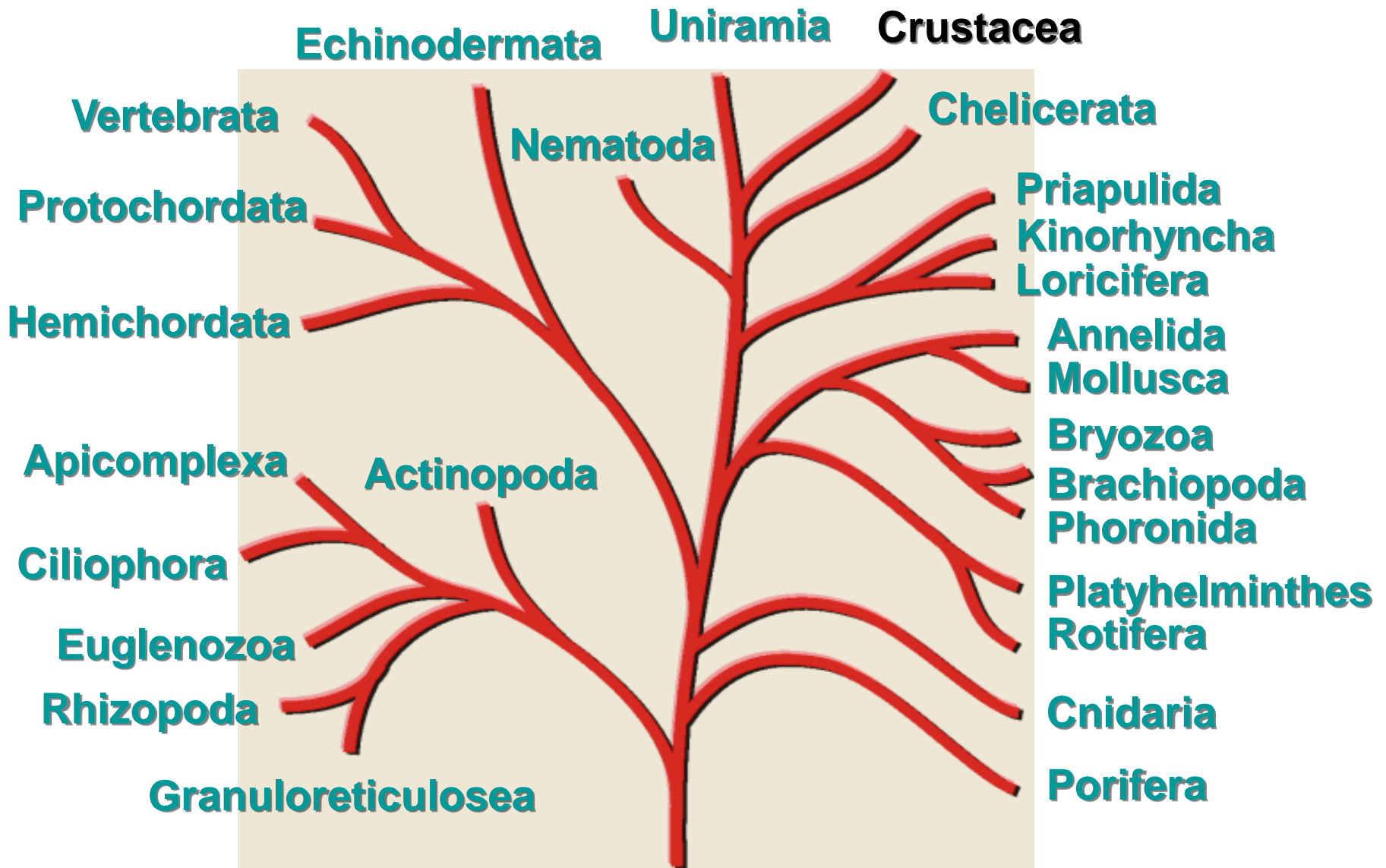


Subphylum Crustacea



Subphylum Crustacea

- **Rakovi** - primarno vodene životinje
- **Broj vrsta:** oko 40.000
- **Životna sredina:** mora, slatke vode (manji broj), poluterestrične i terestrične forme
- **Veličina tela:** 0.1 mm - 60 cm; ogromna raznovrsnost formi; npr. jastozi teški i do 20 kg; ekstremiteti džinovskih kraba (*Macrocheira kaempferi*) dugi i do 4 m

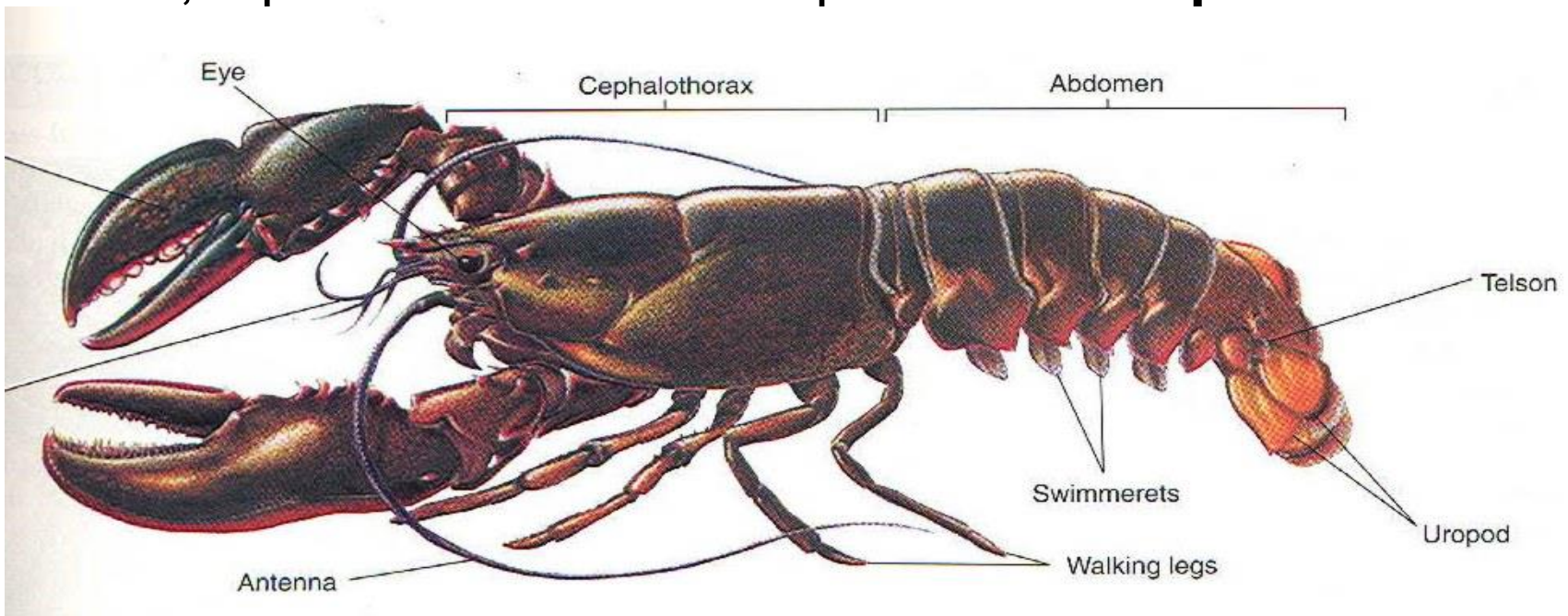


Subphylum Crustacea

- Opšte karakteristike:
 - 2 para **antena**
 - vodeni i većina kopnenih rakova sa **škrigama (Mandibulata - Branchiata)**
 - 5 pari glavenih nastavaka
 - 3 telesna regiona (tagmata) - **glava/grudi/trbuh**
 - poslednji segment je tzv. pravi **telzon**
 - bez nastavaka ili sa njima
 - sa anusom
 - bez ganglije

Subphylum Crustacea

- Tri telesna regiona:
 - Glava** (*cephalon*)
 - Grudi** (*thorax*)
 - Trbuh** (*abdomen*)
- **Glava** – 5 pari ekstremiteta (antene I i II, mandibule, maksile I i II)
- 1-3 grudna segmenta često su pridodati glavenim – **cefalotoraks**; ekstremiteti **maksilopede**
- **Toraks**, a ponekad i čitavo telo pokriveni **karapaksom**



Subphylum Crustacea

- Opšte karakteristike spoljašnje morfologije:
 - glaveni region (akron + 5 segmenata)
 - *cephalothorax*, grudi (*pereion*) i abdomen (*pleon*)
 - antene (2 para) = *preoralni*
 - mandibule (1 par) + maksile (2 para) = *oralni*
 - maksilopede (3 para) + pereiopode (5 pari) = *torakopode*
 - trbušni ekstremiteti (6 pari) = *pleopode*
 - **karapaks** (kod nekih od 2 kapka)
 - **škržna komora** (između karapaksa i telesnog zida)

Subphylum Crustacea

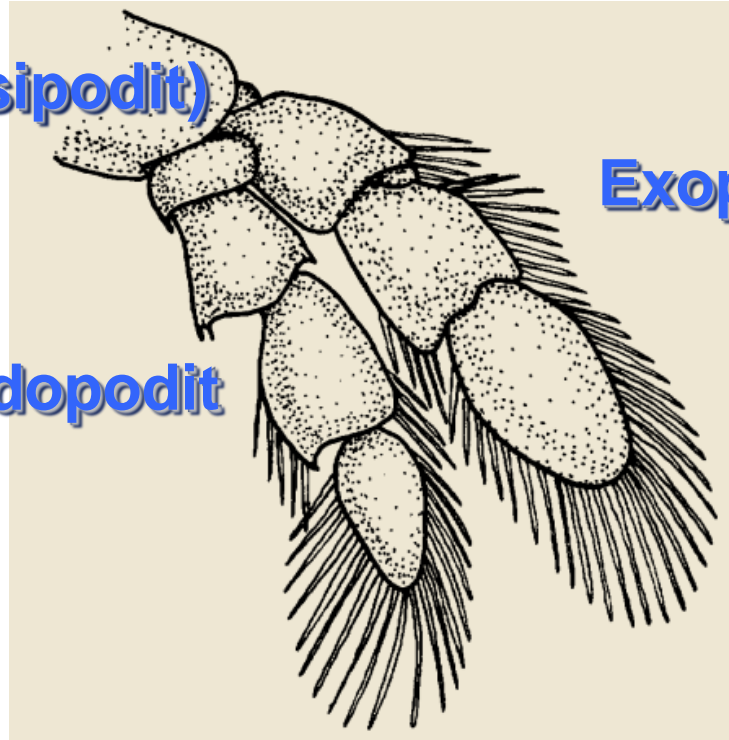
- Opšte karakteristike spoljašnje morfologije:
 - nastavci (ekstremiteti) dvograni i filopodni (*listoliki*) kod “primitivnih” grupa
 - nastavke (ekstremitete) koriste za ishranu, respiraciju, lokomociju i za smeštaj čula

