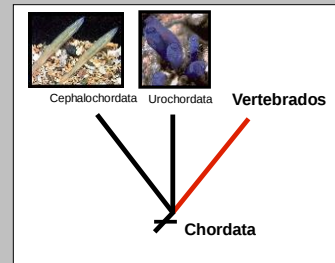


- Introdução aos Vertebrados

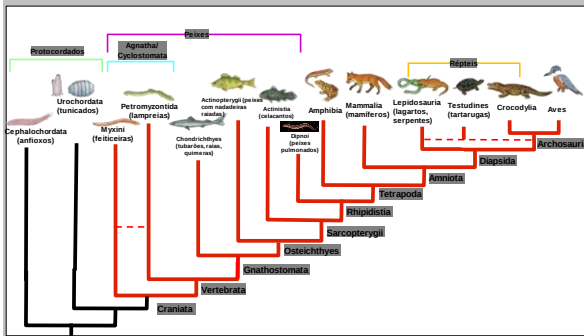
- os “Agnatha” – vertebrados sem maxilas

Objetivos

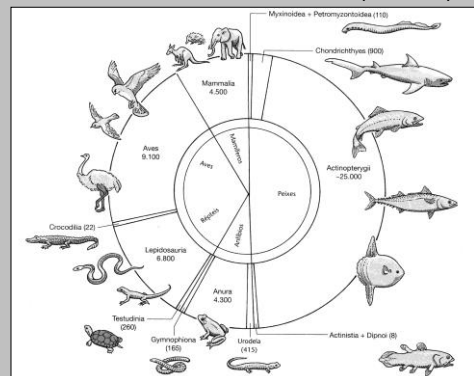
- Caracterizar os vertebrados
- Apresentar a diversidade dos vertebrados sem maxilas recentes (Myxini e Petromyzontida)
- Discutir as relações filogenéticas de Myxini e Petromyzontida (Craniata-Vertebrata)
- Apresentar a diversidade dos vertebrados sem maxilas fósseis



Diversidade atual dos Vertebrados

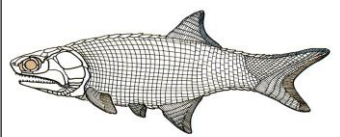


Diversidade atual dos Vertebrados – (60.000 sp +)

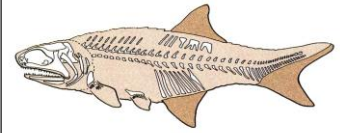


Esqueleto mineralizado - hidroxiapatita

Esqueleto dérmico

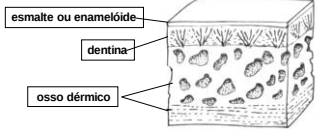


Endoesqueleto



Esqueleto

Esqueleto dérmico



Endoesqueleto

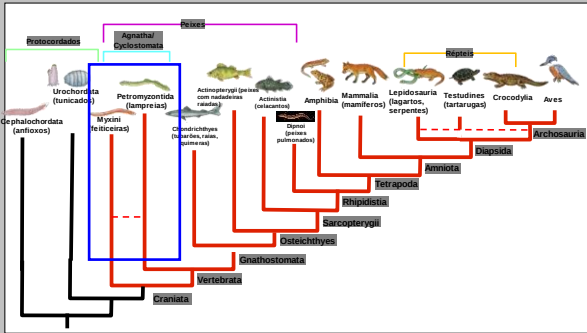
Cartilagem:

- hialina
- prismática
- globular

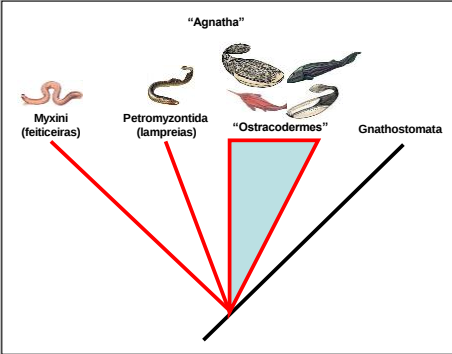
Ossos:

