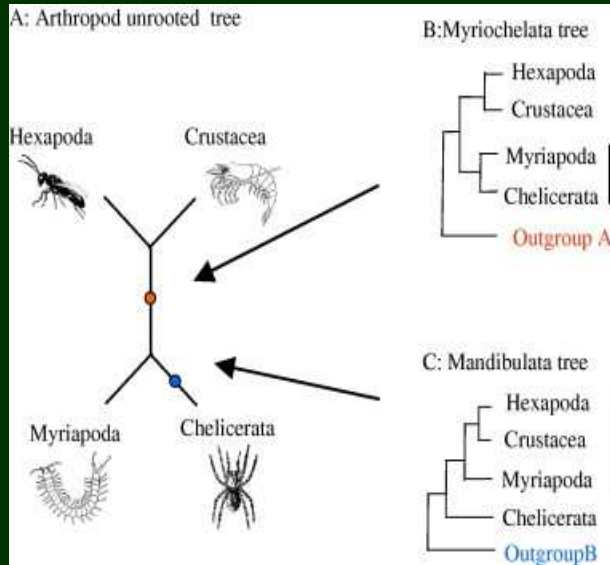
2. Chelicerata



3. Paradoxopoda

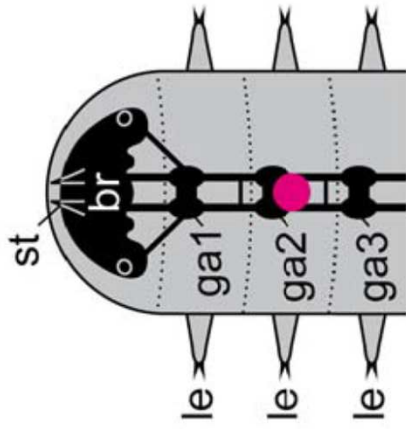


Fylogeneze členovců

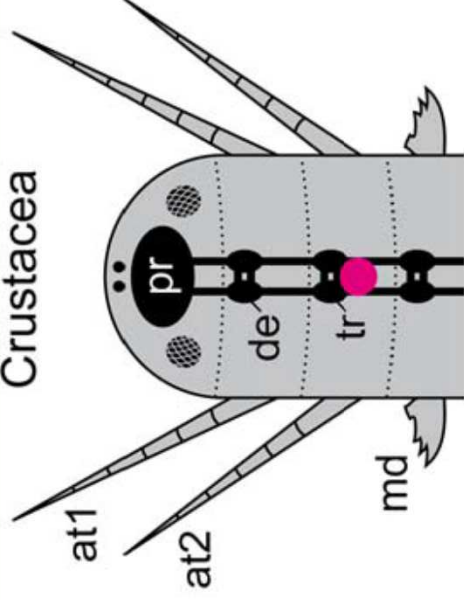


- nejlepší outgroup je *Priapulus*
- (a priori!!!)

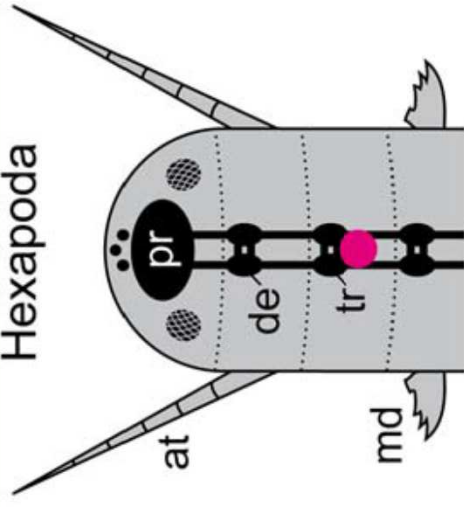
Tardigrada



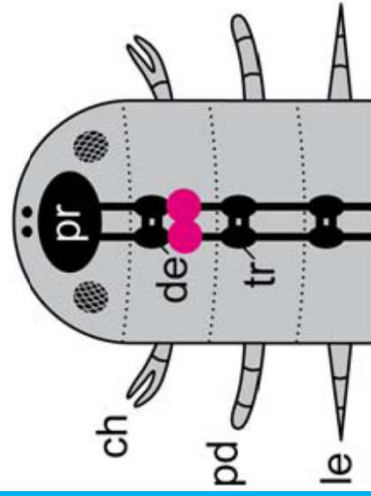
Crustacea



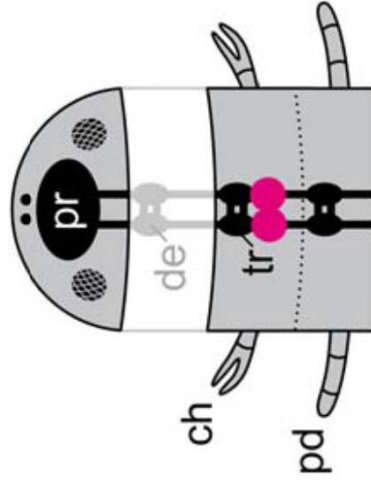
Hexapoda



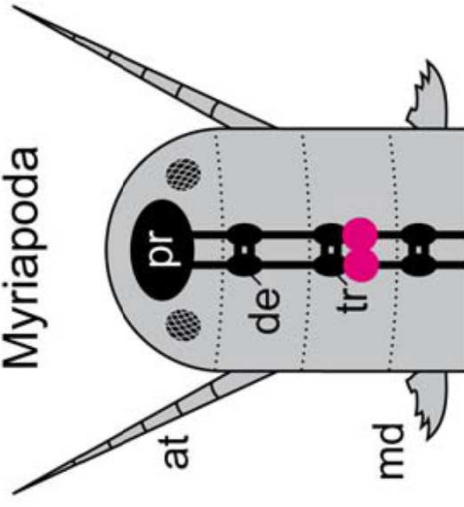
Chelicerata (alternative 1)



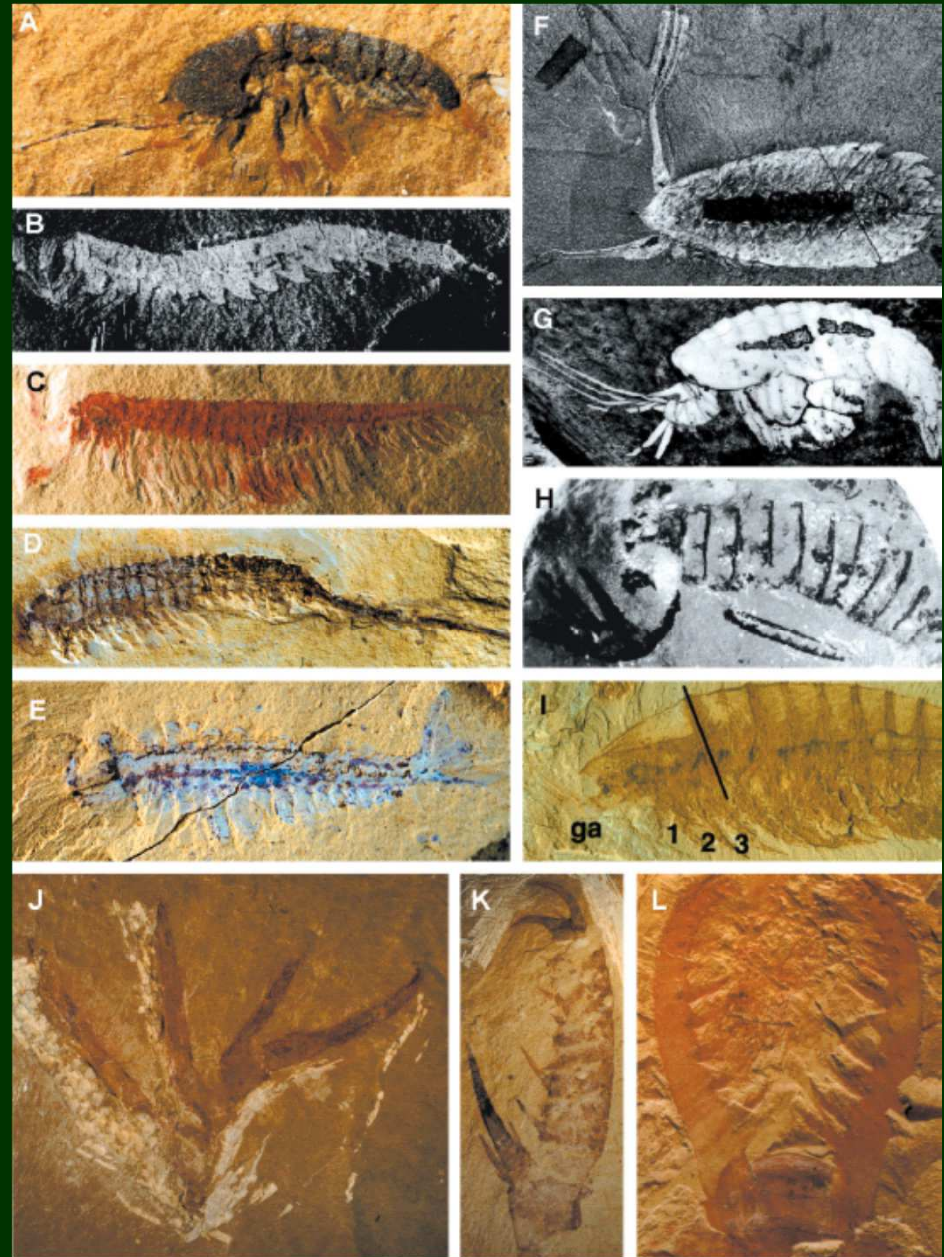
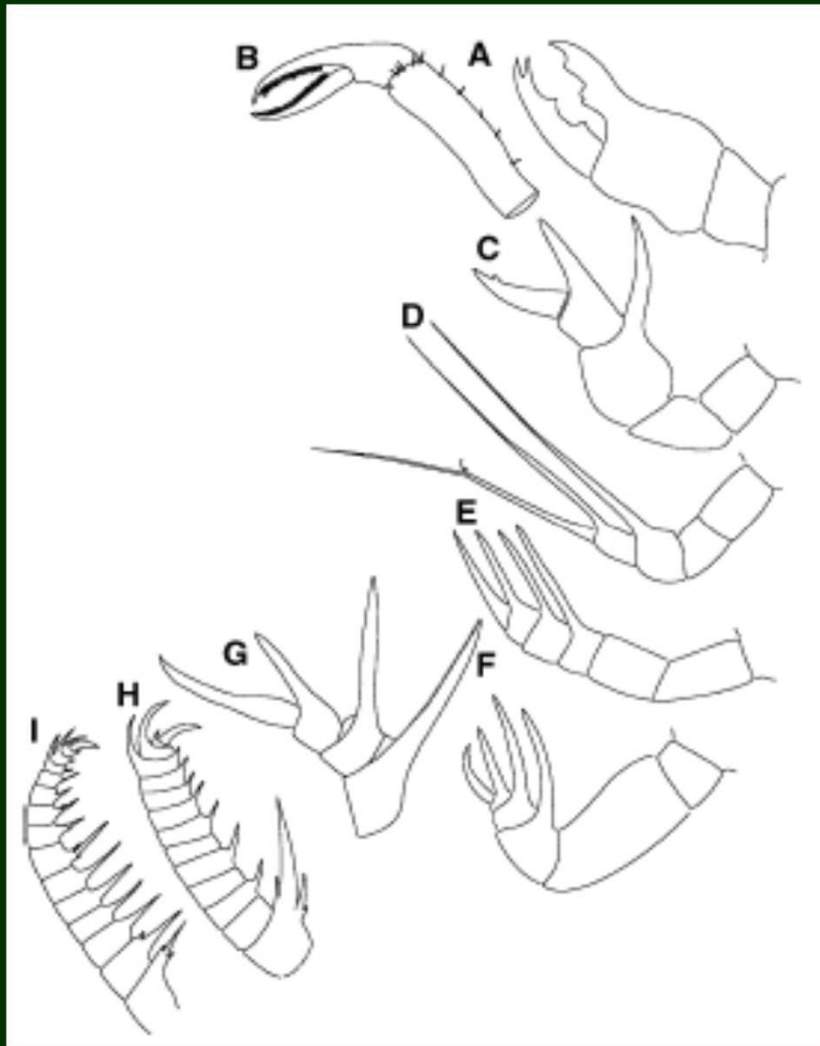
Chelicerata (alternative 2)

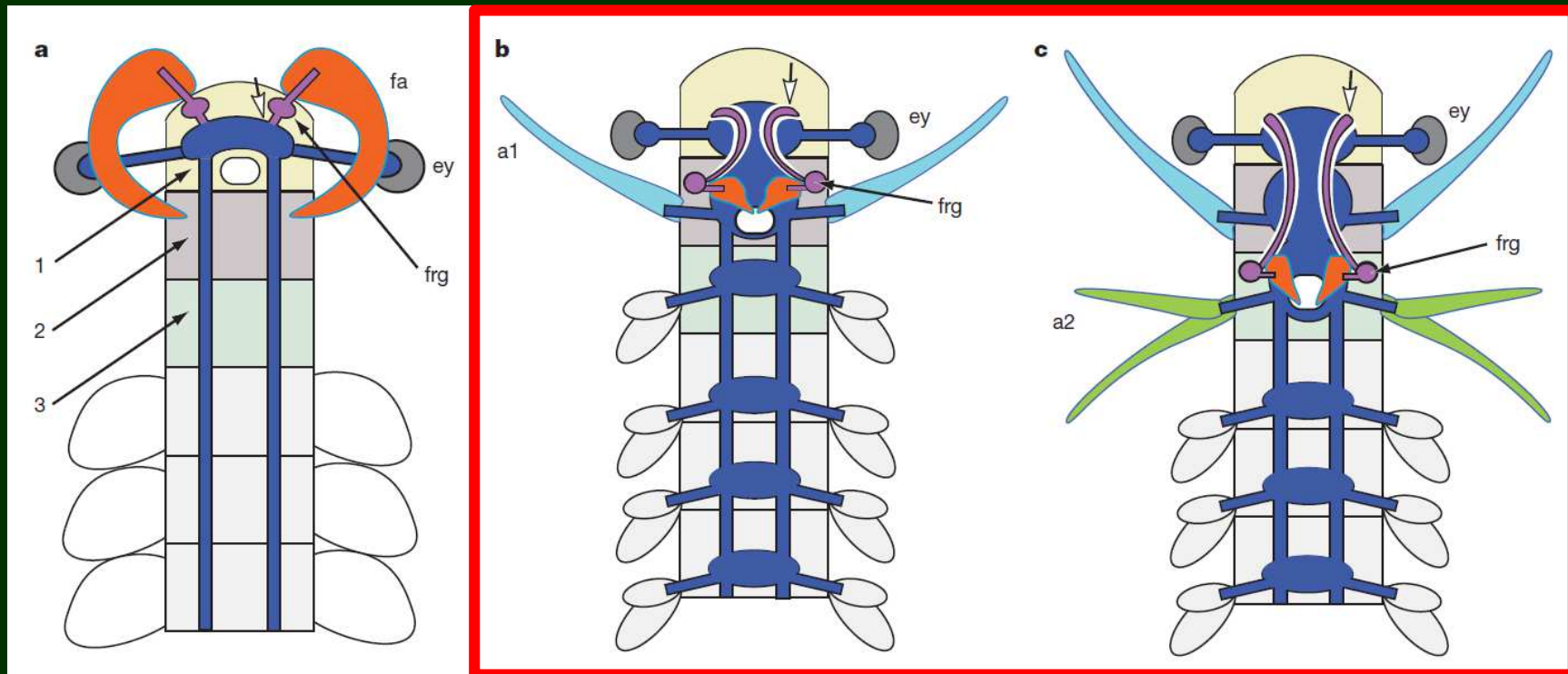


Myriapoda



„Great appendages“ x chelicer/chelifory (A-B)

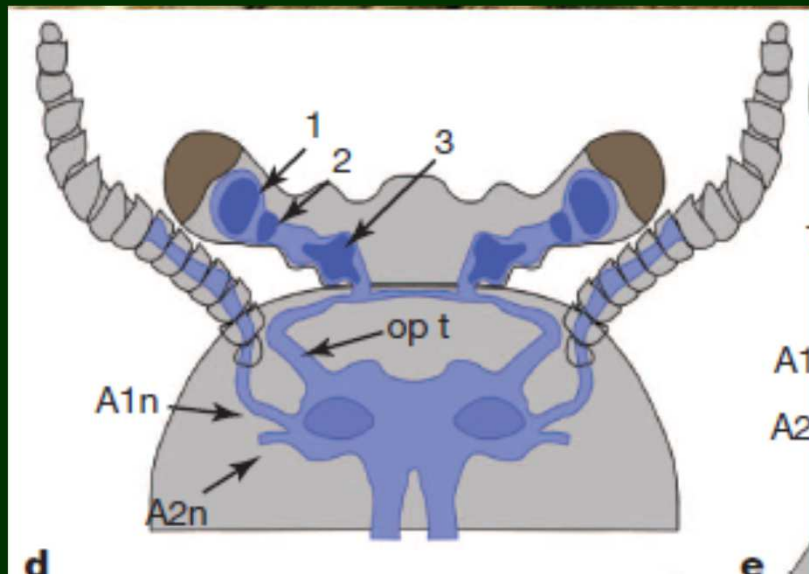




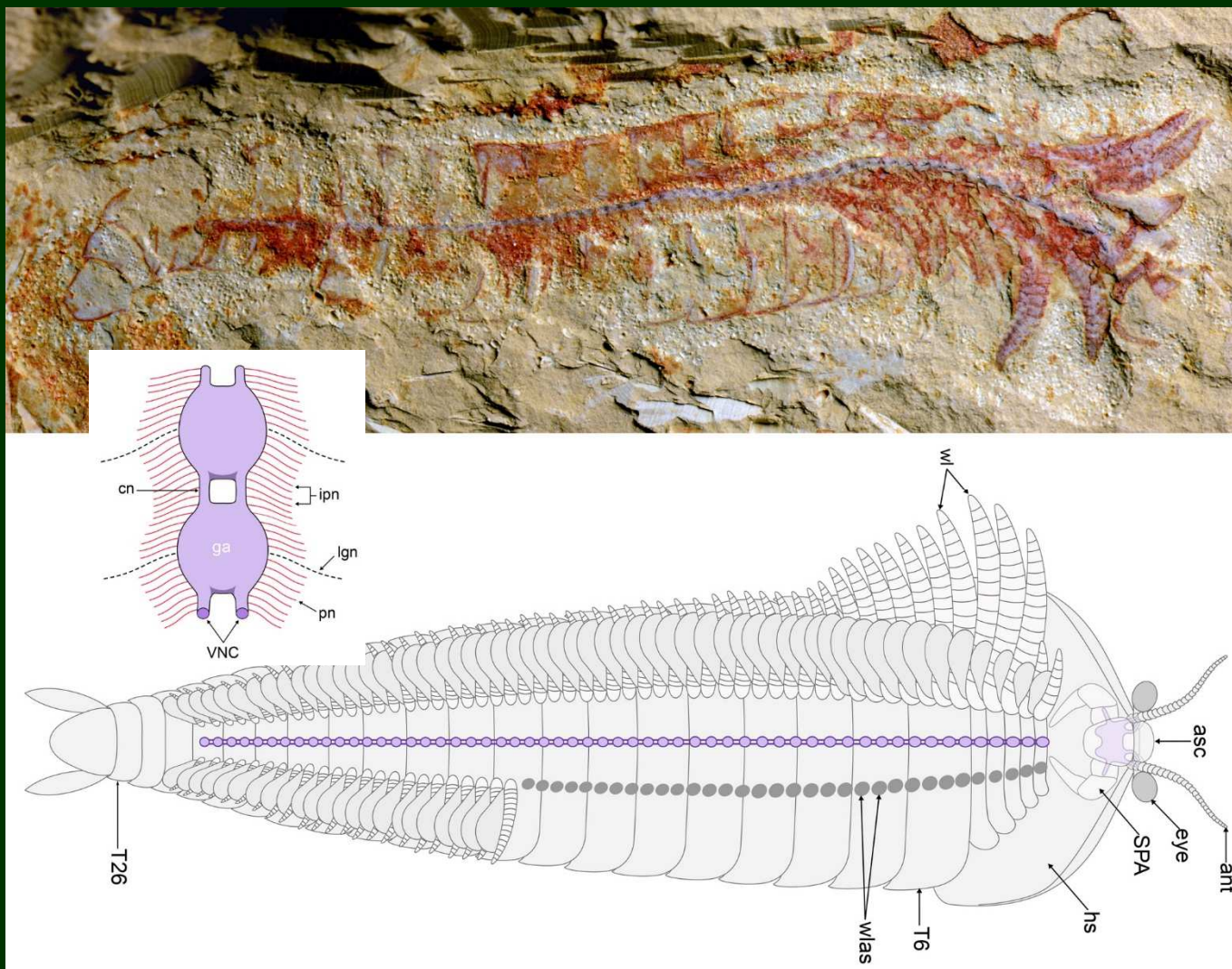
- „velké končetiny“ (pre)protocerebrální → nejsou homologické končetinám členovců (ani *jejich* „velkým končetinám“)
- labrum (párové, inervované z protocerebra, odpovídá končetinám, migruje zředu dozadu)

Fuxianhuia (kambrium)

- složitý mozek a optické loby
- fylogeneze – bazální členovci (?)
- → konvergence s rakovci, anebo důkaz primitivně složitých mozků členovců?

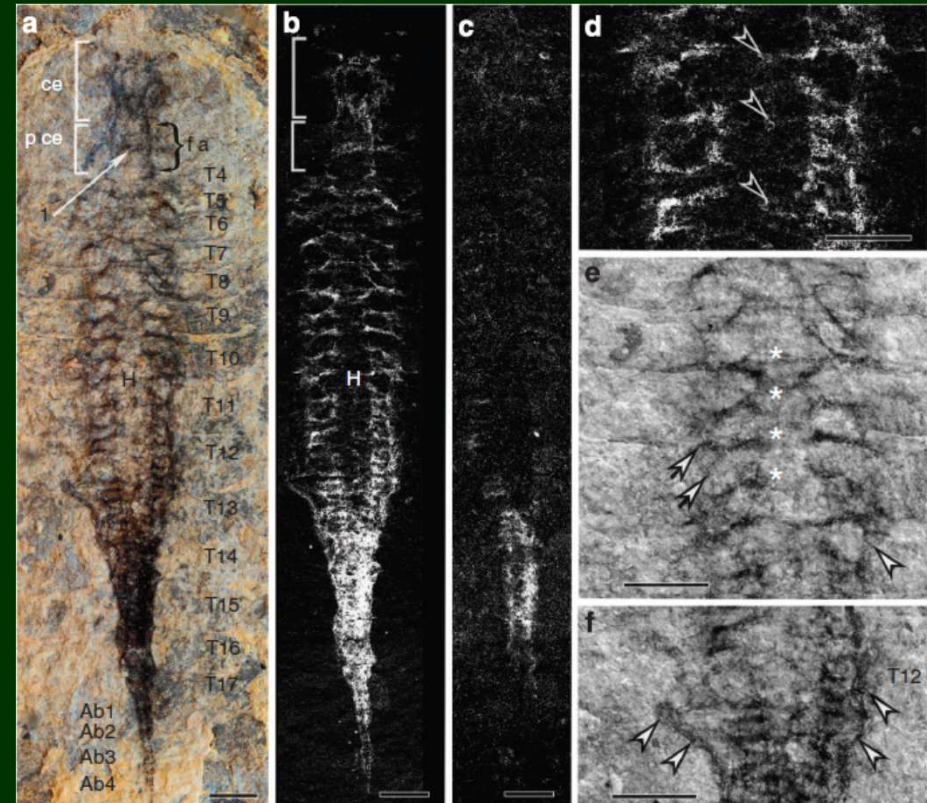
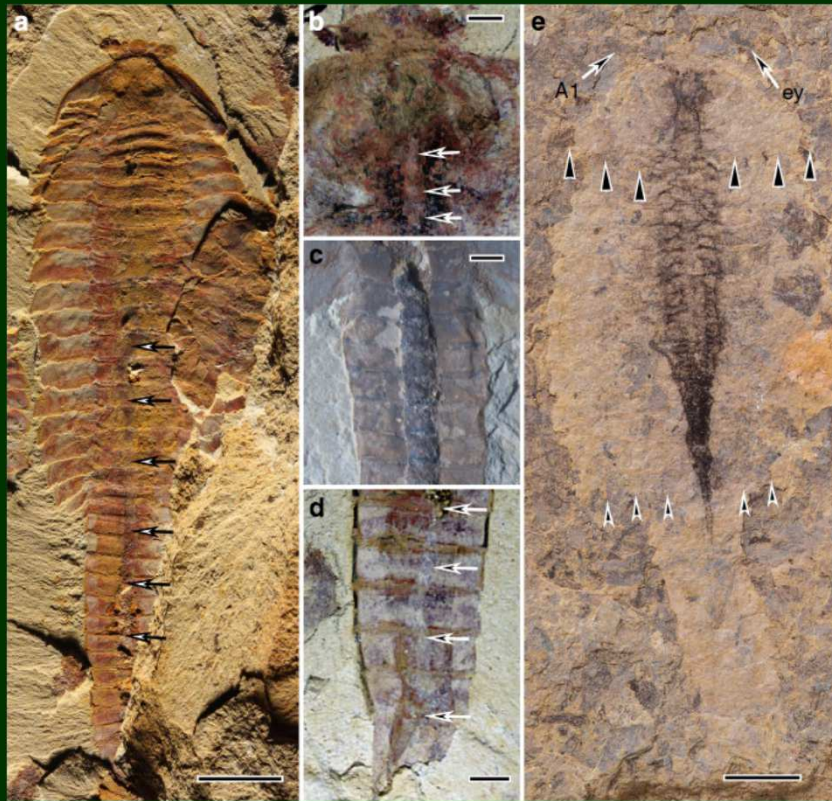


Chengjiangocaris (Fuxianhuiida)



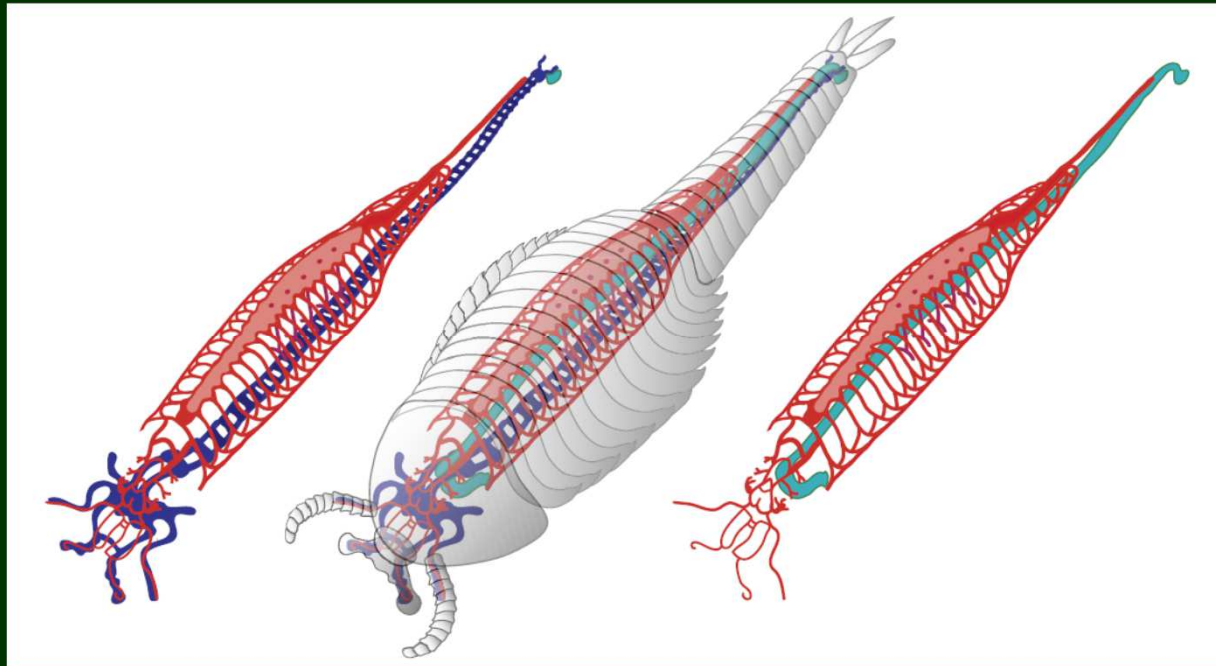
Fuxianhuia

- dokonale zachovaná cévní soustava



Fuxianhuia

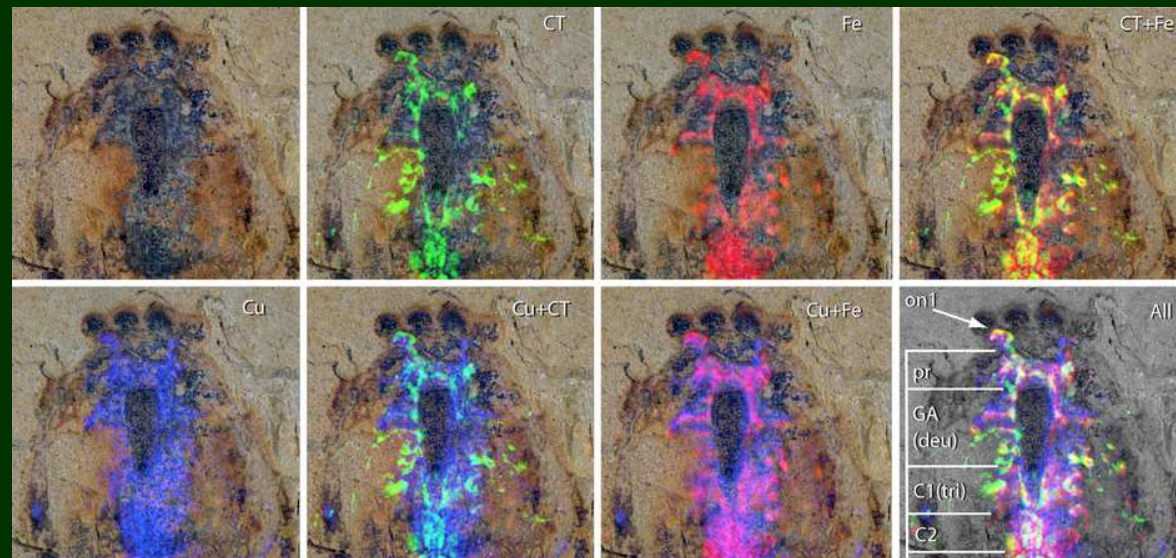
- nečekaně složitá anatomie (cévní zásobování CNS?)