Crustacea - nastavci na telu

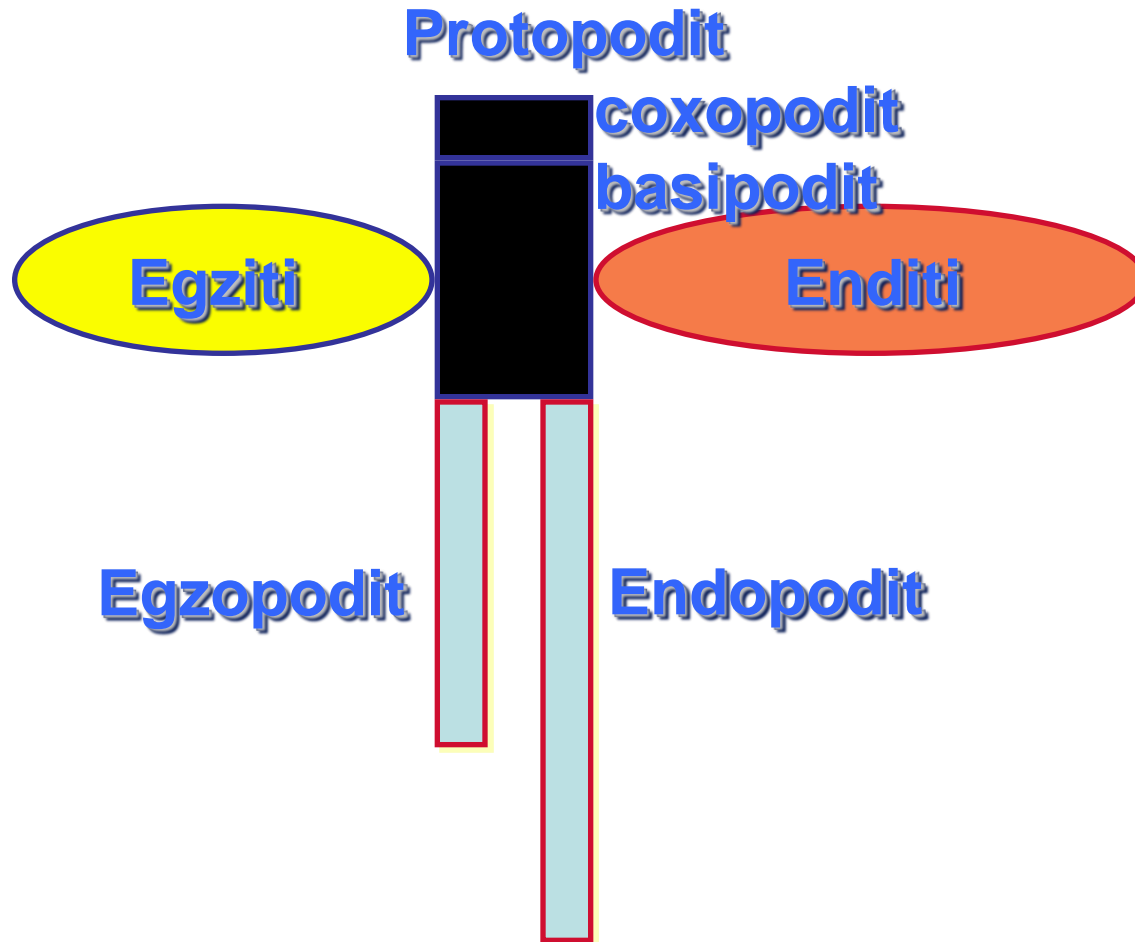
**Protopodit
(coxopodit & basipodit)**

Endopodit

Exopodit

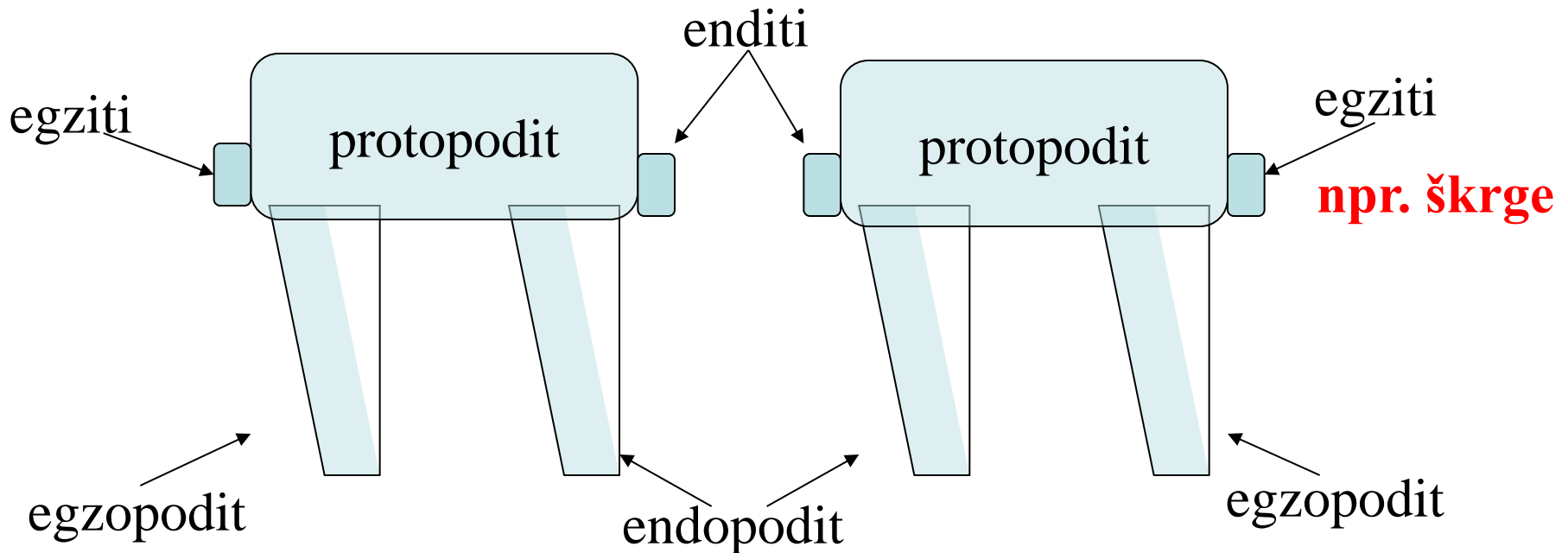


Crustacea - nastavci



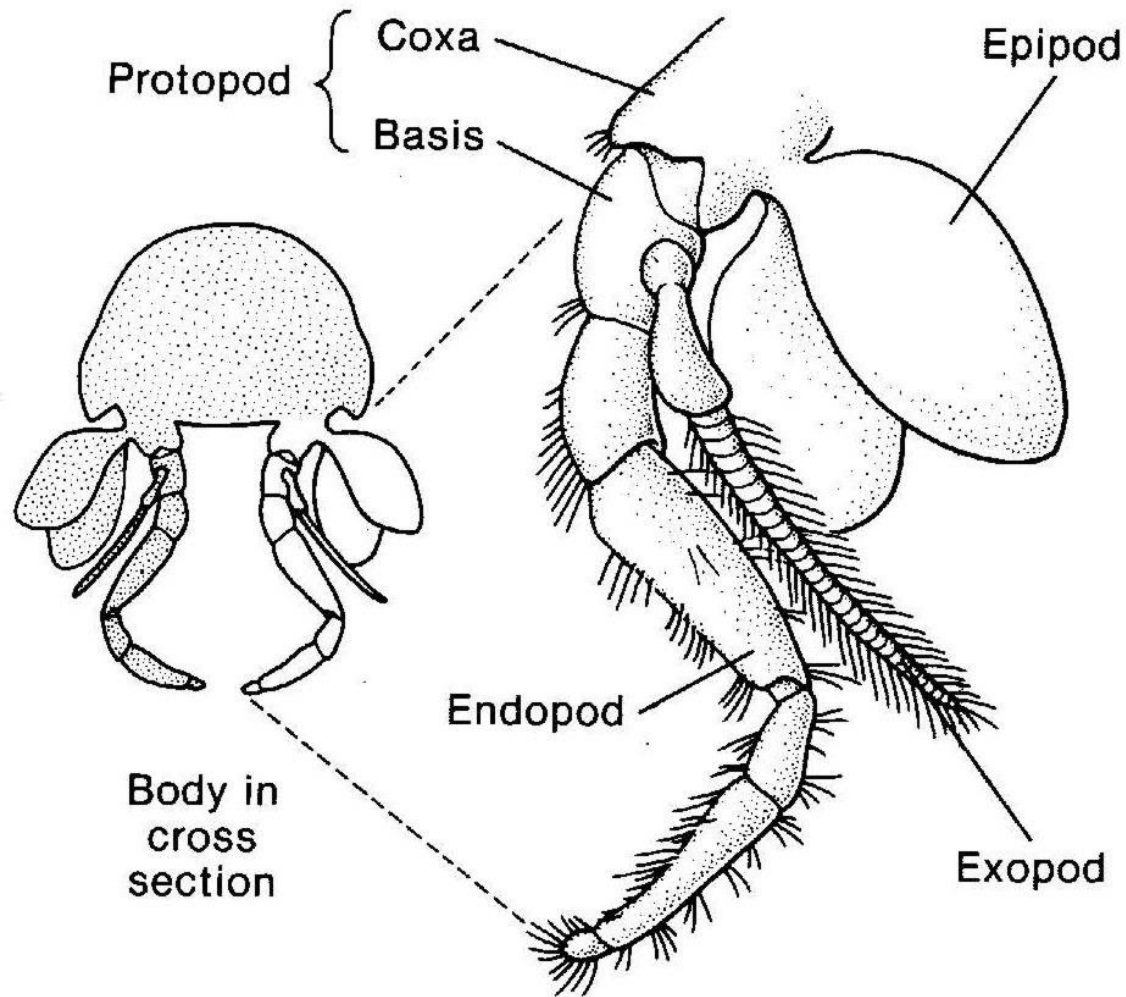
Crustacea - ekstremiteti

- Osnovna struktura ekstremiteta i funkcije:
 - dvogranost: osnovni protopodit + exopodit i endopodit



za ishranu, respiraciju i kretanje

Crustacea - ekstremiteti



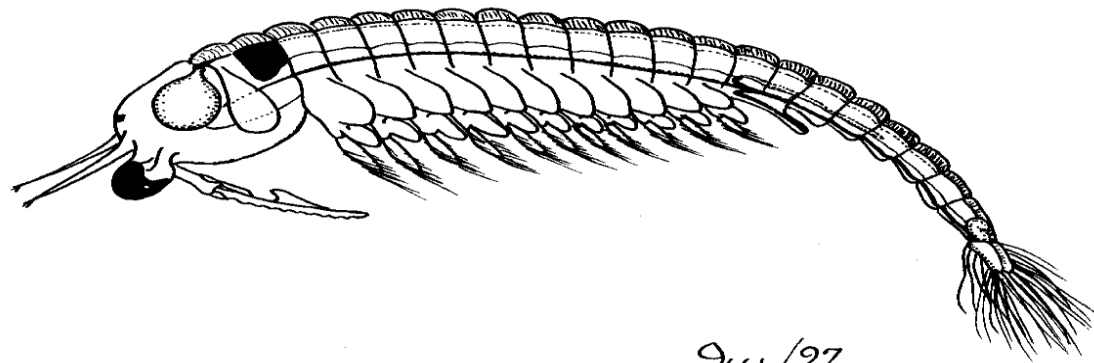
Crustacea - ekstremiteti

- **Filopodni** nastavci:

- listoliki
- negranati
- spljošteni
- najprimitivniji
- nalaze se kod:
 - Branchiopoda
 - Cephalocarida

- **Stenopodni** nastavci:

- granati
- tanki, vitki, cilindrični
- noge za hodanje
- tipični za više rakove

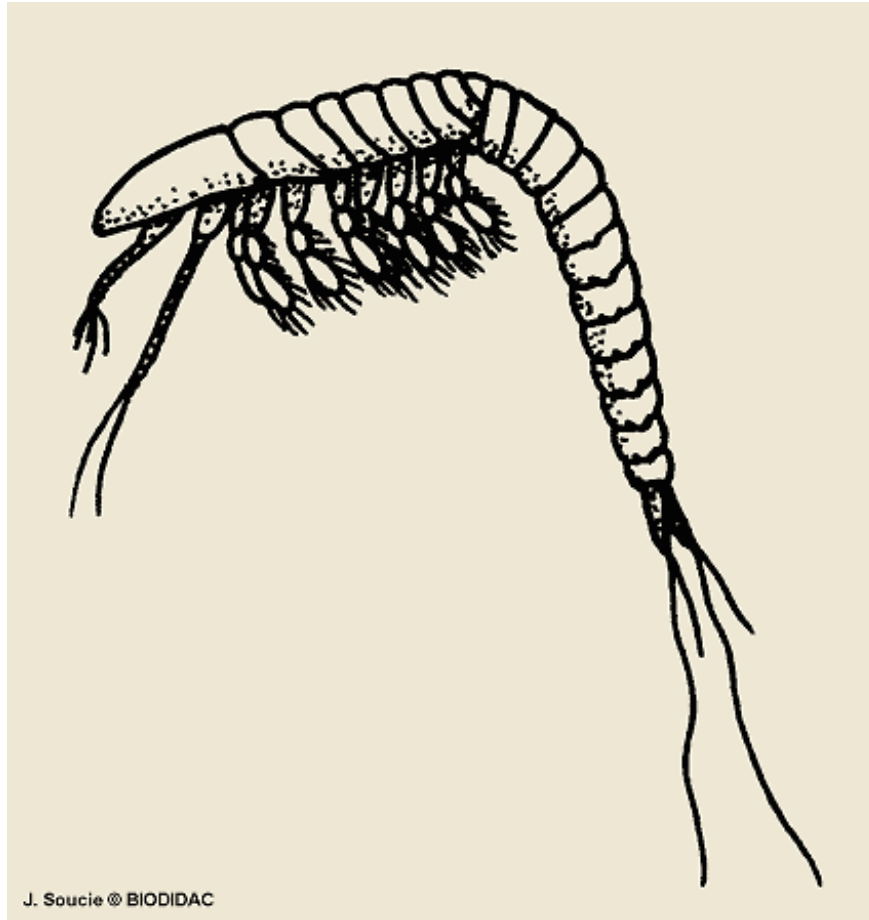


Ivy Livingston © BIODIDAC

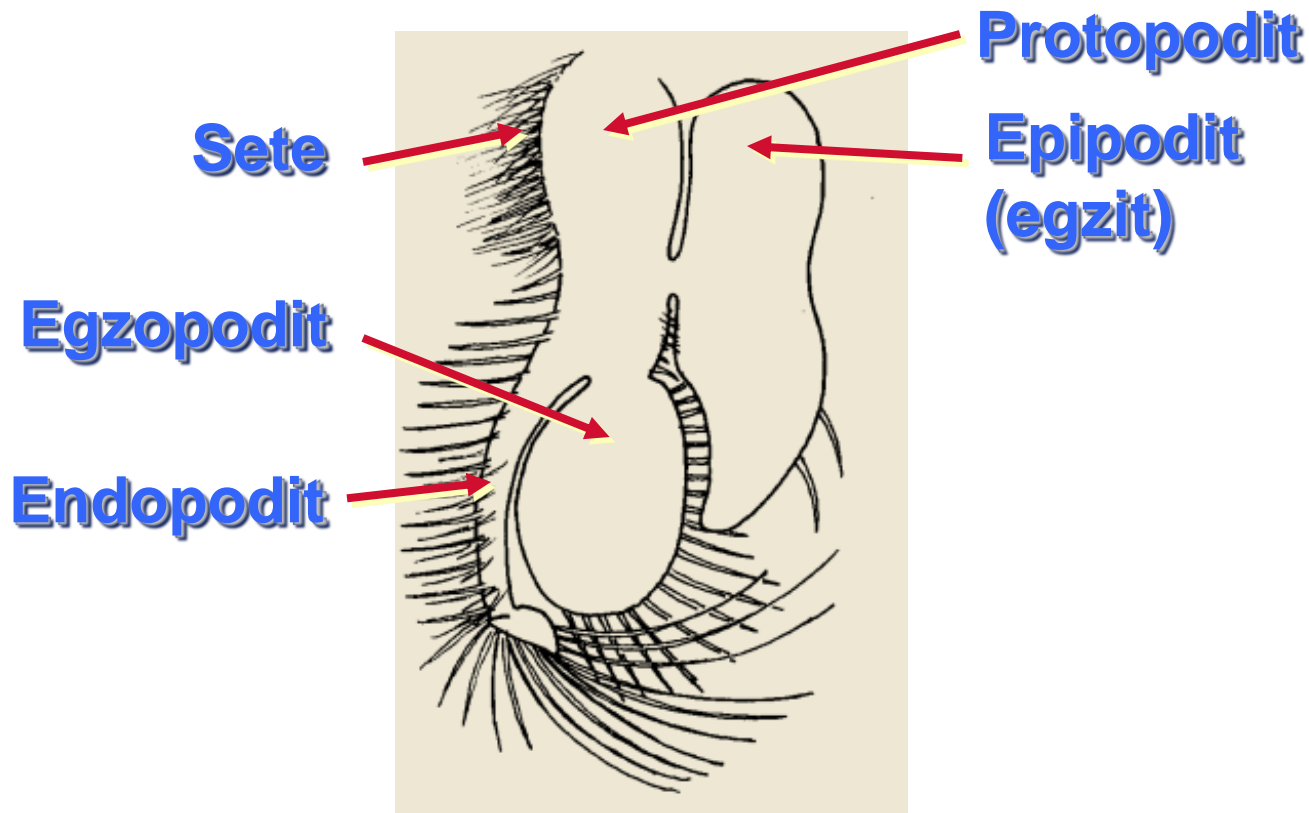
9/4/97

Classis Branchiopoda: Ordo Anostraca: *Artemia* sp.