- pericondral
- endocondral
- membranoso

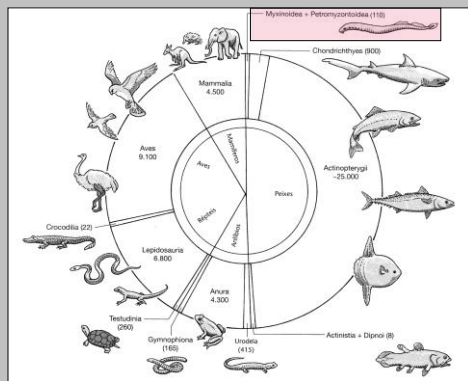
Diversidade atual dos Vertebrados



"Agnatha" – os vertebrados sem maxilas



Diversidade atual dos vertebrados



"Agnatha" recentes (Cyclostomata)

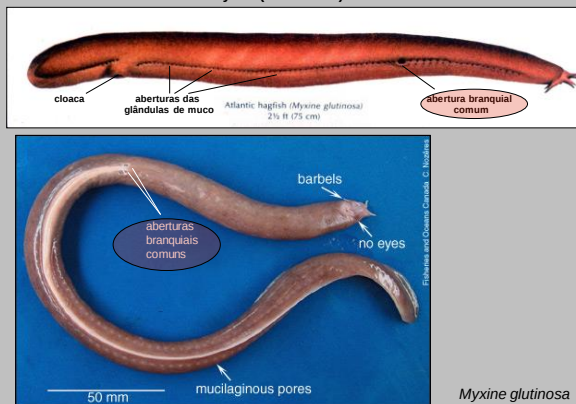
**Myxini**
(Feiticeiras)

77 espécies
marinhas
Brasil: 4 sp.

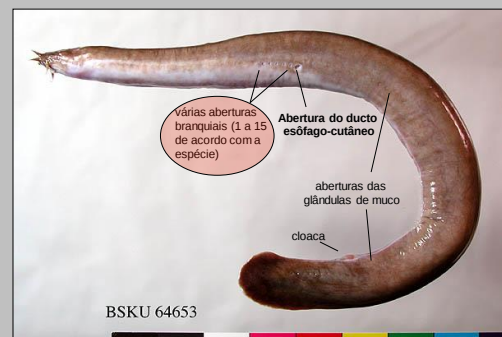
Petromyzontida
(Lampreias)

46 espécies
anádromos ou de água doce
Não ocorrem no Brasil

Myxini (Feiticeiras)



Myxini (Feiticeiras)



Myxini (Feiticeiras)

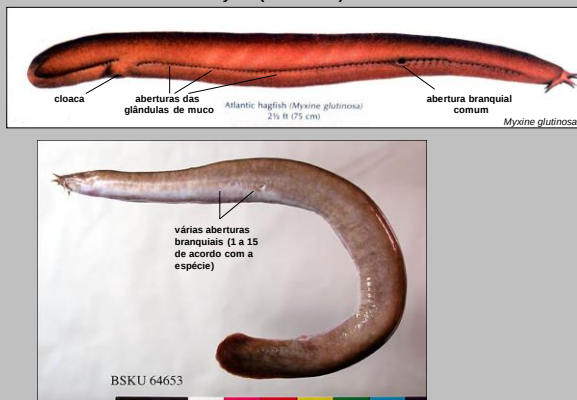


Myxini (Feiticeiras)



Zintzen, V. et al., 2011. Hagfish predatory behaviour and slime defence mechanism. SCIENTIFIC REPORTS 1:131 | DOI: 10.1038/srep00131

Myxini (Feiticeiras)



Myxini (Feiticeiras)