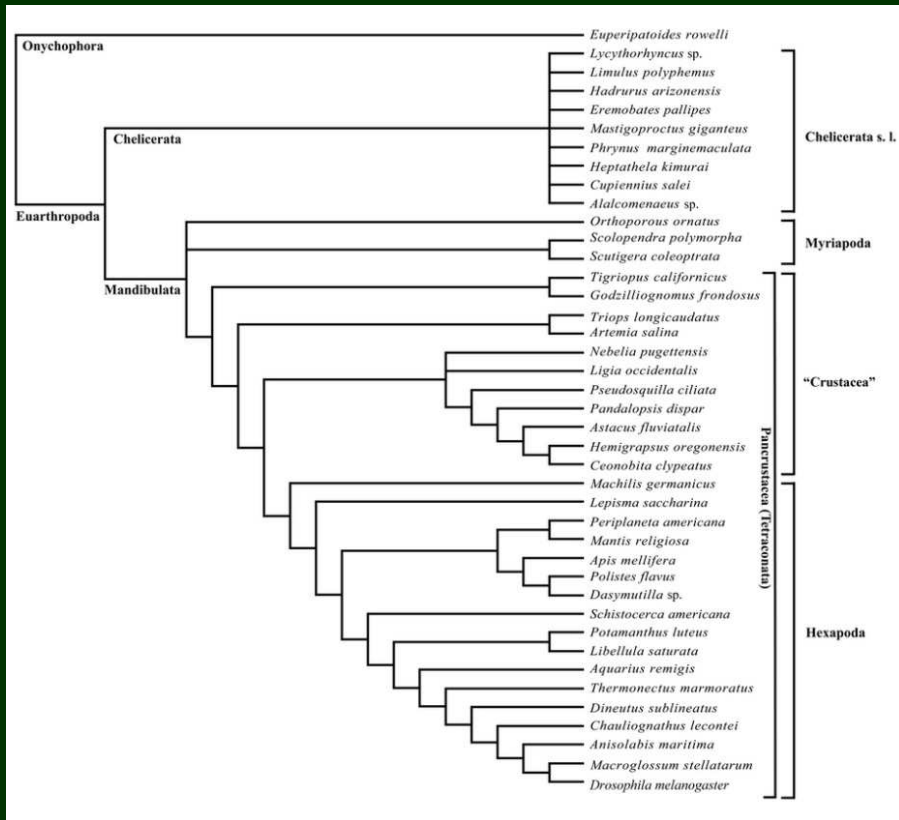


Megacheira: *Alalcomenaeus*

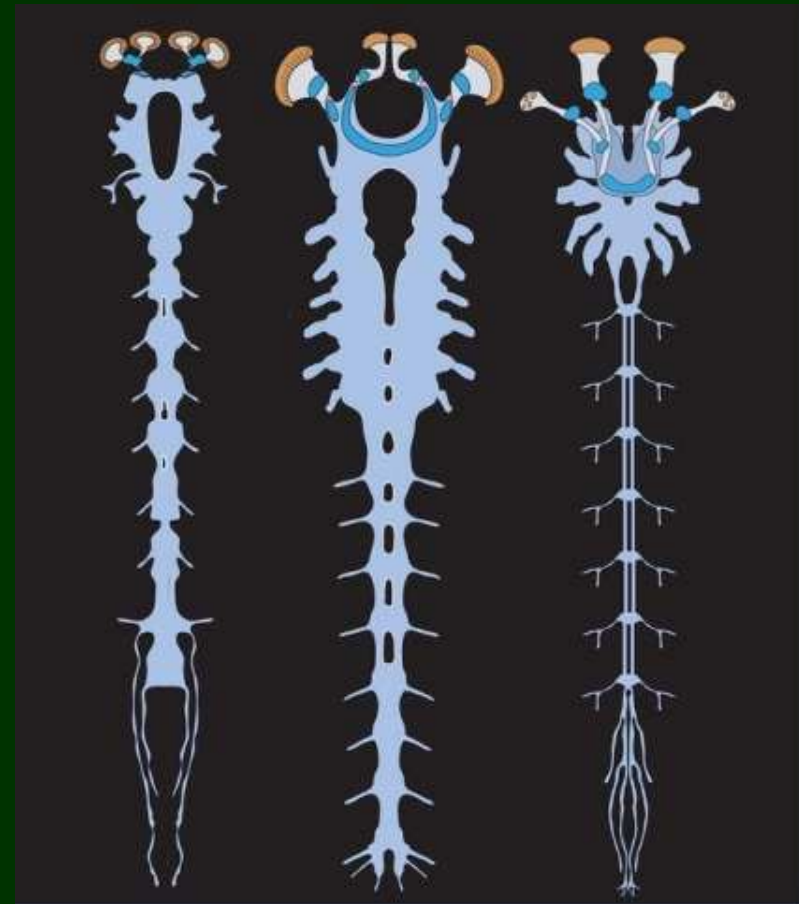
(kambrium)

mozek a inervace „velkých končetin“



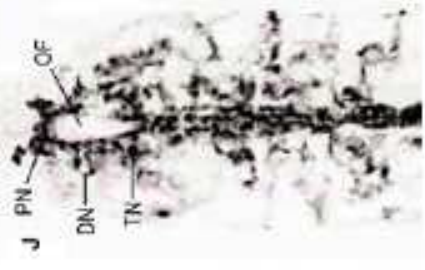
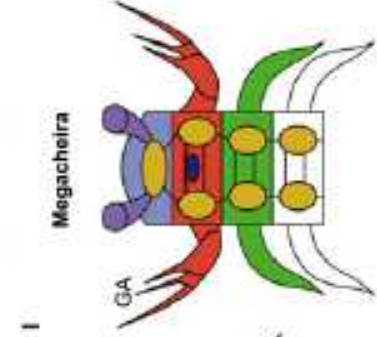
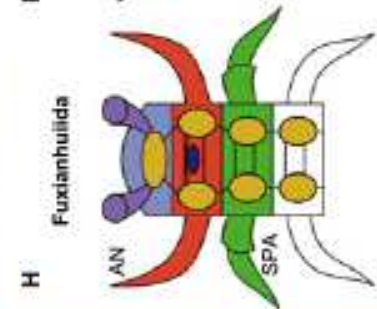
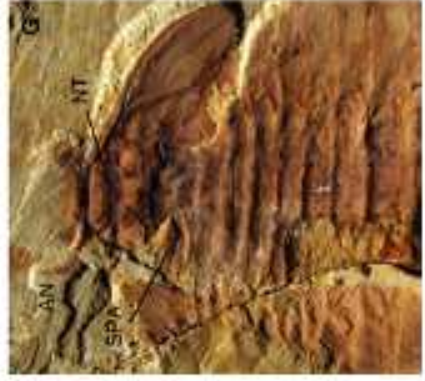
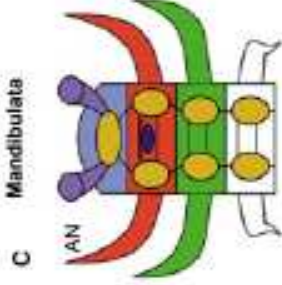
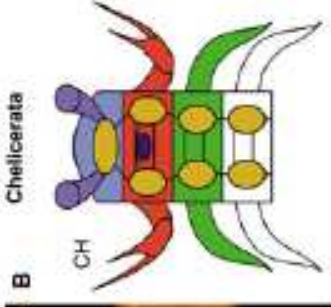


Alalcomenaeus

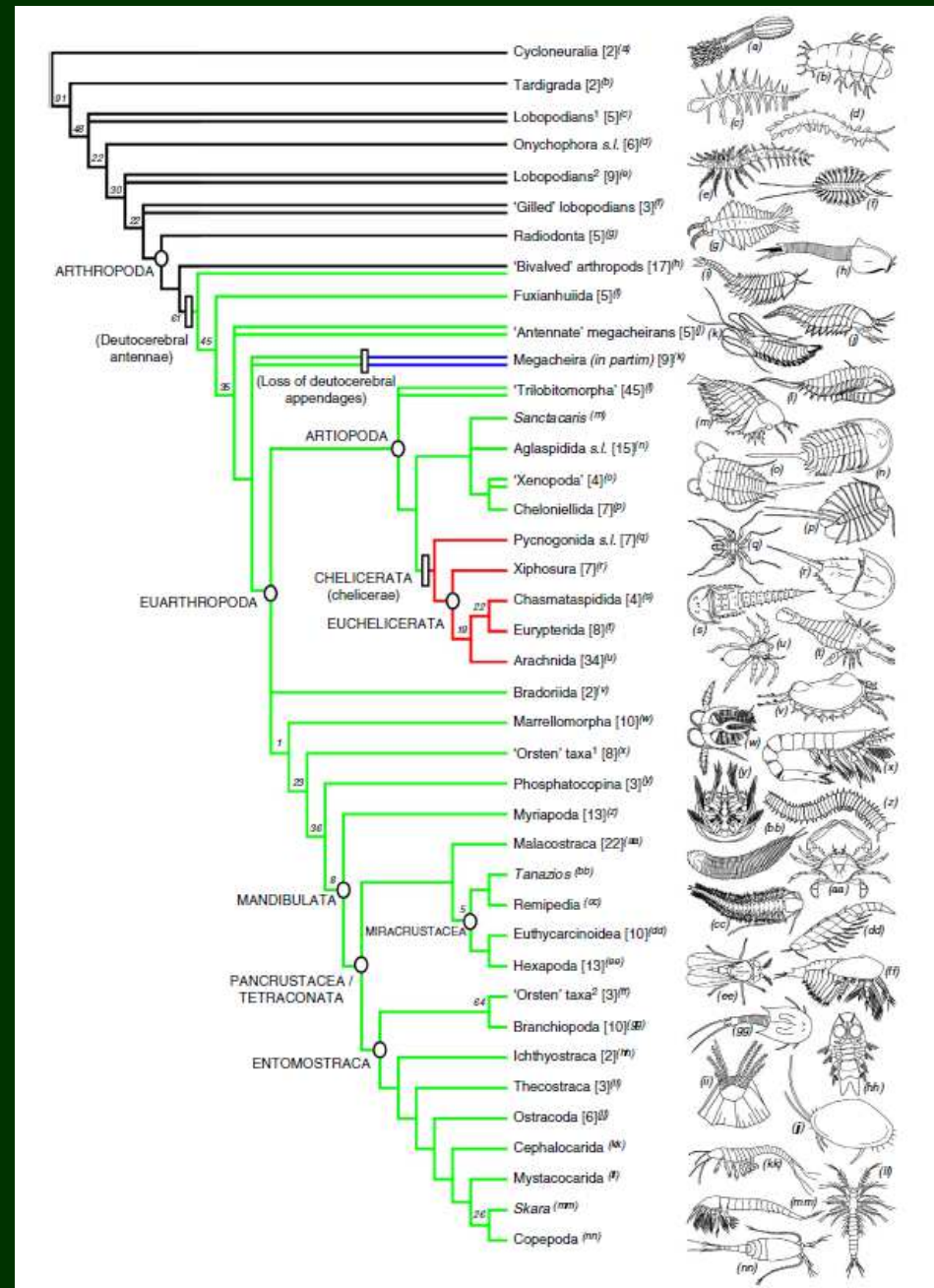


Alalcomenaeus, ostrorep, štír

- „velké končetiny“ jsou deutocerebrální = homologické chelicerám a prvním tykadlům

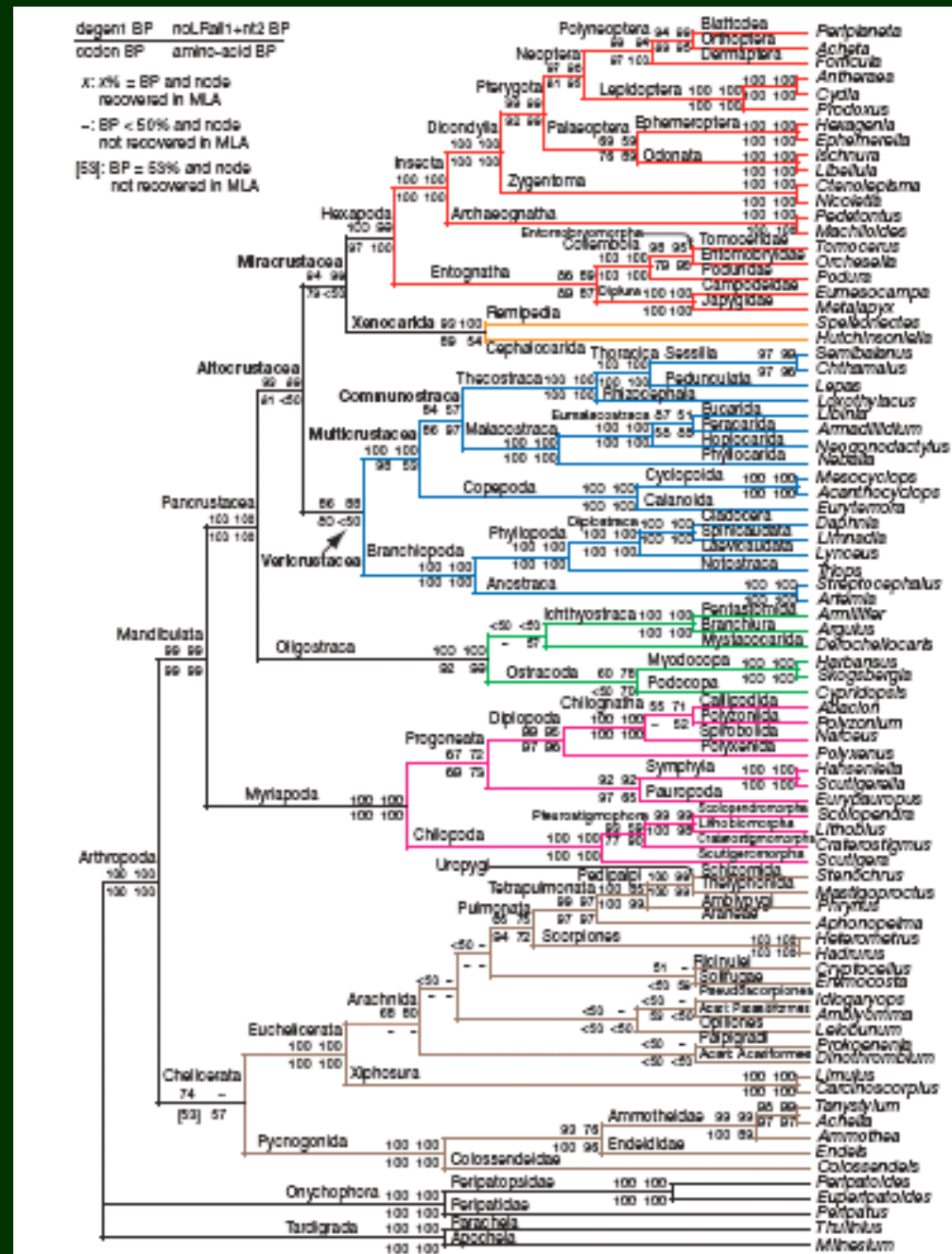


- spíše zvýšení chaosu...
- ALE:
- 1. „velké končetiny“ různých panarthropod asi nejsou homologické (proto-, deuto- i tritocerebrální)
- 2. žádní členovci nemají protocerebrální končetiny
- 3. deutocerebrální tykadla mají skoro všichni → není to podpora pro Mandibulata (→ postavení např. trilobitů)



Fylogeneze členovců

- 2010
- 62 neparalogních nukleárních proteinových genů
- (41 kbp)

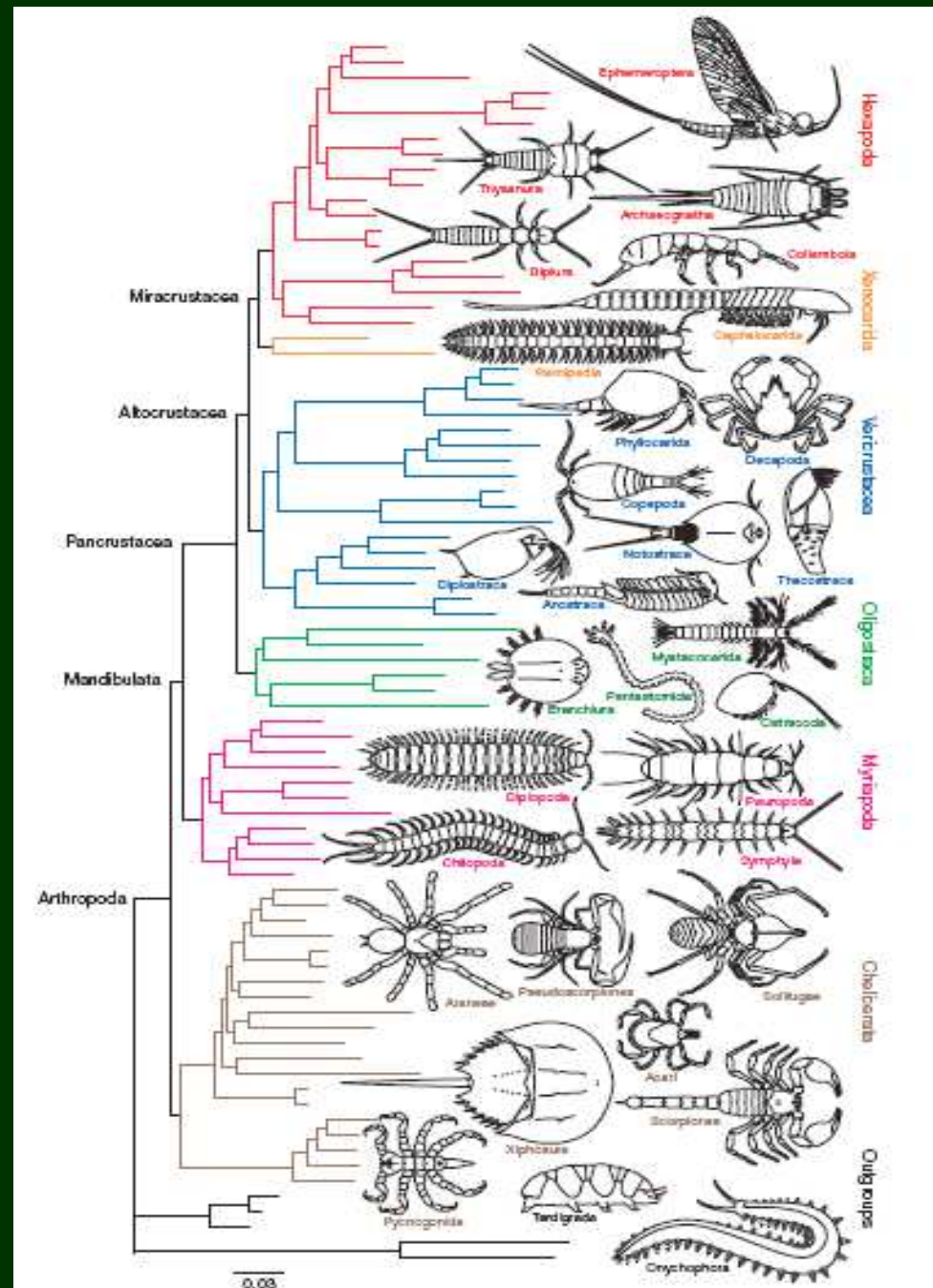


- **Chelicerata**

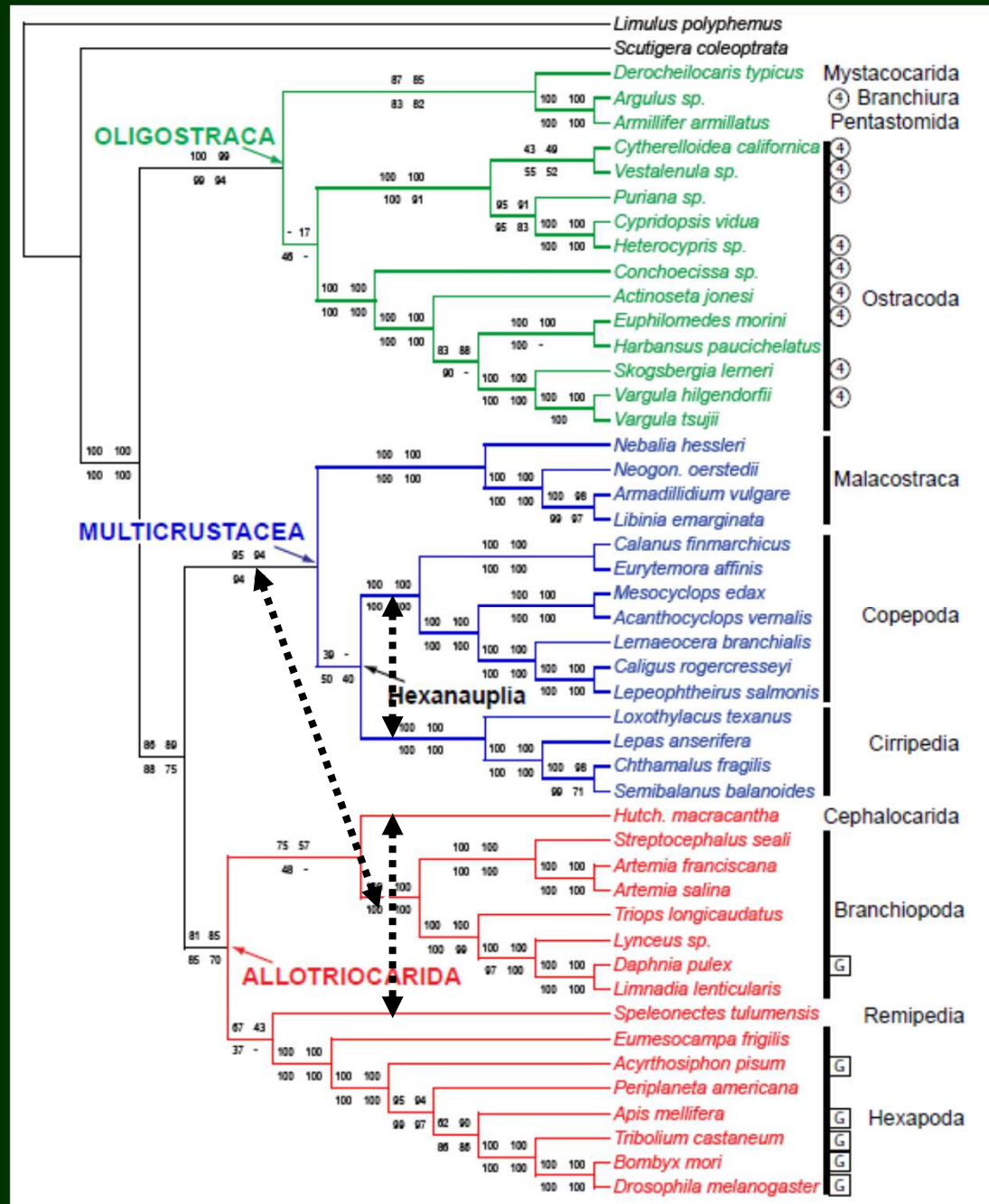
- Pycnogonida
- Euchelicerata
 - Xiphosura
 - Arachnida

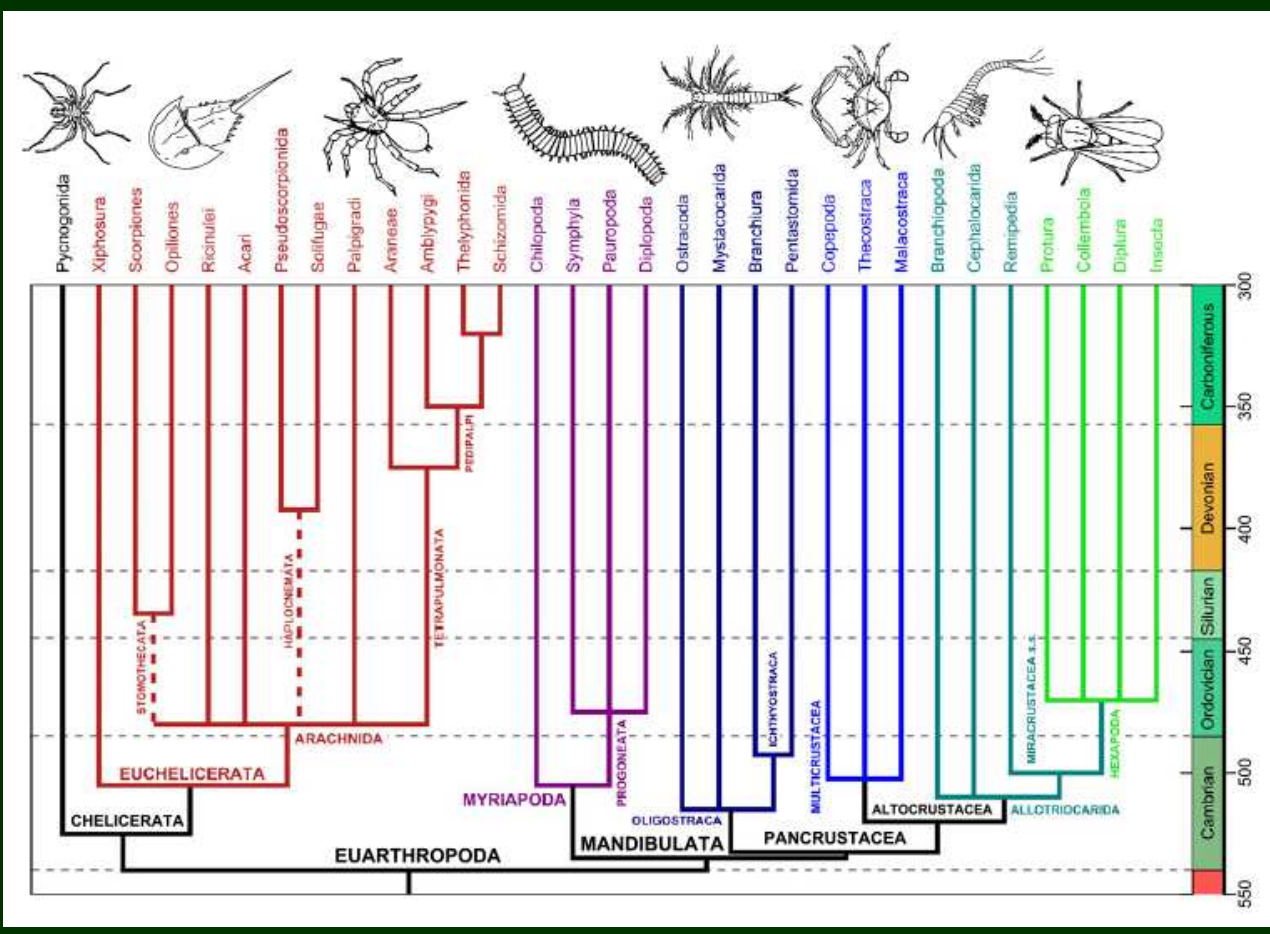
- **Mandibulata**

- Myriapoda
 - Chilopoda
 - Progoneata
- Pancrustacea
 - Oligostraca
 - Multicrustacea
 - Branchiopoda
 - Xenocarida
 - Hexapoda

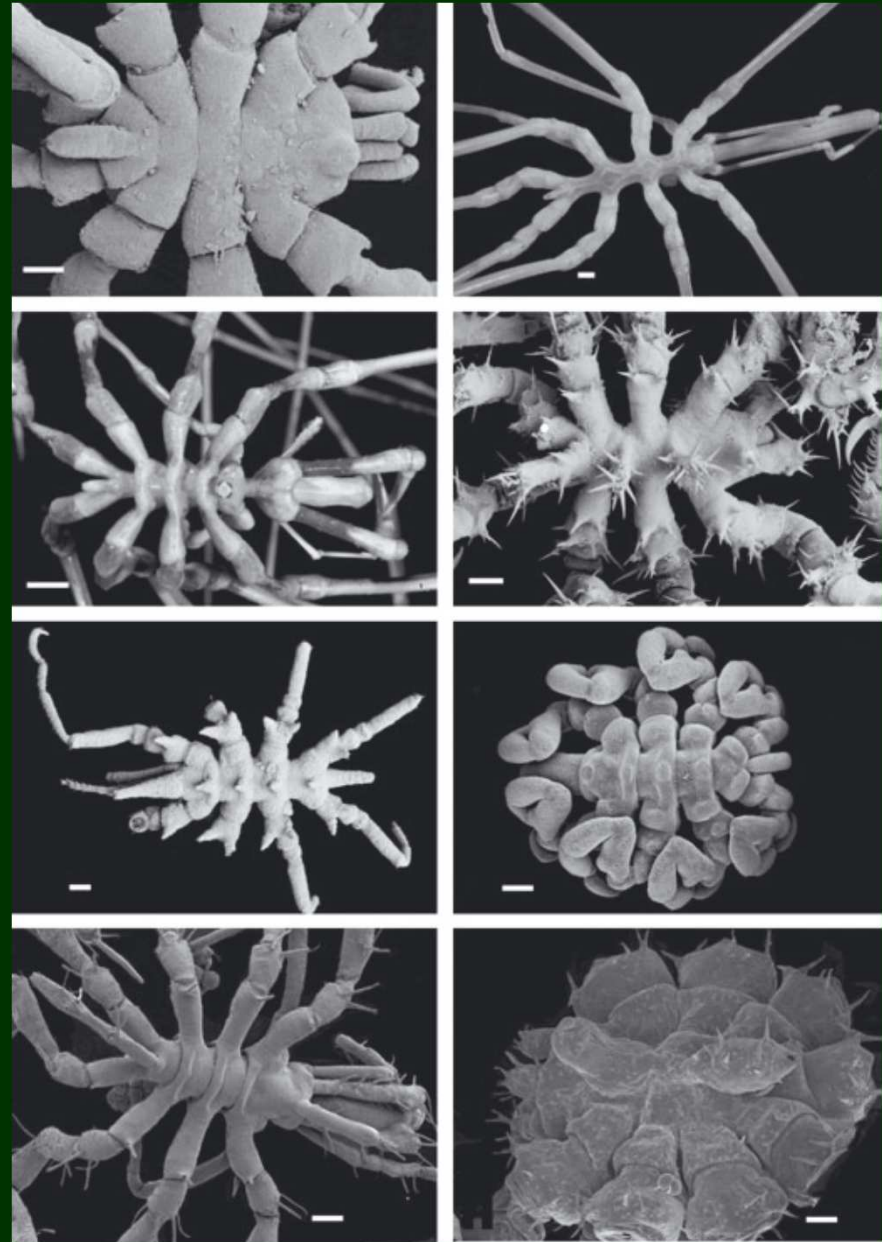


EST + rDNA + mtDNA
+ morfologie

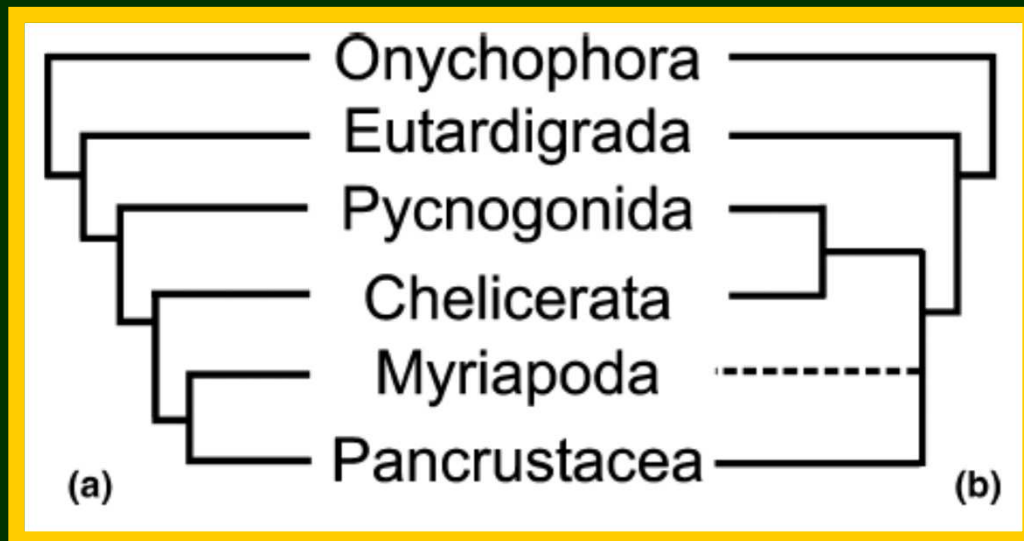
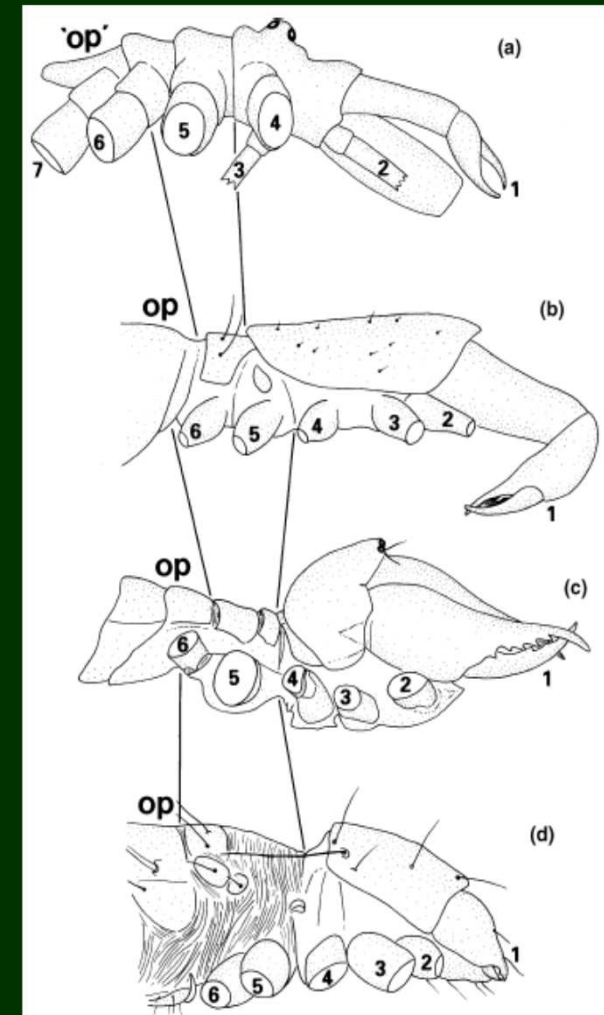
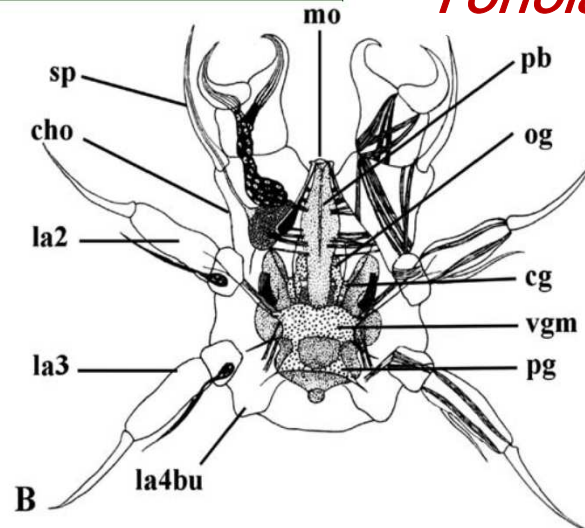
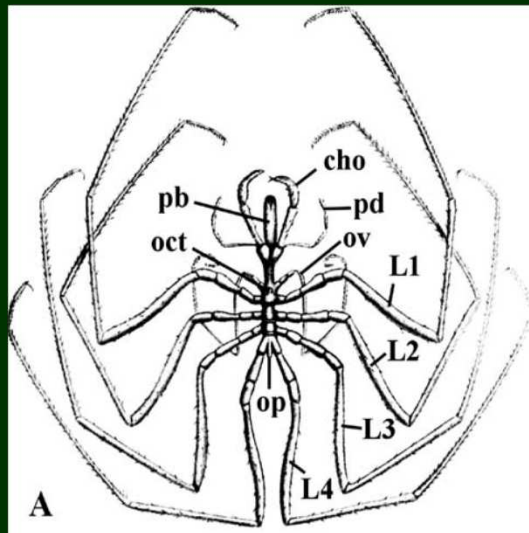
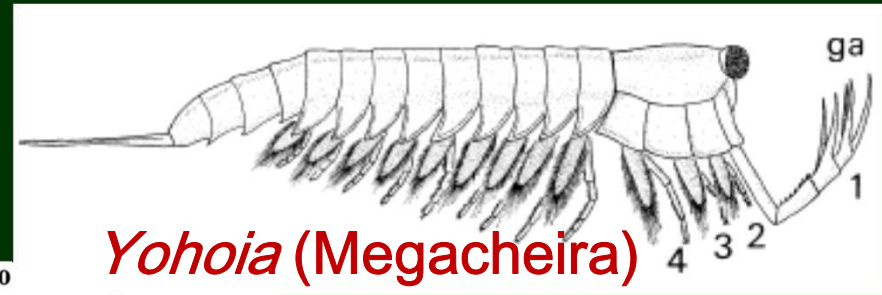




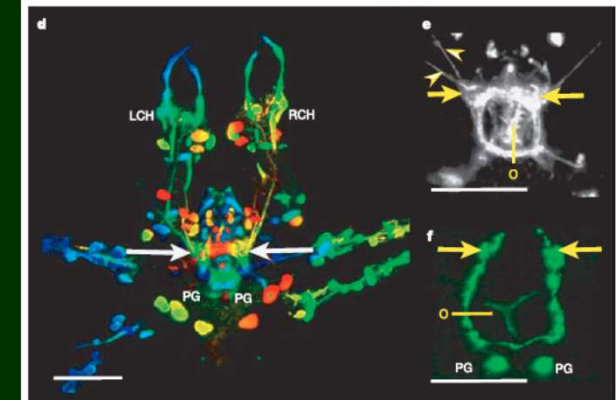
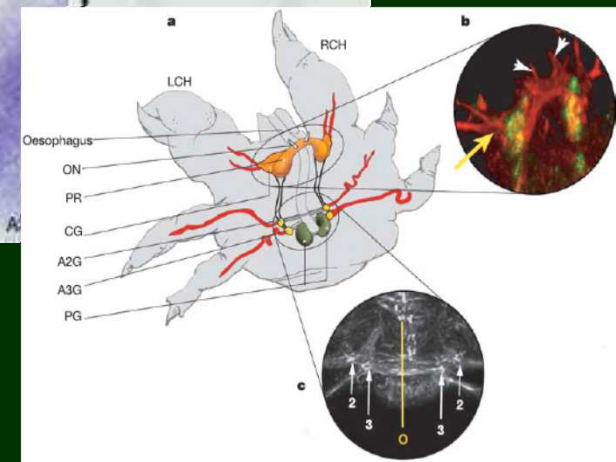
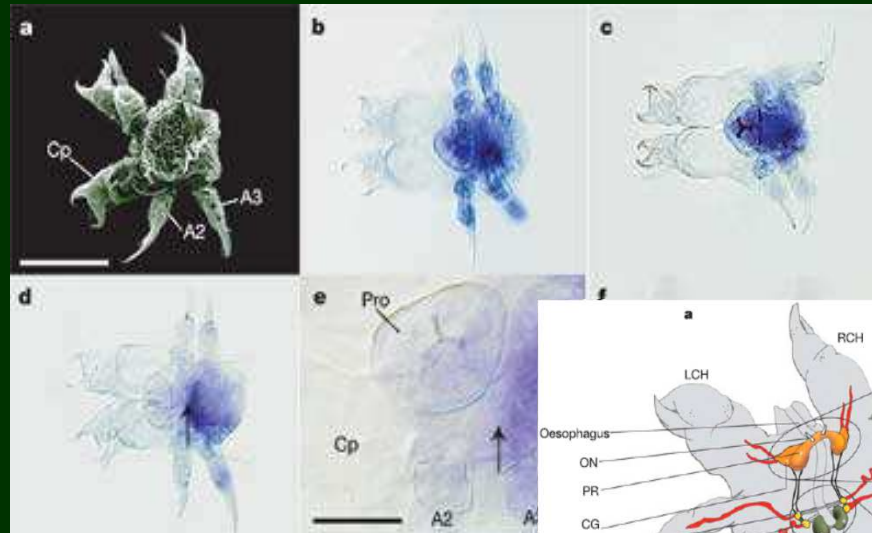
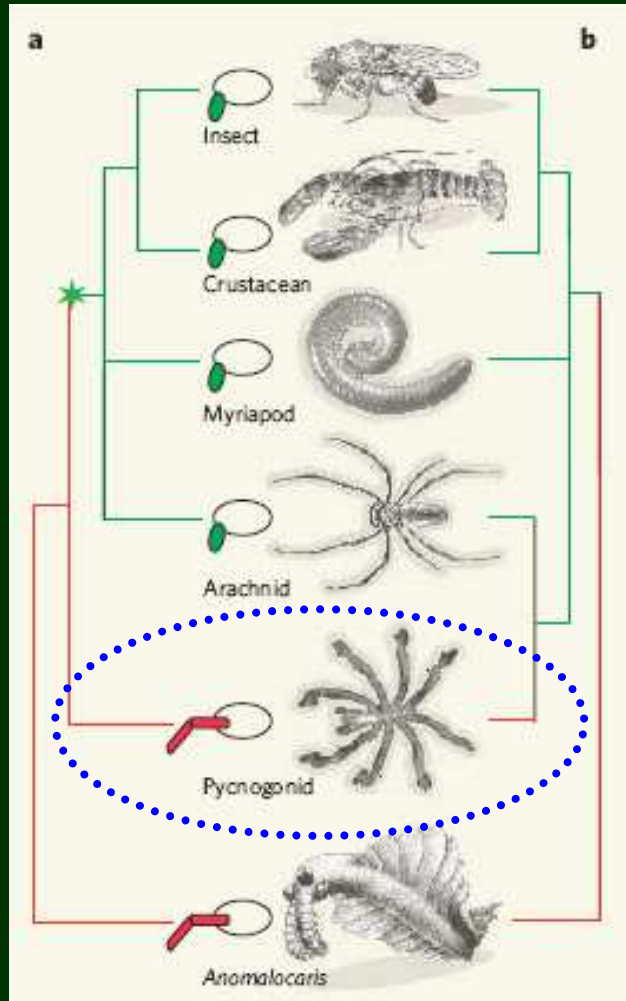
Pycnogonida