Cephalocarida



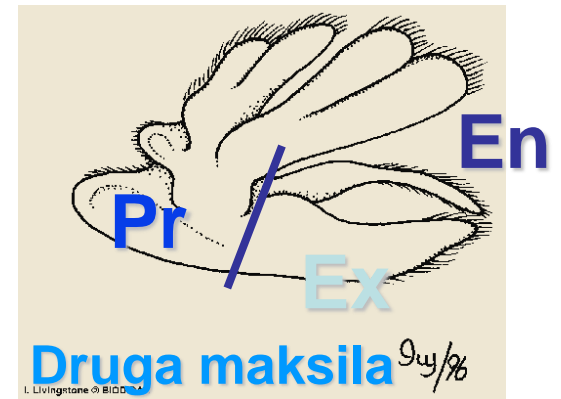
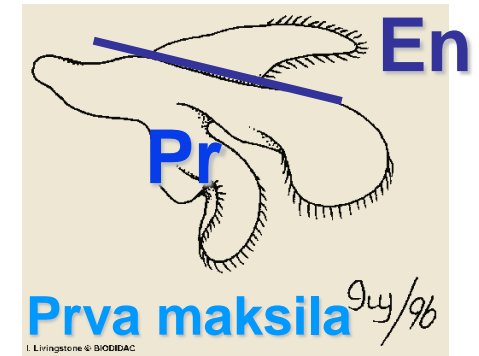
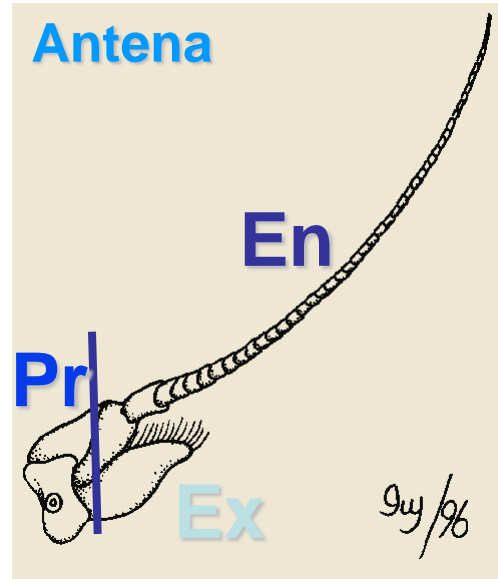
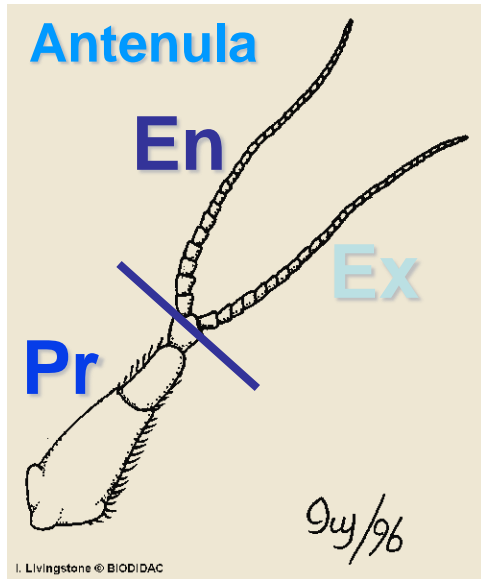
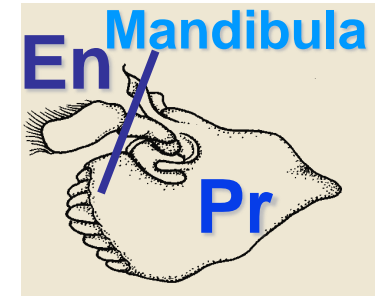
Filopodni ekstremiteti kod Cephalocarida (trograni - primitivna osobina)



Modifikovani nastavci (glava)

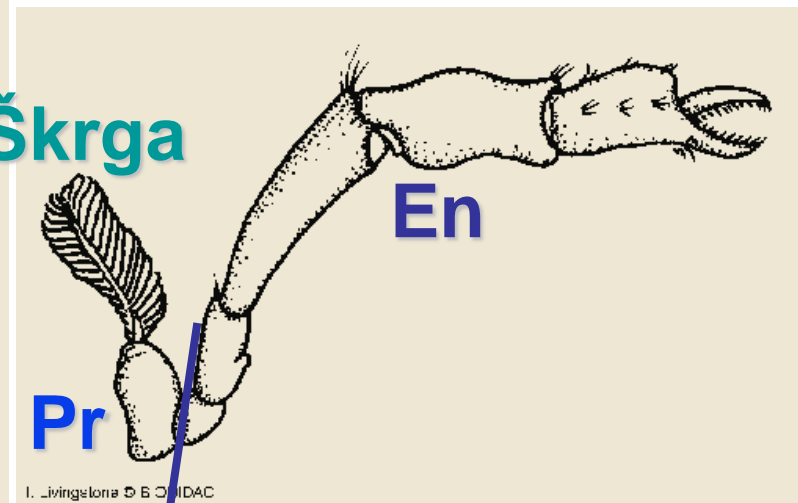
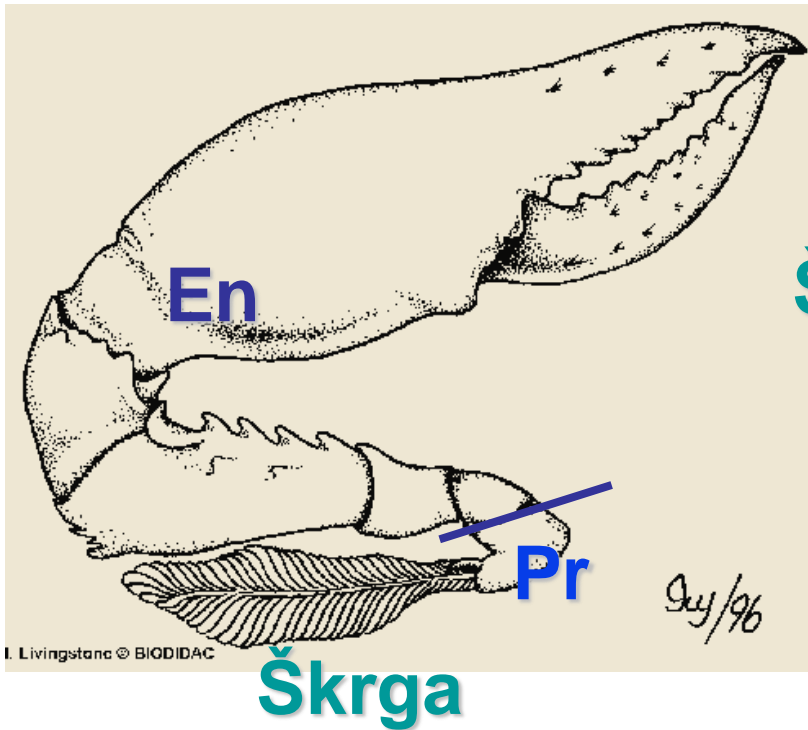
En - endopodit, Ex - egzopodit,

Pr - protopodit



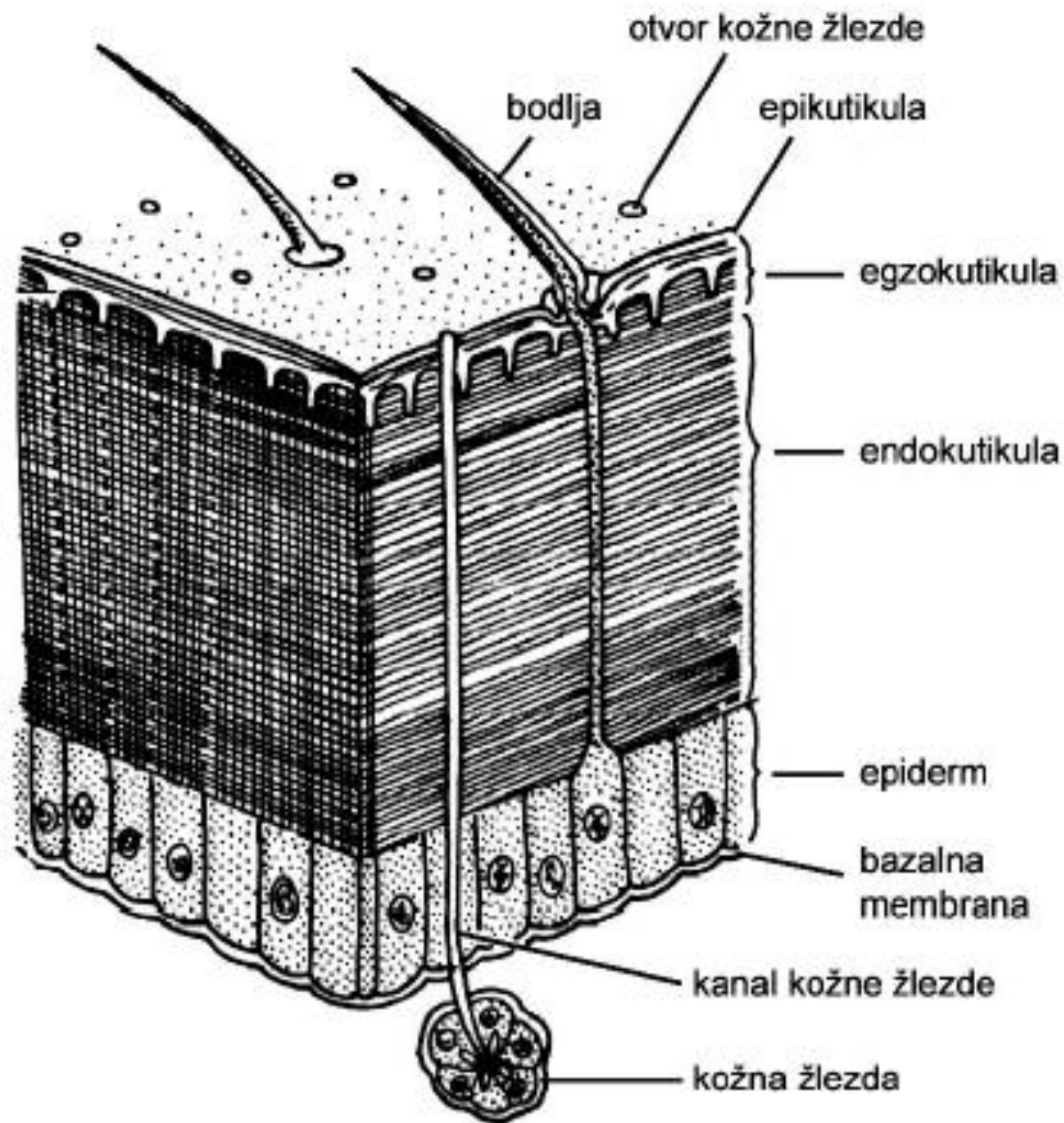
Modifikacije nastavaka (*thorax*)