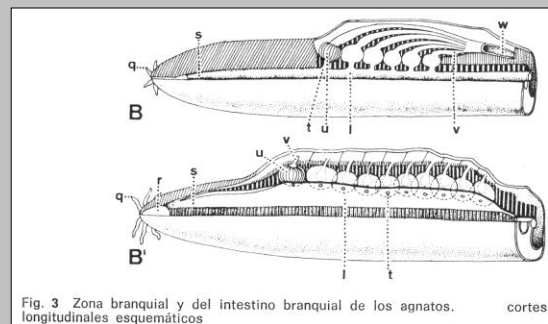


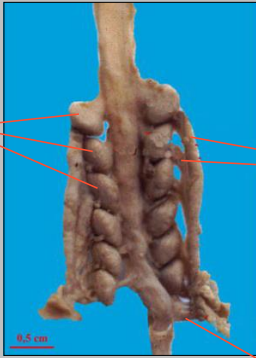
Fig. 3 Zona branquial y del intestino branquial de los agnatos. cortes longitudinales esquemáticos

cortes

Myxini (Feiticeiras)

Região da faringe de *Myxine*

bolsas branquiais

Canais eferentes
confluentes em um
canal comum

Ducto esôfago-cutâneo

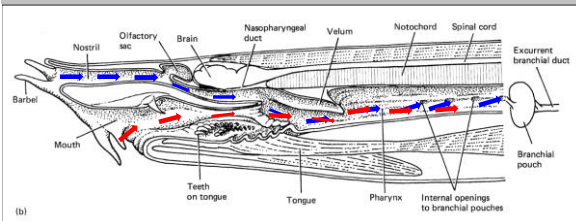
Myxini (Feiticeiras)

Região oral

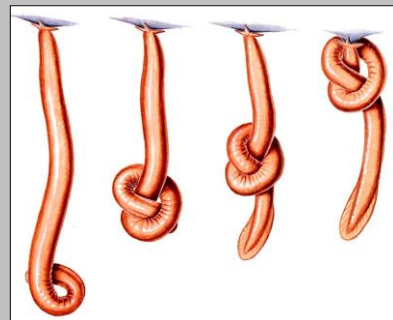


Myxini (Feiticeiras)

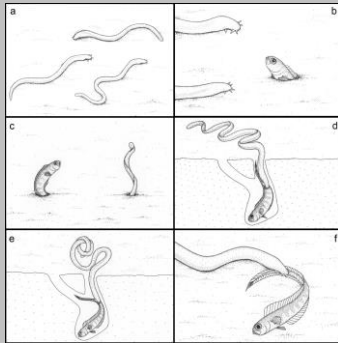
Morfologia interna



Myxini (Feiticeiras)



Myxini (Feiticeiras)

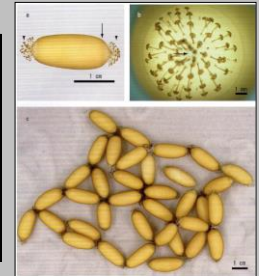


Zintzen, V. et al., 2011. Hagfish predatory behaviour and slime defence mechanism. SCIENTIFIC REPORTS 1:131 | DOI: 10.1038/srep00131

Myxini (Feiticeiras)

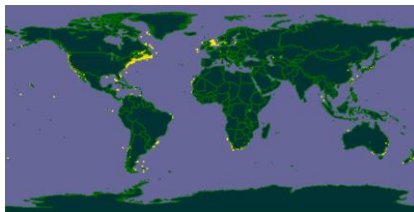
Reprodução:

- Ovários e testículos em um único indivíduo, mas somente uma gônada funcional
- Ovos grandes com muito vitelo
- 30 ovos por indivíduo
- Sem fase larval



Ota & Kuratani, 2006

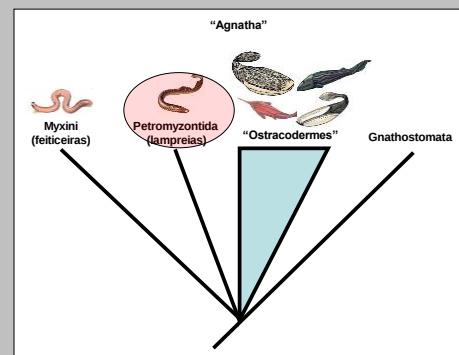
Myxini – distribuição geográfica



Global Biodiversity Information Facility
<http://data.gbif.org/species/13141293>



"Agnatha" – os vertebrados sem maxilas



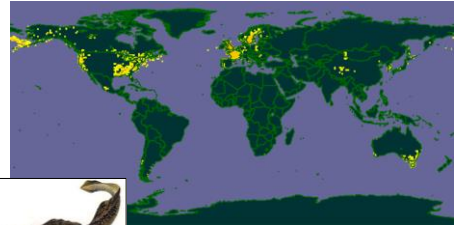
Petromyzontida (Lampreias)