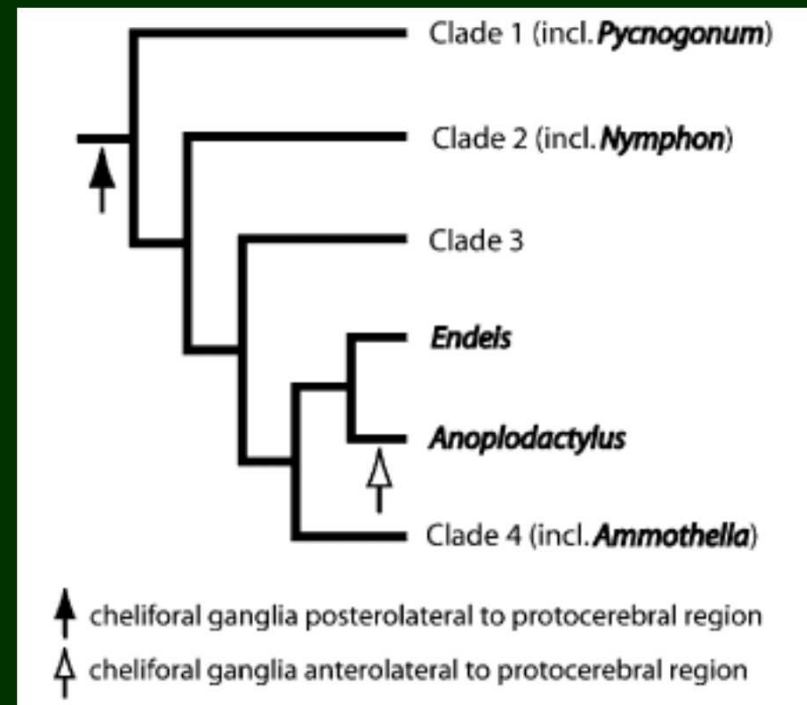
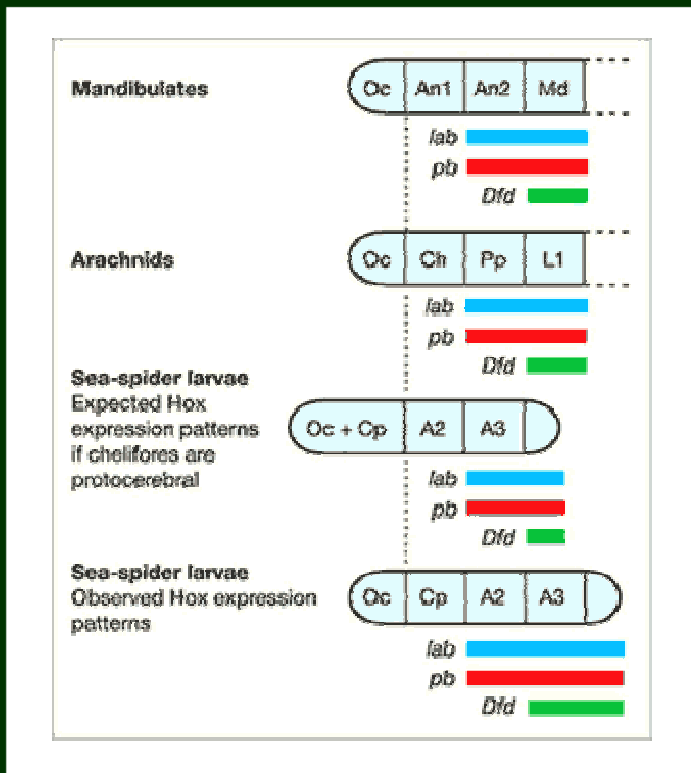
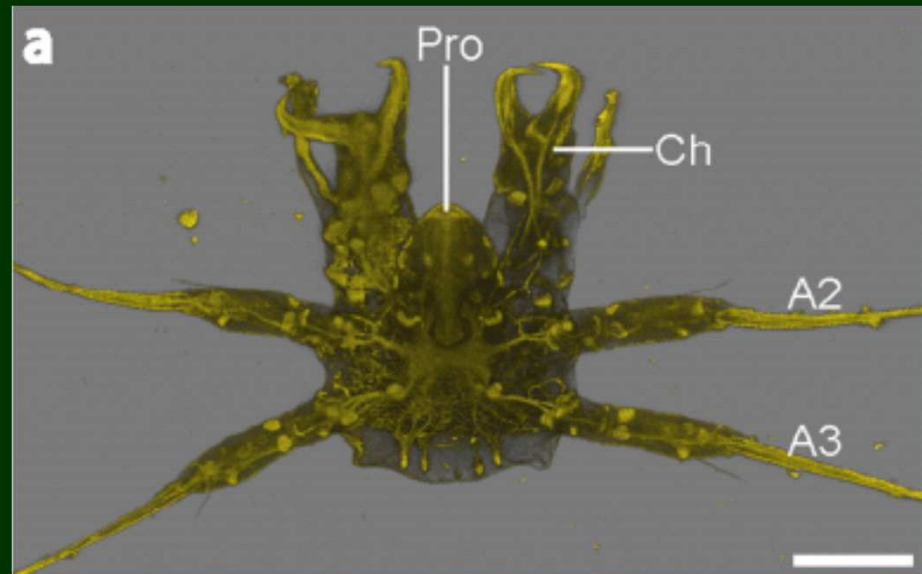
Pycnogonida



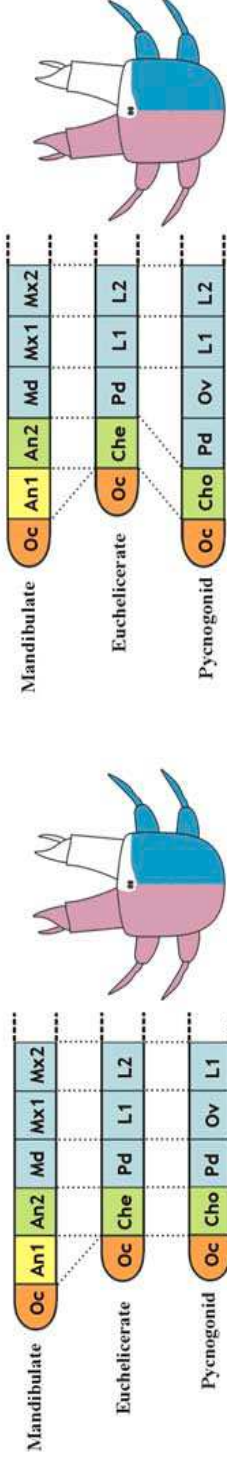
Pycnogonida – neuroanatomie x *Hox*



Diverzita nohatek – zdroj konfliktu???



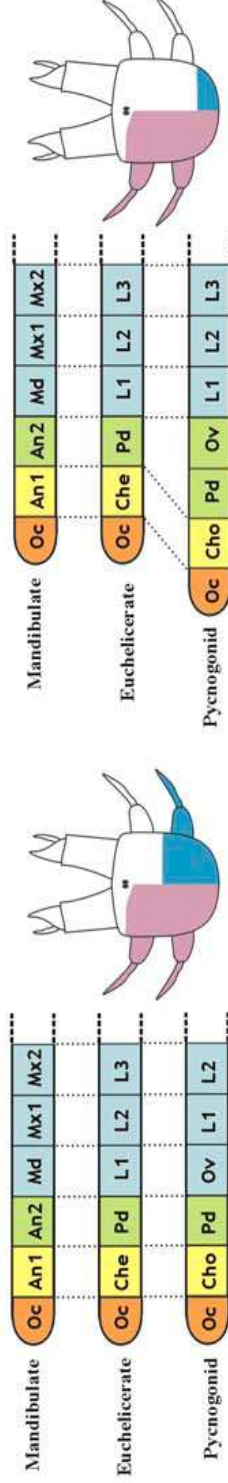
Hypothesis 1. Missing deutocerebrum in arachnids and pycnogonids, tritocerebral chelicerae / chelifores



Hyp. 1.1. Ovigera = modified walking legs

Hyp. 1.2. Ovigera = duplicated pedipalps

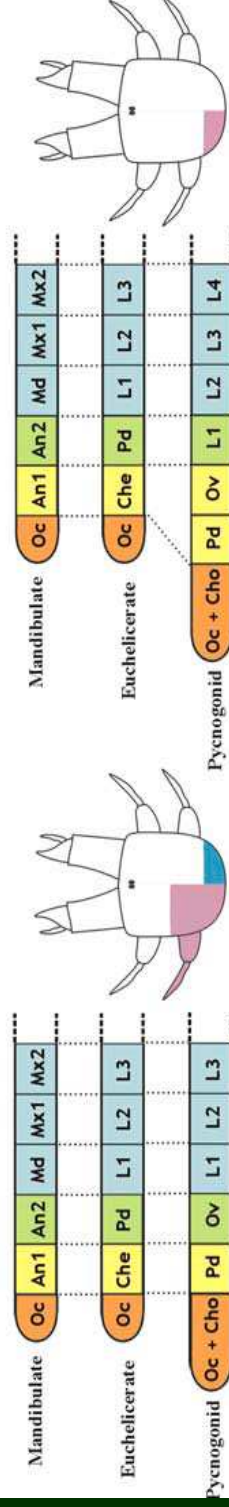
Hypothesis 2. Deutocerebral chelicerae and chelifores



Hyp. 2.1. Ovigera = modified walking legs
Hypothesis supported by observed Hox gene patterns

Hyp. 2.2. Ovigera = duplicated pedipalps

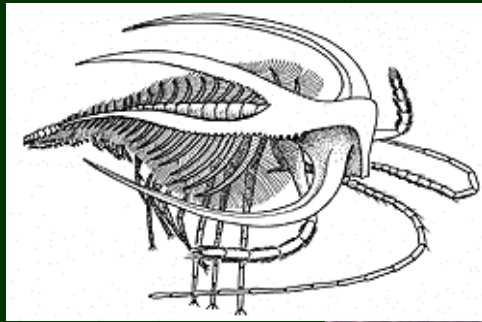
Hypothesis 3. Deutocerebral chelicerae, protocerebral chelifores



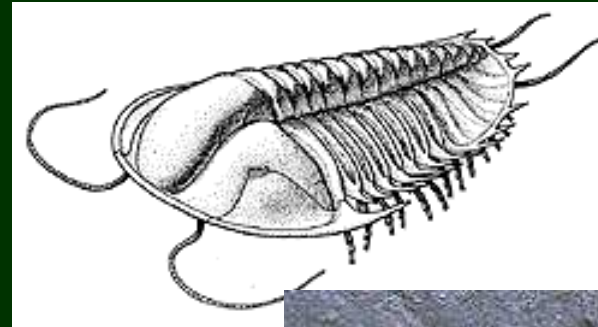
Hyp. 3.1. Ovigera = arachnid pedipalps

Hyp. 3.2. Pedipalps and ovigera = arachnid chelicerae

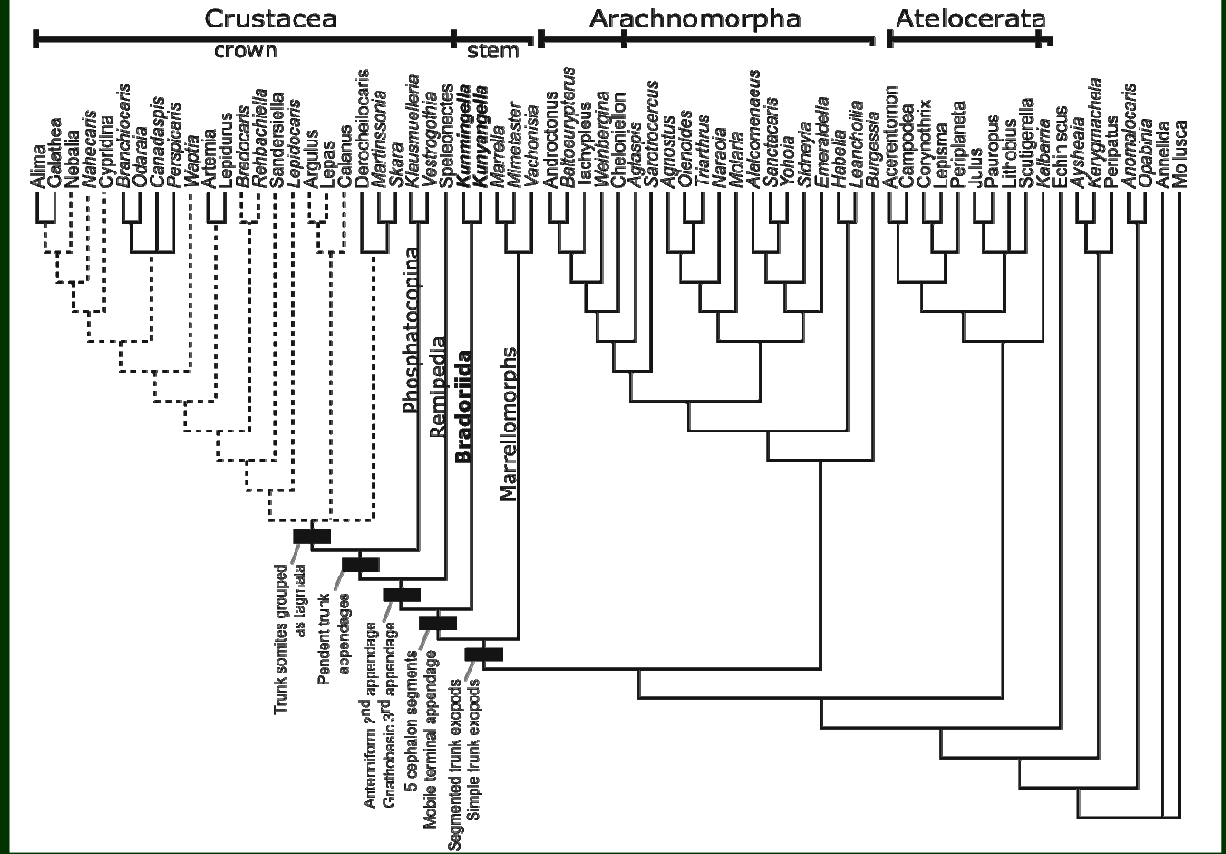
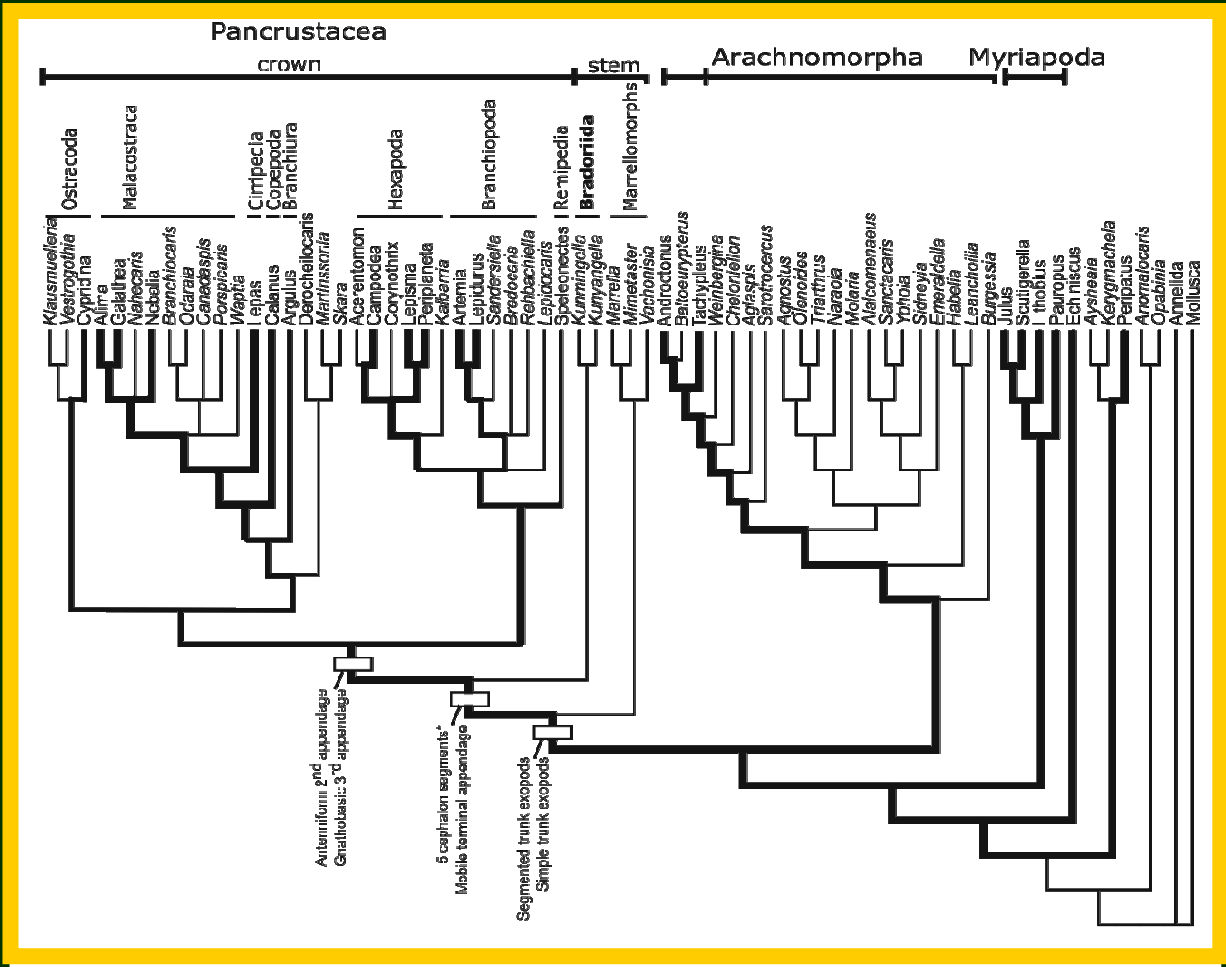
Kambrijští arachnomorfní členovci



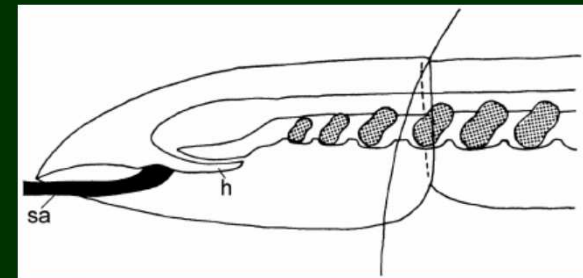
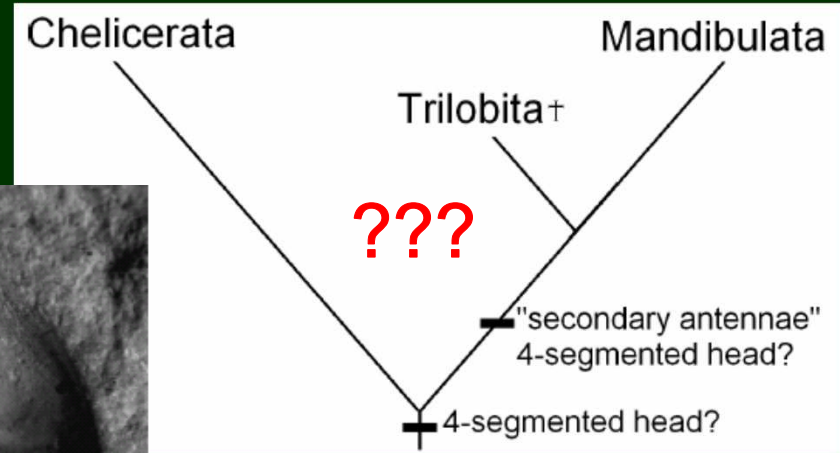
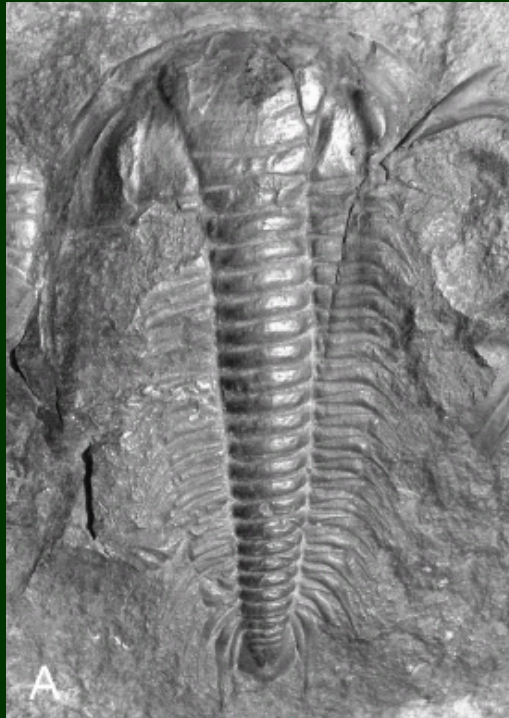
Marellomorpha



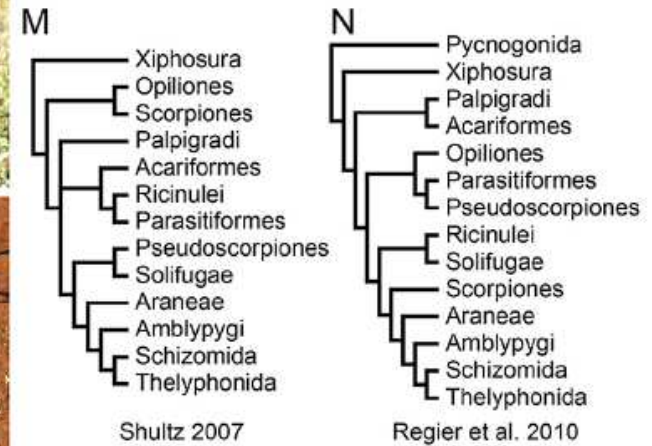
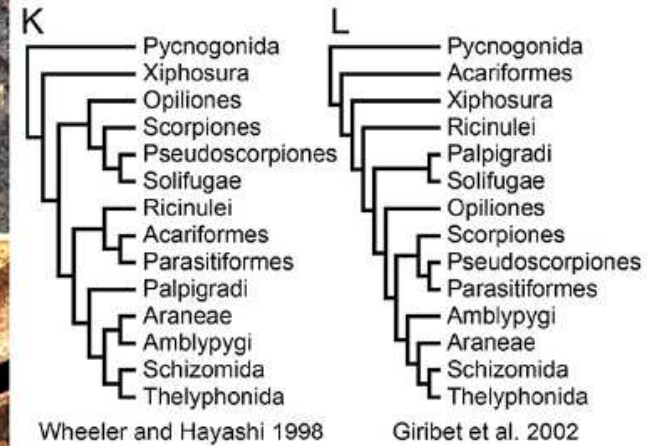
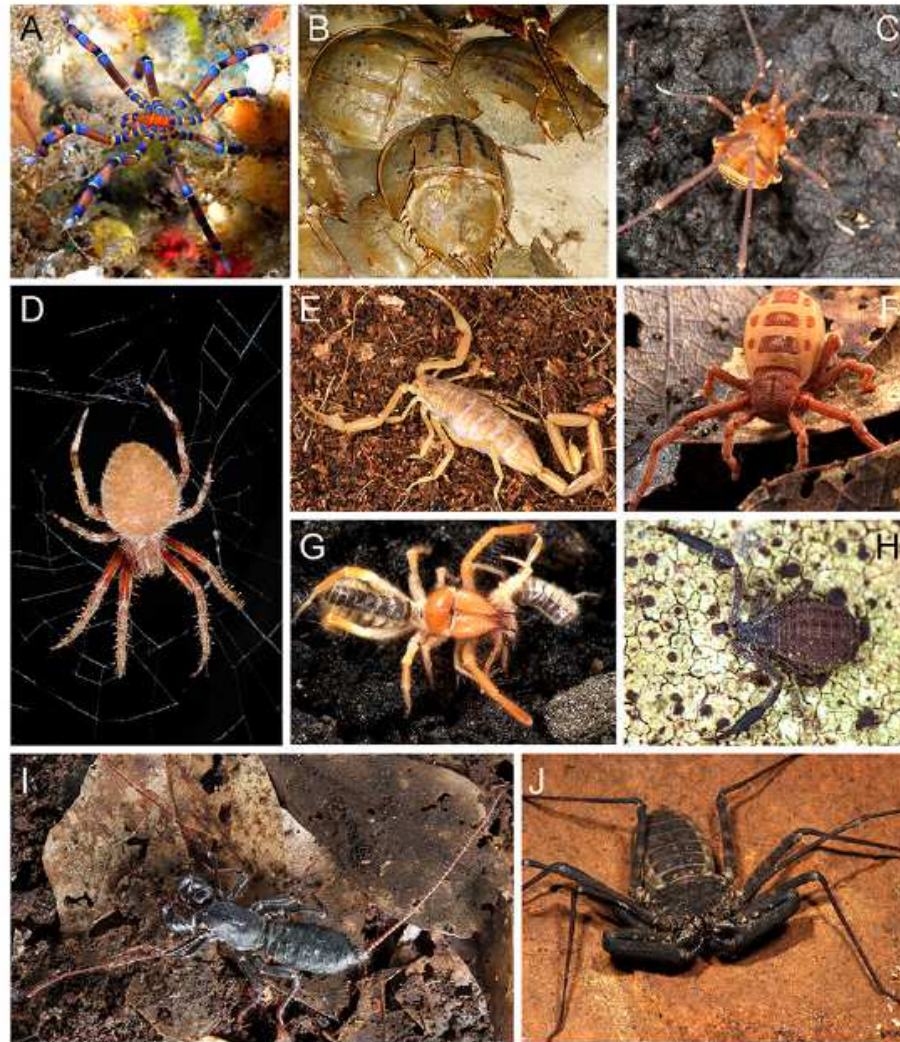
Trilobita



Trilobita

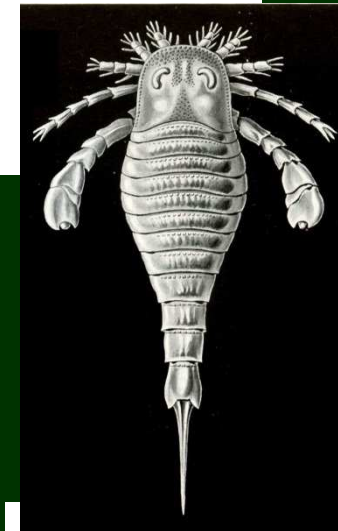
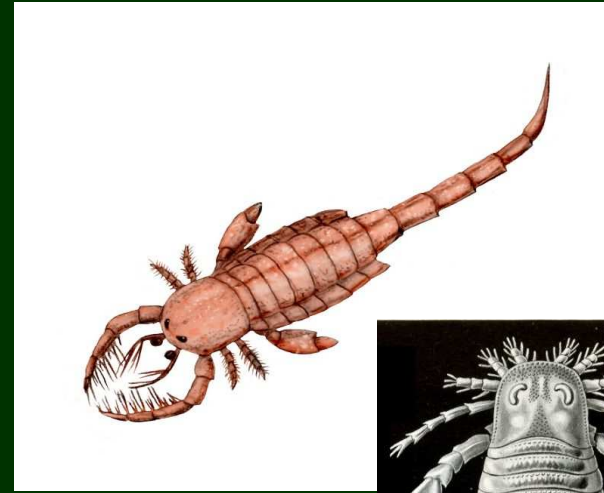


Euchelicerata

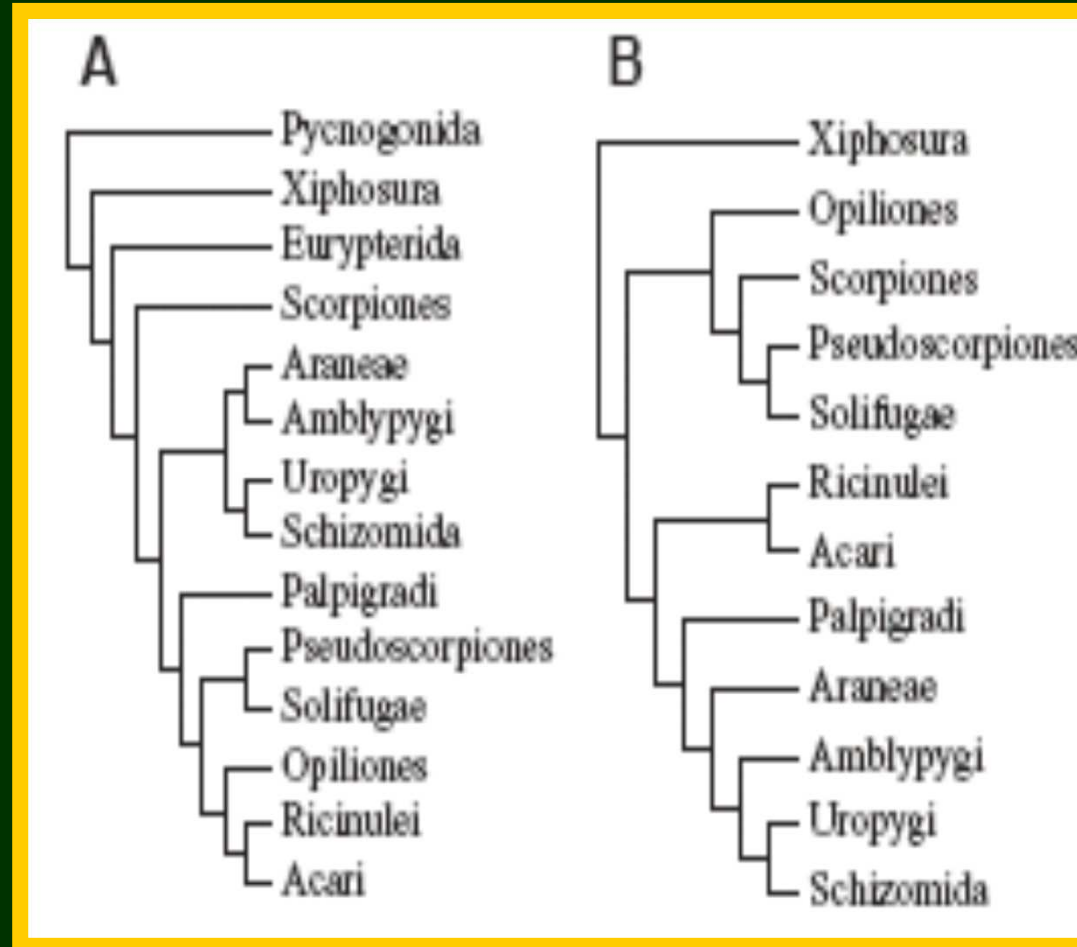


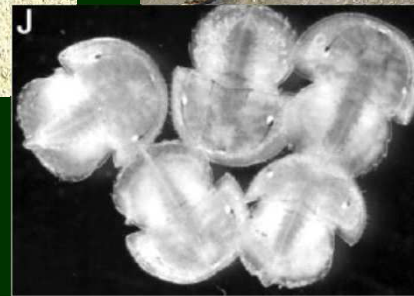
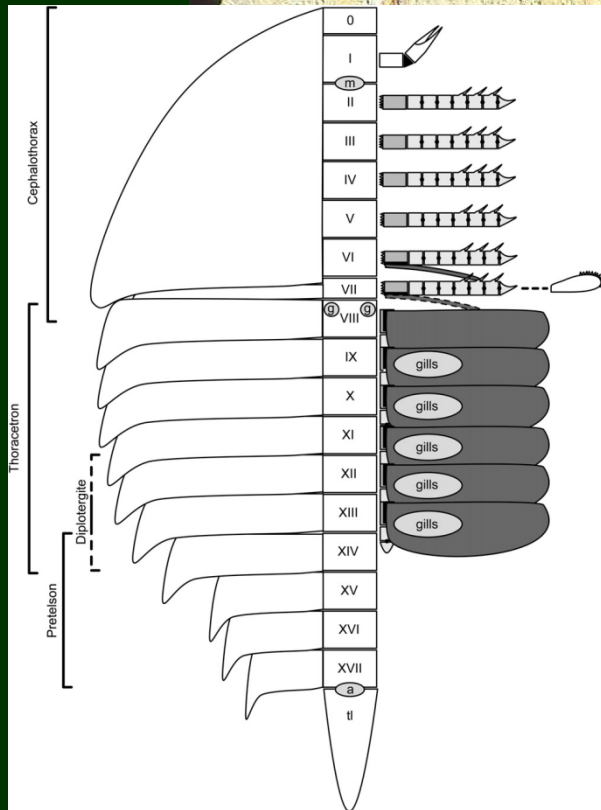
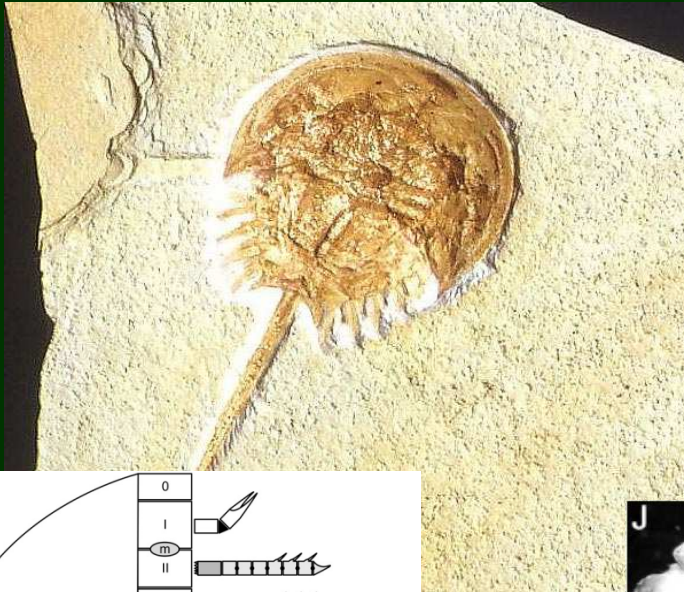
Euchelicerata

- tradičně
„Merostomata“ x
Arachnida
- 1. Xiphosura
- 2.1. Eurypterida
- 2.2. Arachnida



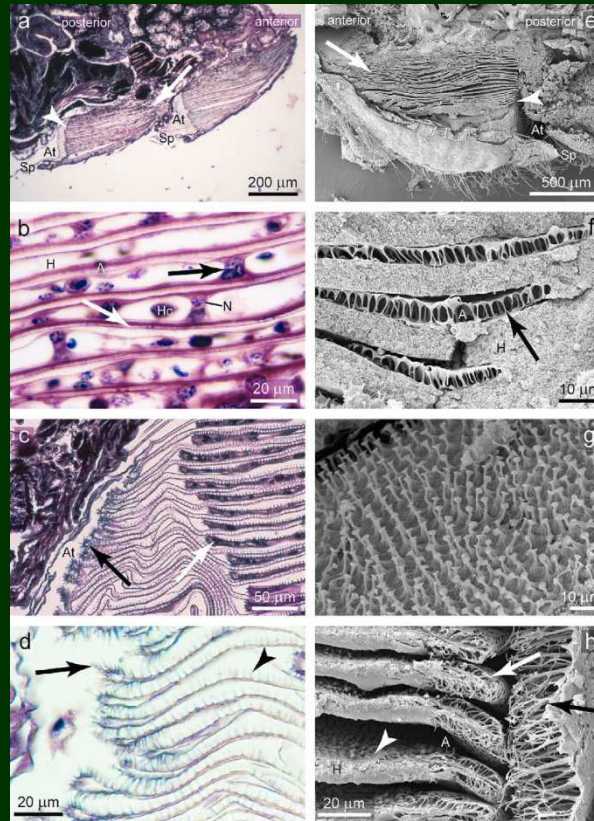
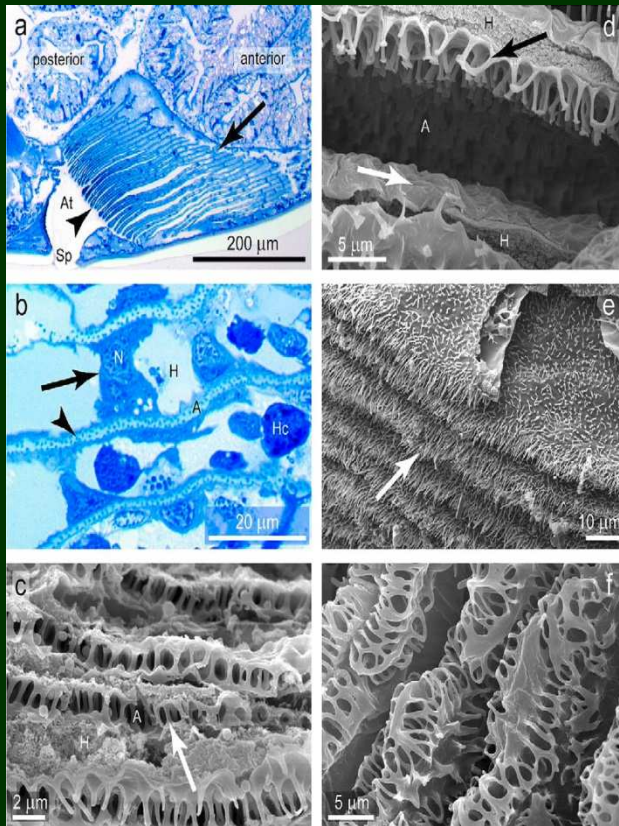
Euchelicerata – fylogeneze





Xiphosura

Arachnida – jedna kolonizace souše?