En - endopodit, Ex - egzopodit, Pr - protopodit

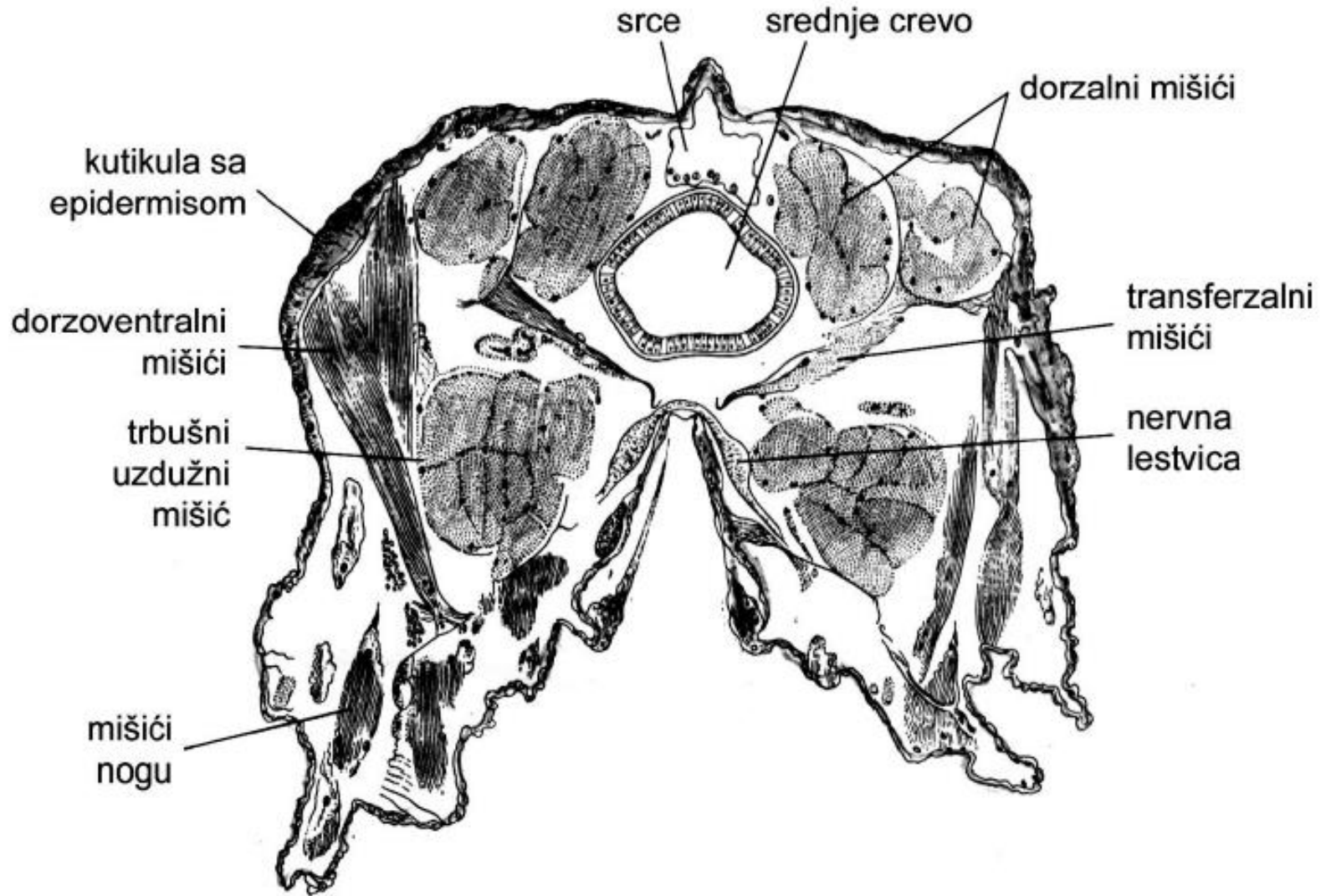


Subphylum Crustacea

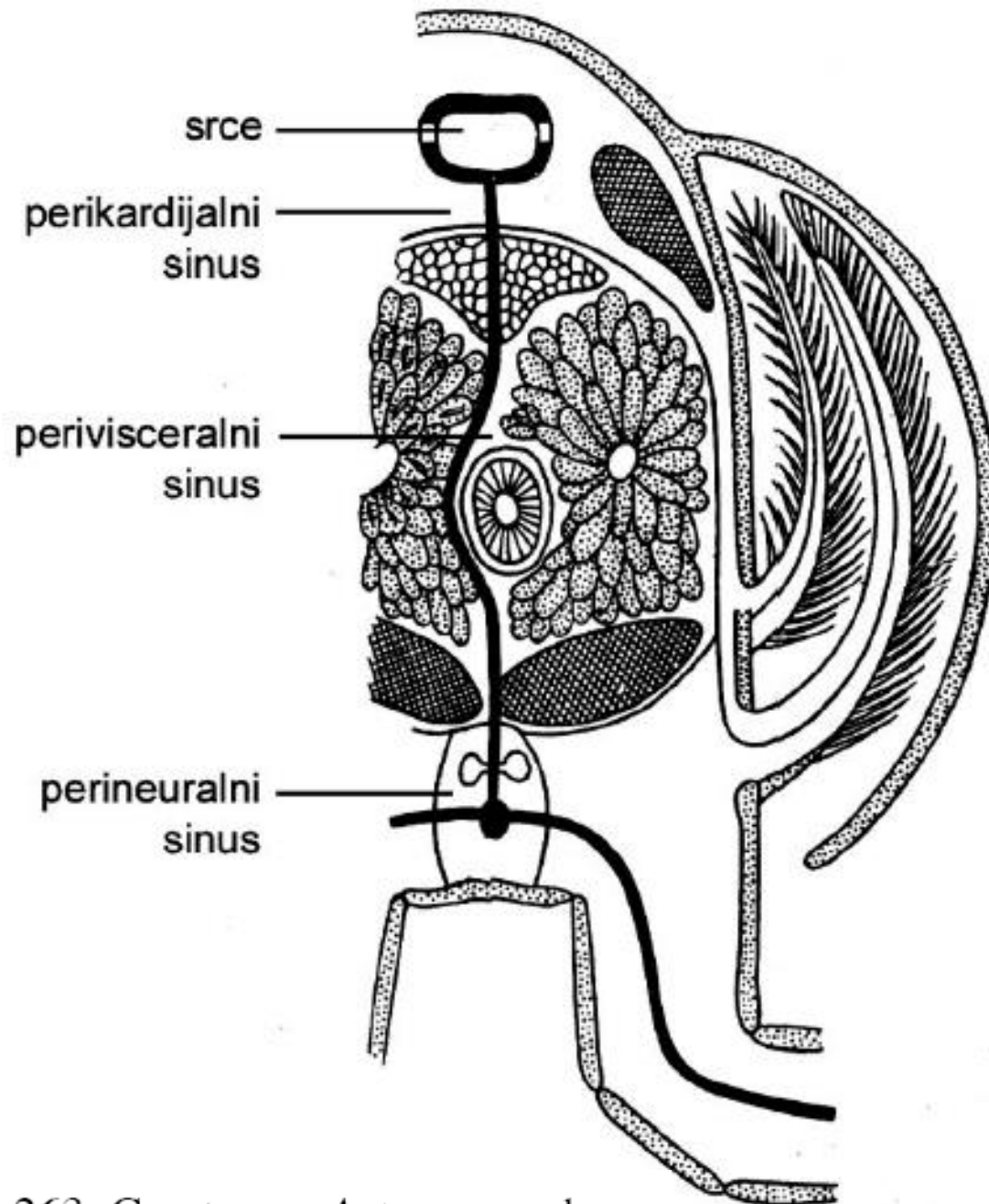
- Opšte morfološke karakteristike:
 - **epidermis** na površini luči **kutikulu** (višeslojna, prožeta CaCO_3)
 - **mišićni sistem** (mišićni snopovi, endapofize)
 - **miksocel** (**celom** samo oko gonada, antenalnih i maksilarnih žlezda)
 - **ishrana**
 - filtriranjem organskih čestica ili mikroorganizama
 - sitnjenjem biljne ili životinjske hrane (predatori)
 - paraziti, komensali



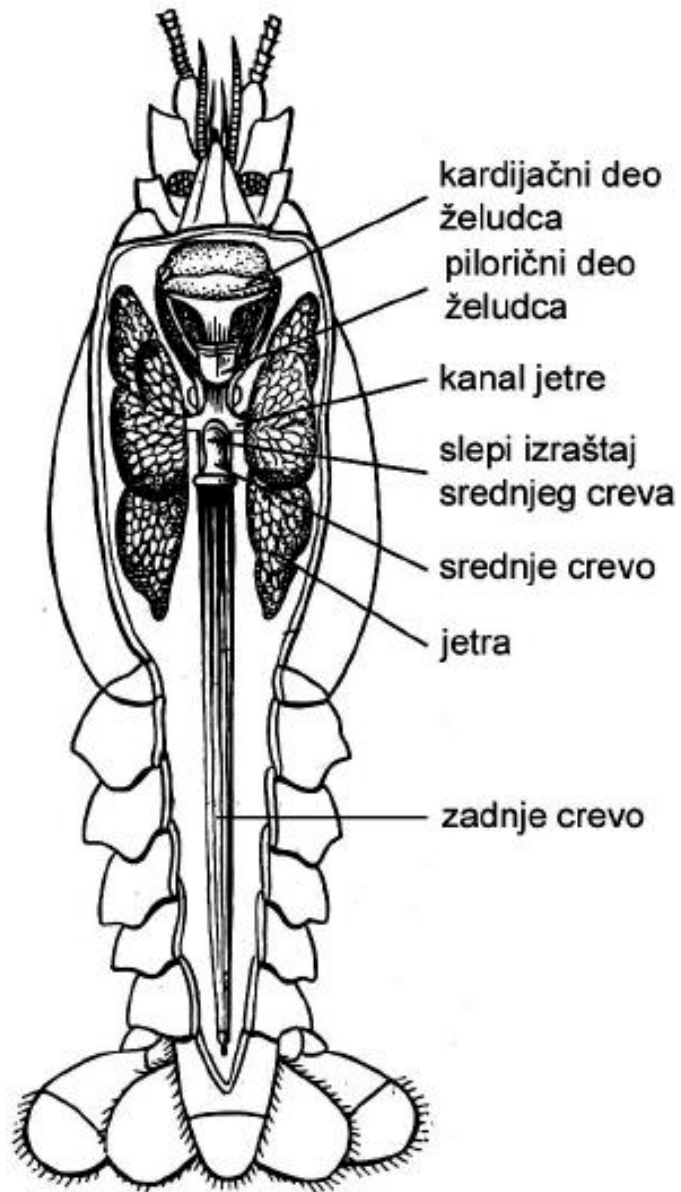
Crustacea, shema građe kutikule.



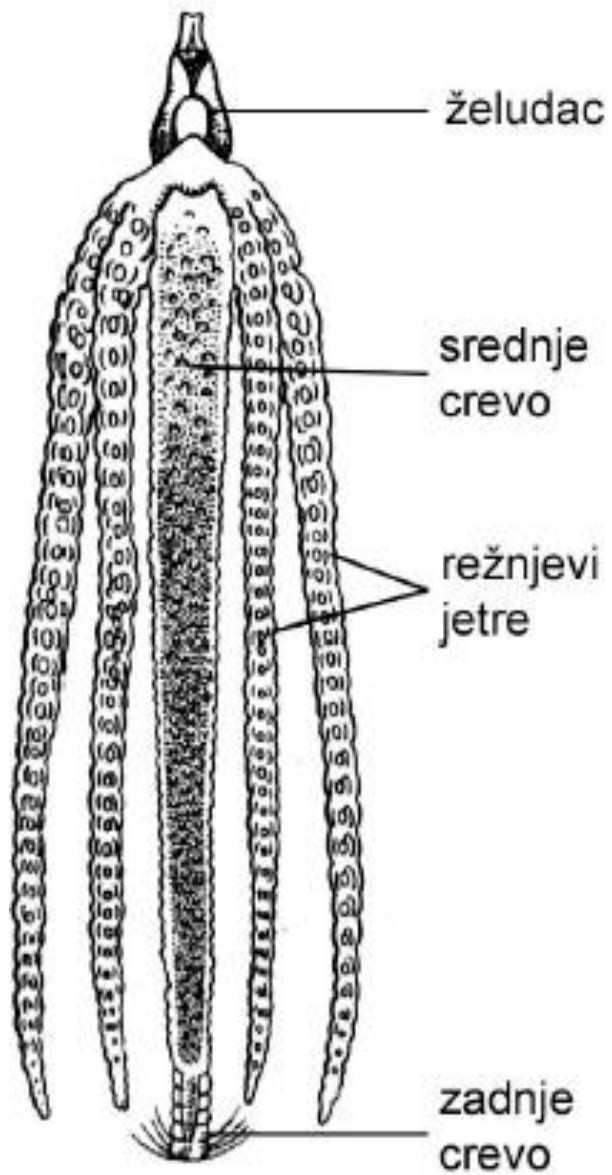
Slika 262. Crustacea, mišićni sistem, *Branchipus stagnalis*, poprečni presek.



Slika 263. Crustacea, *Astacus* sp. shema građe miksocela.



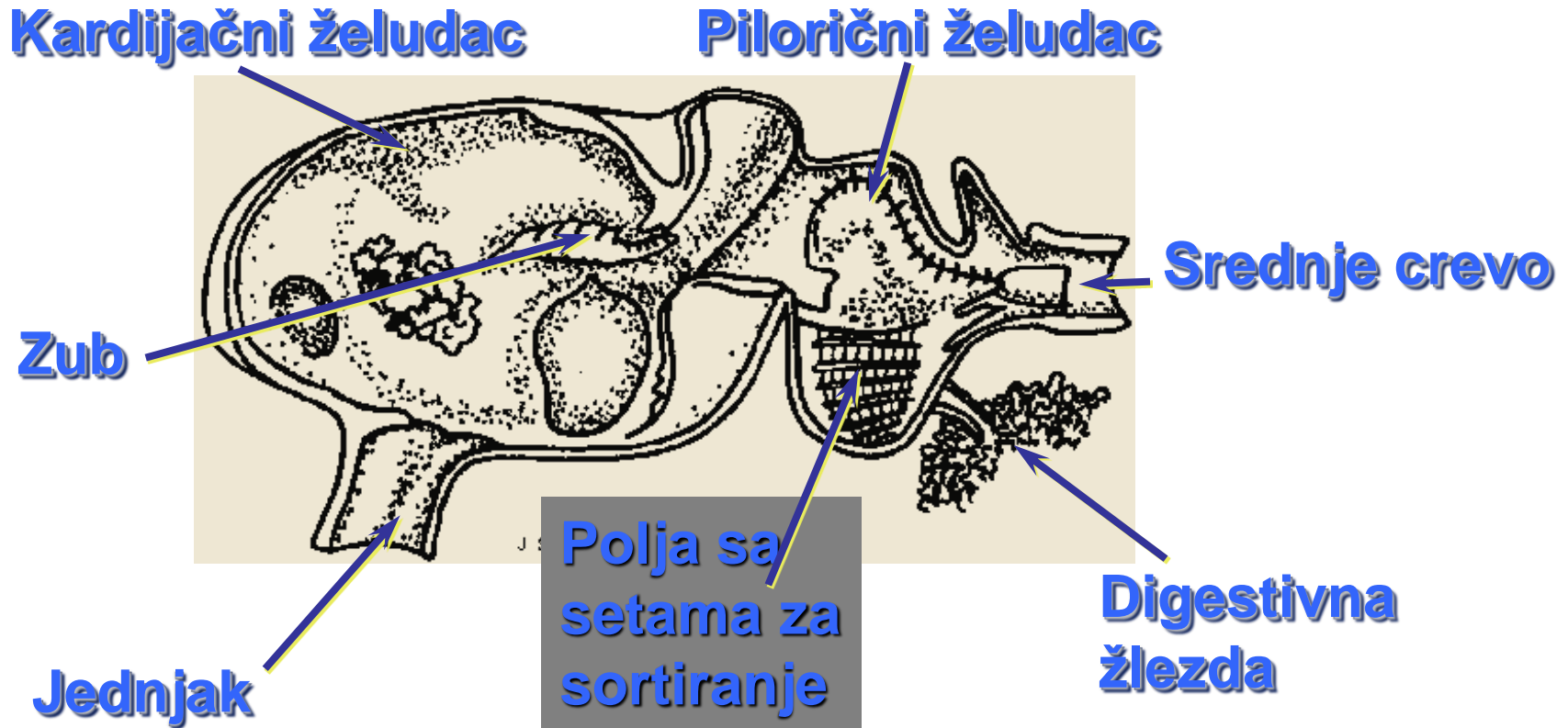
Astacus sp., shema građe crevnog sistema.



Asellus aquaticus, shema građe crevnog sistema.