46 sp.
anádromos e de água doce
Não ocorrem no Brasil



Petromyzontida – distribuição geográfica

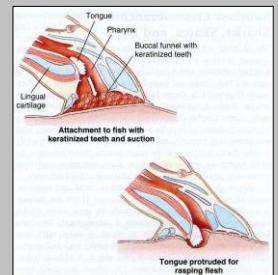


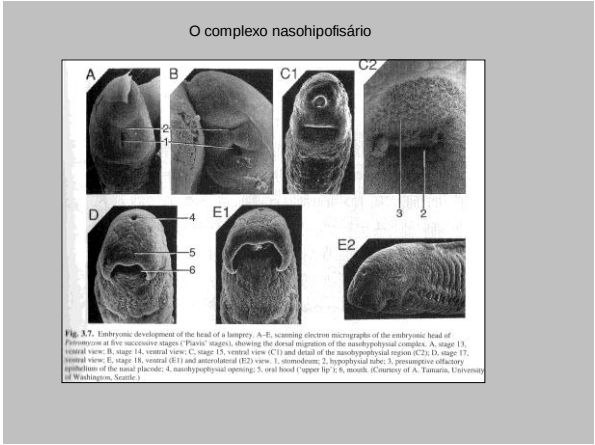
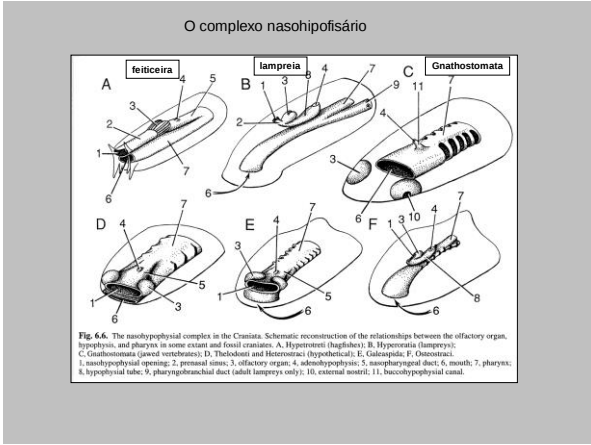
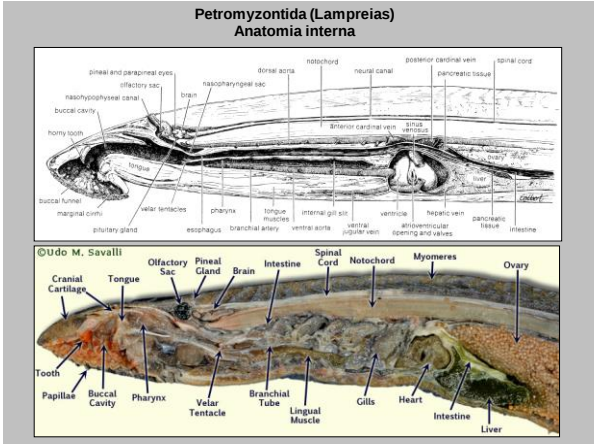
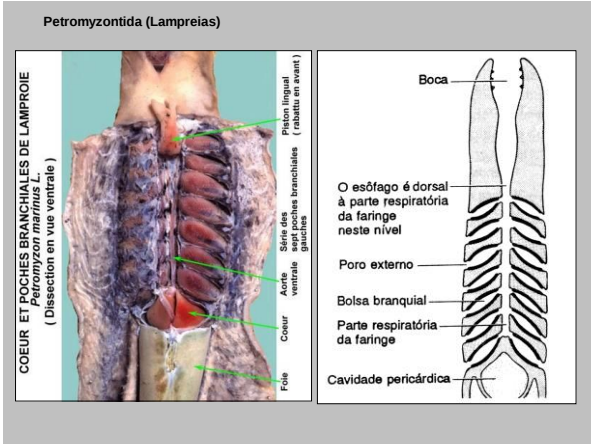
Global Biodiversity Information Facility
<http://data.gbif.org/species>