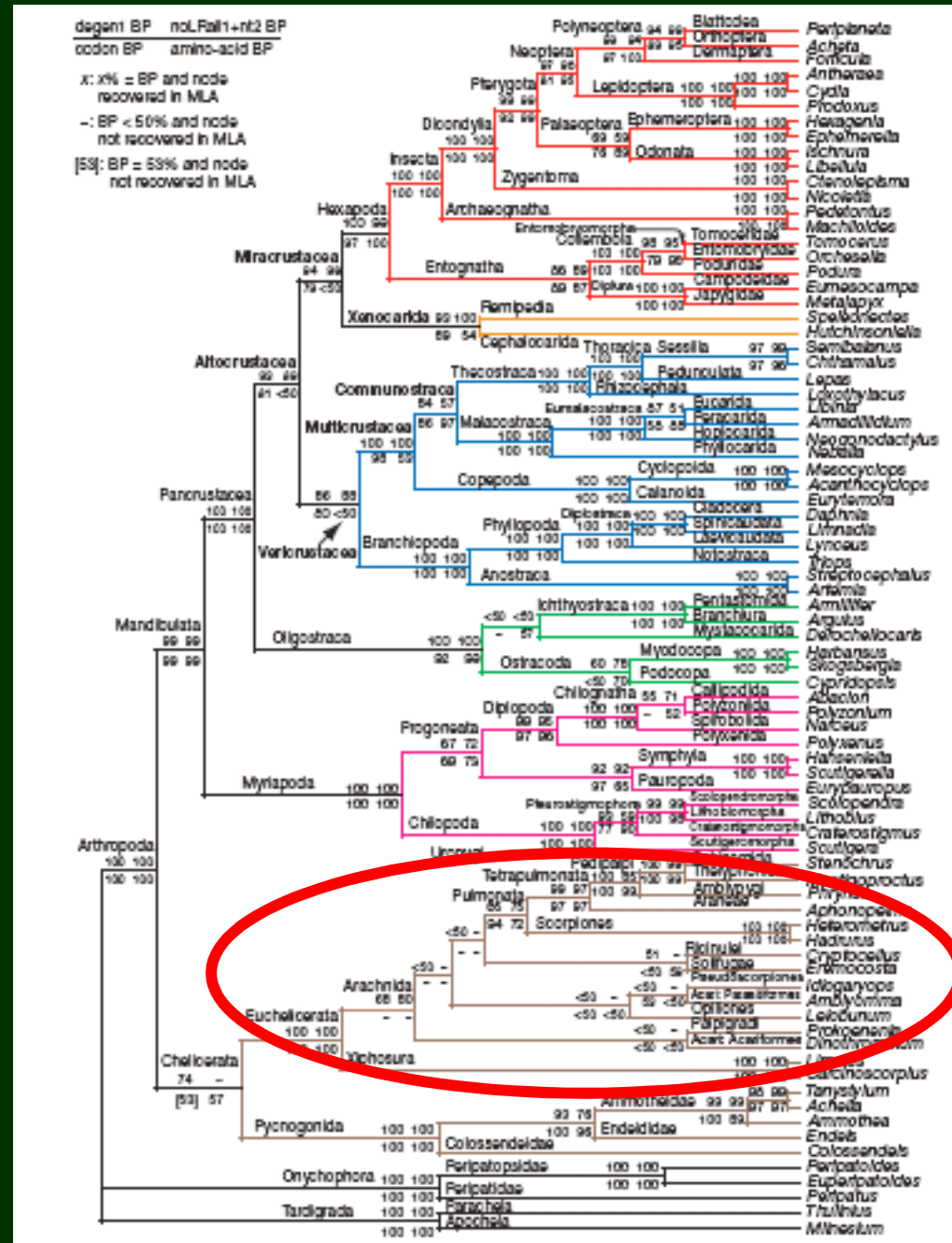


- homologické „plíce“ štírů a pavouků?
- X
- vodní štíři až do devonu (???)



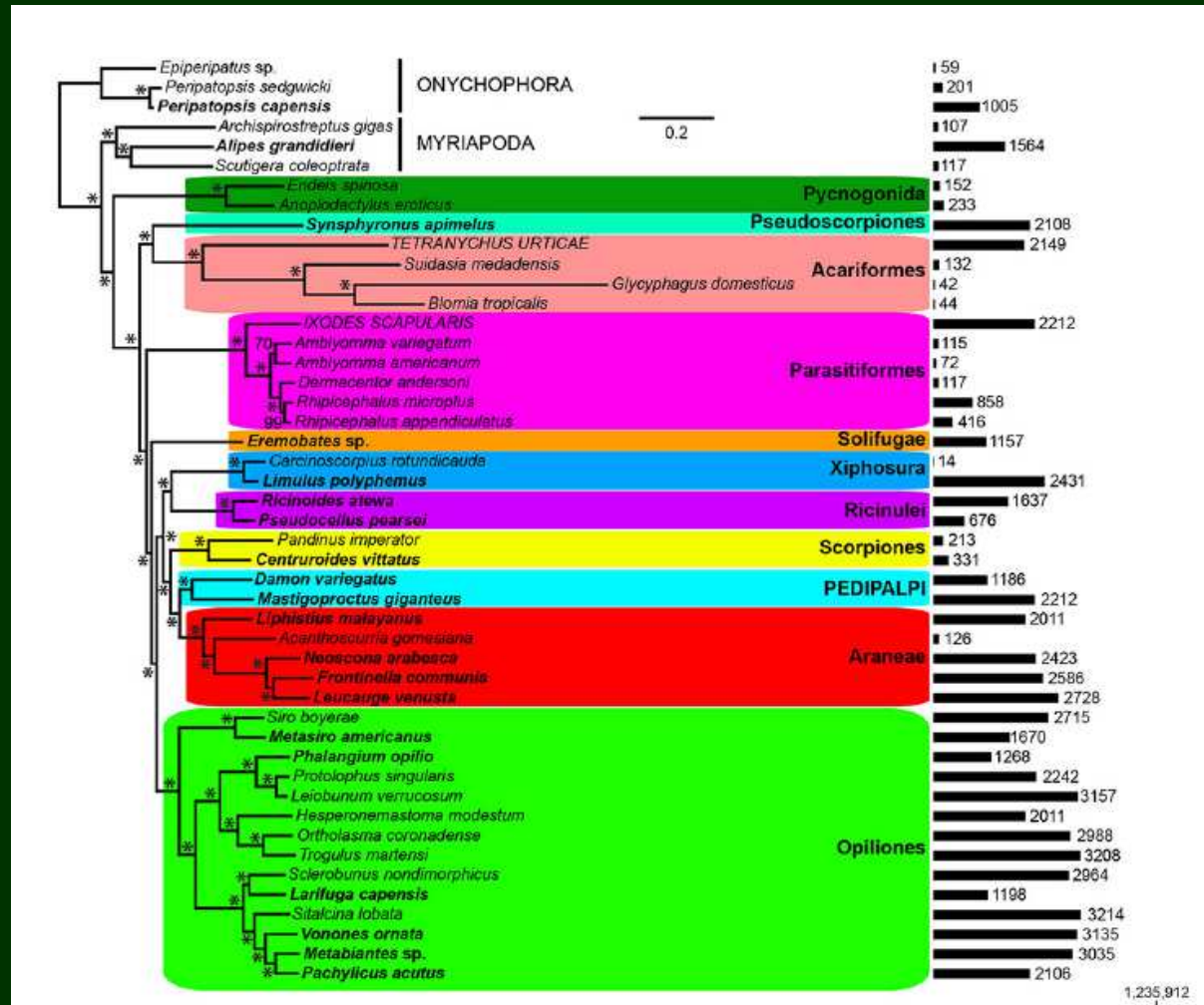
Chelicerata: nejasná fylogeneze

- 62 neparalogných nukleárných proteínových genů
- (41 kbp)
- zase jiná topologie + skoro žádná bazální podpora!
- Xiphosura x Arachnida



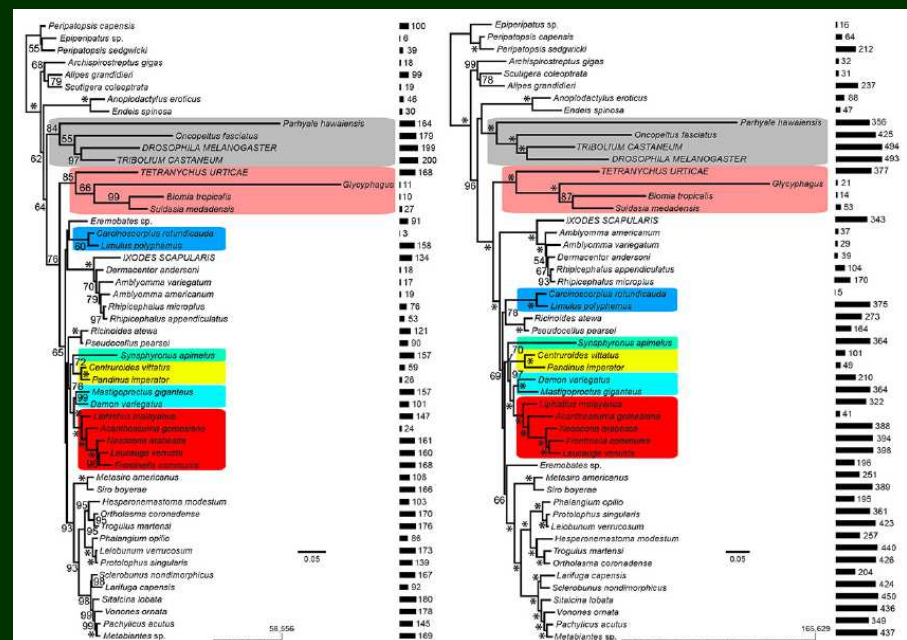
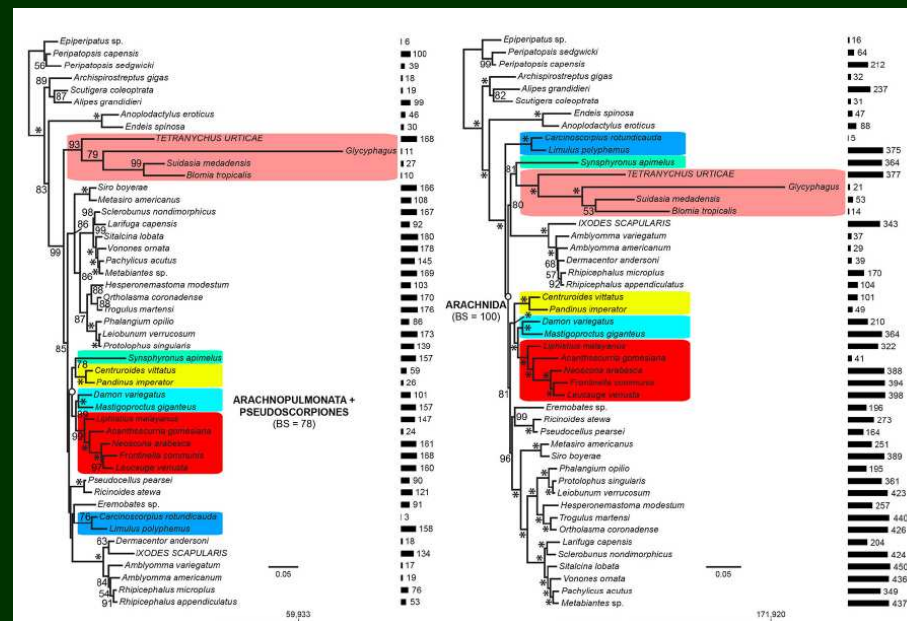
Arachnida – fylogenomika

všechny geny
(3600)



Arachnida – fylogenomika

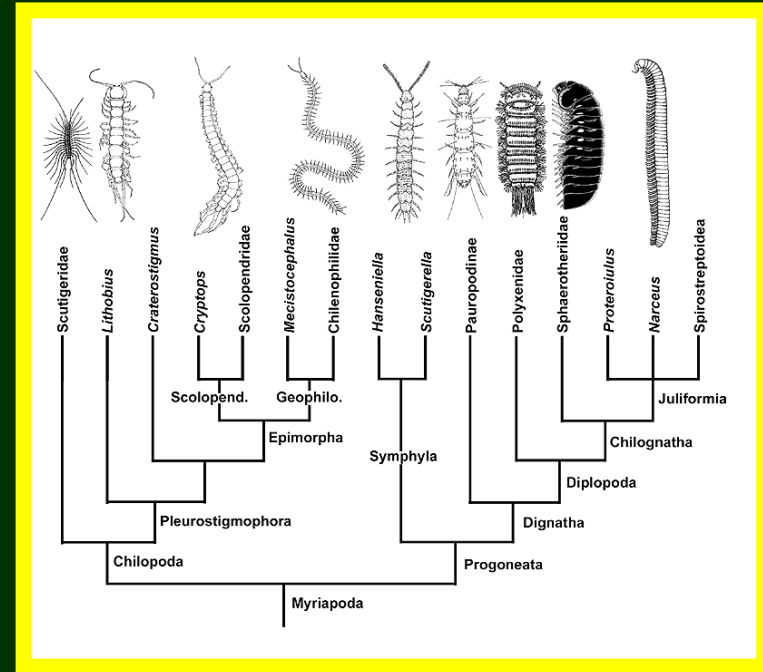
- nejpomalejší geny
- (Opiliones (Ricinulei + Solifugae))
- (Scorpiones + Tetrapulmonata) = **Arachnopulmonata**
- Pseudoscorpiones + Arachnopulmonata
- nejasná monofylie pavoukovců (!!!)
- jistá ne-monofylie roztočů



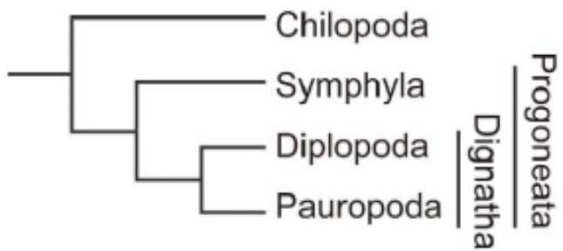


Myriapoda

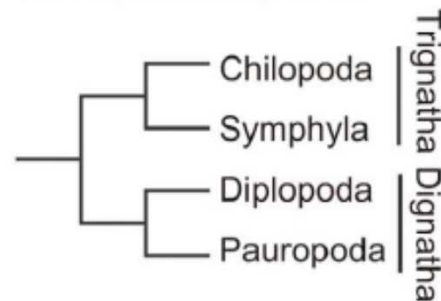
- 1. Chilopoda
- 2. Progoneata
 - Edafopoda
 - Dignatha



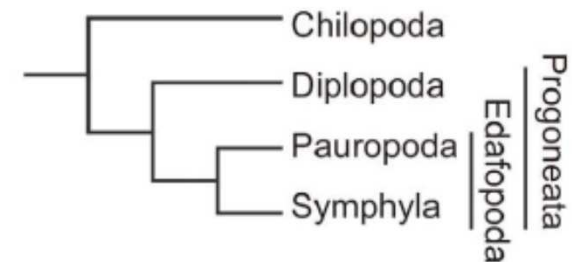
(a) Progoneata-Dignatha



(b) Trignatha-Dignatha

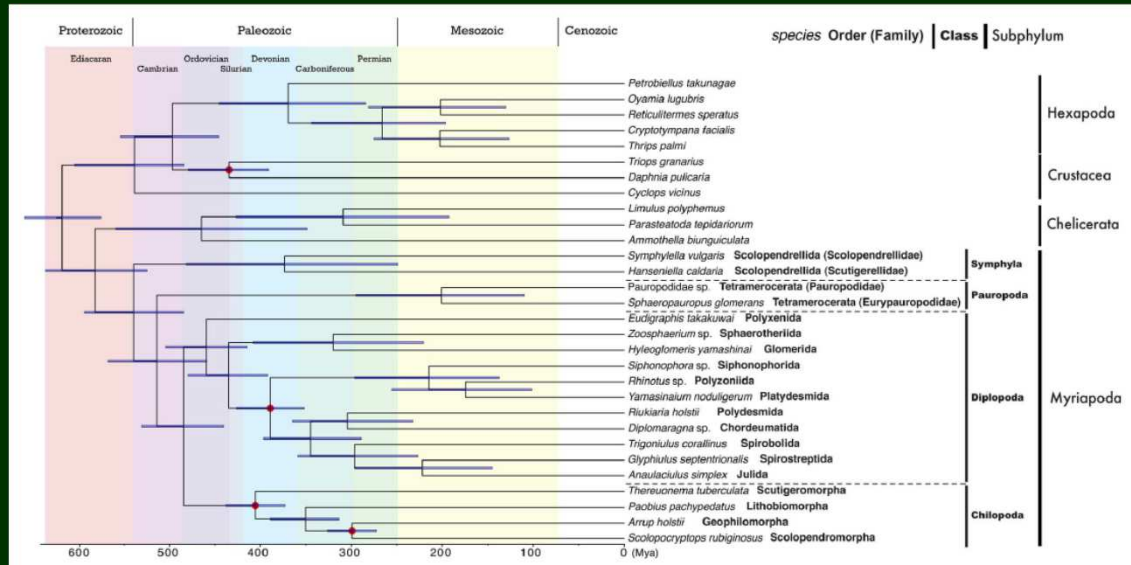
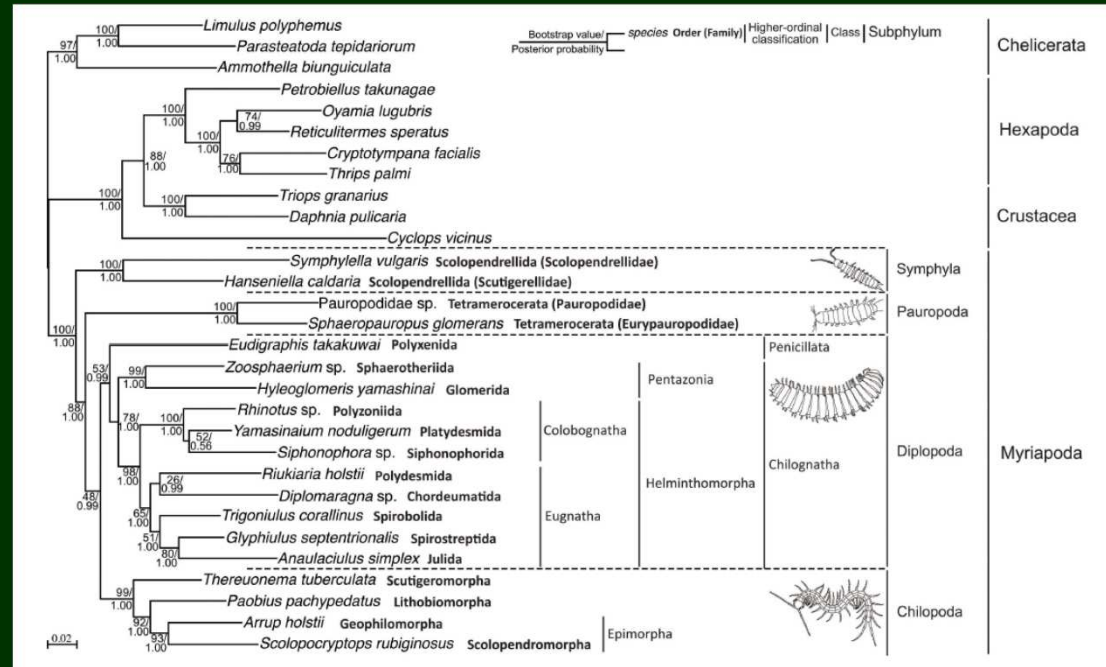


(c) Progoneata-Edafopoda



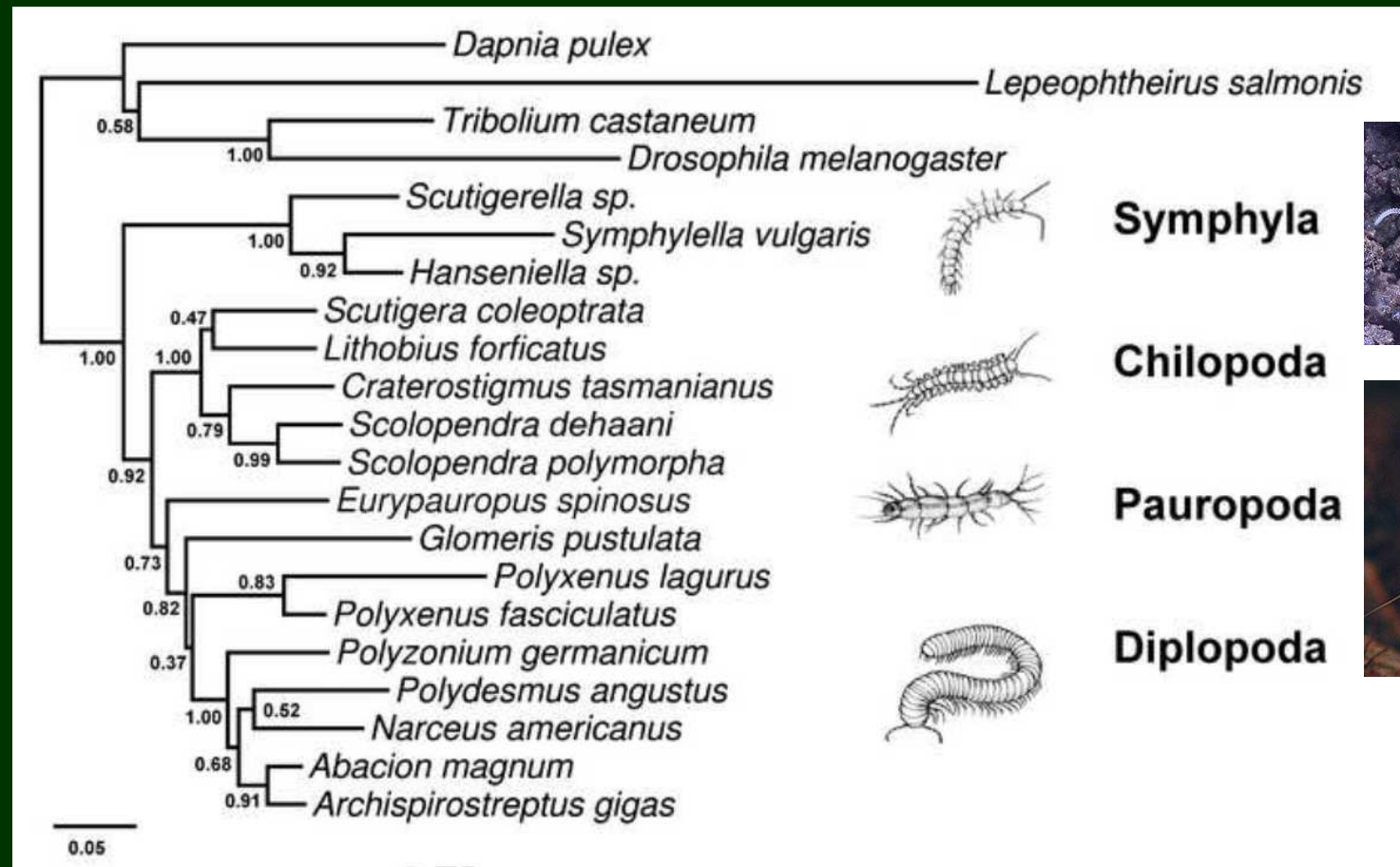
Myriapoda

- 3 nukleární proteinové proteiny



Myriapoda

- fylogenomika



Symphyla



Chilopoda



Pauropoda

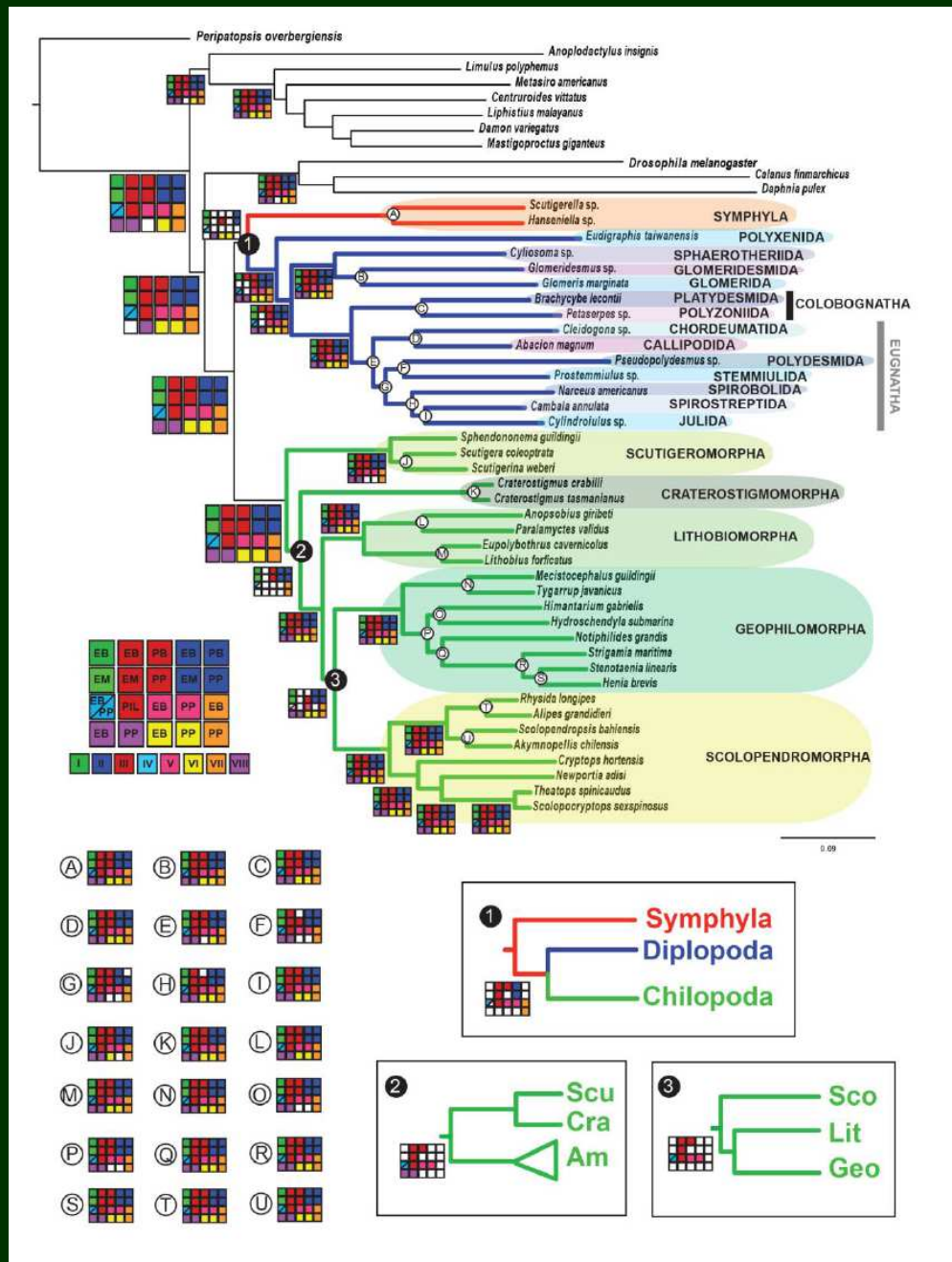


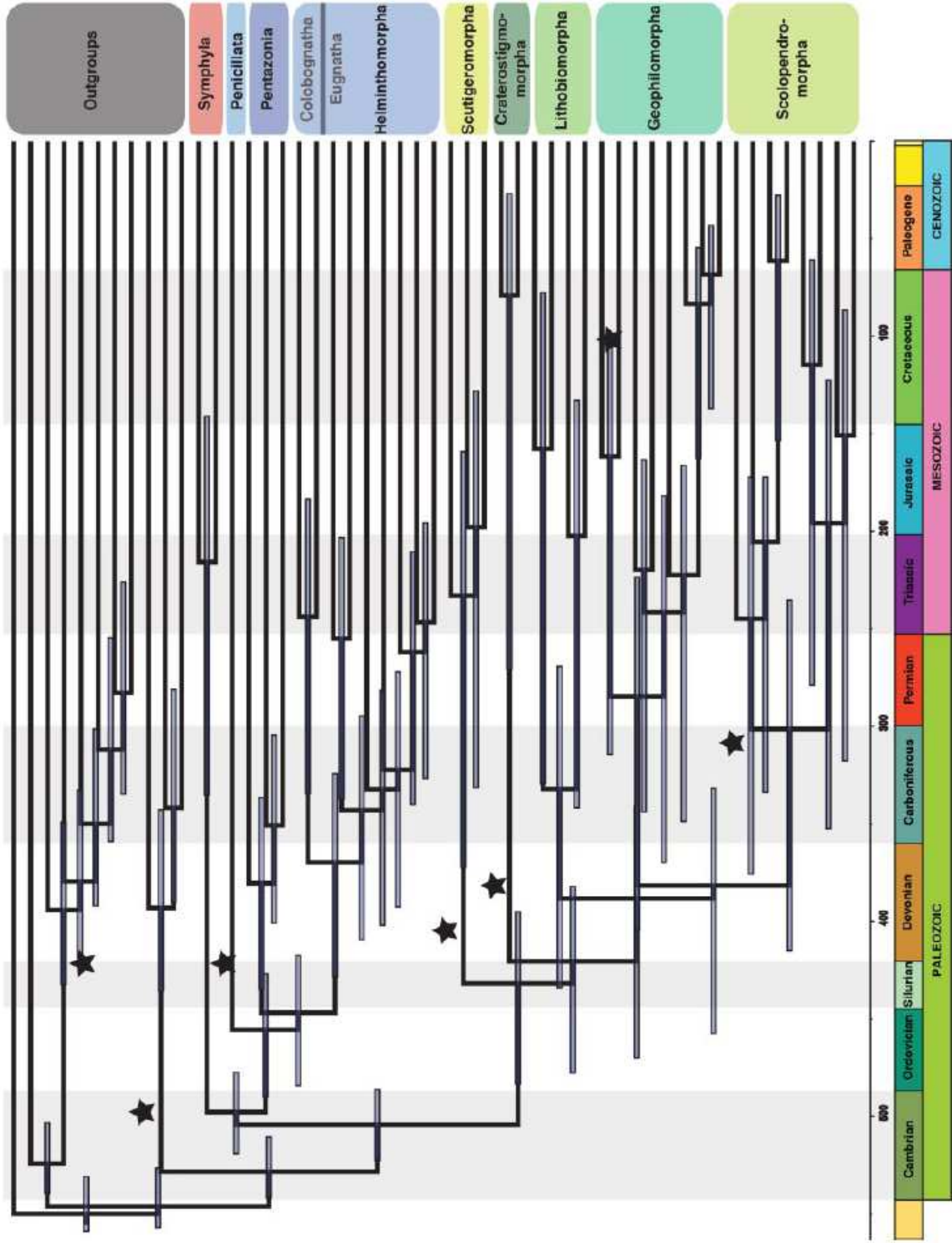
Diplopoda



Myriapoda

- fylogenomika
- Pauropoda – jenom 4 geny (sg Symphyla)