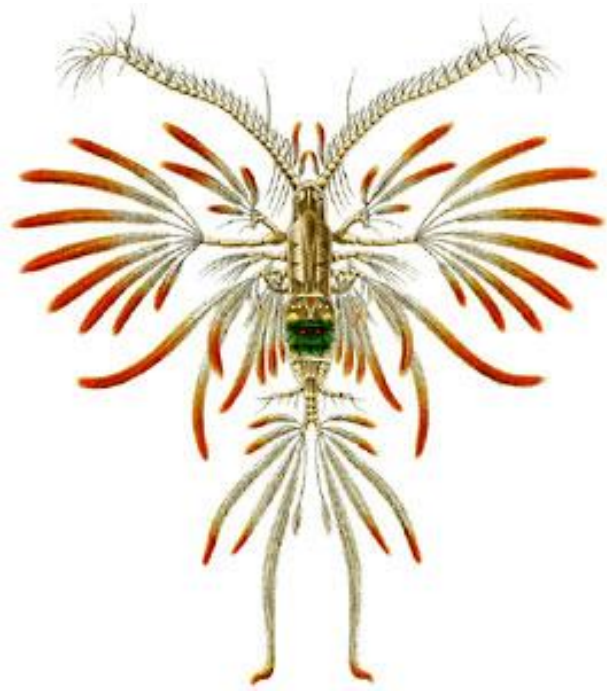
Želudačni mlin

Ishrana i varenje

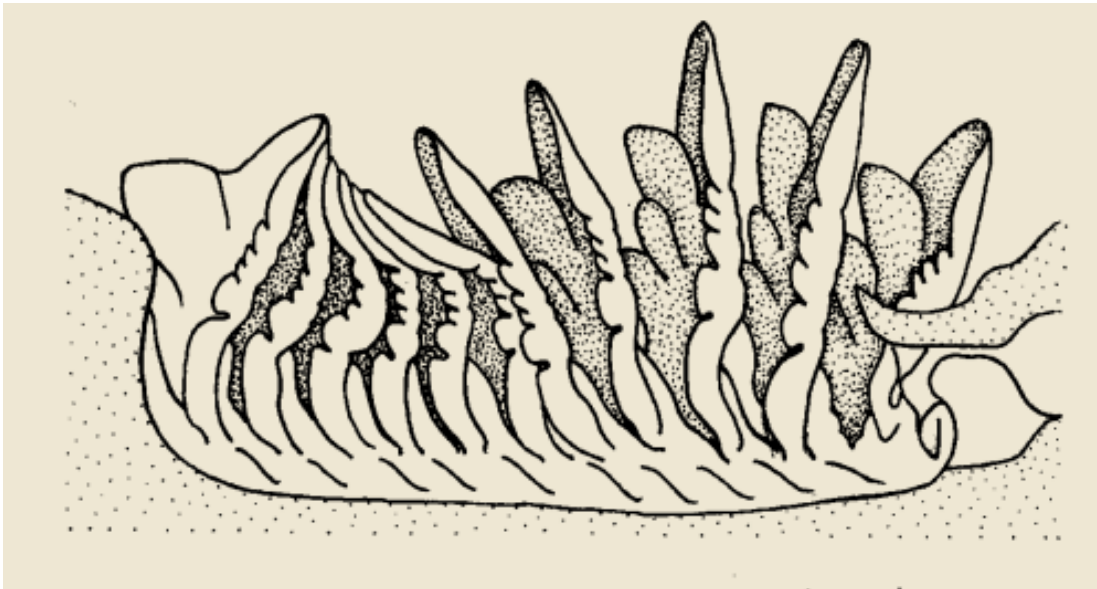
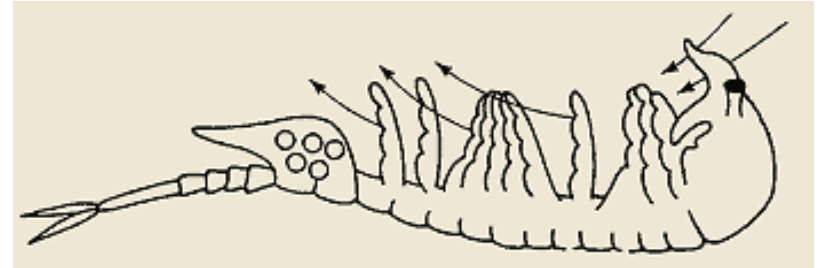


Subphylum Crustacea

- Staništa:
 - **Bentosne** vrste dorzoventralno spljoštene (krupniji dekapodni rakovi)
 - Važna komponenta **zooplanktona** - izraštaji na telu planktonskih vrsta;
Euphausia superba – glavna hrana za kitove resane u antarktičkim morima
 - **Zarivajuće** i **sesilne** forme (redukovan abdomen)

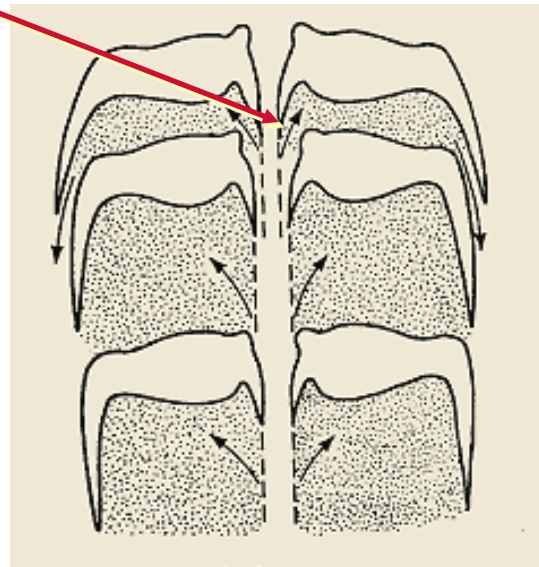


Ishrana filtriranjem



Ishrana filtriranjem

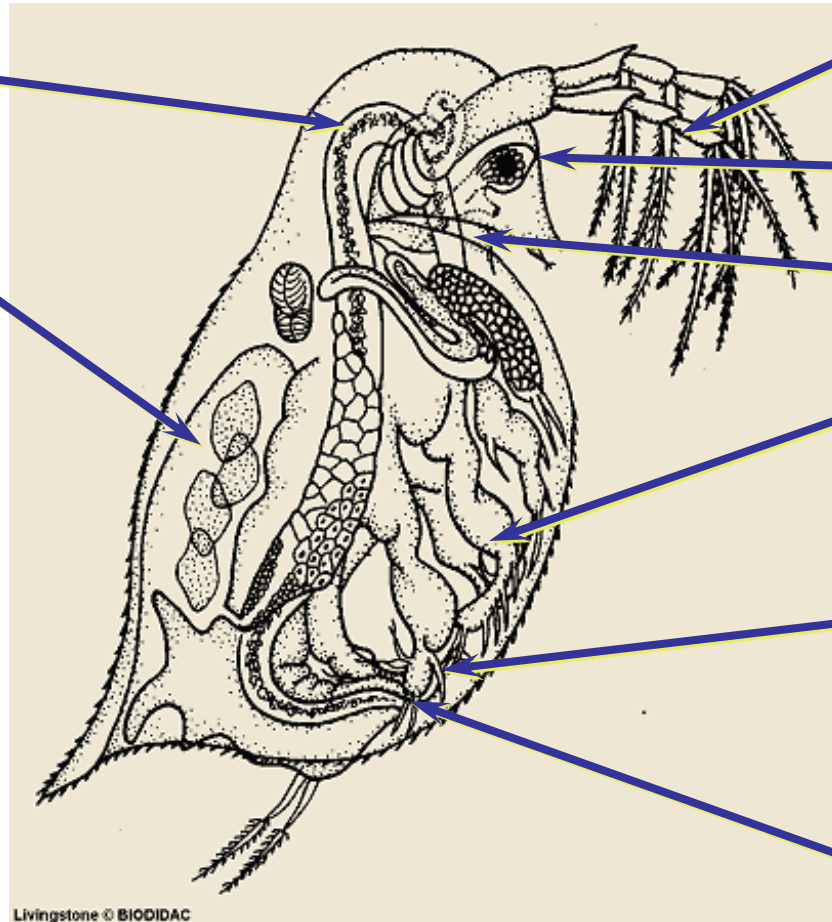
Hranljiva brazda
vodi do glave



Daphnia spp. - Branchiopoda

Crevni sistem

Ležajna komora



Antena

Oko

Usta

Torakalni nastavci

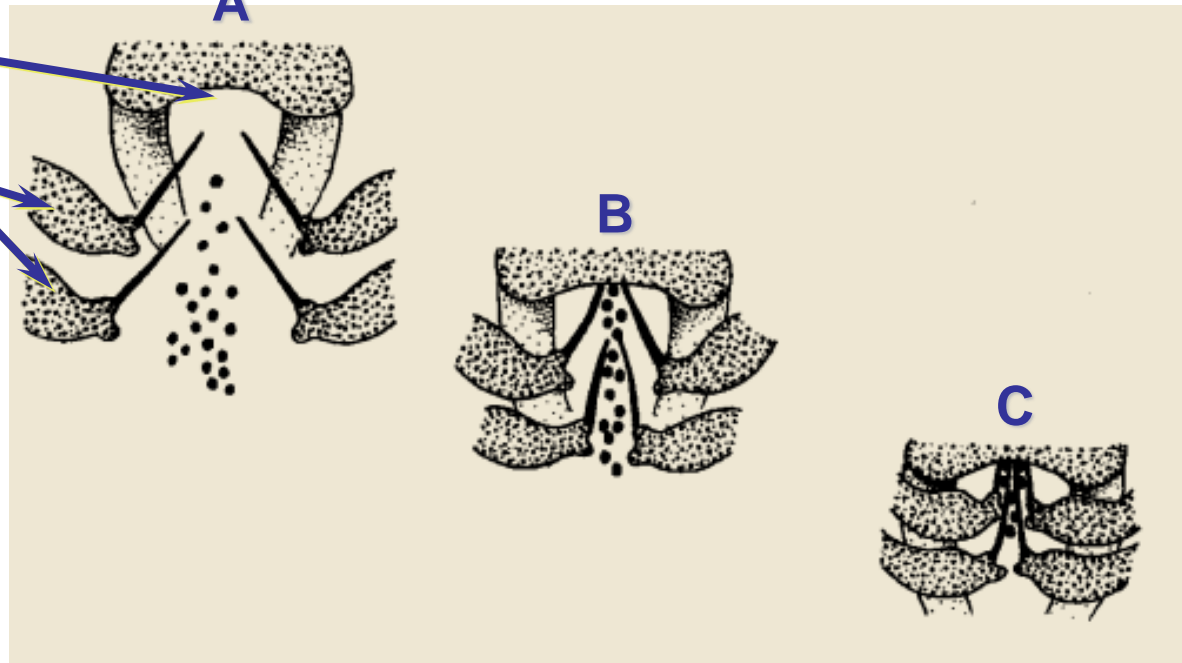
Abdominalne kandže

Anus

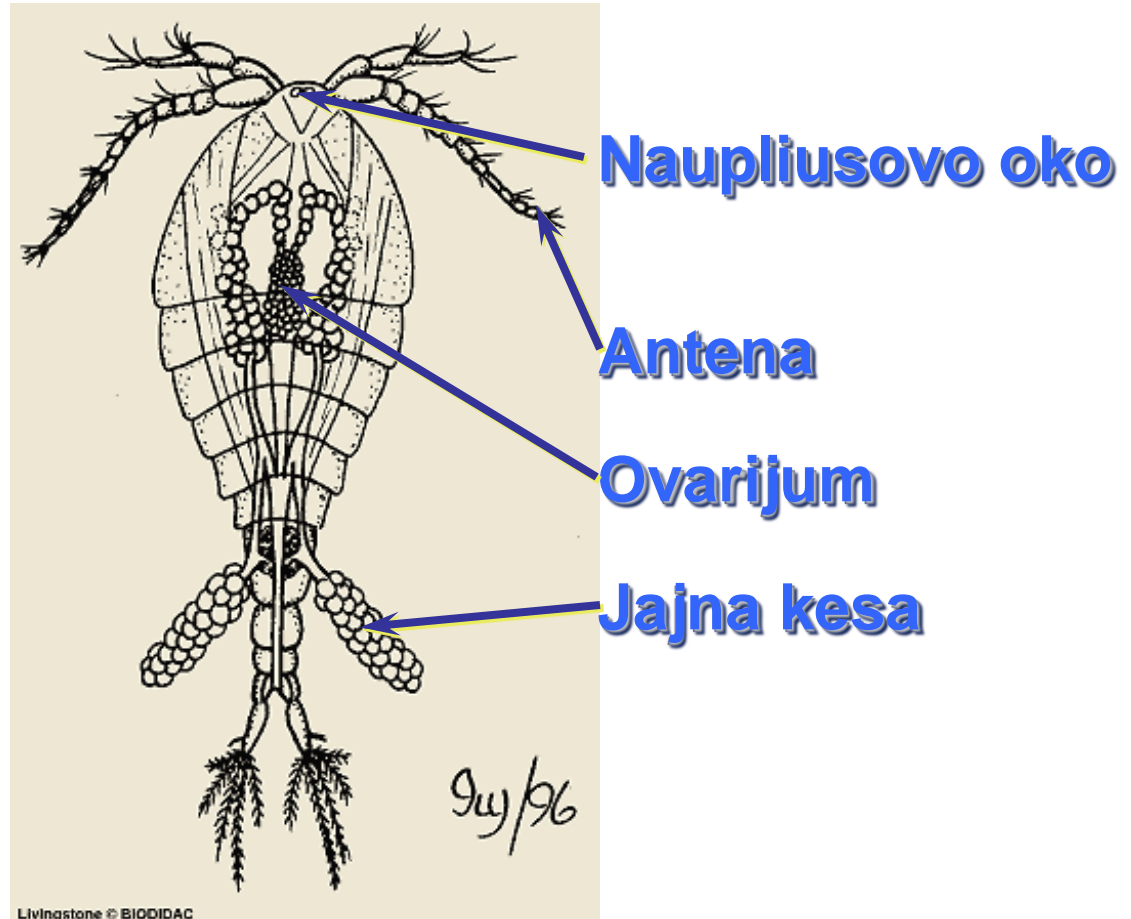
Daphnia spp.