Petromyzontida (Lampreias)



Petromyzontida (Lampreias)

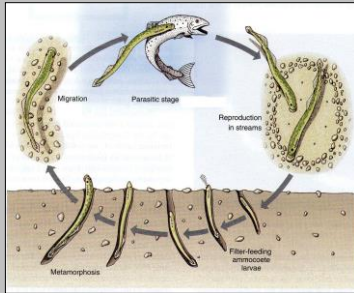




Petromyzontida (Lampréias)

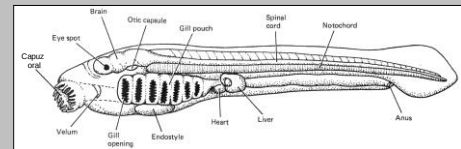
Reprodução:

- Sexos separados
- Ovos pequenos com pouco vitelo
- 100 a 1000 ovos por indivíduo
- Com fase larval



Petromyzontida (Lampréias)

Larva: amocete



Petromyzontida (Lampréias)

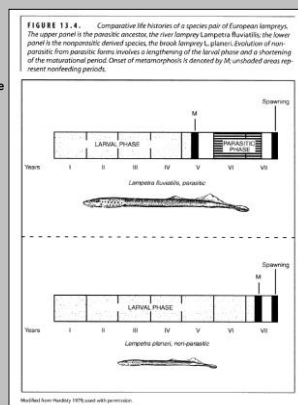
História de vida

46 espécies (total)

-Aprox. 1/2 são parasitas na fase adulta
(As espécies ou fases não parasitas sempre confinadas à água doce)

Larva: 22 cm

Adulto parasita: 1,2 m



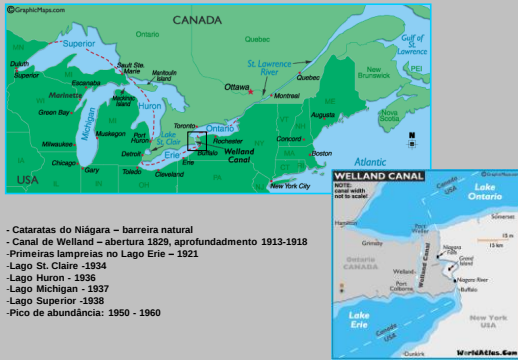
Petromyzontida (Lampréias)

adulto larva

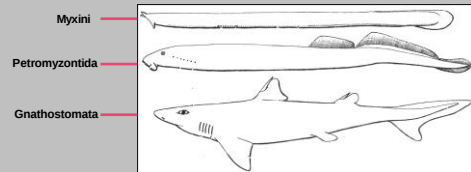


Mordacia mordax – Australia, parasita, adulto migra para o oceano 3 a 4 anos após eclodir do ovo

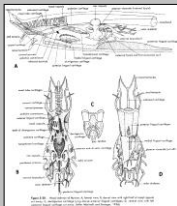
Petrymyzontida (Lampréias)