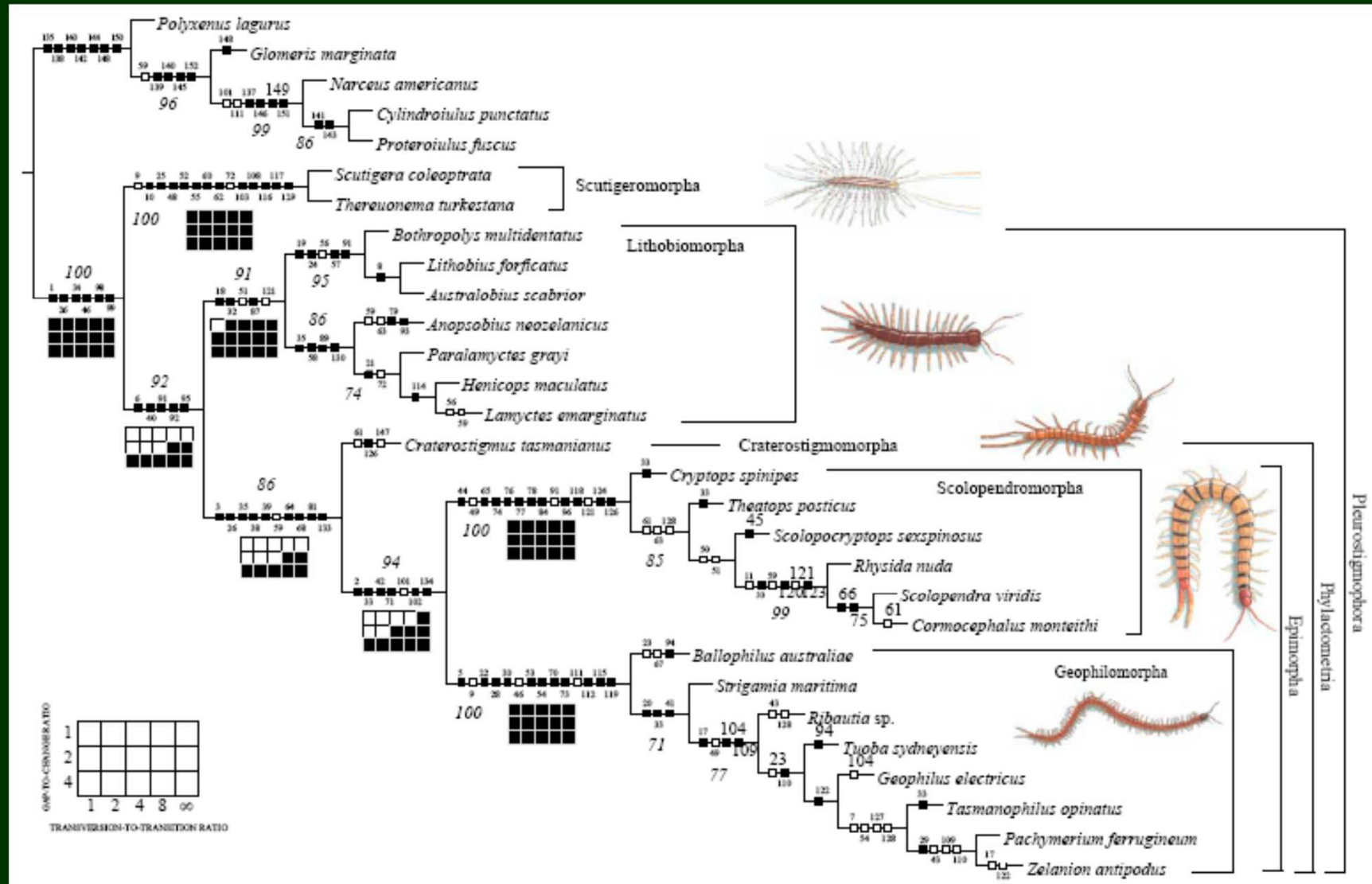
Chilopoda

- 1. Notostigmophora
- 2. Pleurostigmophora
 - Lithobiomorpha
 - Craterostigmomorpha
 - Scolopendromorpha
 - Geophilomorpha

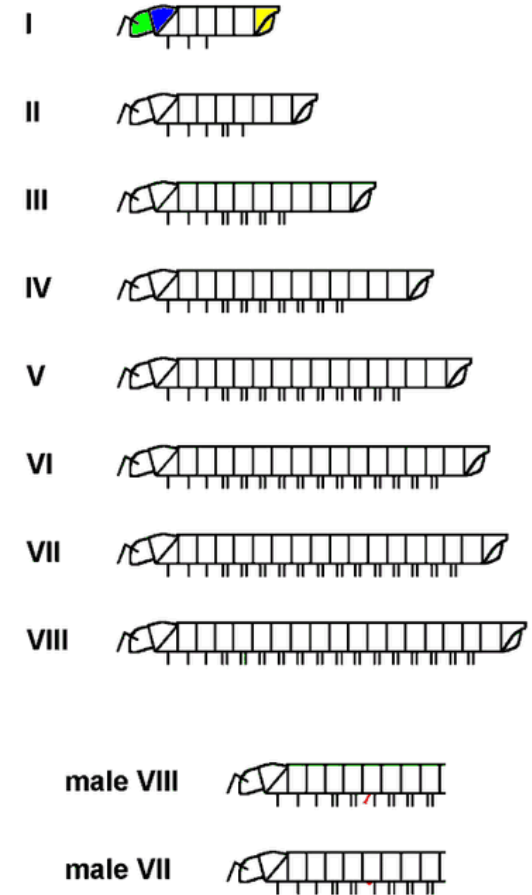
E

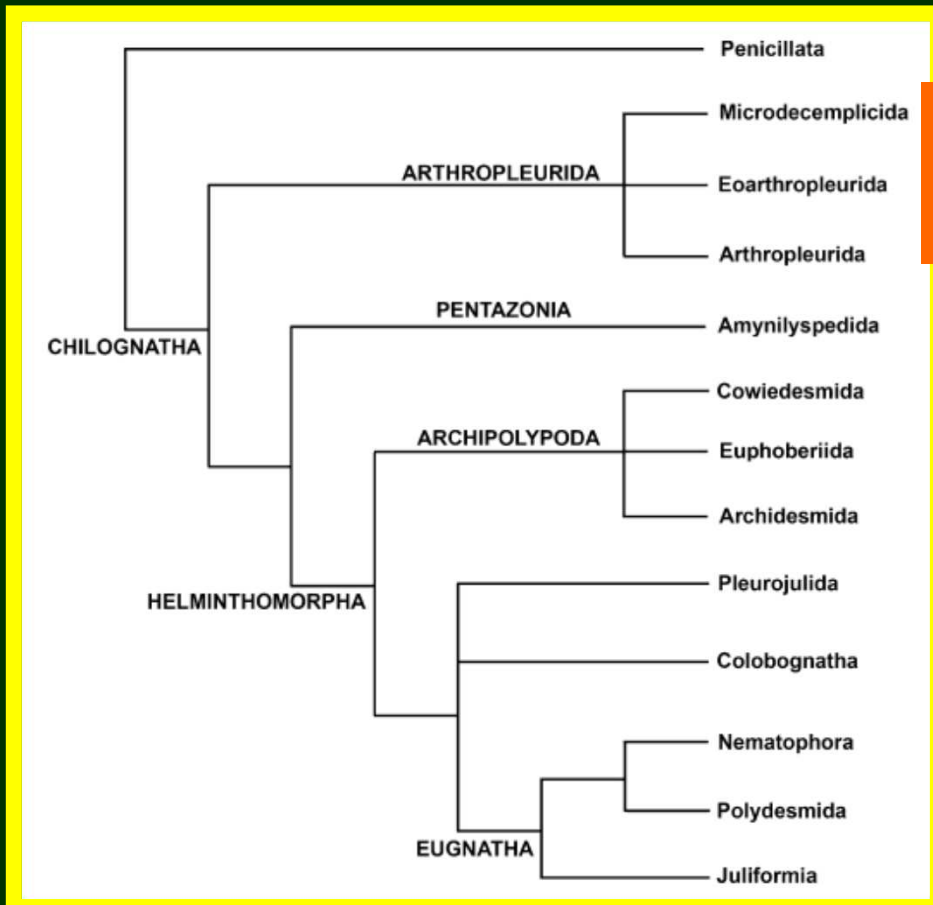


Chilopoda



Diplopoda

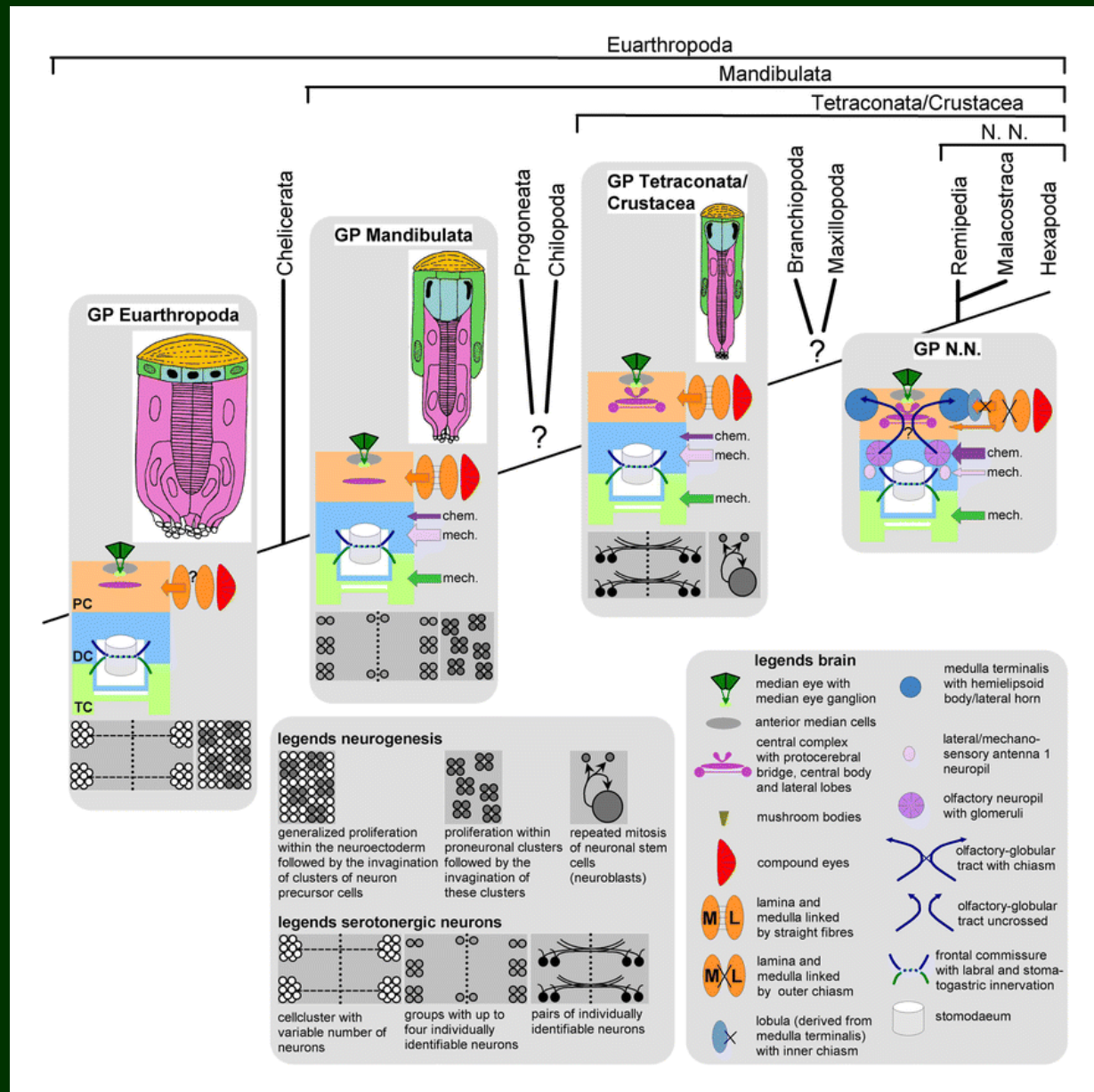




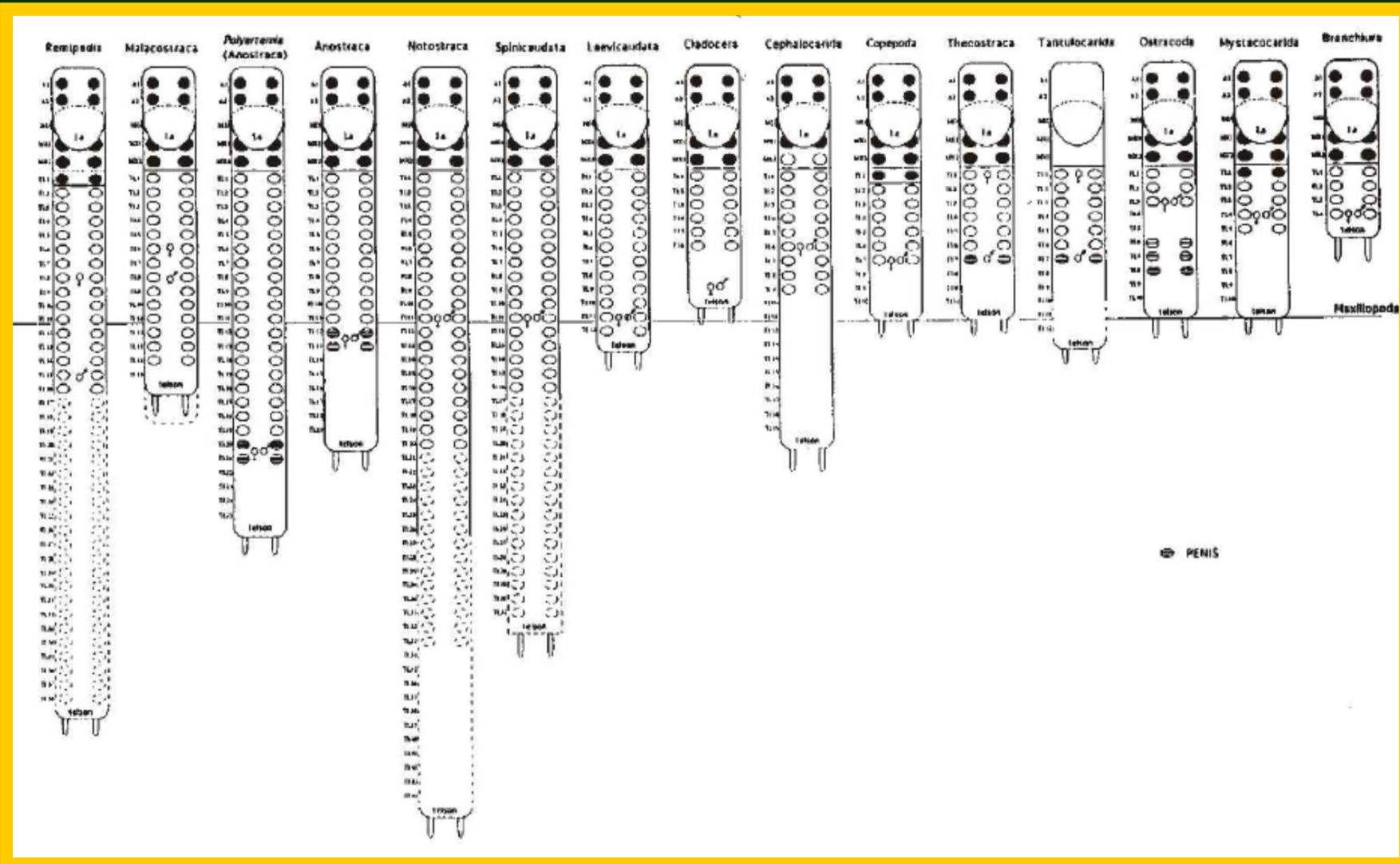
Arthropleurida

Pancrustacea

neuroanatomie +
smyslové orgány

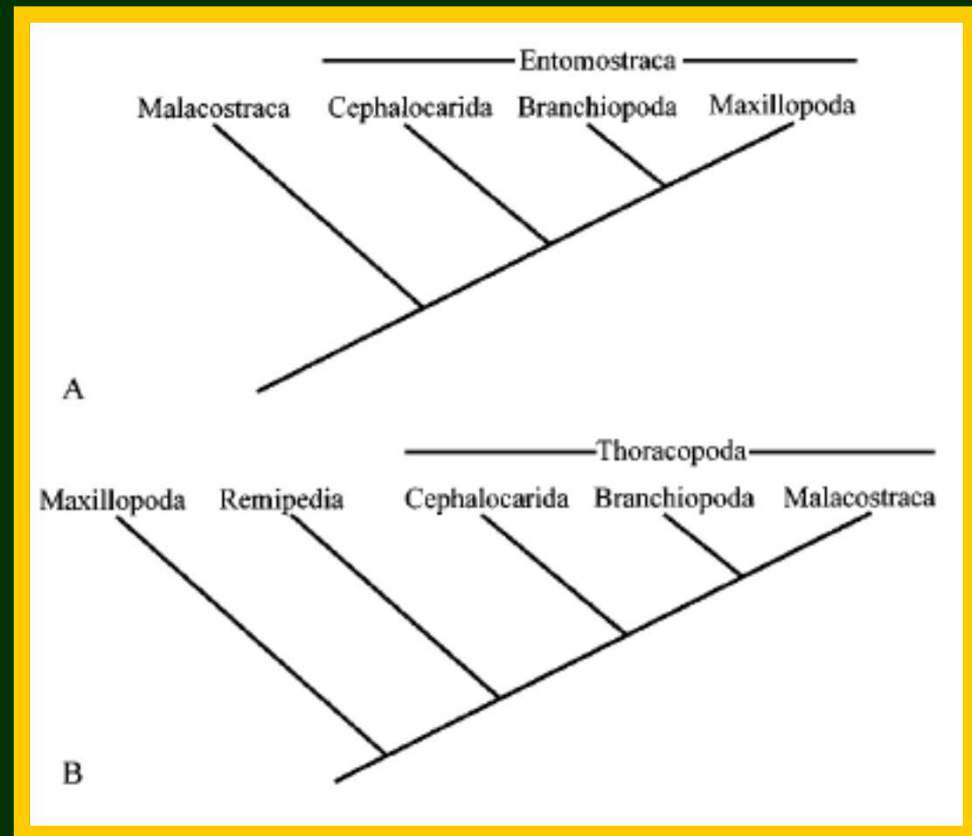


Crustacea – tagmatizace



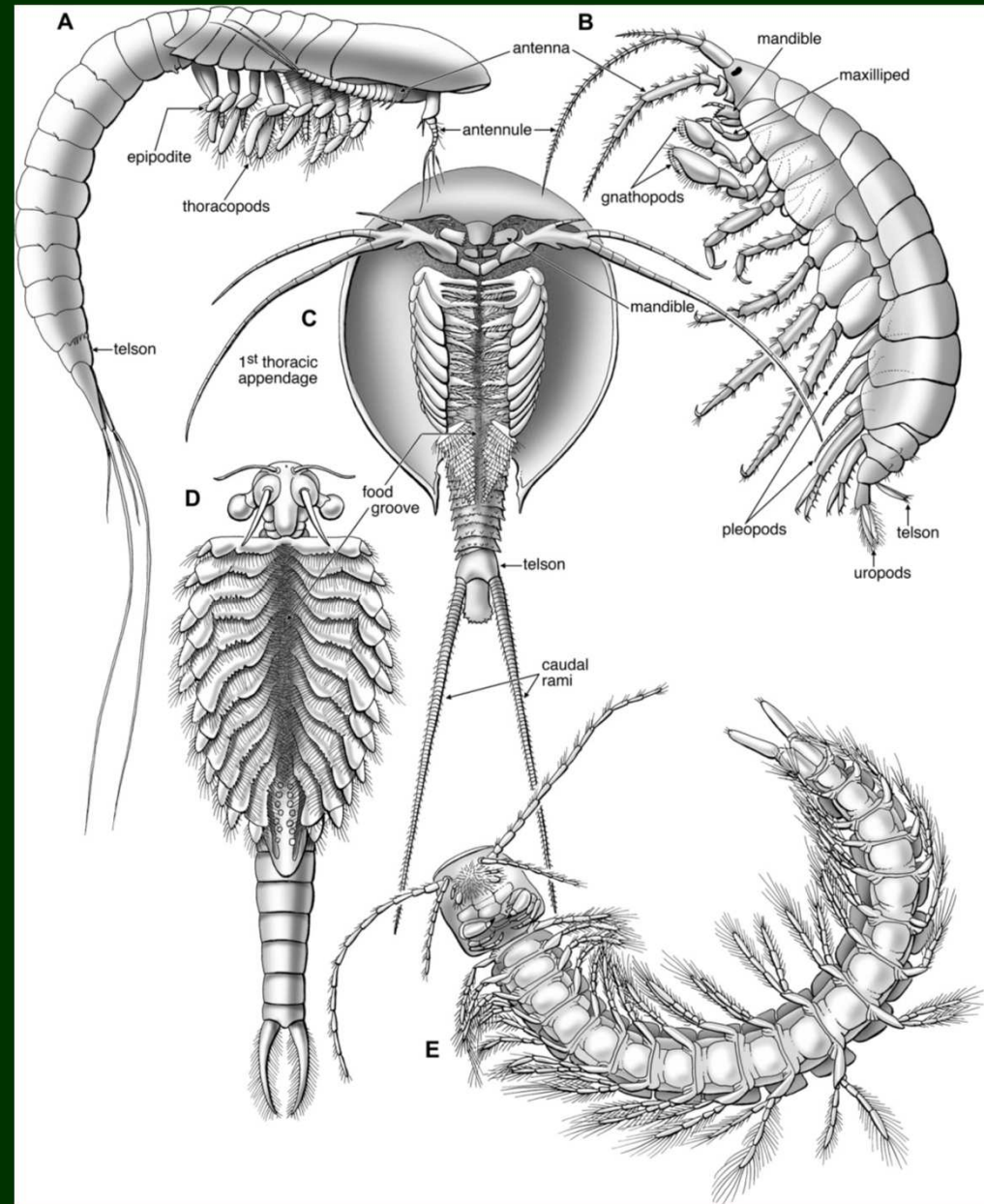
Systematika korýšů

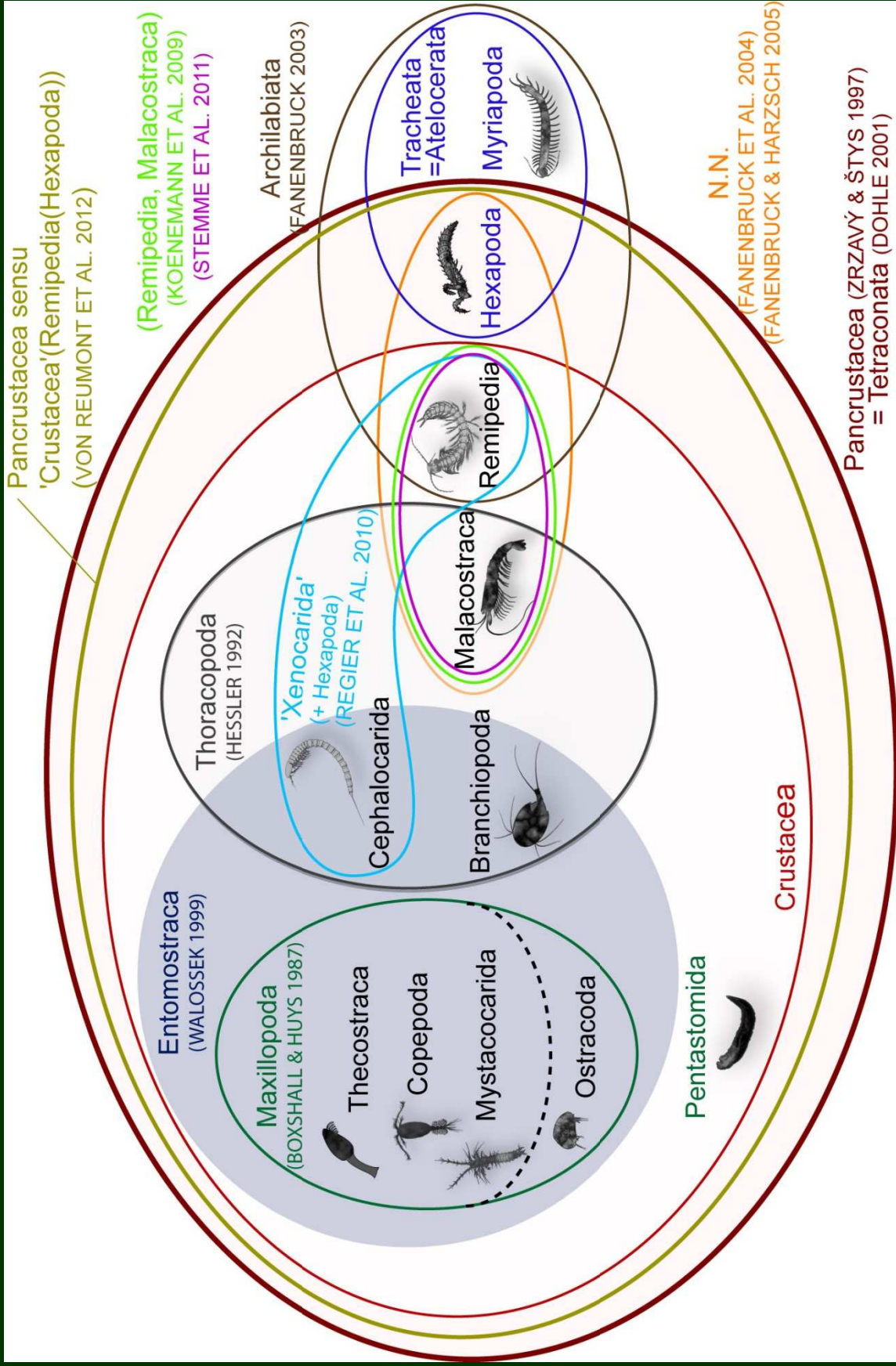
- tradičně
- **Entomostraca** x Malacostraca
- Maxillopoda x **Thoracopoda**
- + Hexapoda
- + Pentastomida

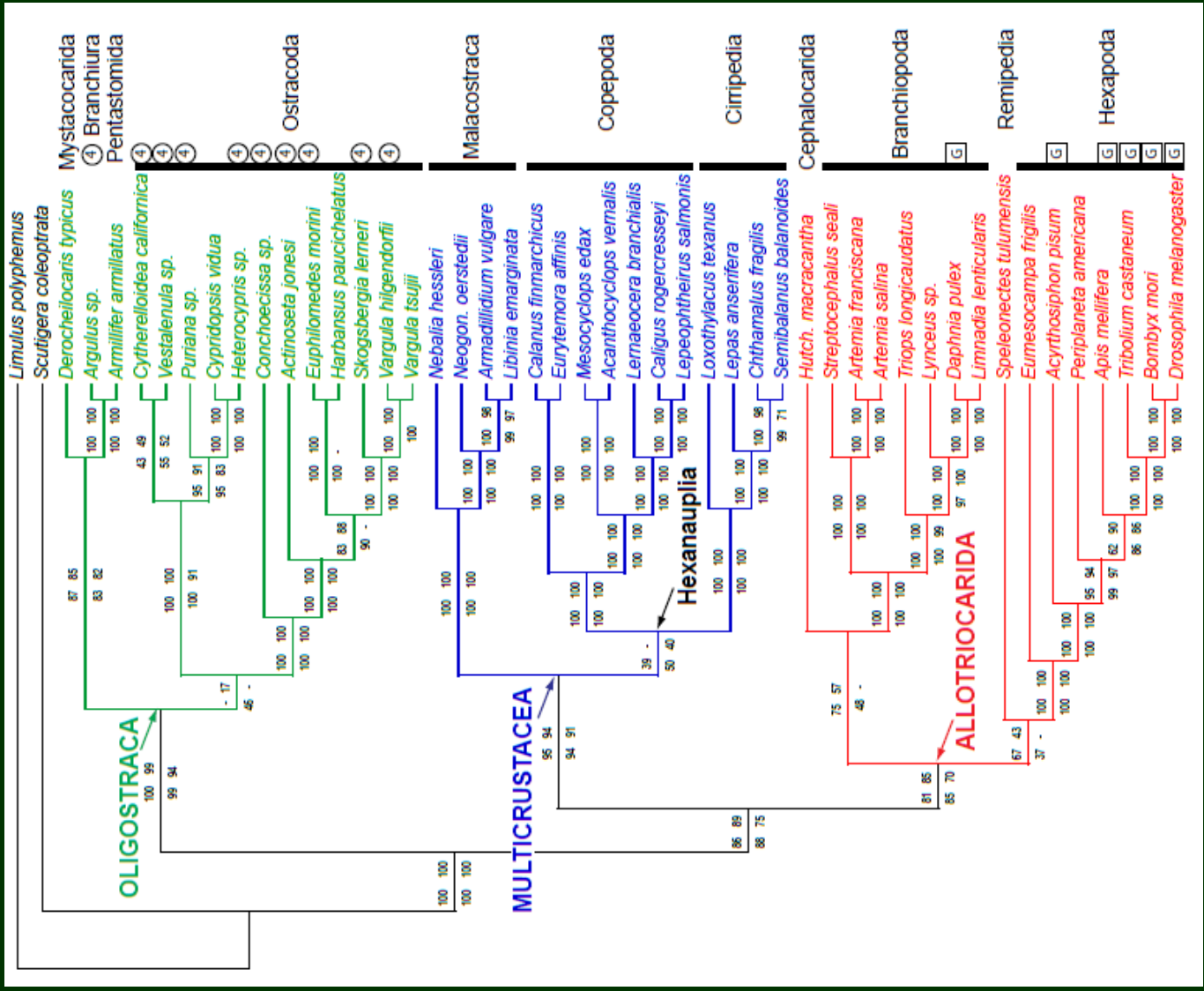


Pancrustacea

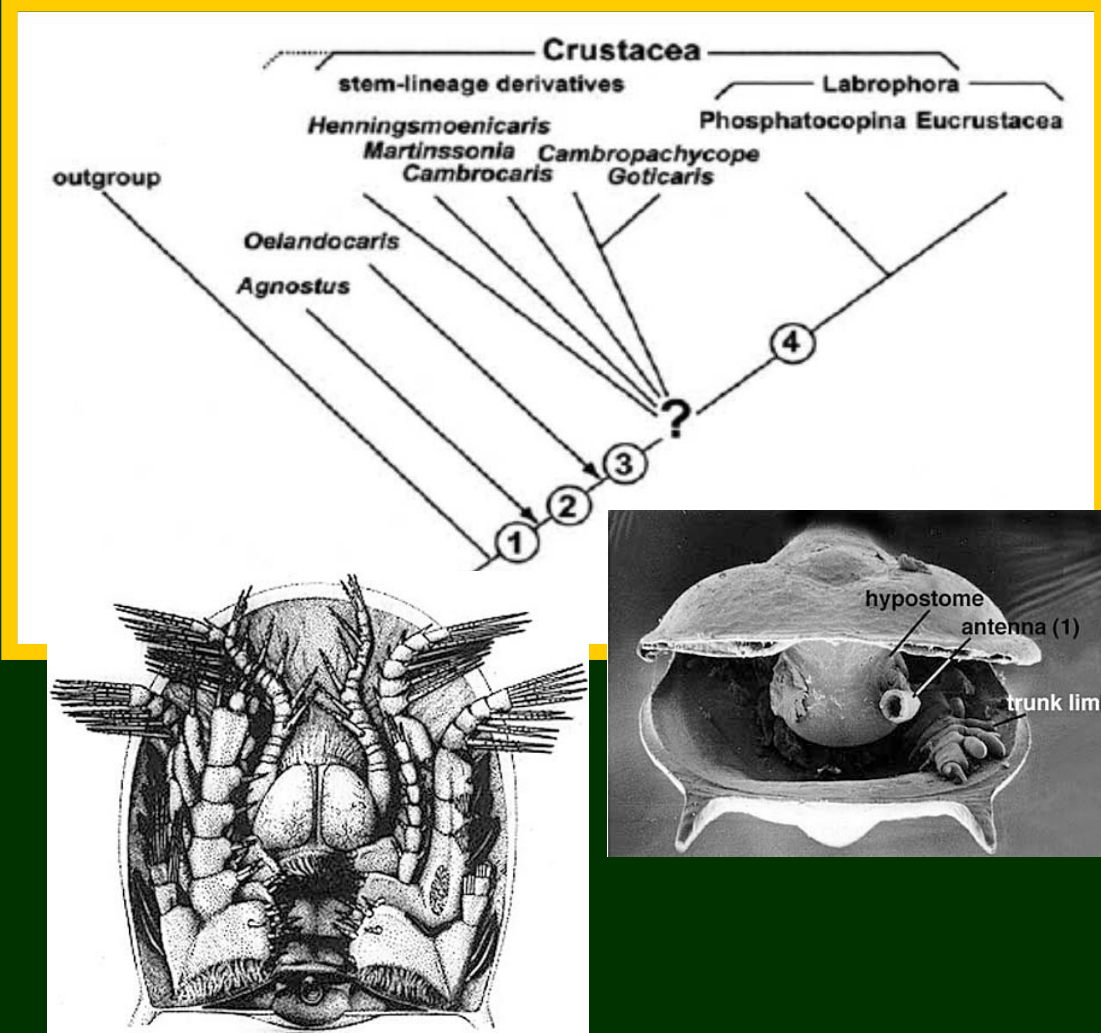
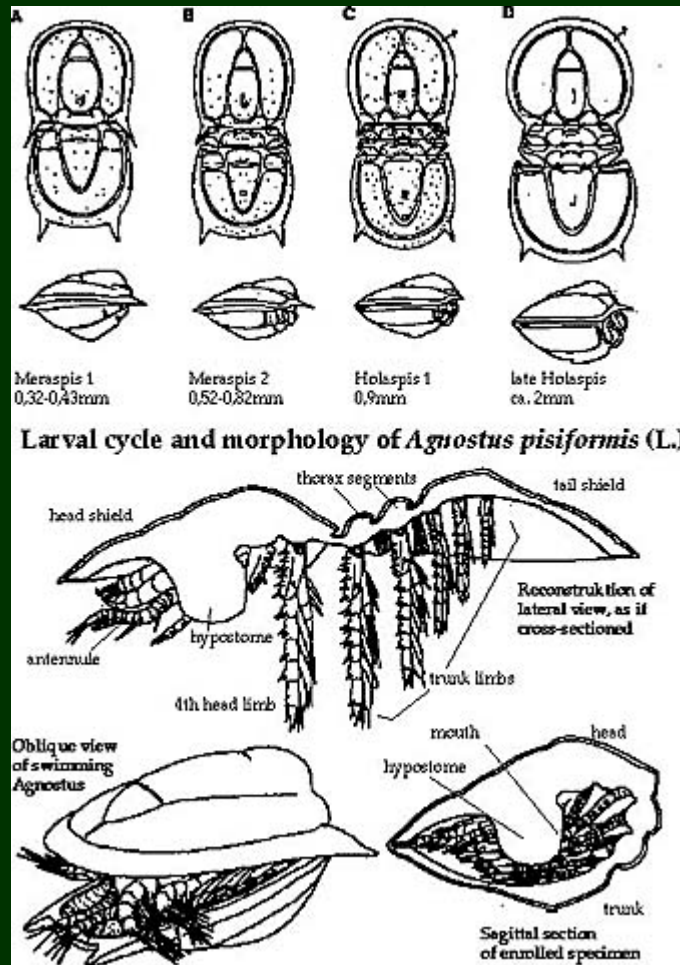
- možné sesterské skupiny hexapod
- Remipedia
- Xenocarida (= Remipedia + Cephalocirrida)
- Xenocarida + Branchiopoda
- Malacostraca