Hranljiva brazda

Torakalni nastavci



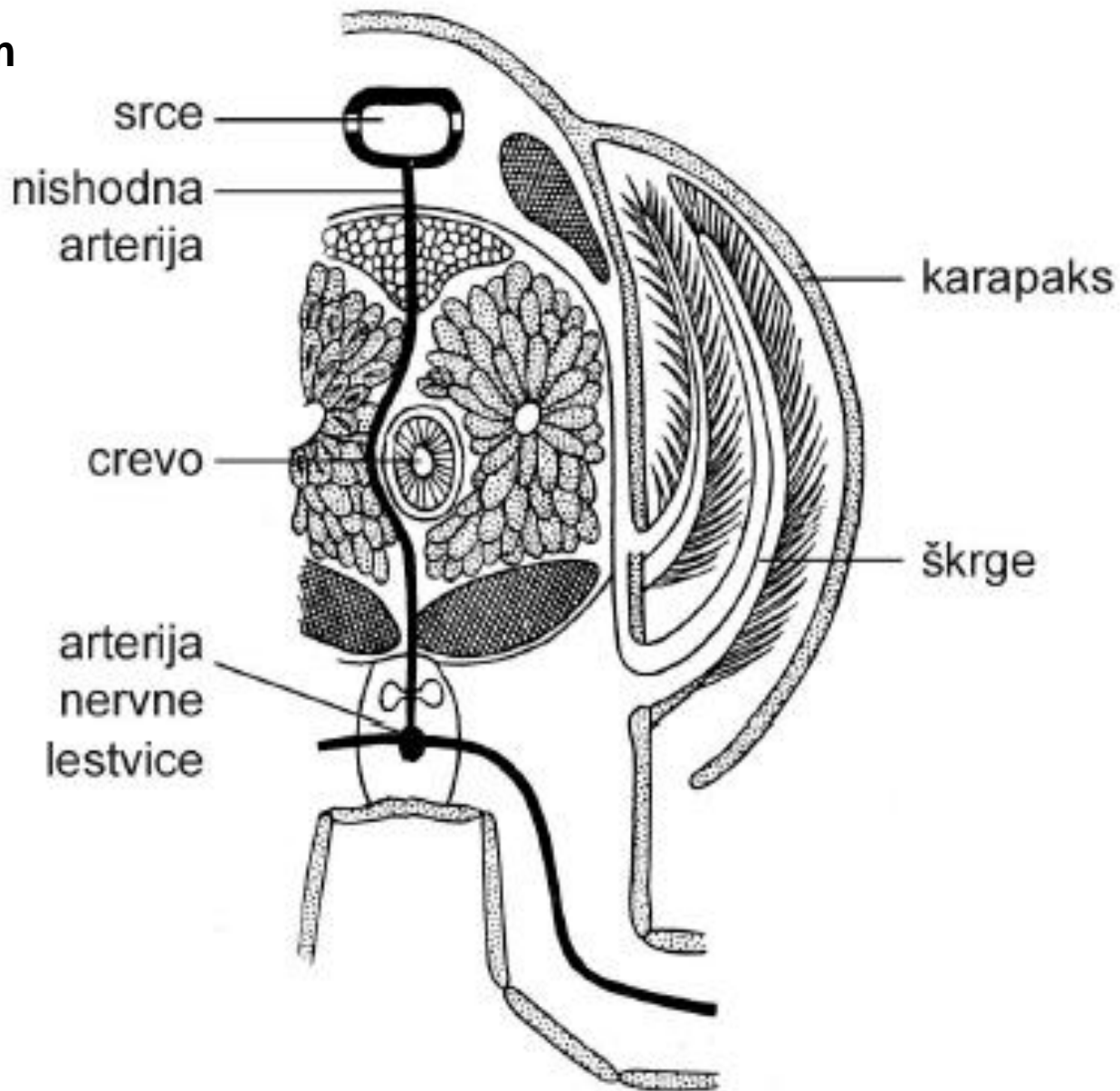
Copepoda - Maxillopoda



Krupne Crustacea



Respiratorni sistem Crustacea

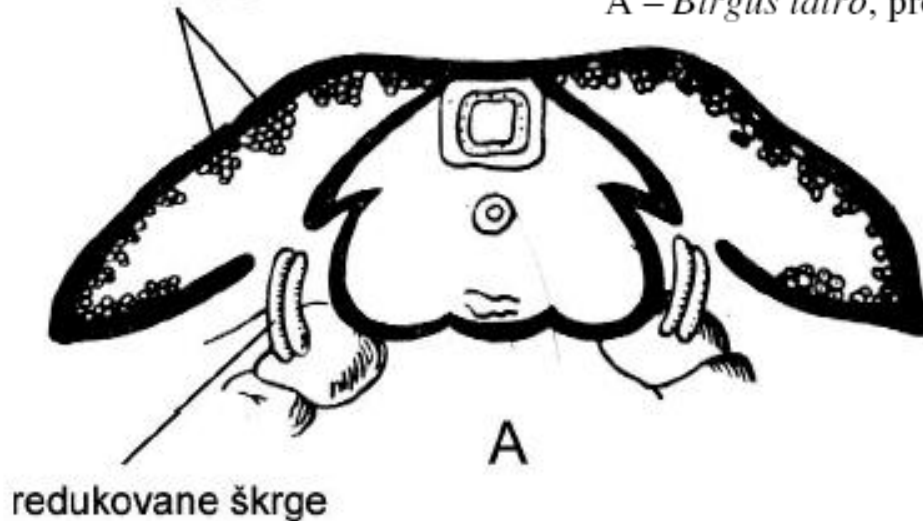


Astacus sp., škržna komora sa škrigama.

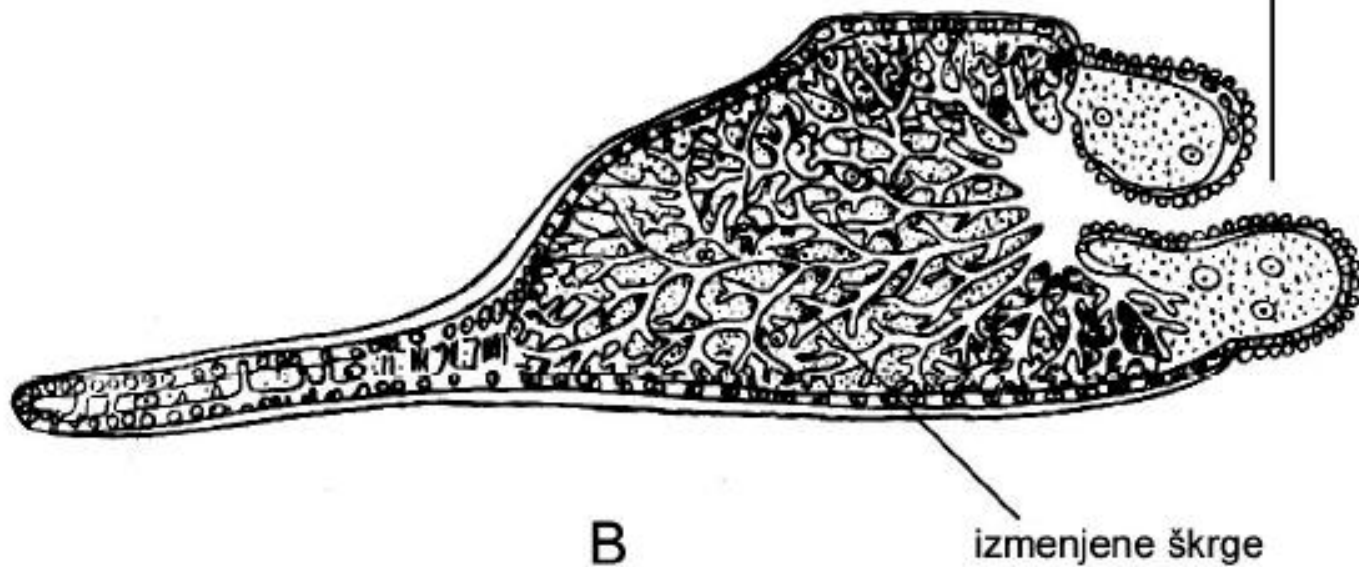
Respiratorni sistem Crustacea

sunderašti epitel
škržne duplje

A – *Birgus latro*, presek kroz telo

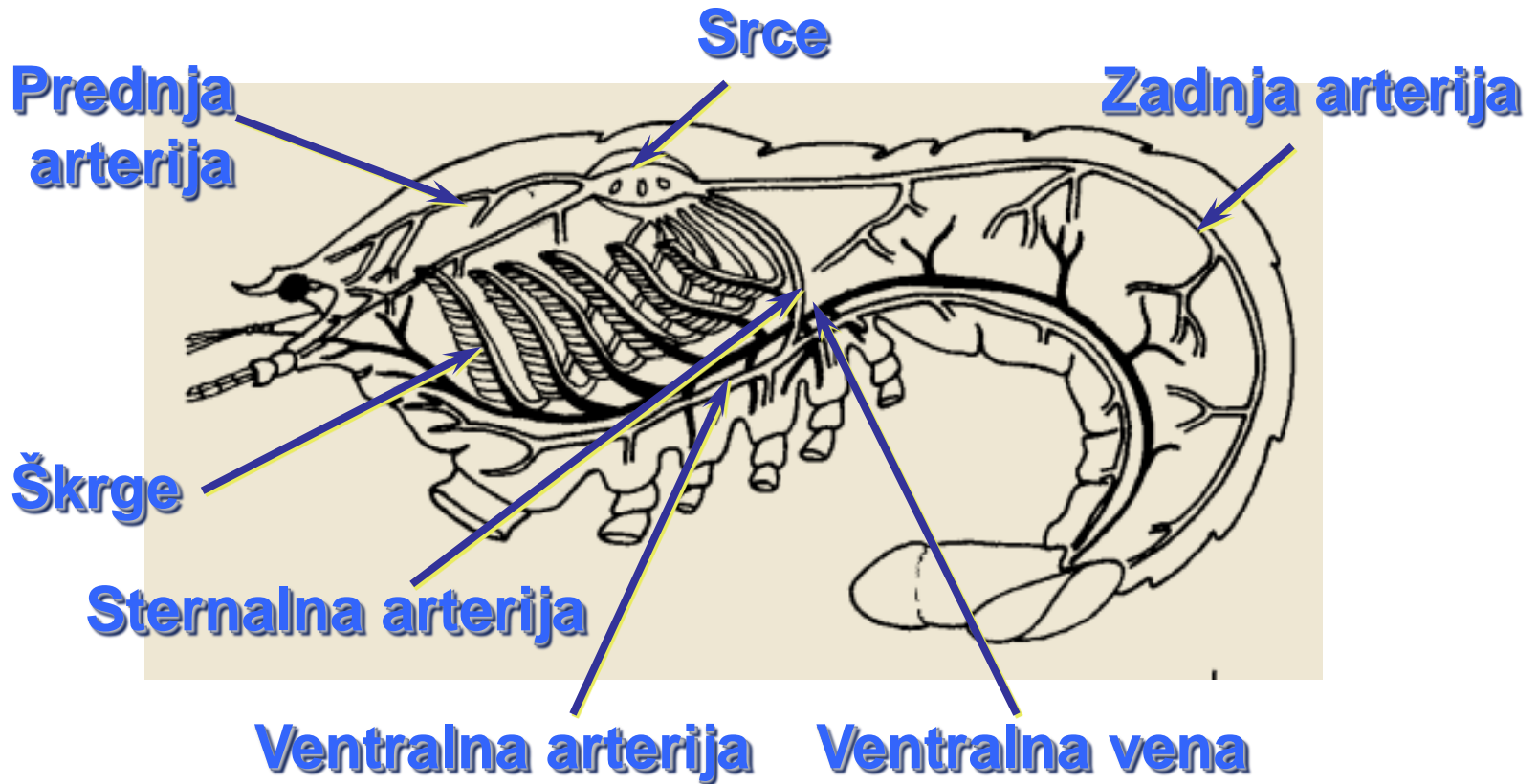


otvor škrge



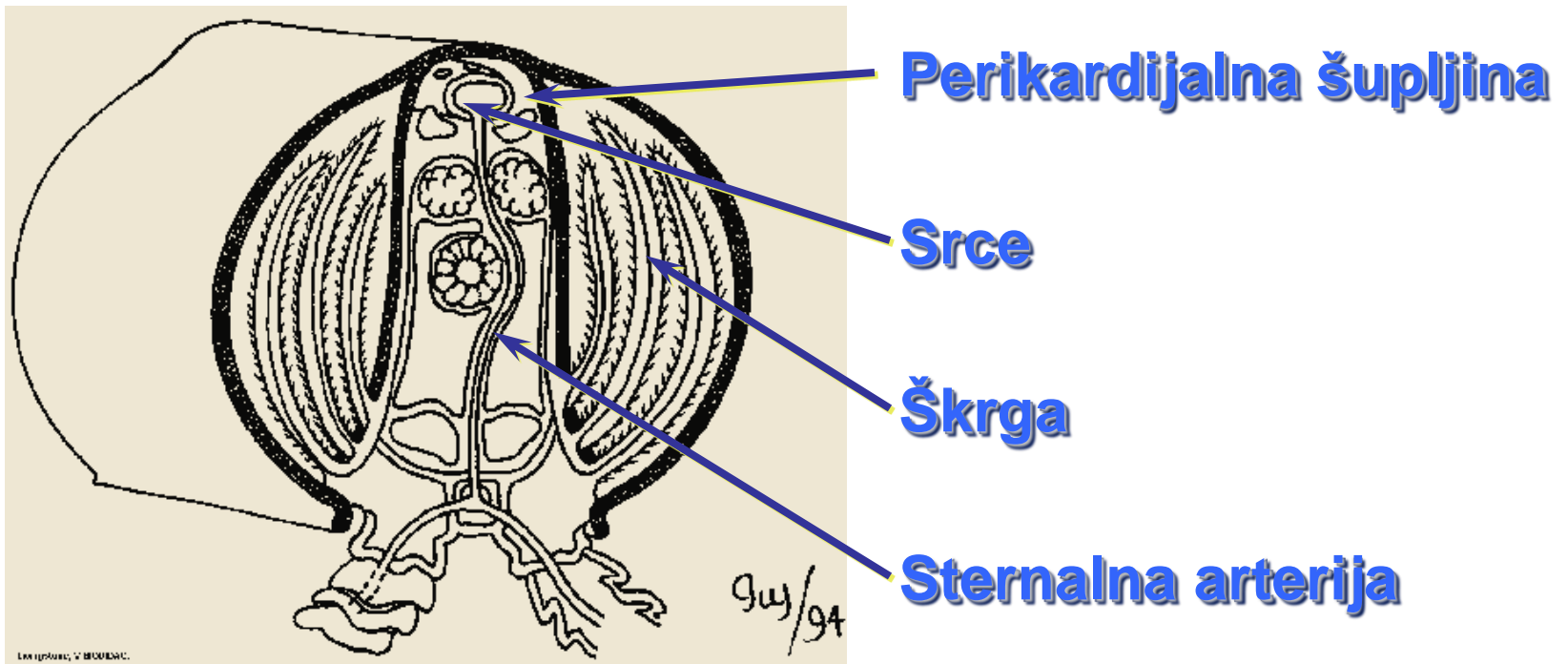
B – Isopoda, presek abdominalne noge sa škrgom.