Invasão dos Grandes Lagos pela lampréia *Petromyzon marinus*

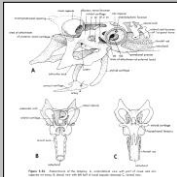
A questão Craniata-Vertebrata



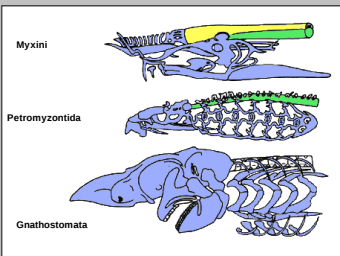
Myxini



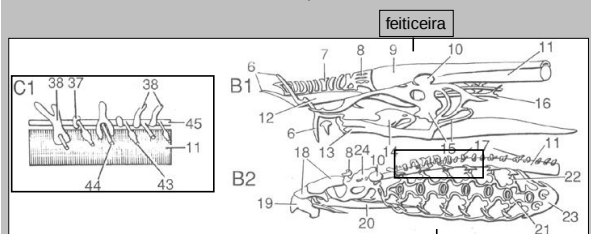
Petrymyzontida



Crânio e arcos viscerais

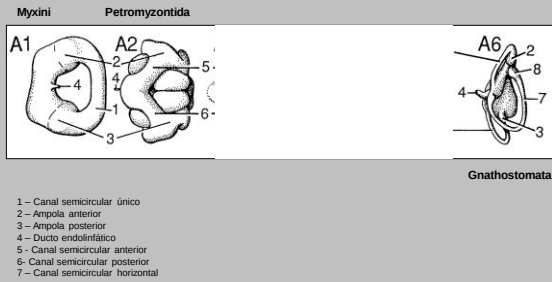


Endoesqueleto



- 9 - tecido fibroso envolvendo encéfalo
 10 - cápsula ótica
 11 - notocorda
 13 - placas do aparato lingual
 14 - cartilagem dentígera
 17 - arcúscula
 19 - cartilagem anular
 22 - arcos branquiais
 24 - crânio

Ouvido interno: canais semicirculares



Aparato lingual

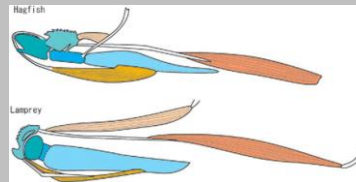
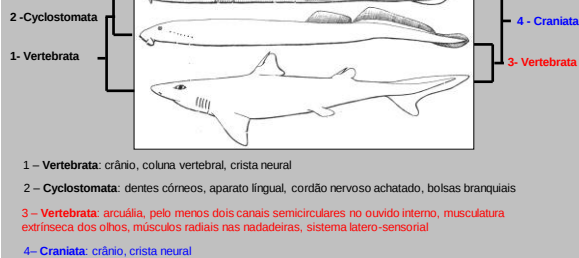


Fig. 4. Homology in the feeding apparatus. Diagrammatic representations of the mandibular arch-derived feeding organs in hagfishes (upper) and lampreys (lower). Shown from left lateral views. Homologous muscles and skeletal elements are indicated with the same colors. Modified from [Valdén \(1993\)](#).

feiticeira

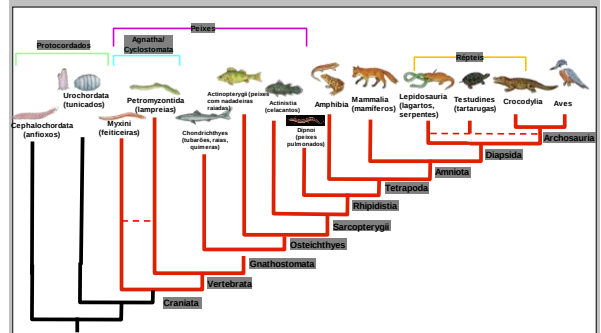
lampreia

Ota & Kuratani, 2006

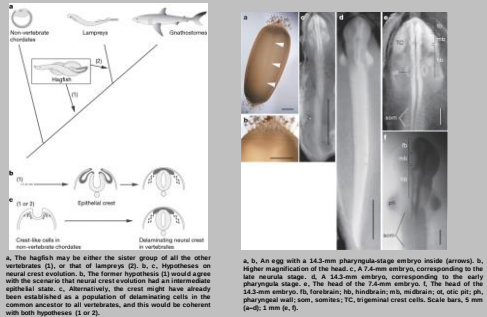


1758: Linnaeus: *Sistema naturae* – 10ª ed. – Vertebrata-Craniata (lampreias e vertebrados com maxilas);
feiticeiras incluídas no grupo ("Vermes intestinales")
1806: Duméril: "Cyclostomi" – lampreias e feiticeiras
1889: Cope: "Agnatha" e "Gnathostomata"
1977: Lovtrup: Vertebrata (lampreias e Gnathostomata) e Craniata (feiticeiras, lampreias e Gnathostomata)