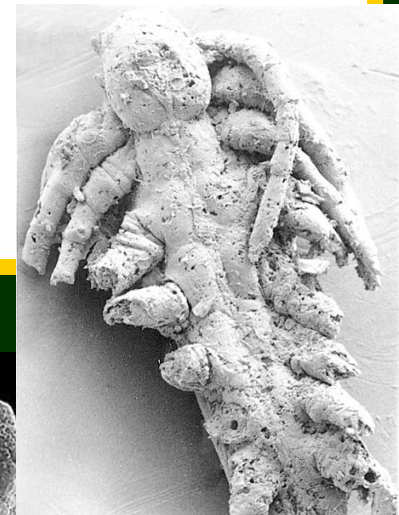
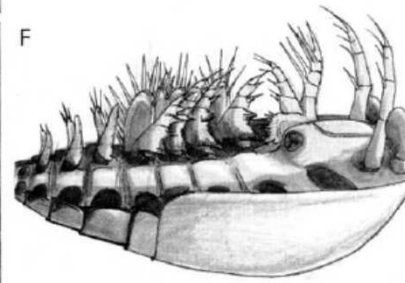
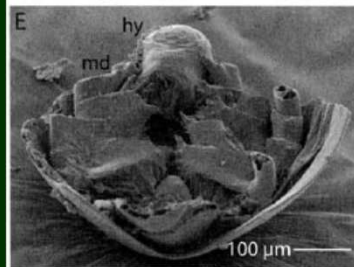
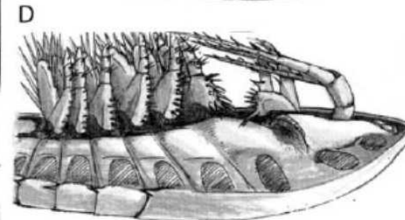
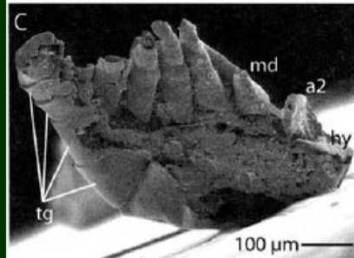
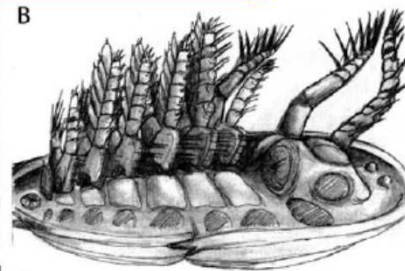
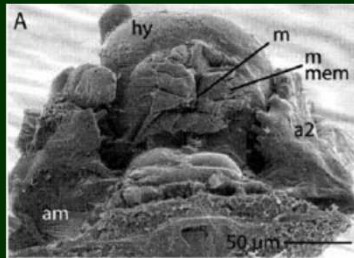
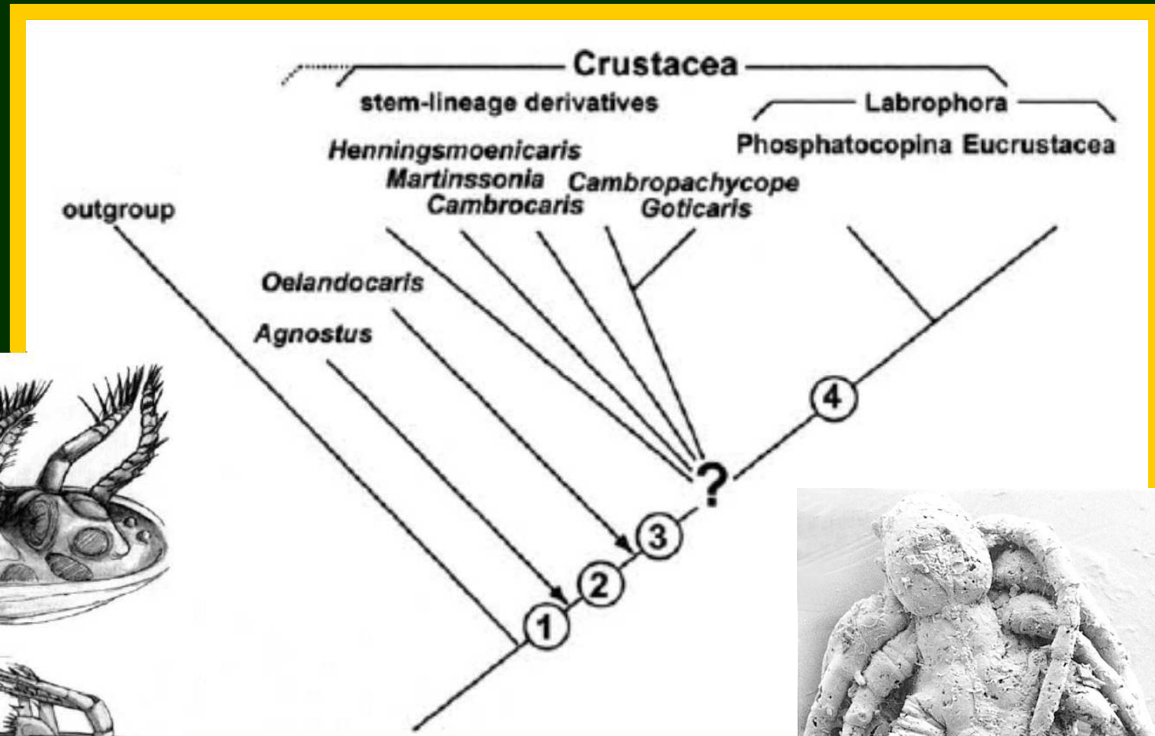


kmenová linie korýšů: *Agnostus*

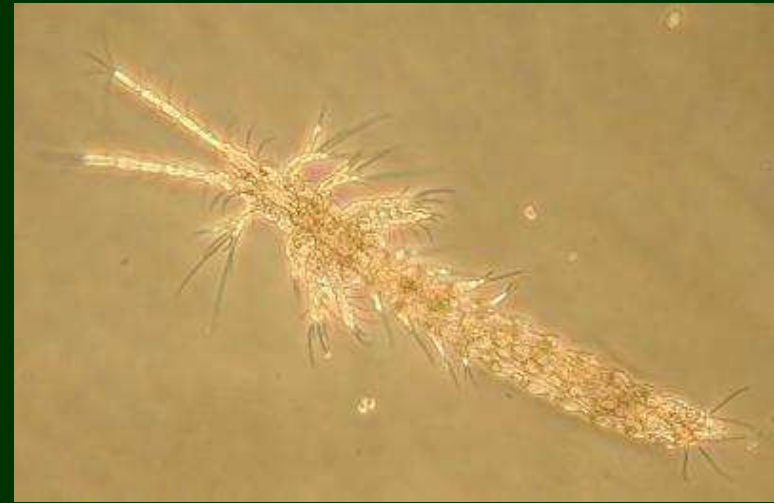


kmenová linie korýšů 2

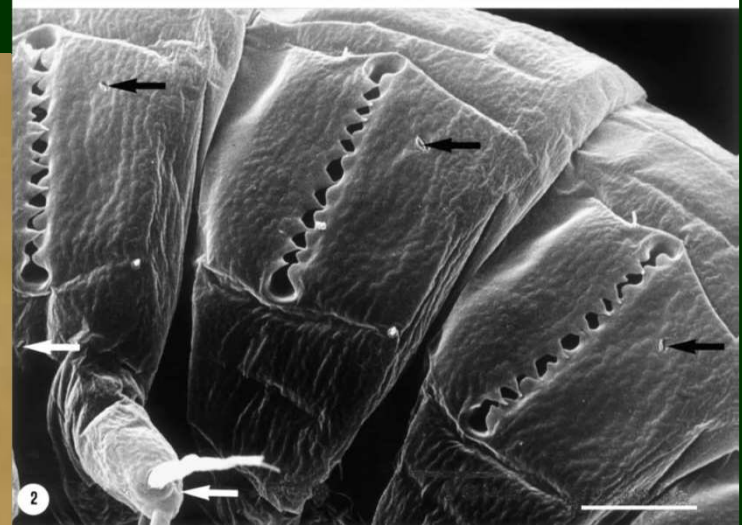
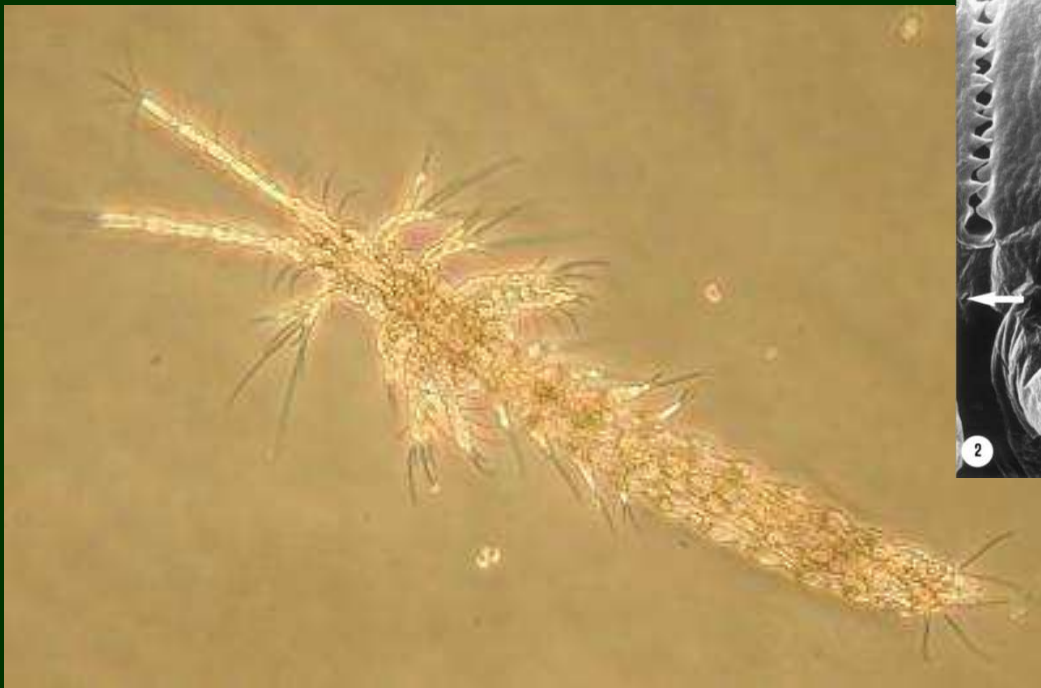
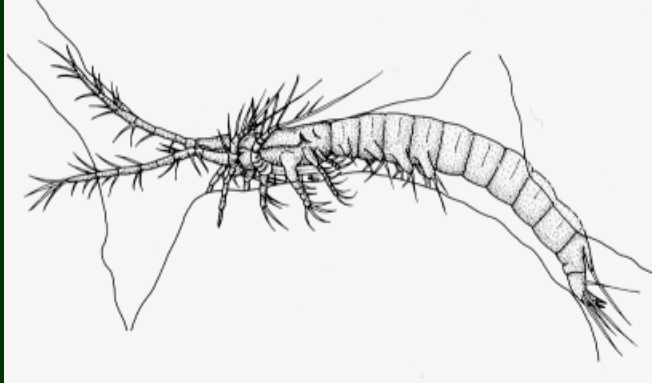
- *Oelandocaris*
- *Martinssonina*
- *Cambropachycope*
- *Cambrocaris*
- *Goticaris*
- *Henningsmoenicaris*



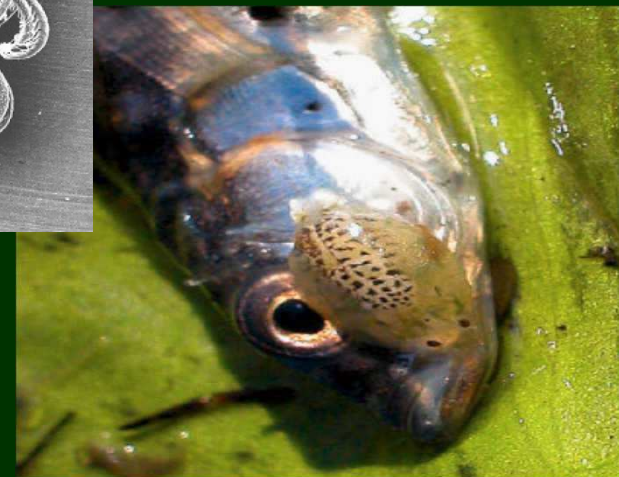
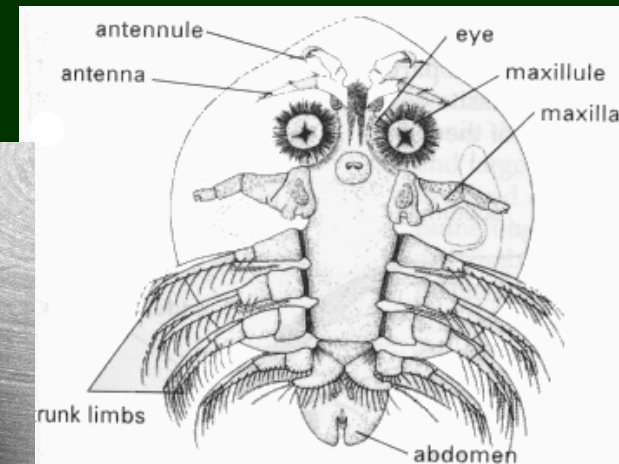
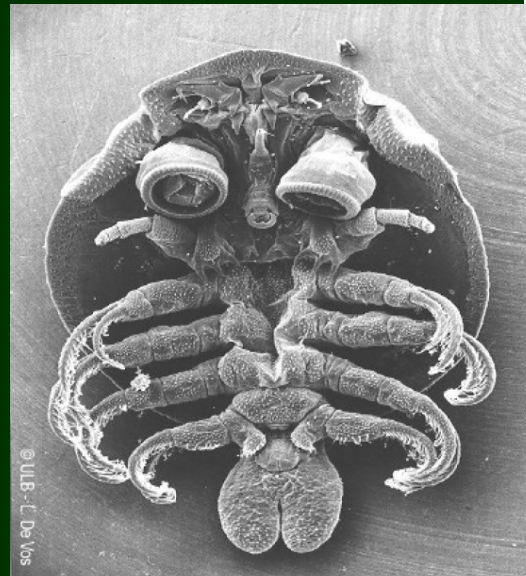
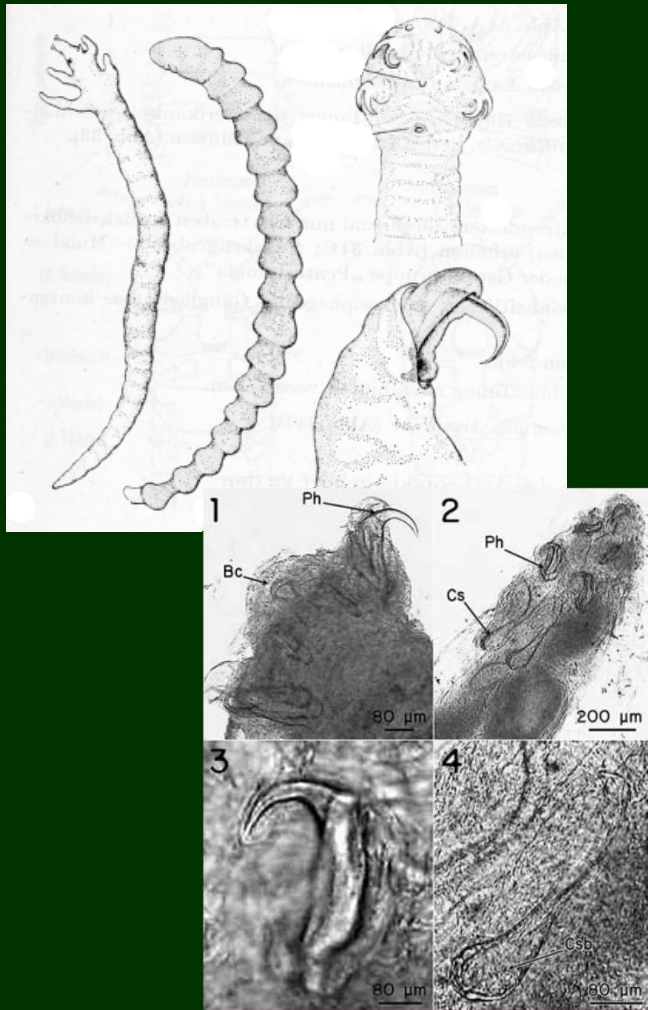
Oligostraca



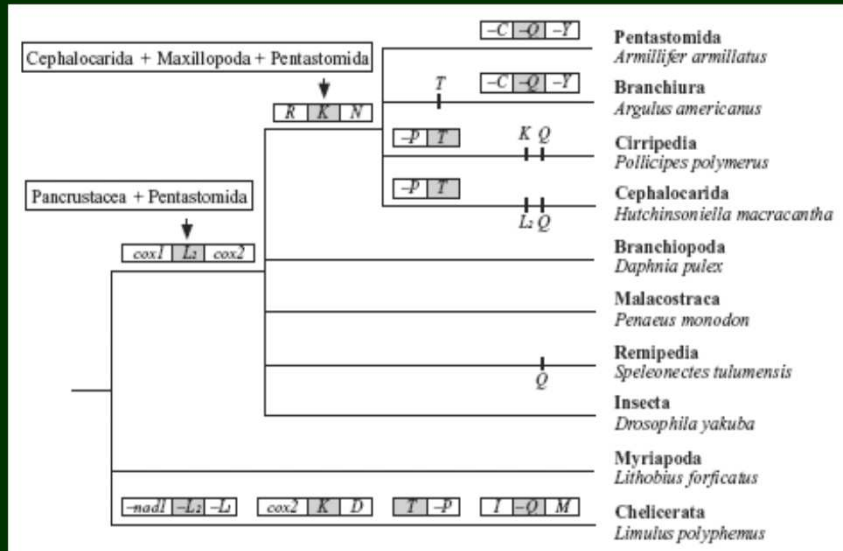
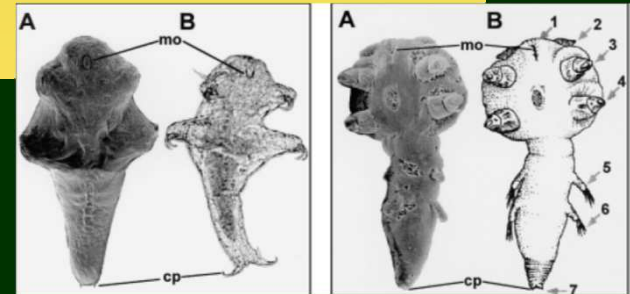
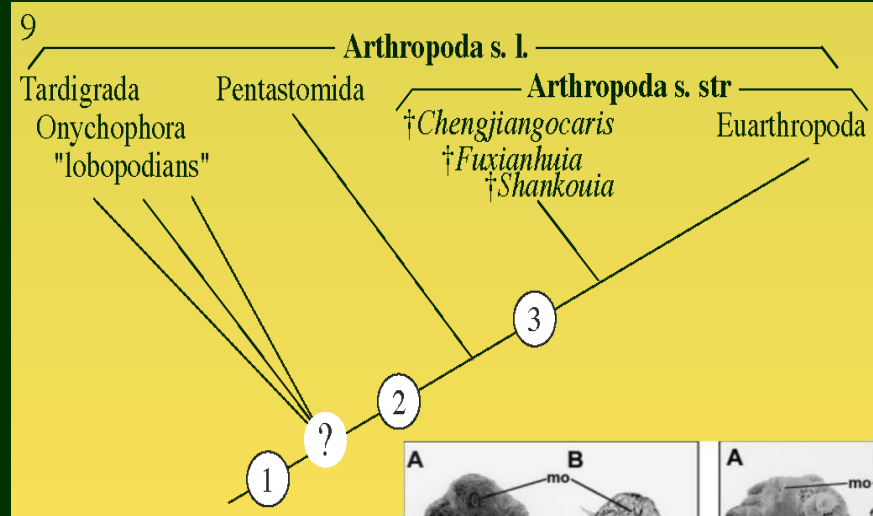
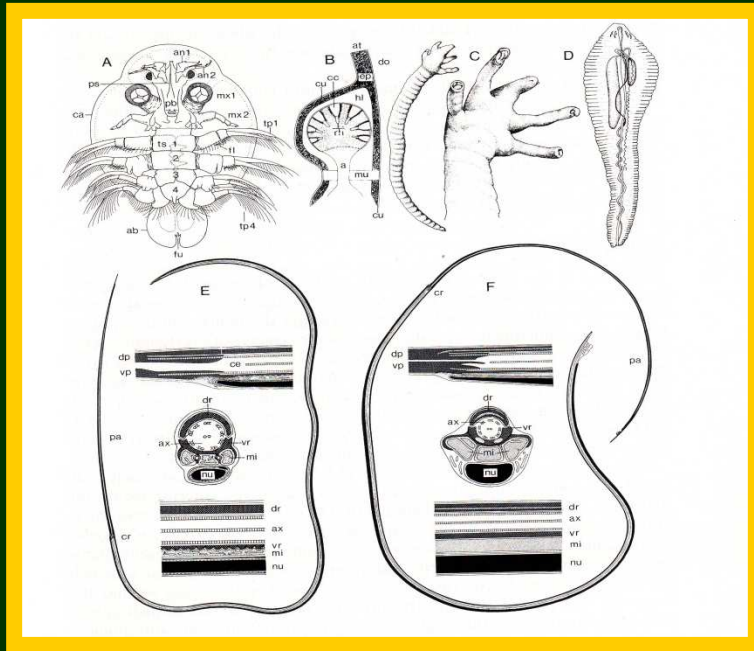
Mystacocarida



Oligostraca: Ichthyostraca

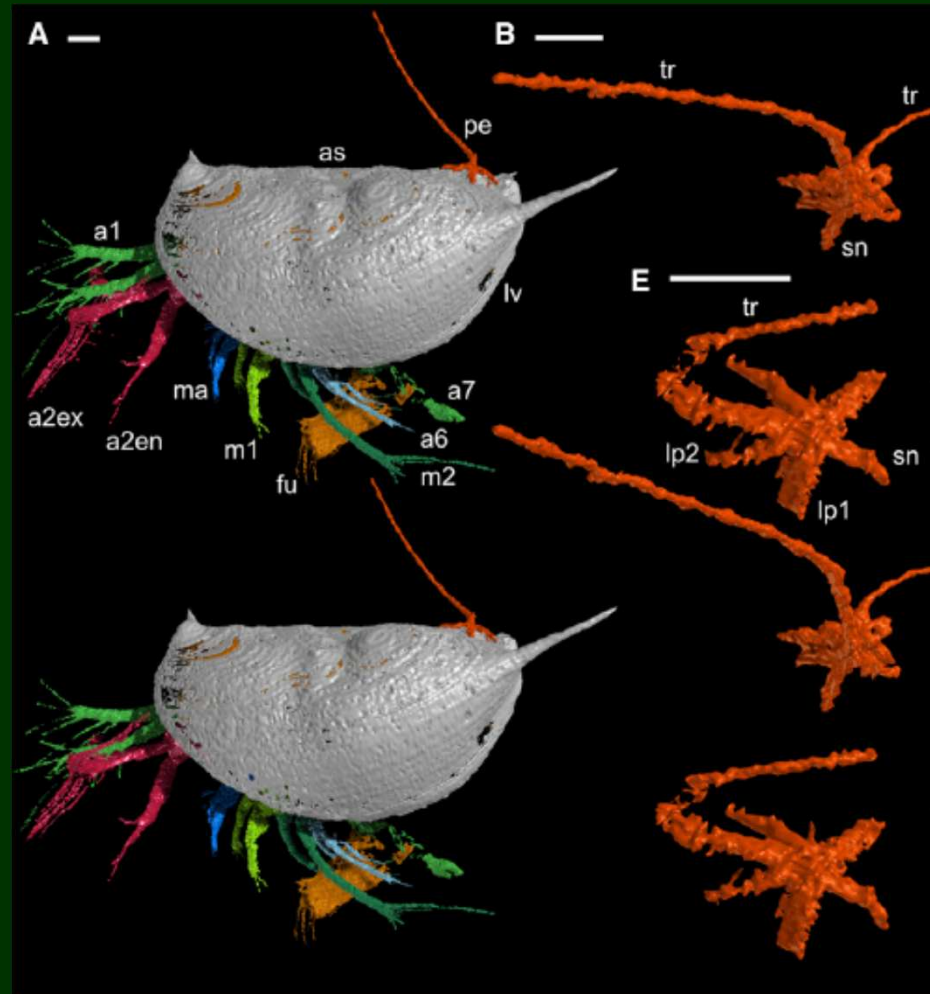


Ichthyostraca



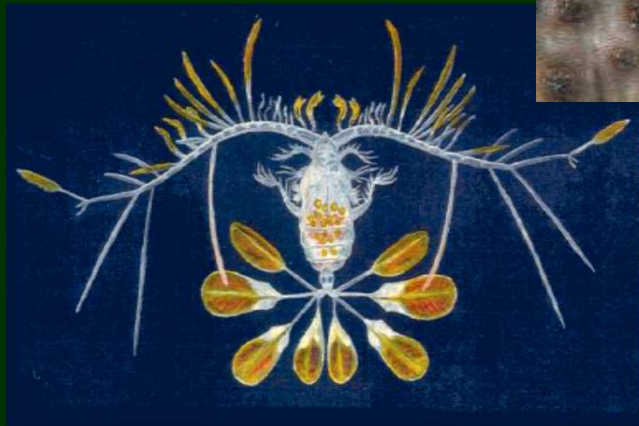
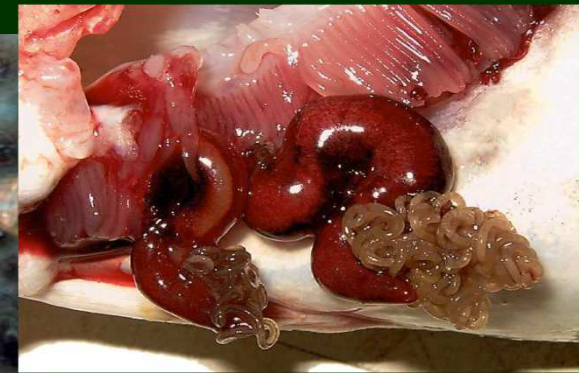
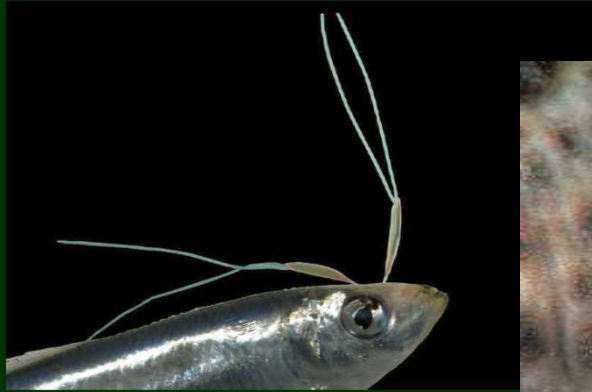
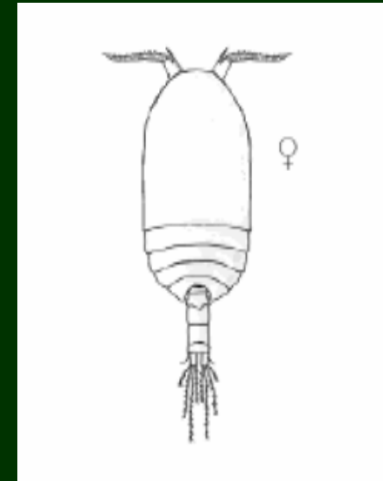
Invavita

- silurská jazyčnatka
- ektoparazit lasturnátek

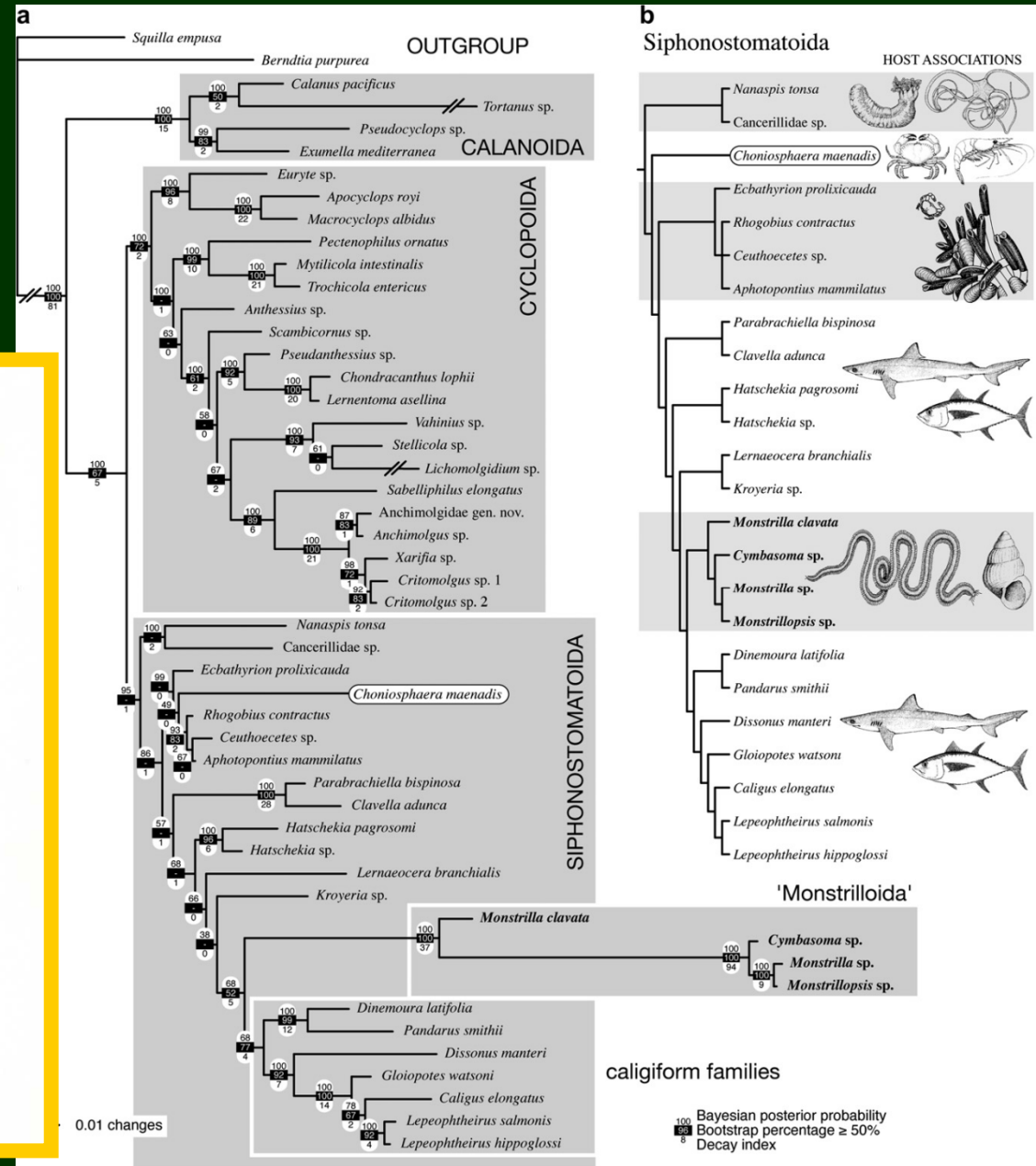
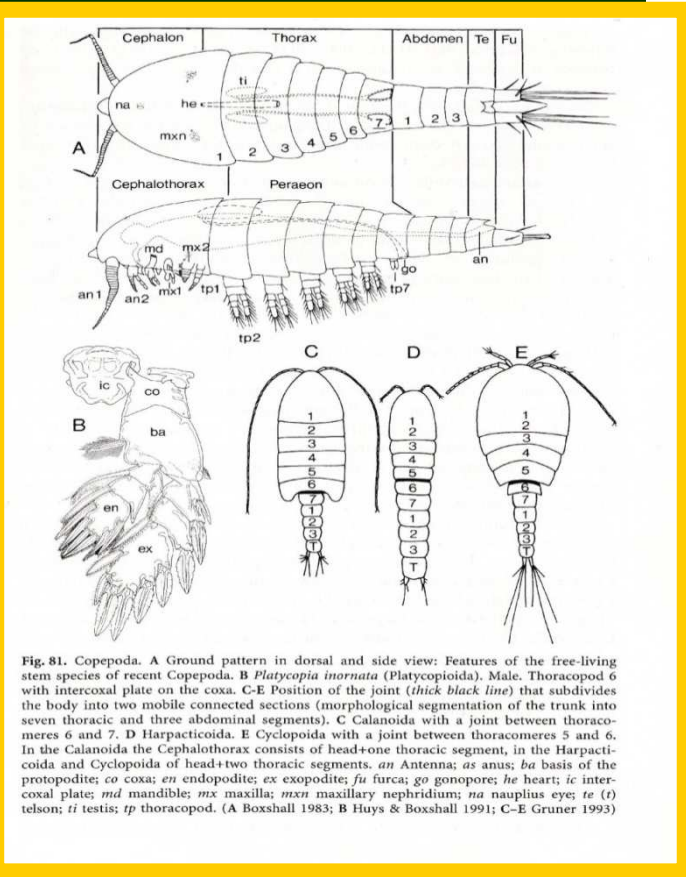