Cirkulatorni (krvni) sistem

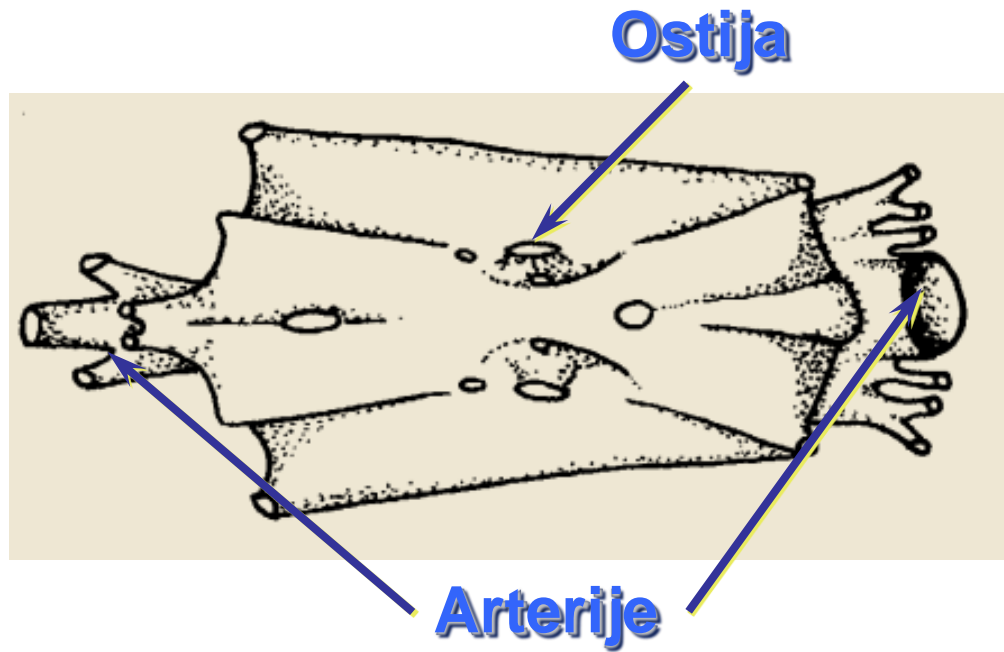


- Respiratorni pigmenti **hemoglobin** i hemocijanin
- Srce varira po veličini i položaju