Diversidade atual dos Vertebrados

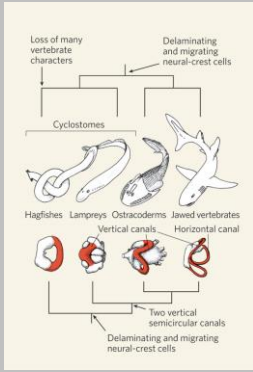


Formação da crista neural - Myxini



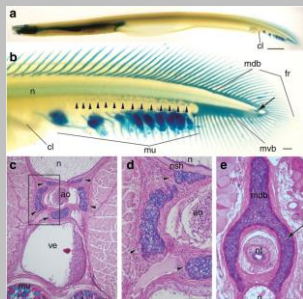
Ota et al., 2007 Nature 446:672-675

Formação da crista neural - Myxini



Janvier 2007 (Nature 446:622-623)

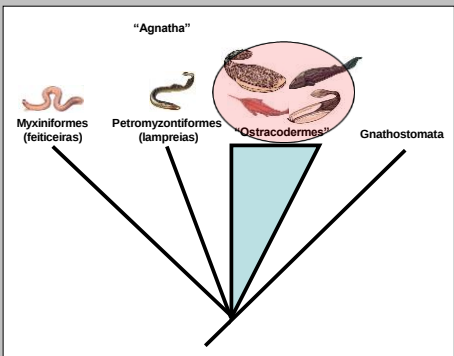
Presença de elementos vertebrais em Myxini (?)



The putative vertebral elements of *E. burgeri*. (a) Lateral views of whole-mount Alcian blue-stained adult hagfish. Anterior is to the left. (b) This high-magnification view of the caudal fin area shows small cartilaginous nodules (the putative vertebral elements) located on the ventral side of the notochord at the post-dorsal level (arrowheads). More posteriorly, dorsal and ventral fin rays are connected with median cartilaginous plates, previously called 'median dorsal and ventral bars'. (c-e) Transverse views of paraffin sections of *E. burgeri* stained with haematoxylin and eosin and Alcian blue. (c) The putative vertebral elements (arrowheads) are located ventral to the notochord surrounding the dorsal aorta at the post-dorsal region. (d) Higher magnification of the box shown in c. (e) The median dorsal bar is attached to a pair of cartilaginous arches on both sides of the notochord at the caudalmost level (arrow). ao, dorsal aorta; cl, cloaca; fr, fin ray; mdb, median dorsal bar; mu, mucus gland; mvb, median ventral bar; n, notochord; nsh, notochordal sheath; nt, neural tube; ve, vein. Scale bars, 1 cm (a); 1 mm (b); 100 μ m (c-e).

Ota et al., 2011 (Nature communications 2:373)

"Agnatha" – os vertebrados sem maxilas



Astraspida (Ordoviciano)

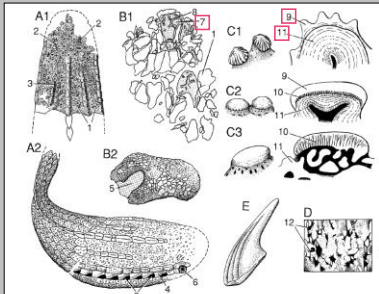
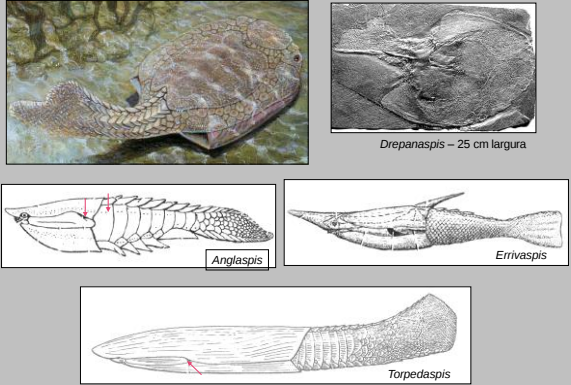