Copepoda

- 1. Progymnoplea = Platycopioidea
- 2. Neocopepoda



Copepoda

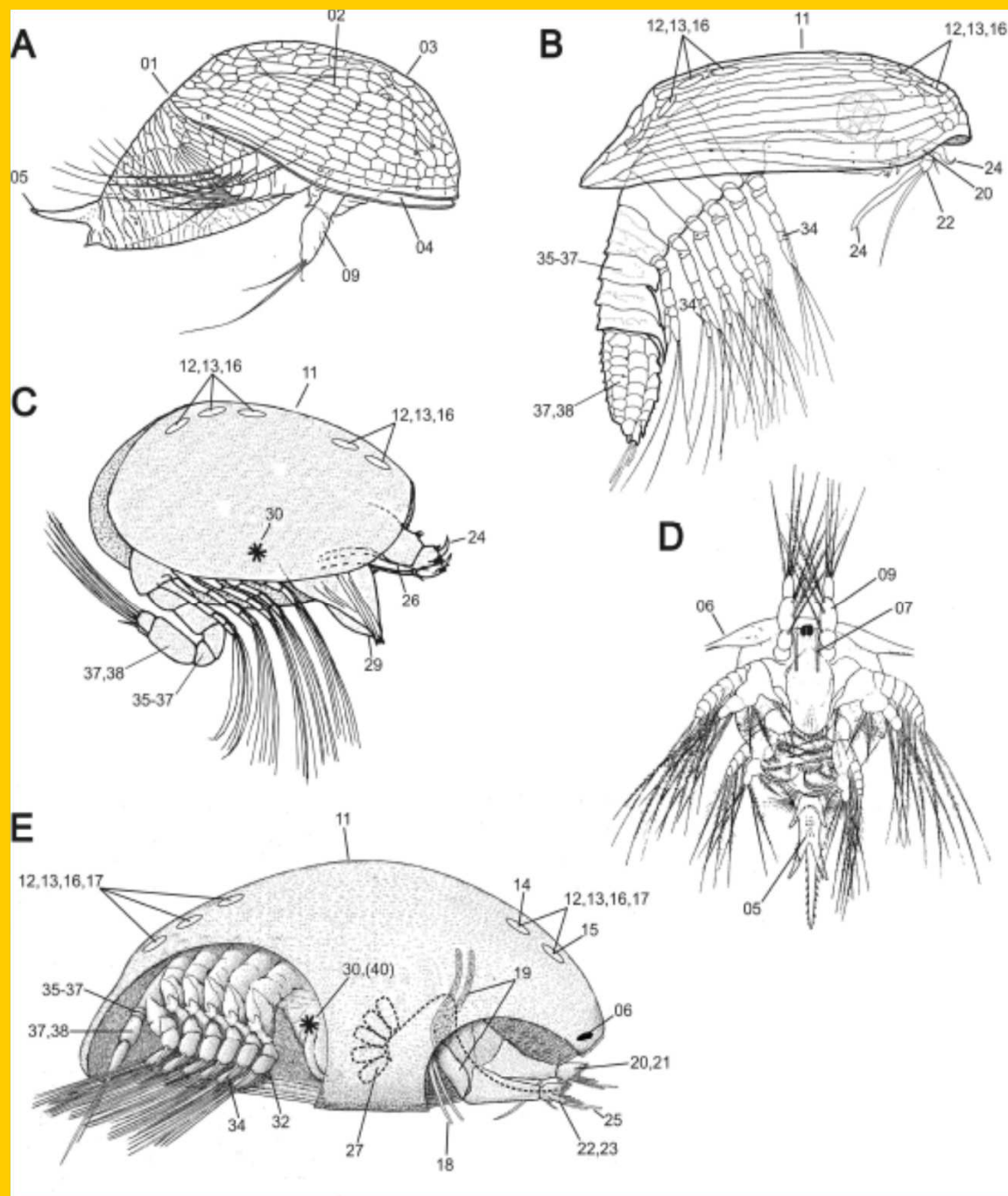


Thecostraca



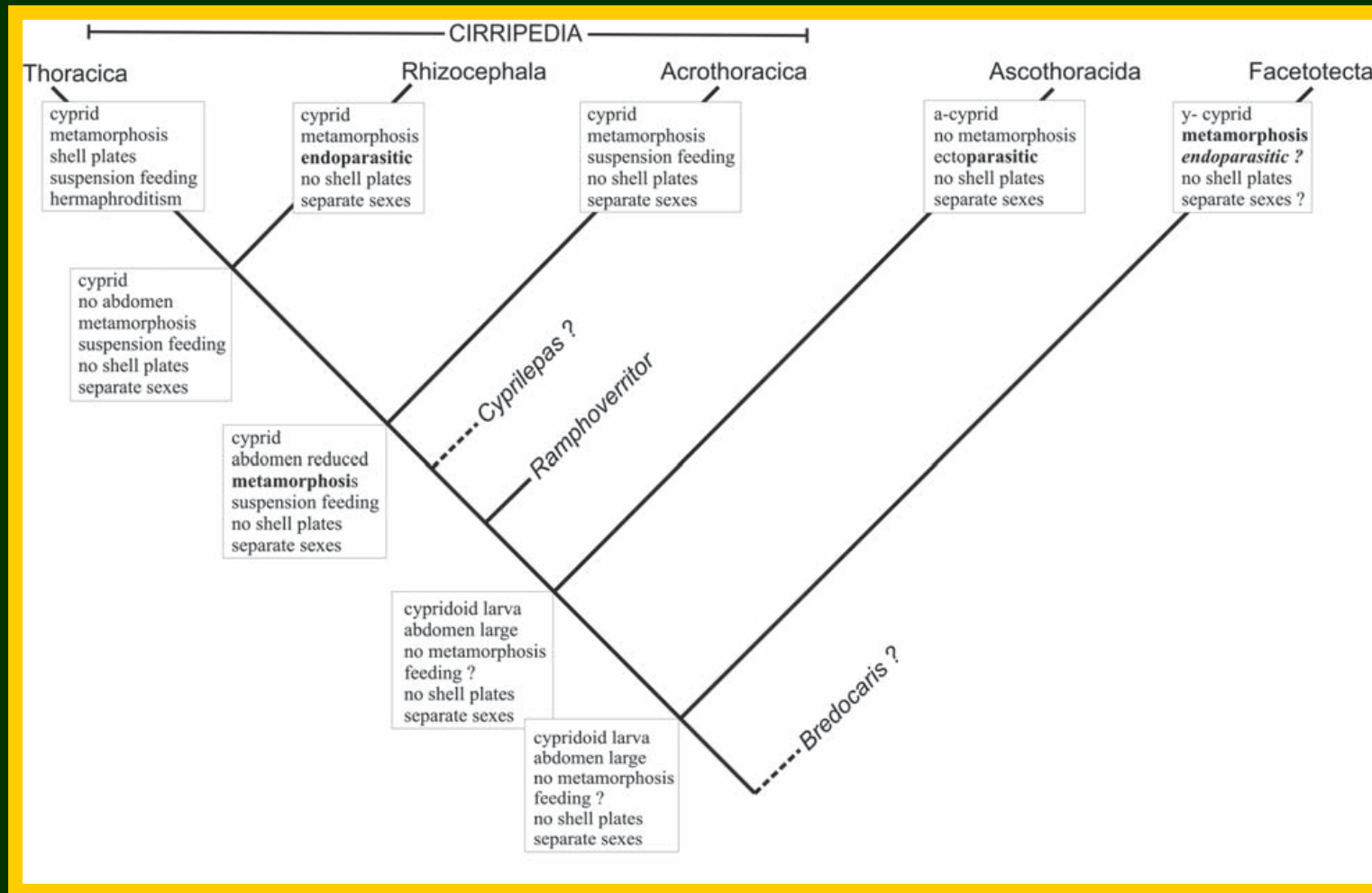
Thecostraca

larvy – Facetotecta (A, B), Ascothoracida (C), Cirripedia (D, E)

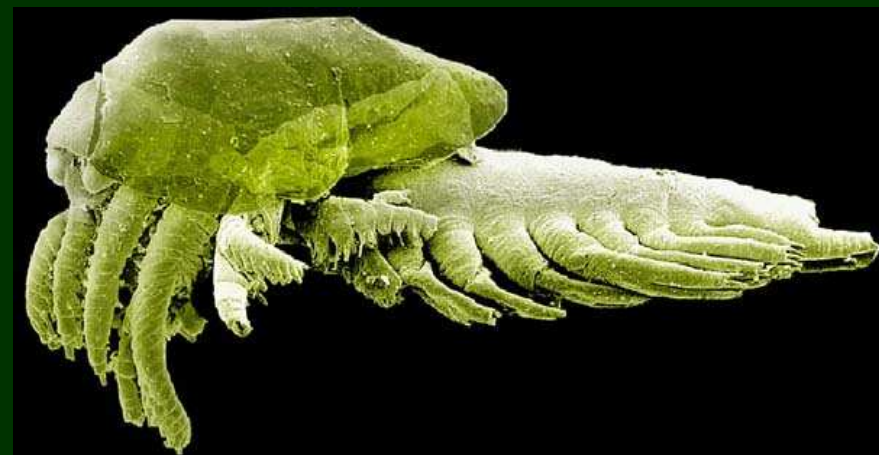
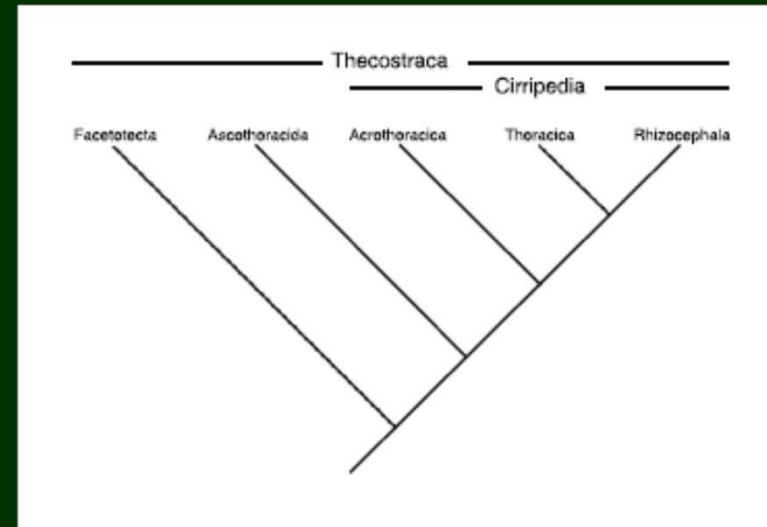
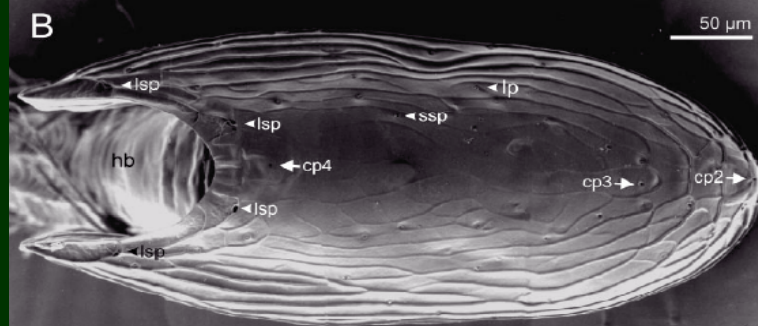
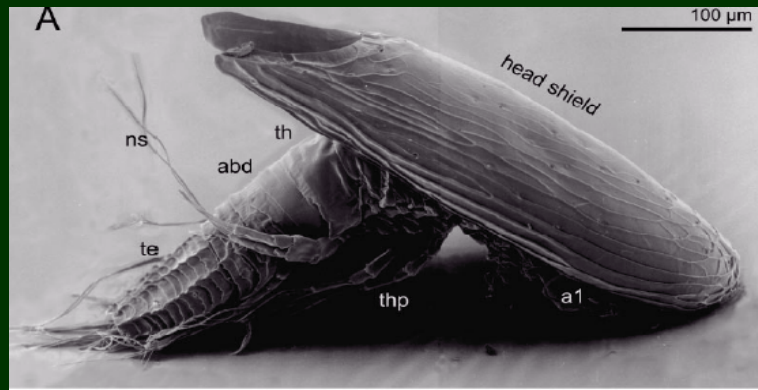


Thecostraca

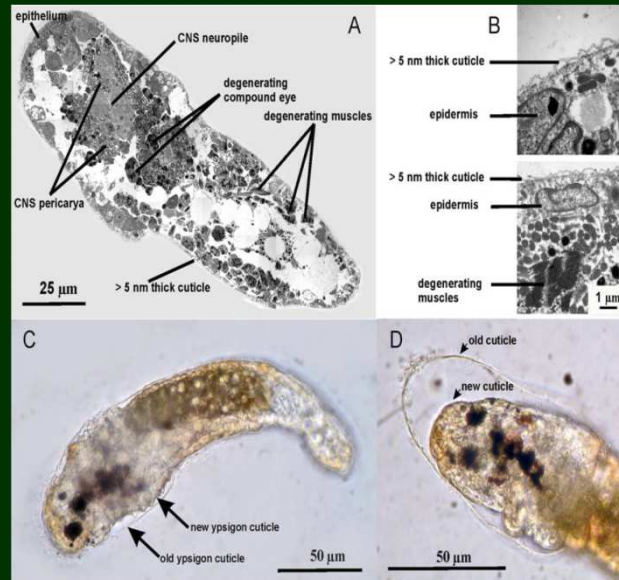
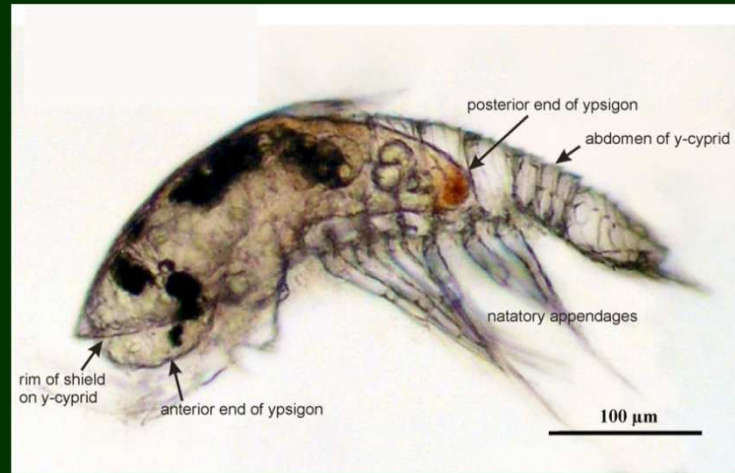
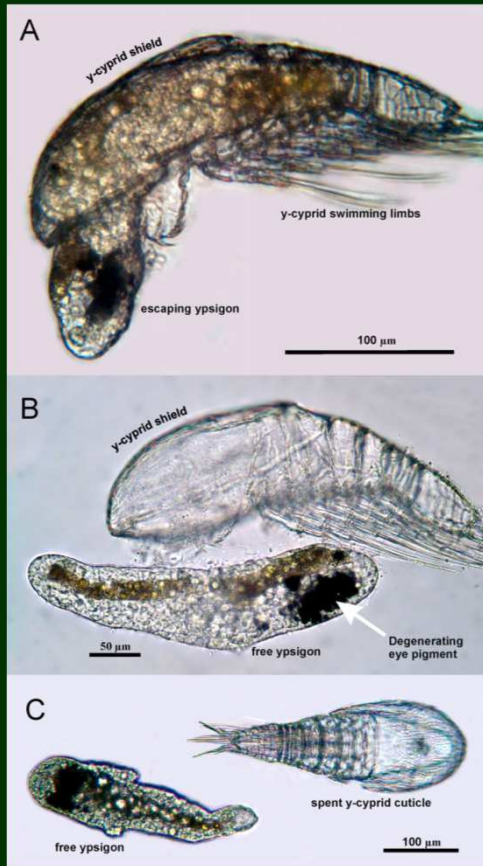
evoluce metamorfózy a ekologie



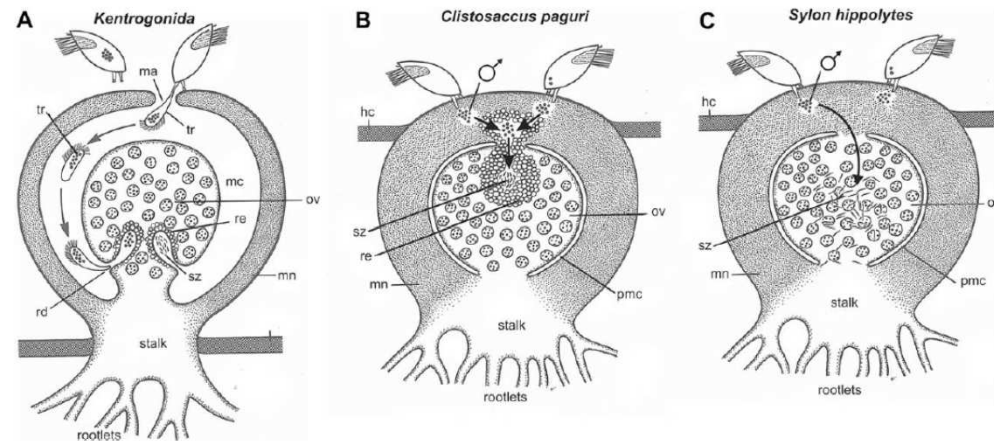
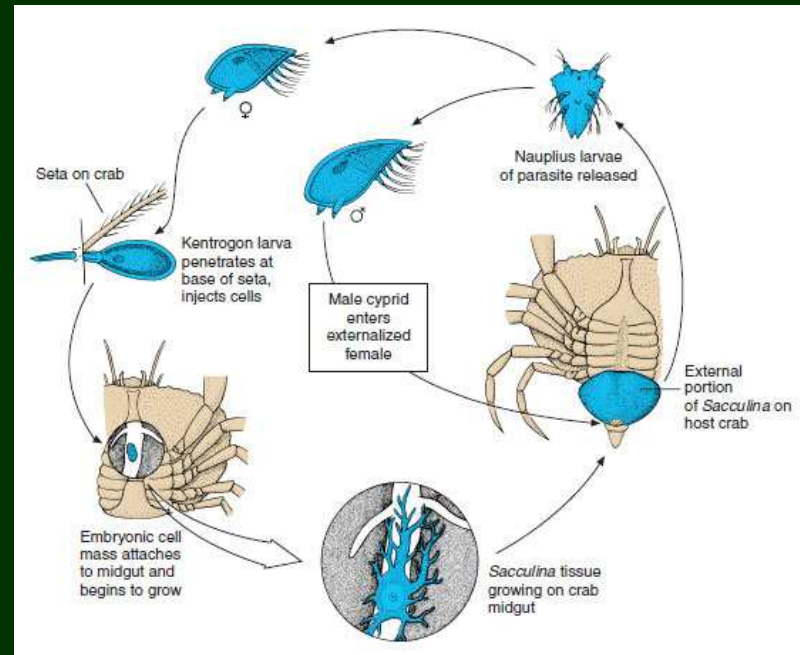
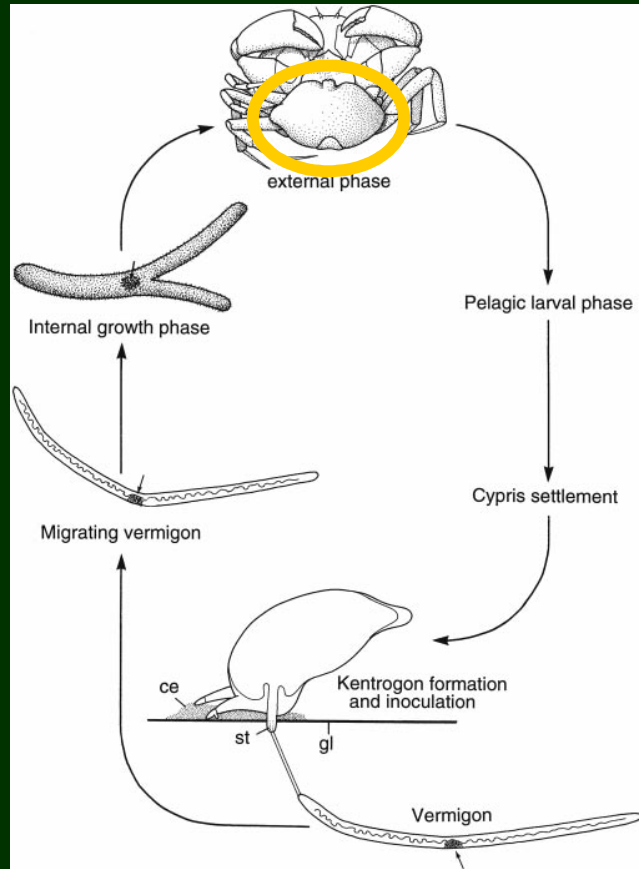
Facetotecta ~ *Bredocaris*???



Facetotecta: indukovaná metamorfóza („ypsigon“)

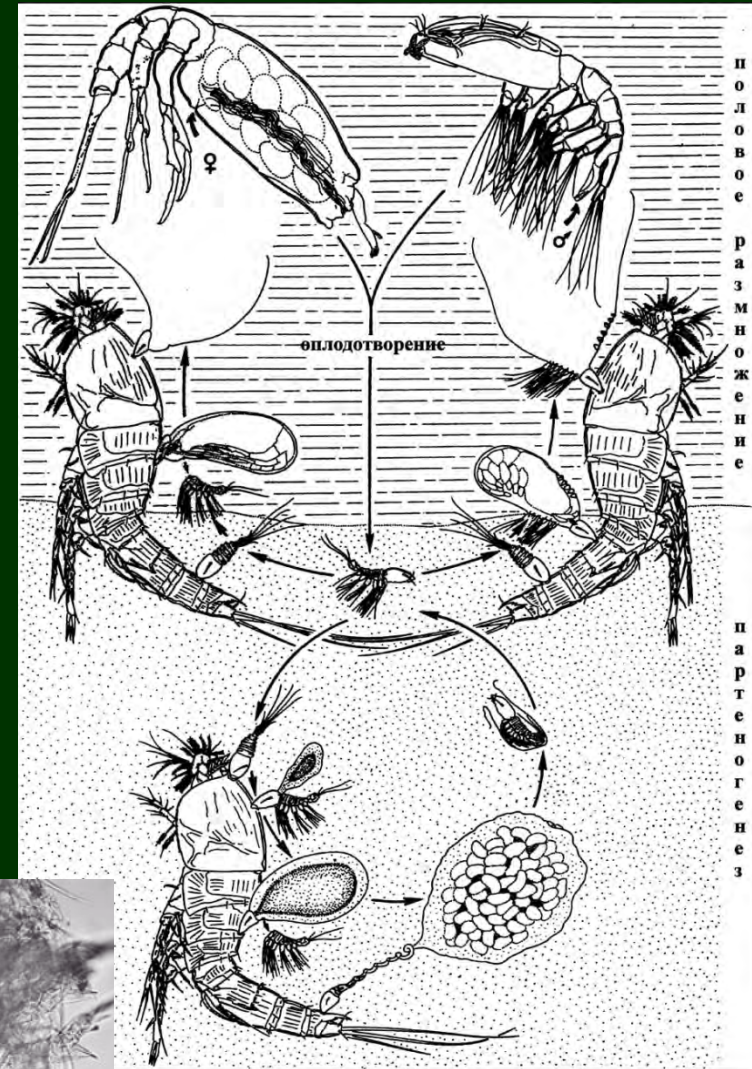
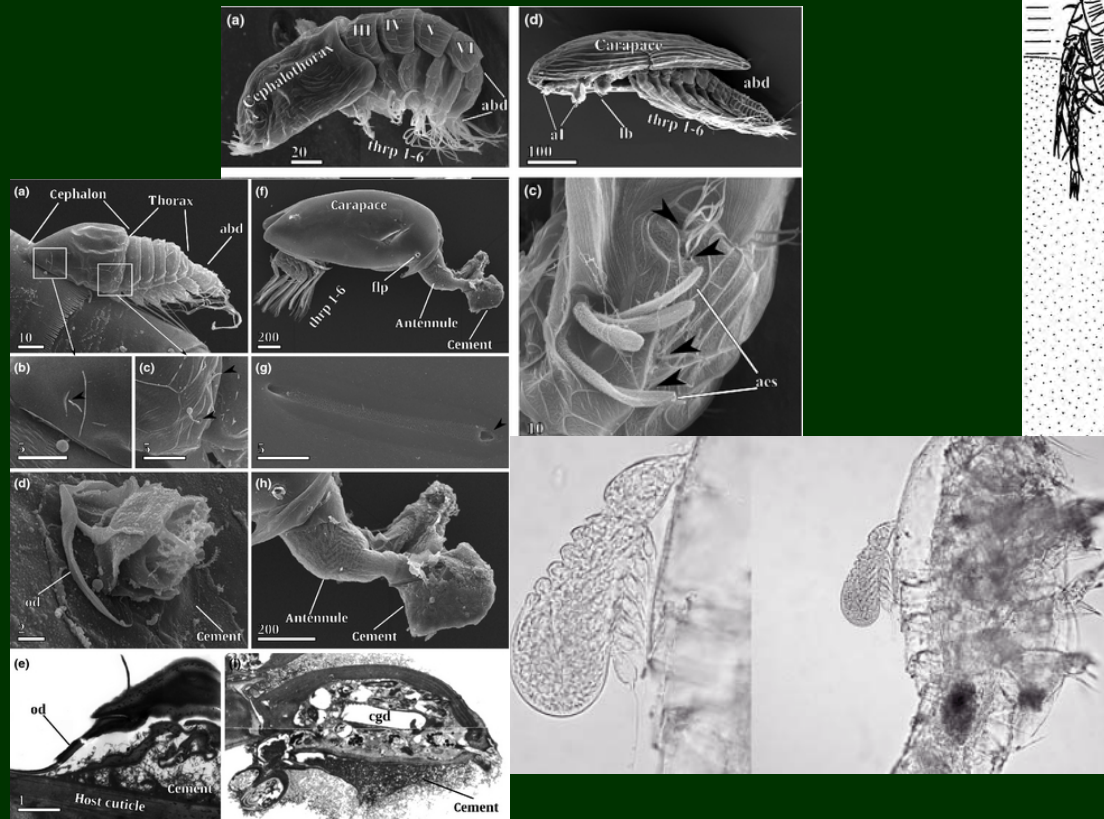


Rhizocephala



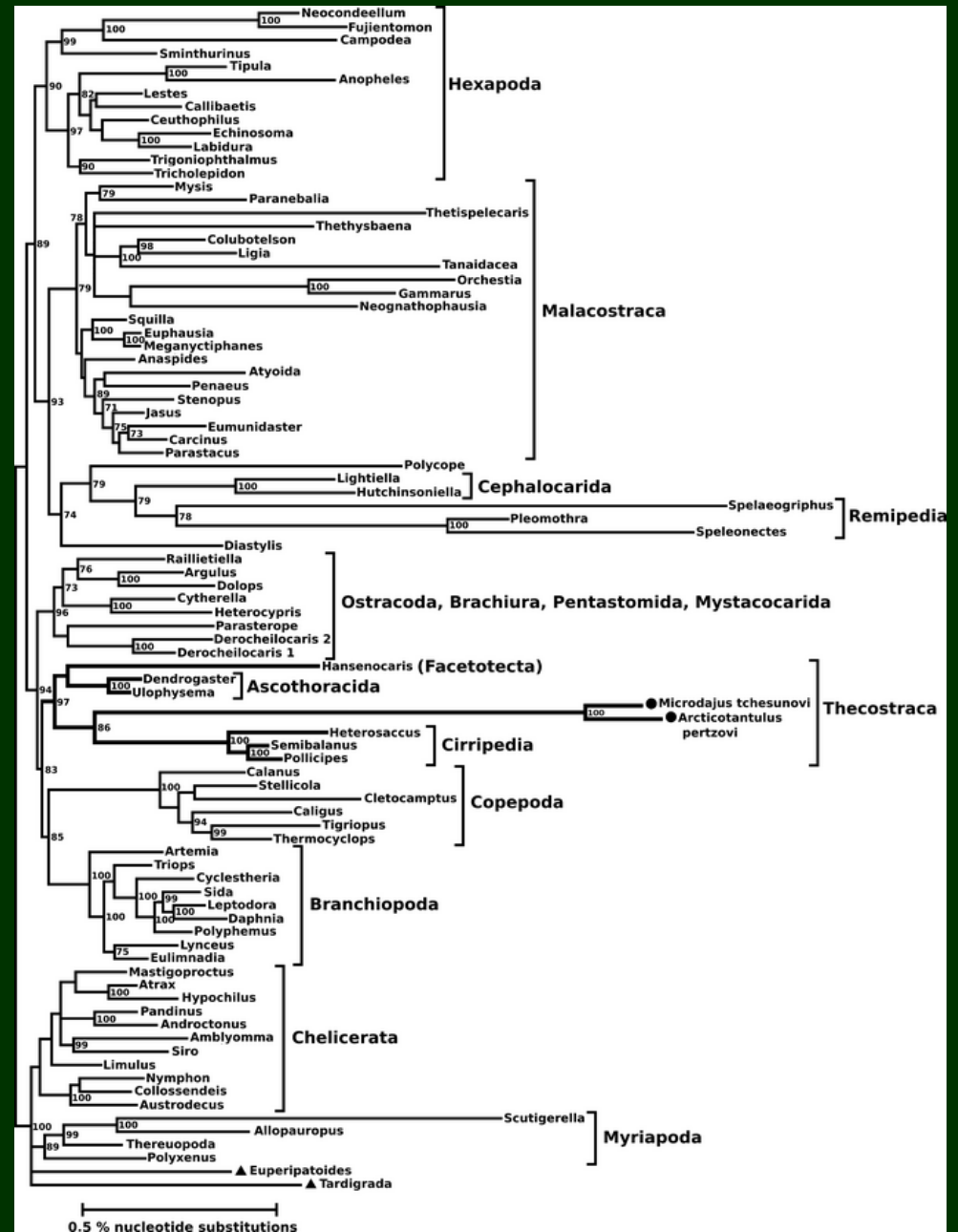
Tantulocarida

- + Rhizocephala: nepárový stylet + absorbující systém v hostiteli (tantulus)



Tantulocarida

18S



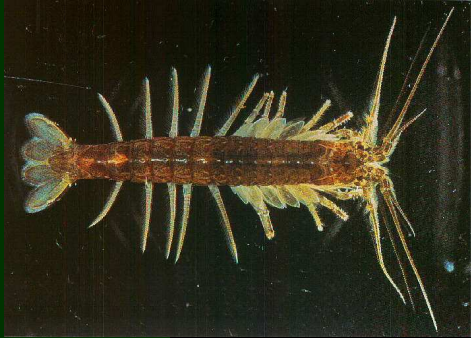
Malacostraca

Phyllocarida = Leptostraca

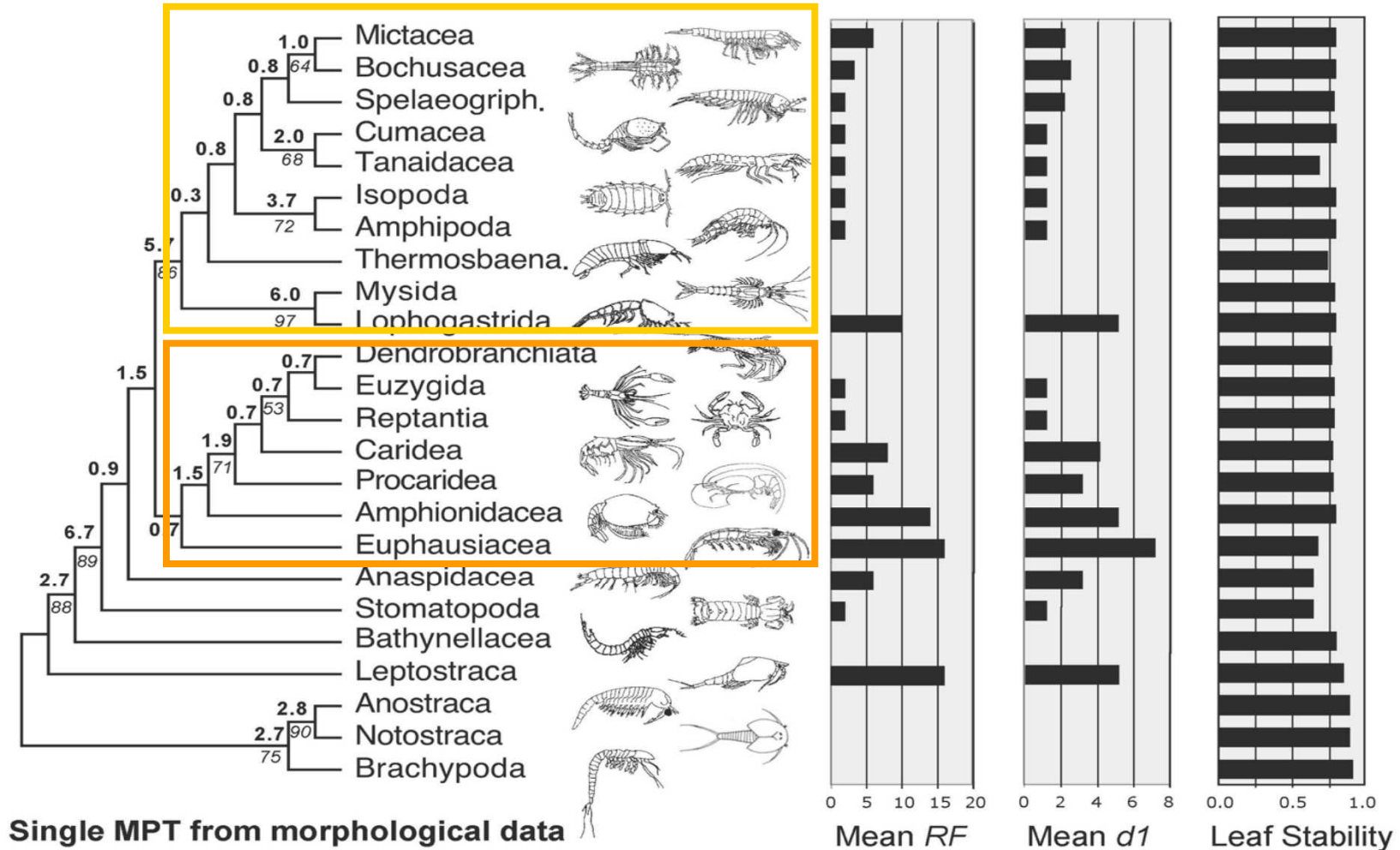
Eumalacostraca (incl. Stomatopoda?)