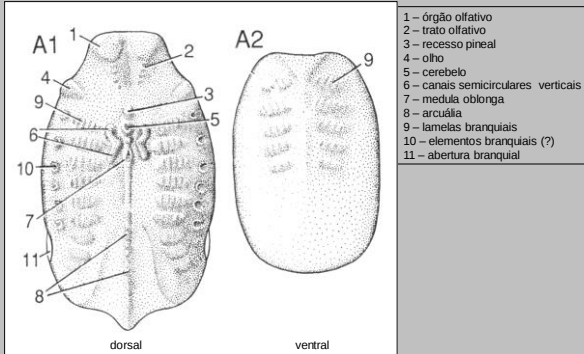
Fig. 4.3. Astraspida and other Ordovician vertebrates. A, *Astraspis*, Late Ordovician of North America, dorsal shield in dorsal view (A1, A2) and reconstruction in dorsoventral view (A2); B, *Pyramopterus*, Late Ordovician of North America, partially articulated skull in dorsal view (B1, B2), showing masses of glabrous calcified cartilage with canals (triangles), and isolated branching plate (B2, B3); C, comparison of the aspect and structure (vertical sections) of the subchondral of the dorsal ornamentation in *Astraspis* (C1, C2), *Pyramopterus* (C3) and *Pyramopterus* (C3) from the Ordovician of North America; D, cell space (thick line) in the basal bone of an endochondral vertebrate from the Ordovician of North America (about 1800 E, Devonian, Ordovician of Siberia, a possible vertebrate dorsal element); E, *Pyramopterus*, 2, uppermost sensory tentacle; 3, longitudinal ridge; 4, branching plate; 5, branching opening; 6, eye; 7, calcified endochondral glabrous calcified cartilage; 8, groove for subchondral vessels; 9, extended; 10, dorsomedian (sensory or sensory); 11, quadrate; 12, cell space (A1, from Hatala (1973a); A2, from Hatala (1973b); B1, from Thomson (1967); B2, C, based on Dring (1958, 1960); D, from M. M. Smith (1951); E, from Modak (1971)).

Heterostraci – morfologia externa

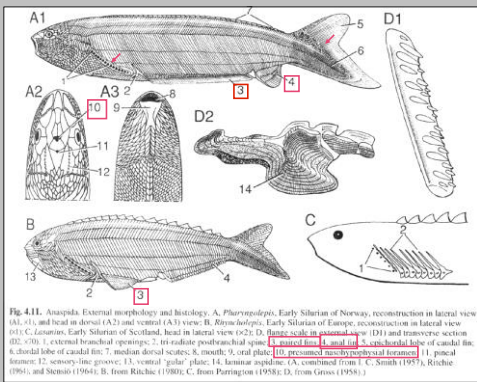


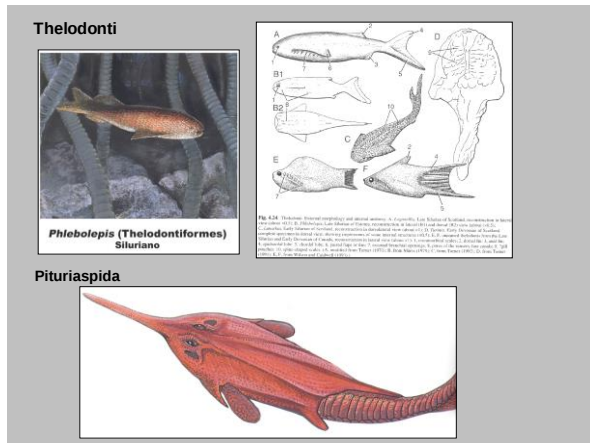
Heterostraci – morfologia interna

Molde da carapaça dérmica

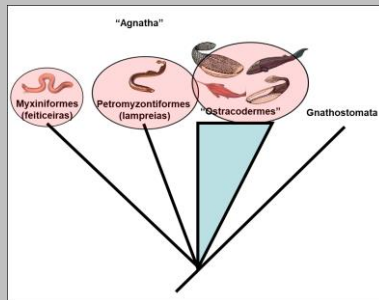


Anaspida





"Agnatha" – os vertebrados sem maxilas



- 1) Quais as relações filogenéticas dos "ostracodermes"?
- 2) De que maneira os "ostracodermes" contribuem para o entendimento da evolução das características que levou ao aparecimento dos Gnathostomata?