Eumalacostraca

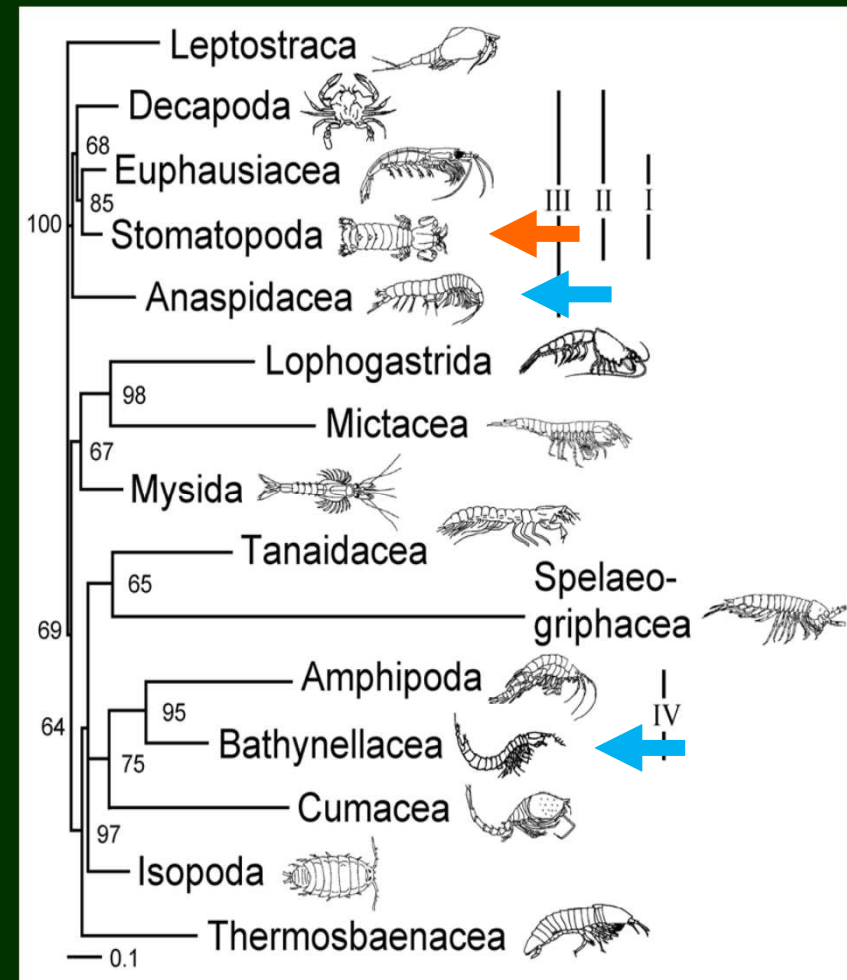
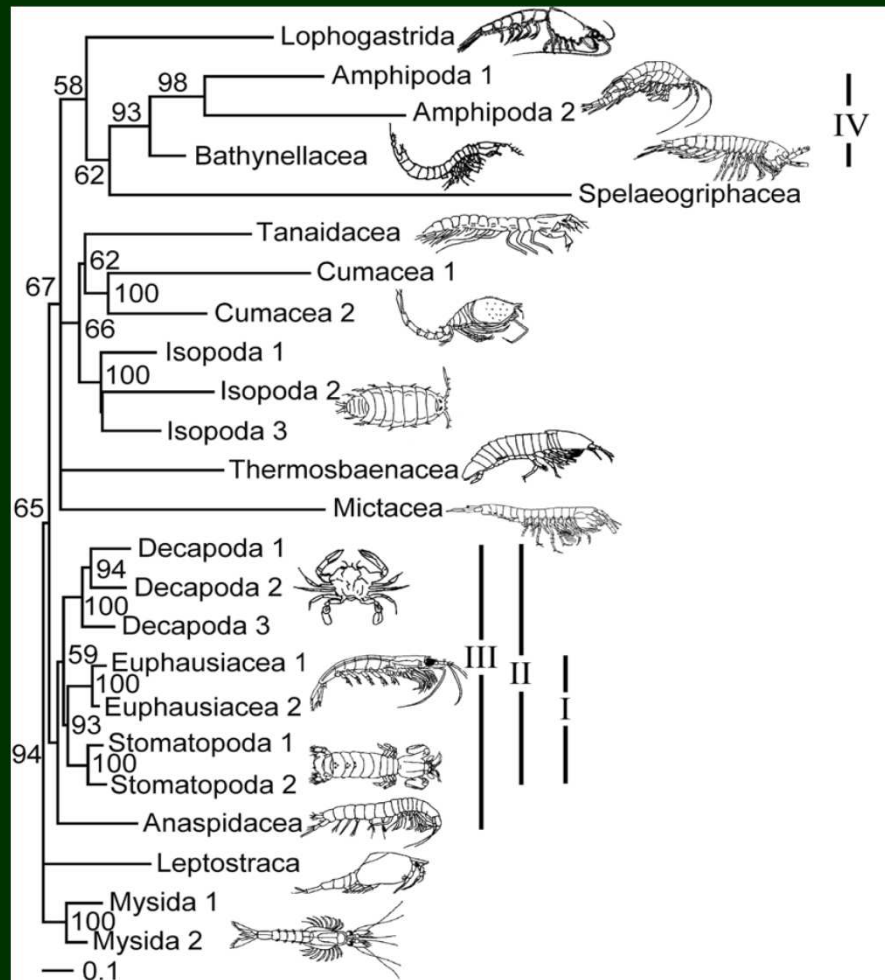


Malacostraca – morfologie



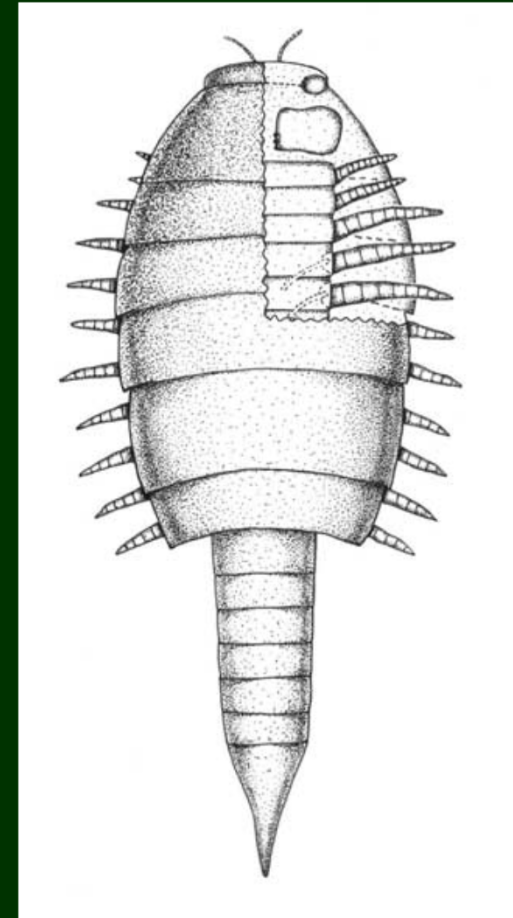
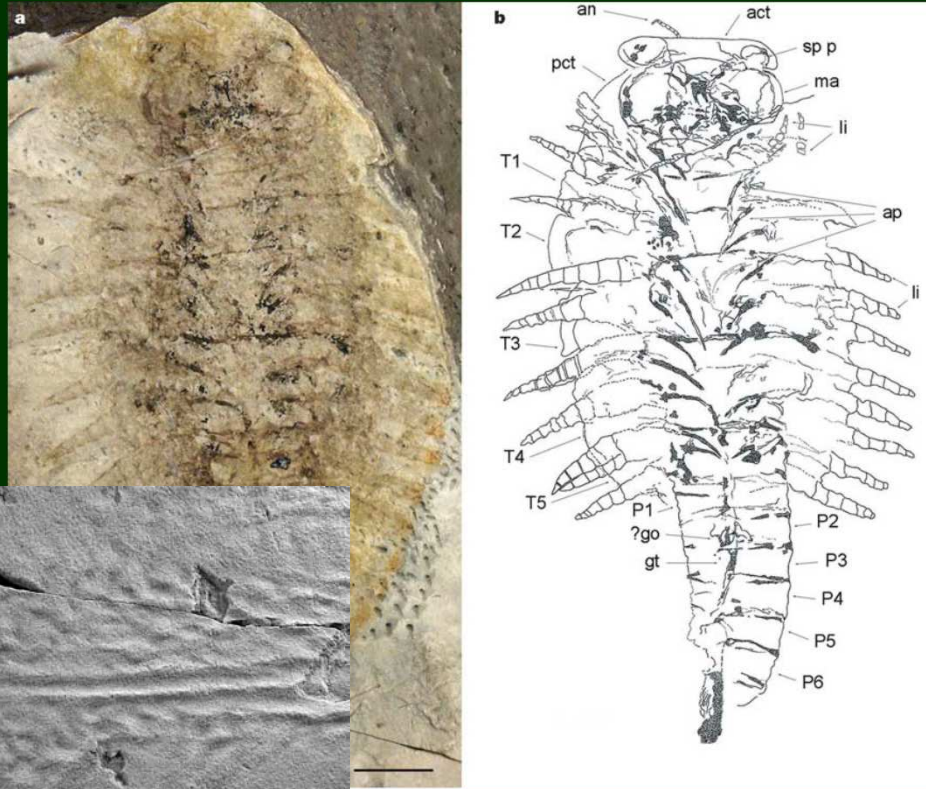
Malacostraca

- bayesovské analýzy kombinovaných MOL a MOR+MOL dat



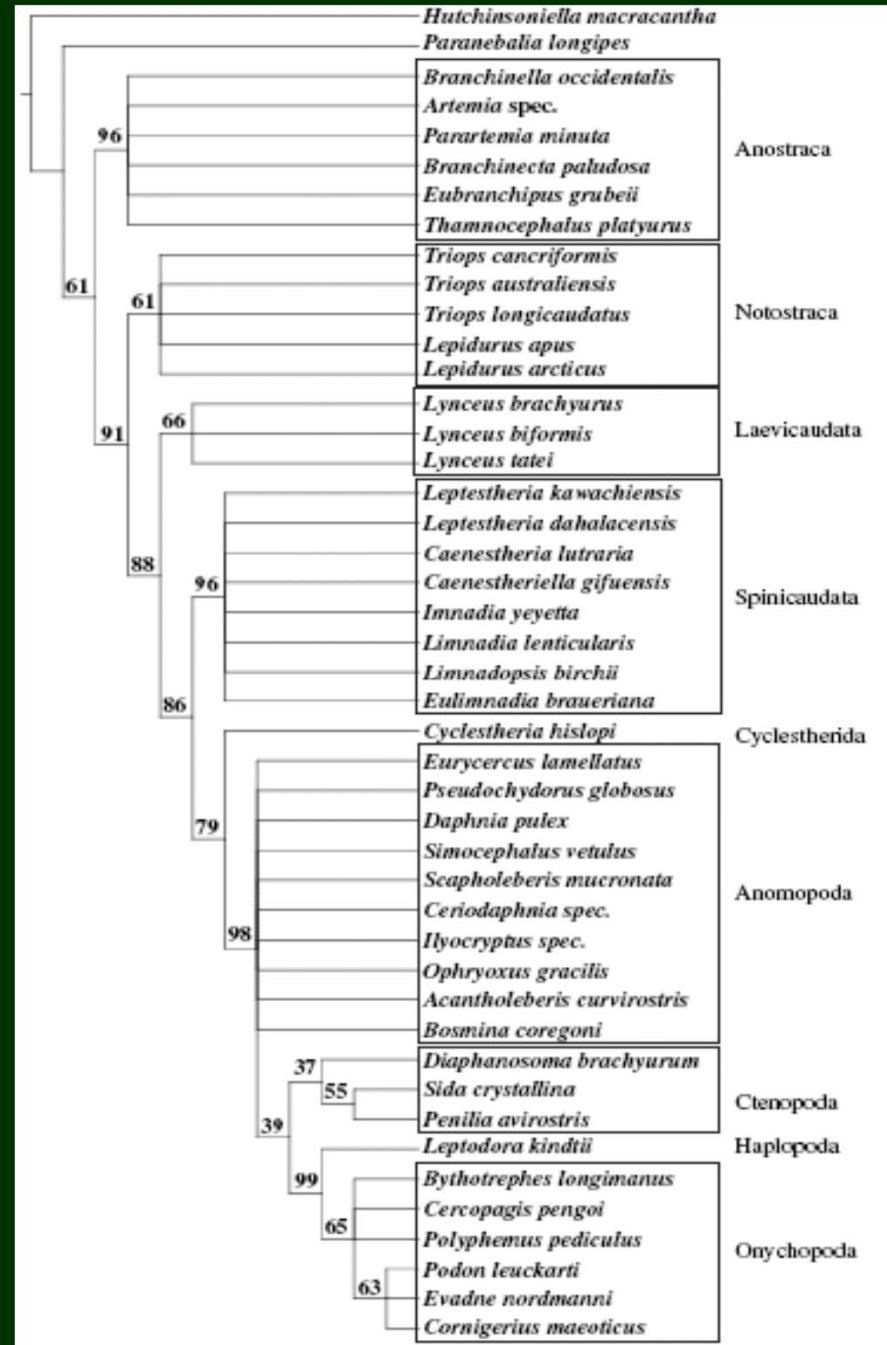
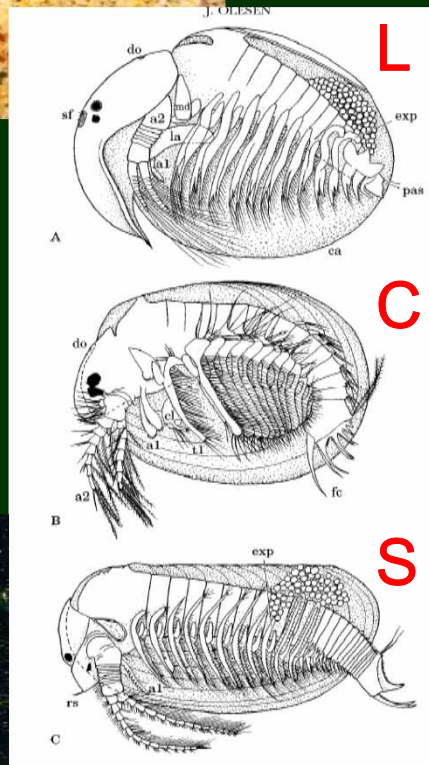
Euthycarcinoidea

- kambrium–trias
- mořské i sladkovodní



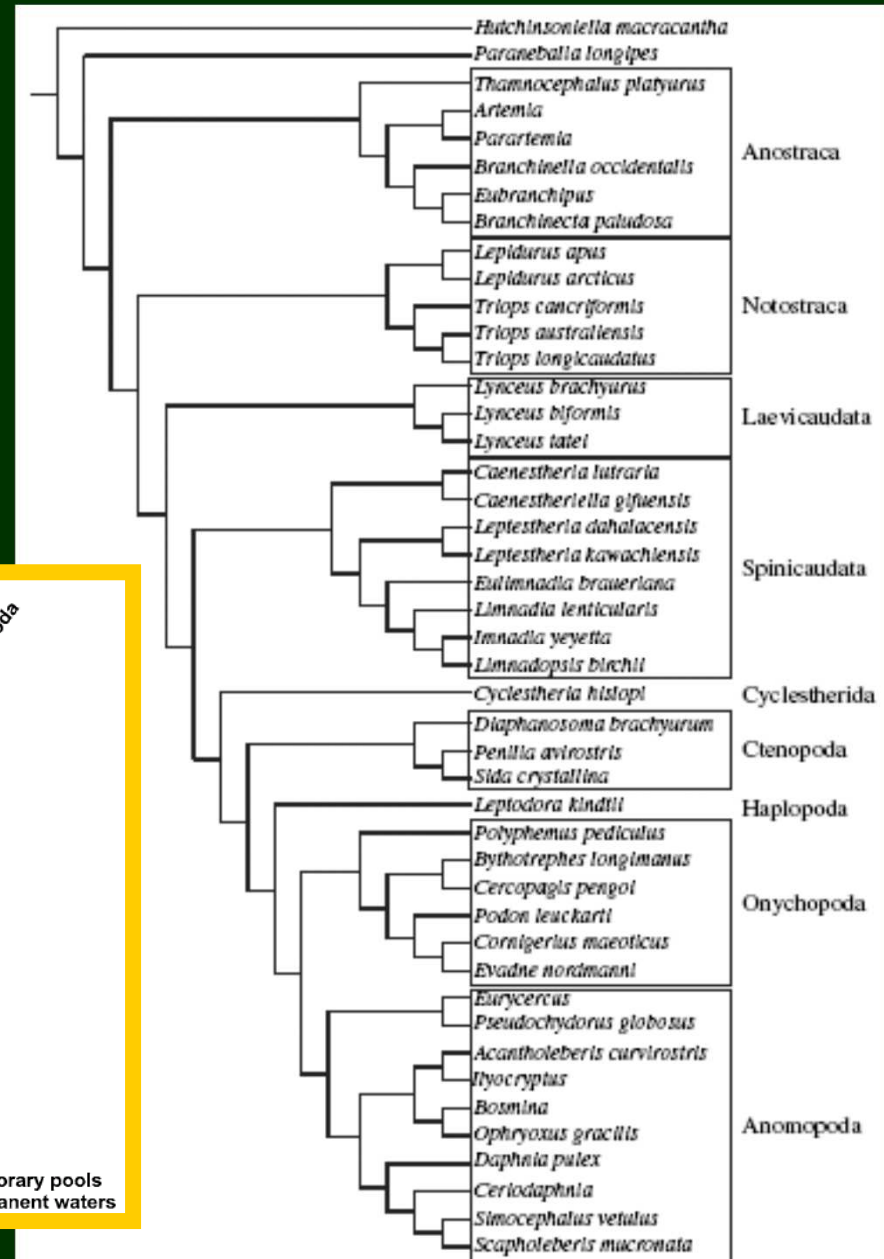
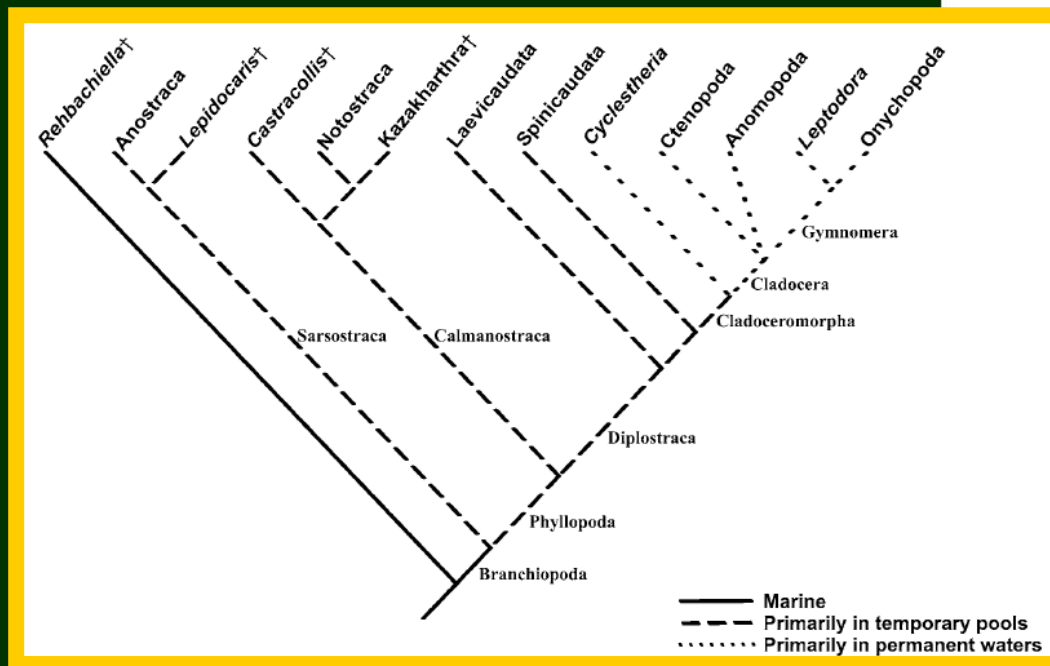
Branchiopoda

morfologie



Branchiopoda

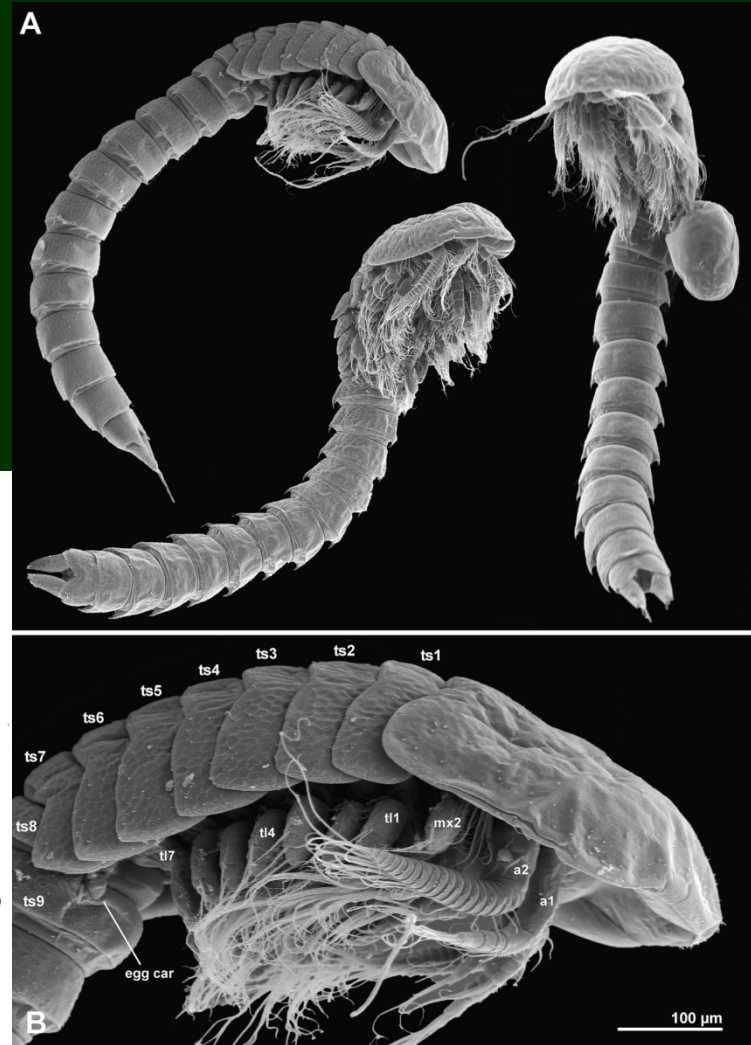
- morfologie + 6 genů



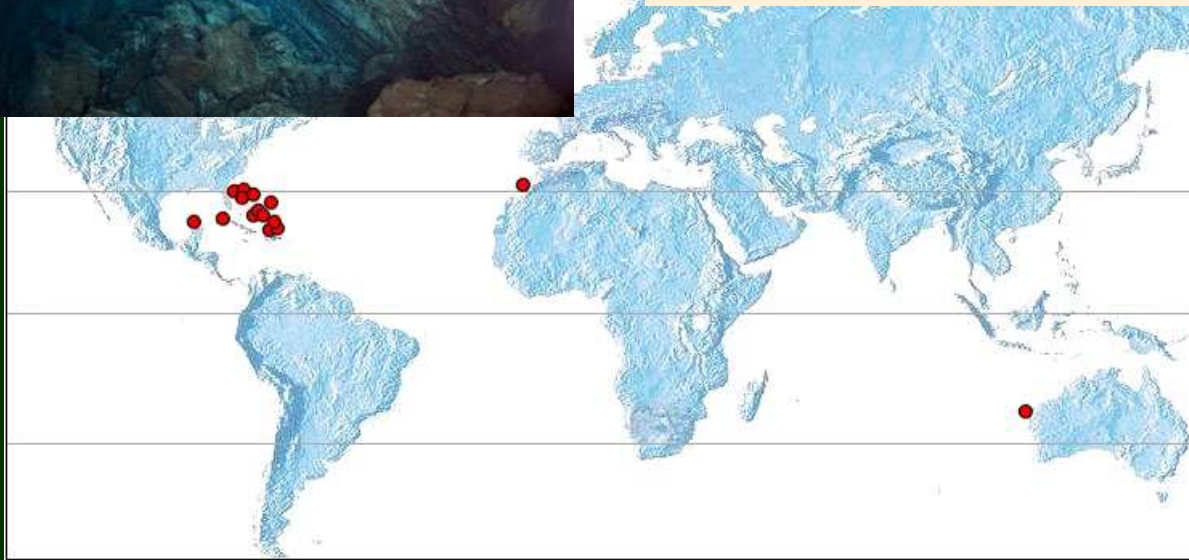
Cephalocarida



- | | |
|-------------------------------------|----------------------------------|
| 1 <i>Chiltoniella elongata</i> | 7 <i>Lightiella monniotae</i> |
| 2 <i>Hampsonellus brasiliensis</i> | 8 <i>Lightiella serendipita</i> |
| 3 <i>Hutchinsonella macracantha</i> | 9 <i>Sandersiella acuminata</i> |
| 4 <i>Lightiella floridana</i> | 10 <i>Sandersiella bathyalis</i> |
| 5 <i>Lightiella incisa</i> | 11 <i>Sandersiella calmani</i> |
| 6 <i>Lightiella magdalenina</i> | 12 <i>Sandersiella kikuchii</i> |

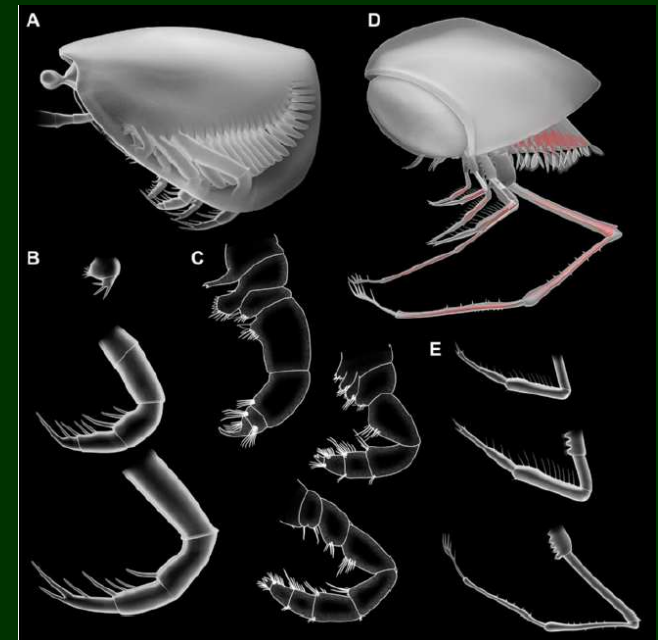
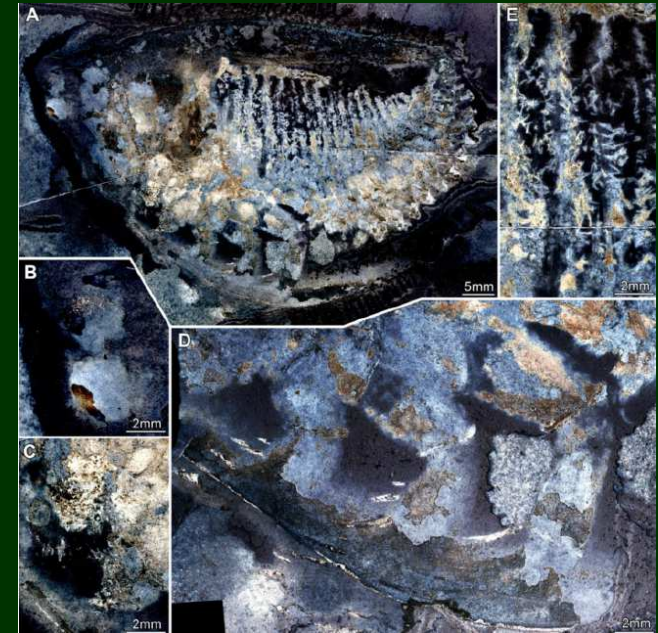


Remipedia



Thylacocephala

- silur–křída
- dvouchlopňový karapax, raptoriální končetiny (neví se, z jakého segmentu)
- sesterská skupina remipedií?



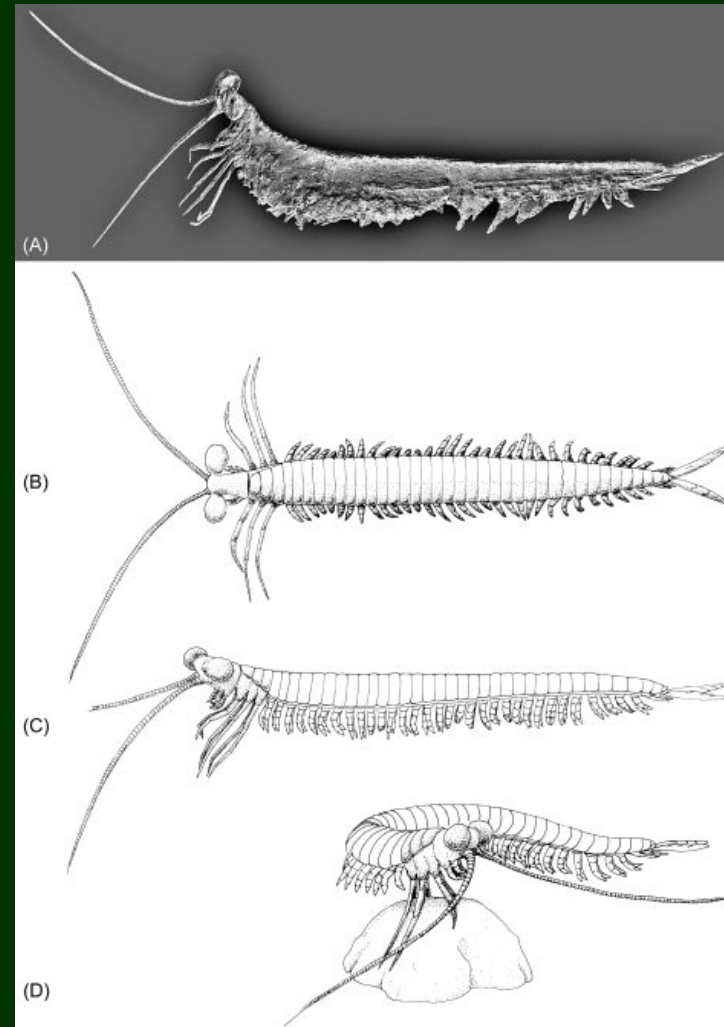
Tanazios (silur)

- bazální korýš s redukovanými antenami???



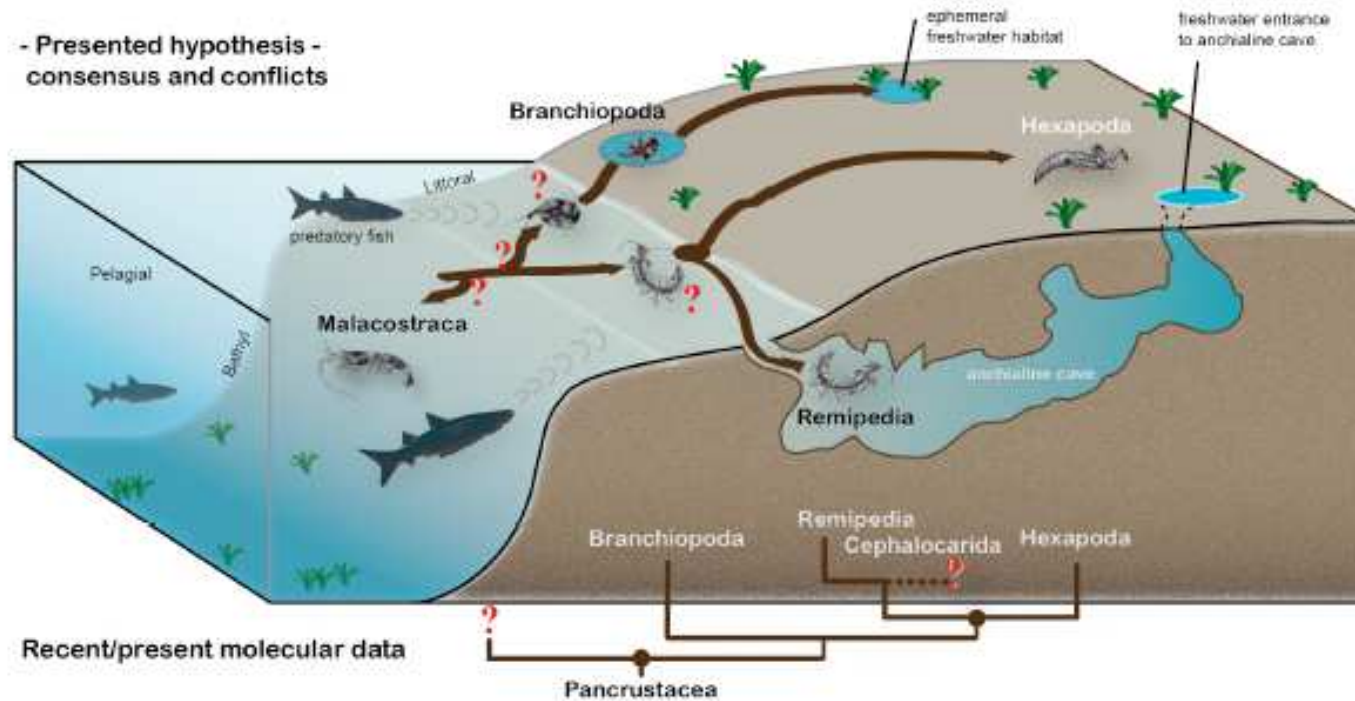
“*Devonohexapodus*”

- nově identifikován jako *Wingertshellicus*
- bazální Euarthropoda nebo ~ Remipedia?



Remipedia a Hexapoda

- Presented hypothesis -
consensus and conflicts



Hexapoda – klasická taxonomie

- 1. **Entognatha**

- Diplura

- Ellipura (Parainsecta)

- Collembola

- Protura



- 2. **Ectognatha**

- Archaeognatha (Microcoryphia)

- Dicondylia

- Zygentoma (Thysanura s.str.)

- Pterygota



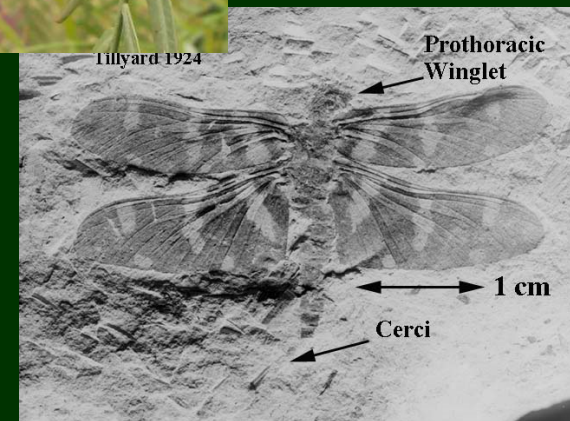
Ectognatha

- 1. Archaeognatha
- 2. Dicondylia
 - *Tricholepidion*
 - Zygentoma
 - Pterygota



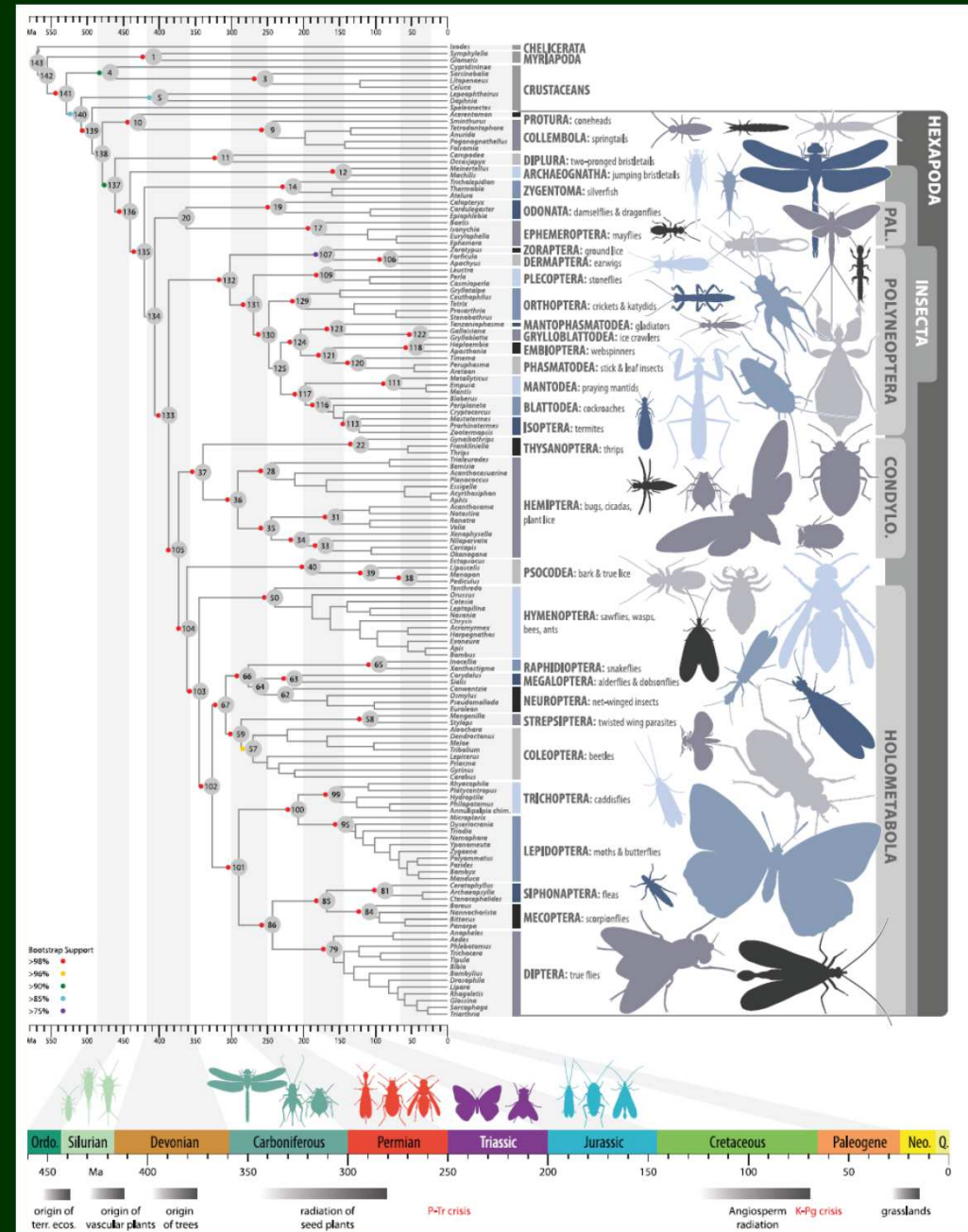
Pterygota

- 1. Ephemeroptera
- 2. Odonatoptera
- 3. Palaeodictyopteroidea
- 4. Neoptera
 - Polyneoptera
 - Paraneoptera
 - Holometabola



Hexapoda

- cca 1500 nukleárních neparalogních genů
- 1. **Ellipura** (Protura + Collembola)
- 2. **Cercophora** (Diplura + Insecta s. str.)



Neoptera: Polyneoptera



Neoptera: Paraneoptera (?)



Neoptera: Holometabola (= Endopterygota)