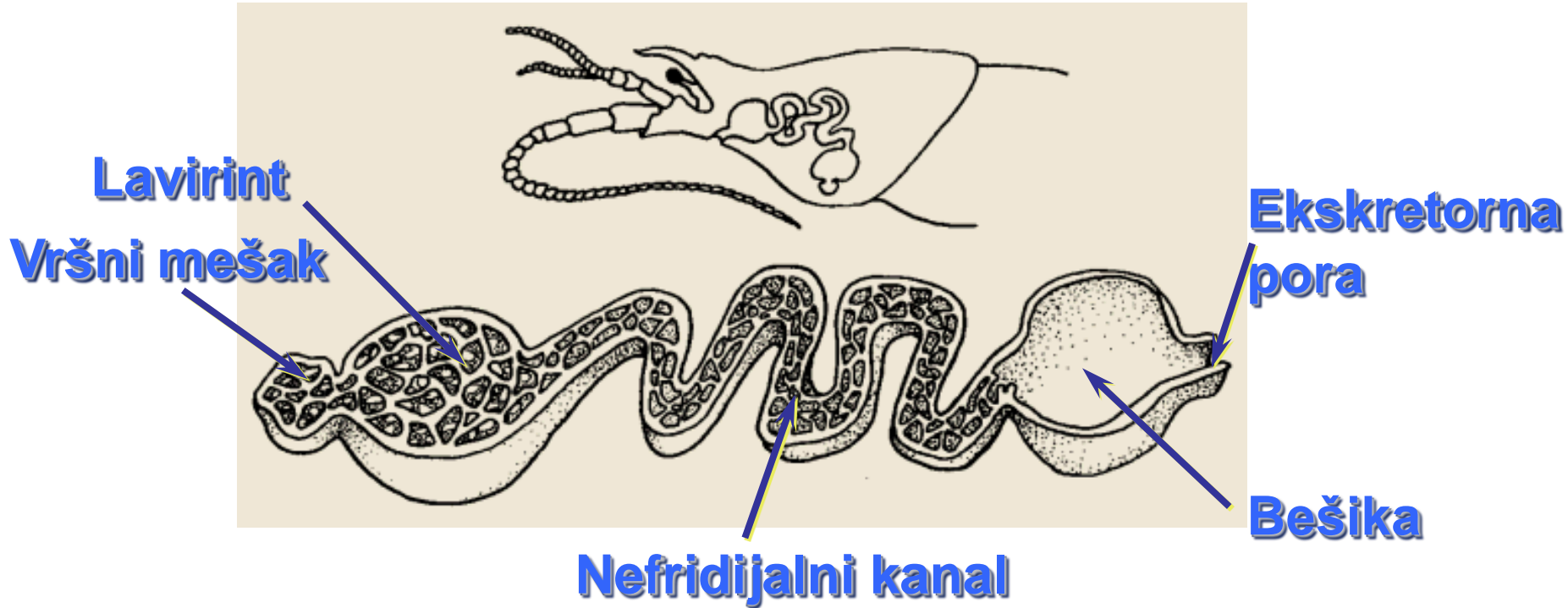
Cirkulatorni (krvni) sistem



Krvni sistem - srce

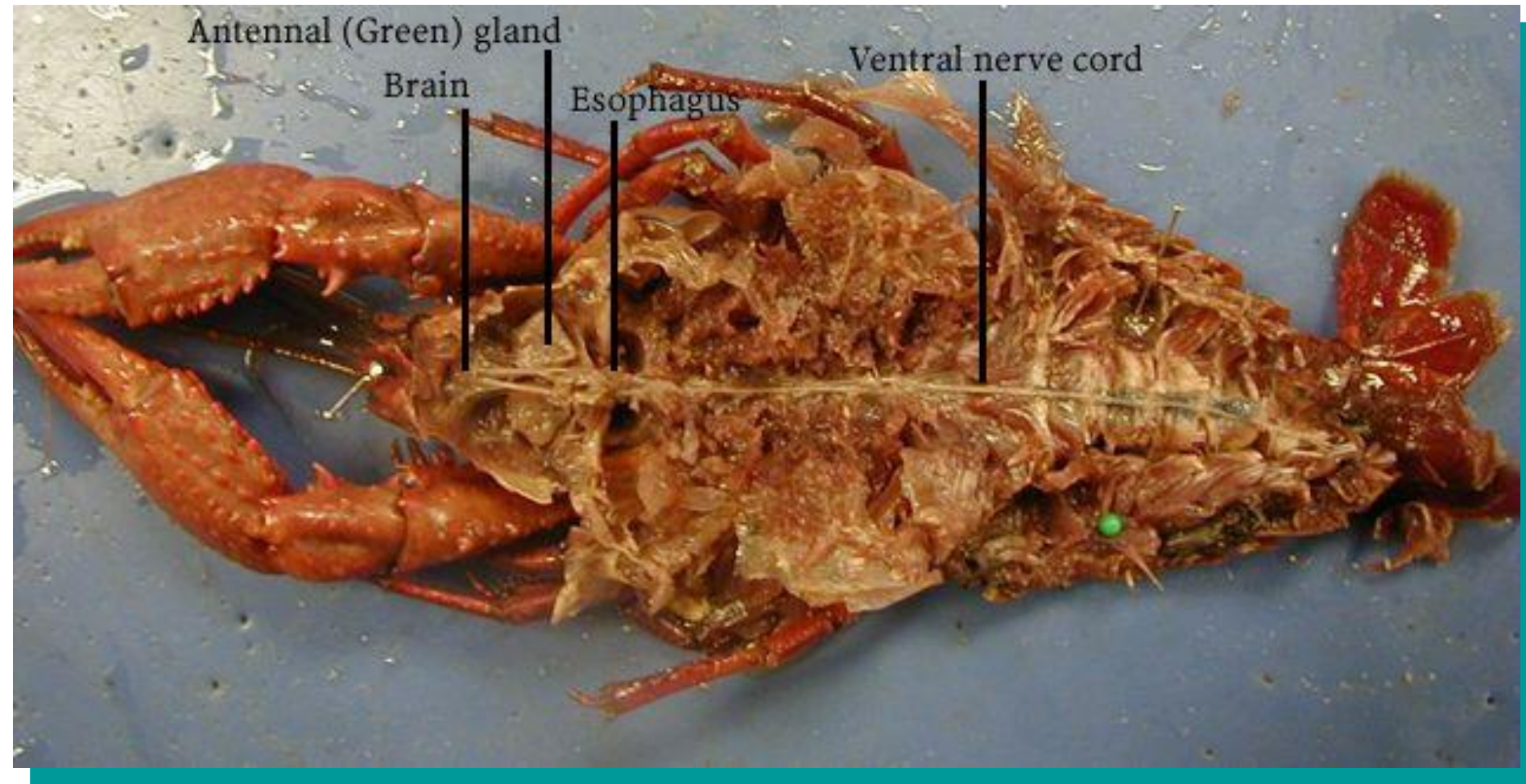


Ekskretorni sistem - antenalne žlezde

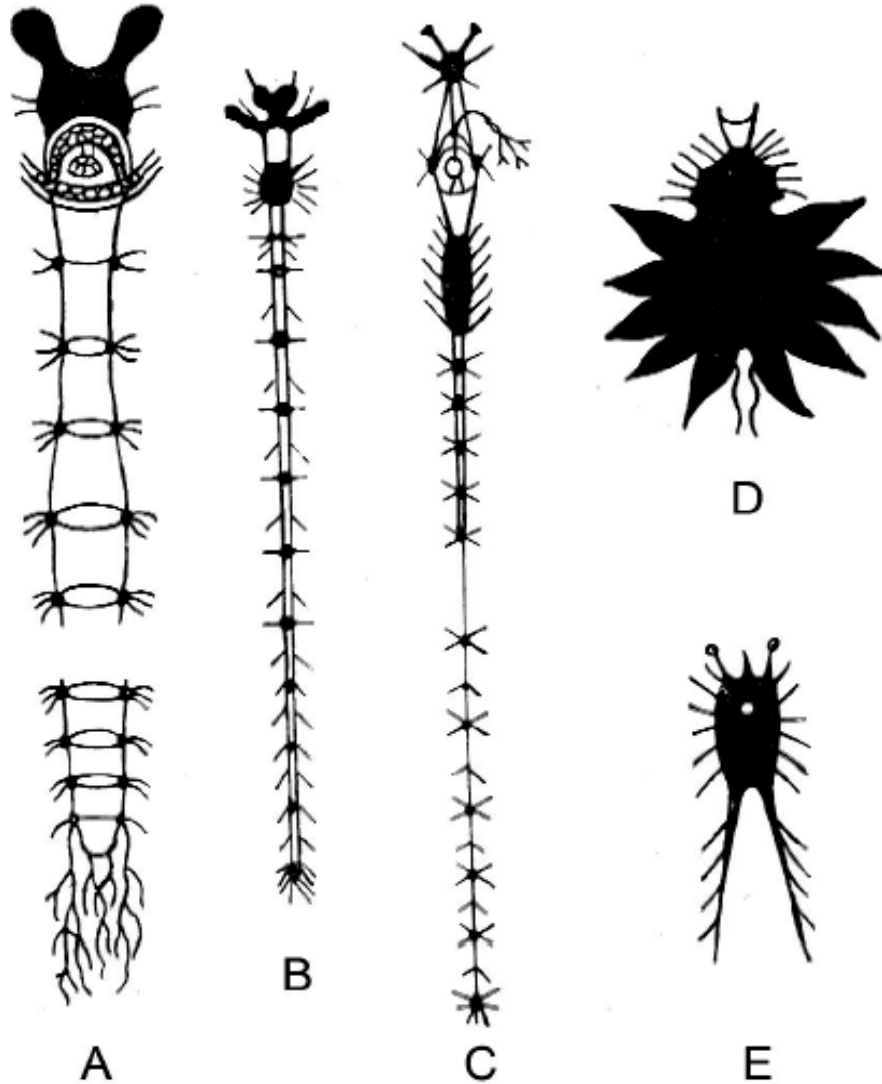


- **Ekskrecija** - antenalne i maksilarne žlezde, škrge, nefrocite

Crustacea - nervni sistem



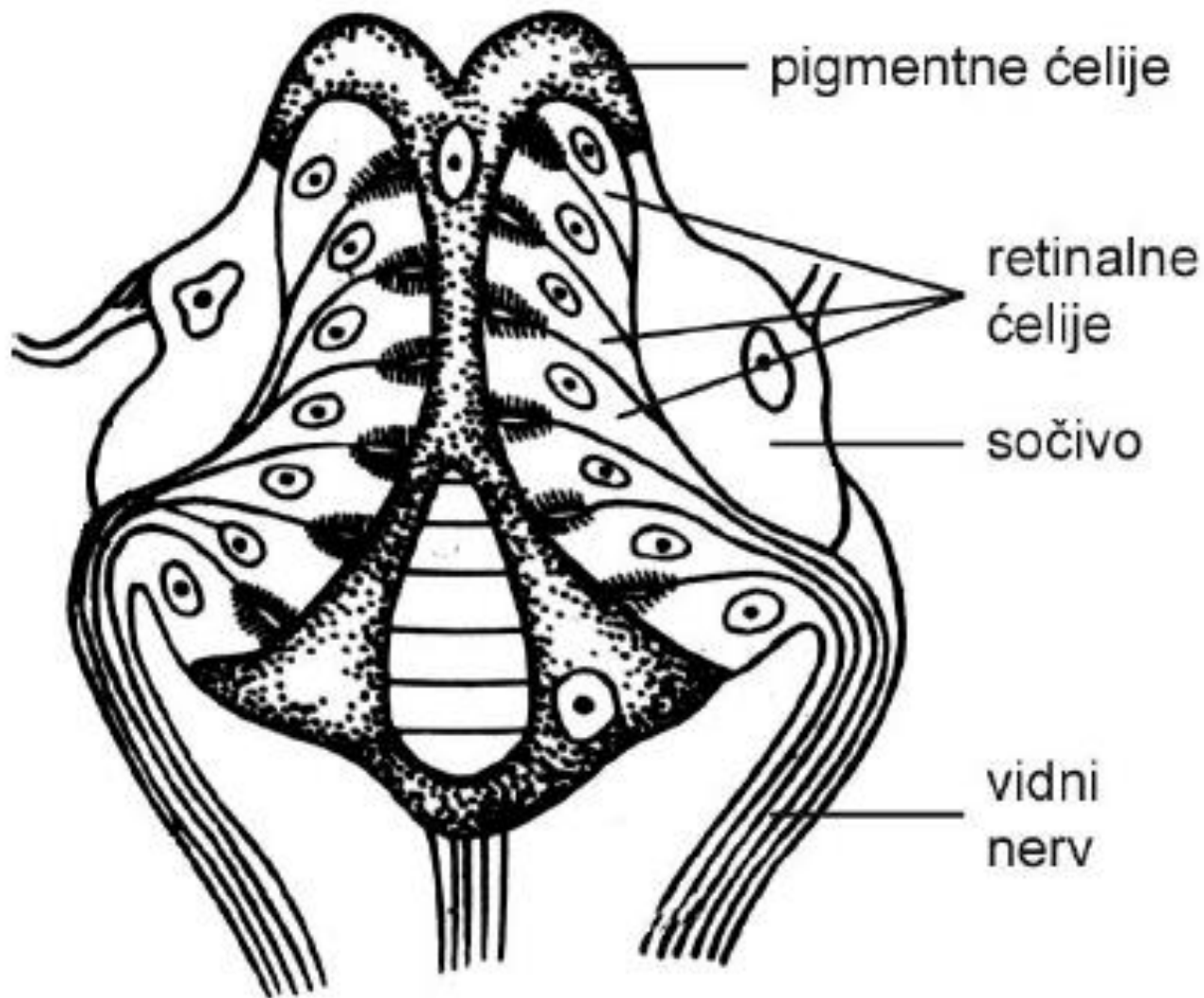
Crustacea - nervni sistem



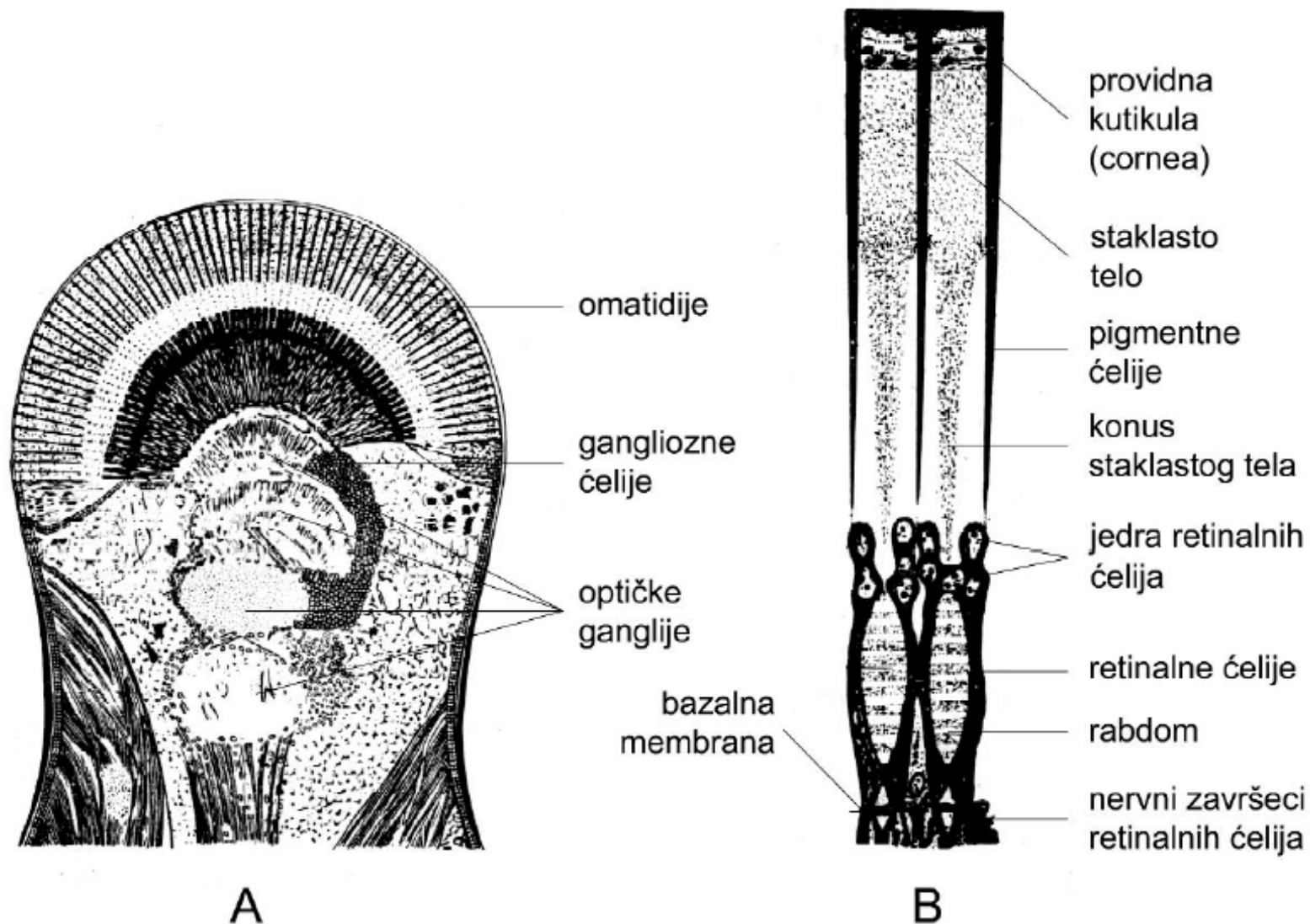
Crustacea - nervni sistem

- **lestvičast** po tipu
- proteže se čitavom dužinom tela
- jasno vidljivi **konektivi** između **ganglija** (kod primitivnijih grupa rakova)
- **gigantski fibrili** (brzo i naglo prenošenje impulsa)
- prenošenje impulsa i sekrecija neurohormona

- **čula**: taktilna, optička, hemijska
 - **složene oči** (često na drškama) razvijene kod većine rakova (do 14.000 omatidija); razlikuju oblik i veličinu, a ponekad i boje



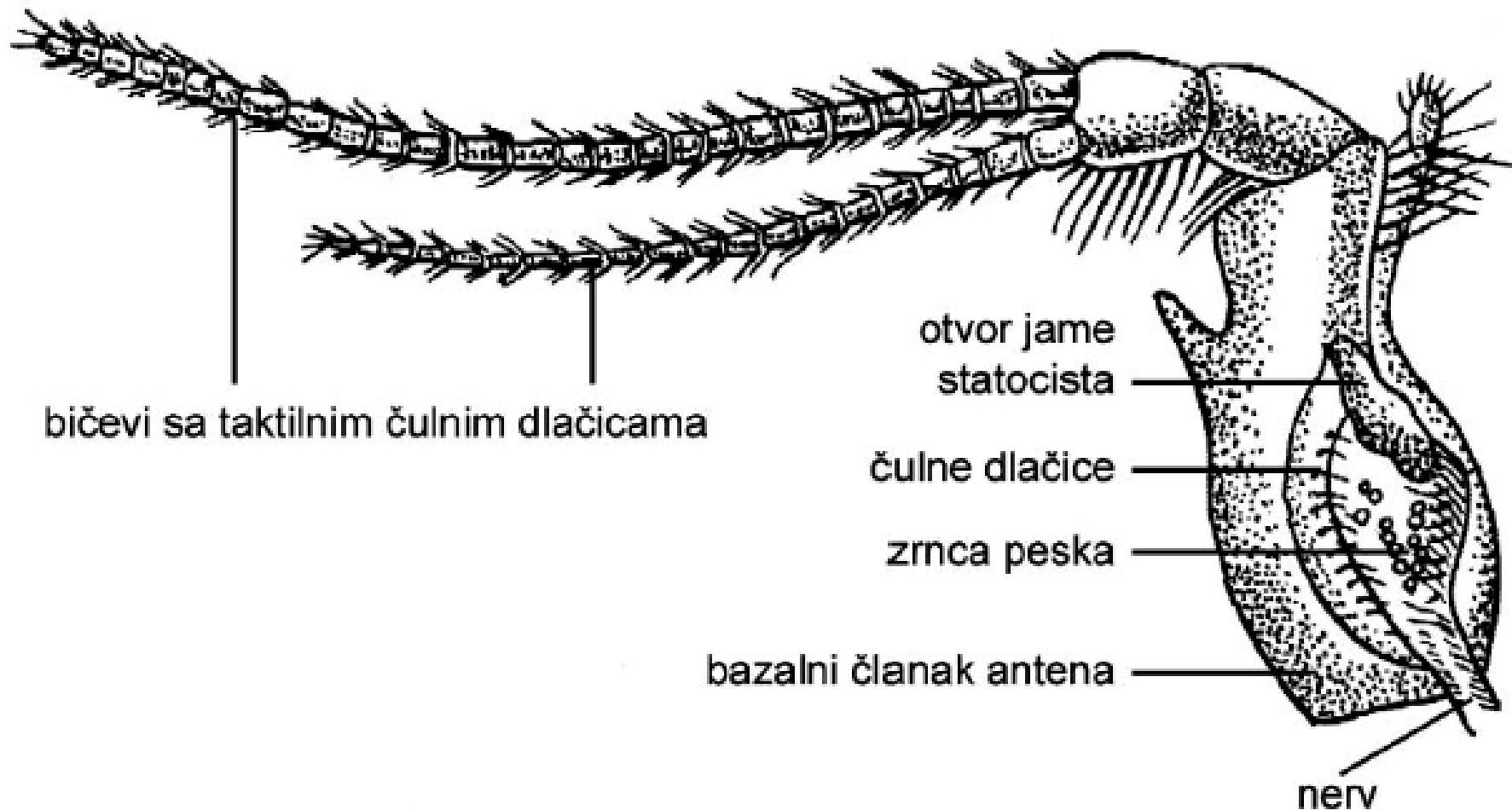
Shema građe naupliusovog oka.



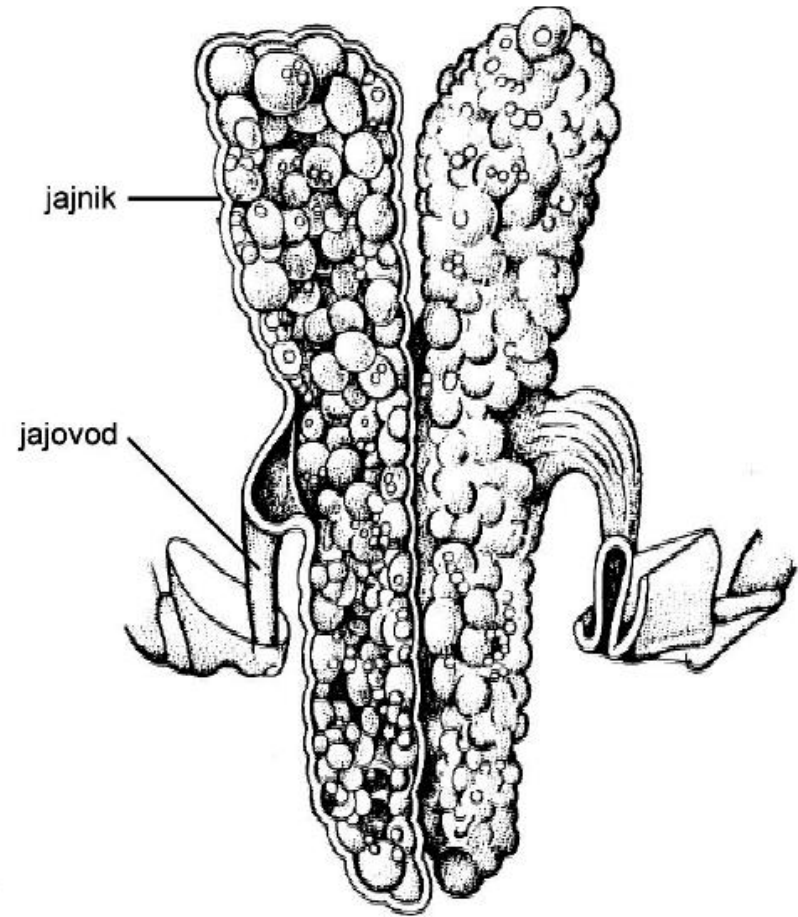
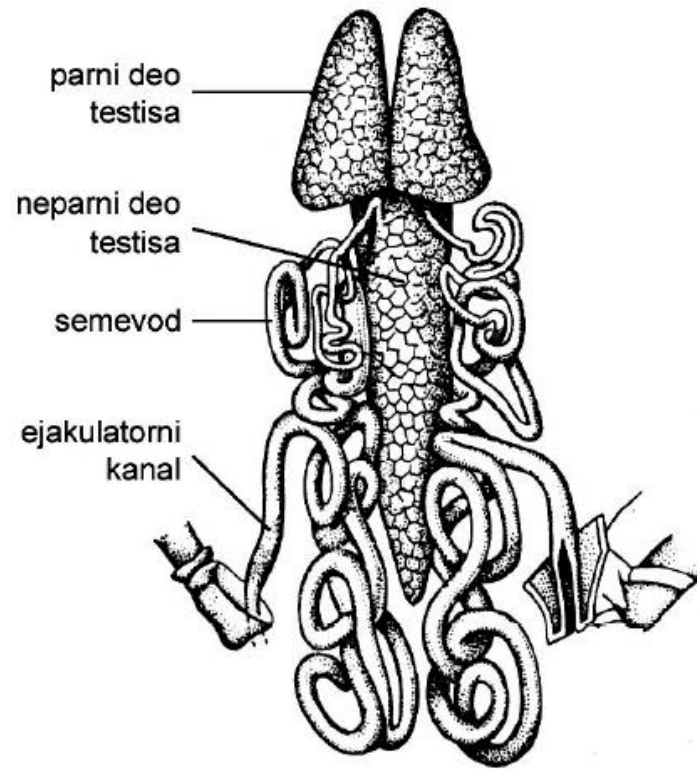
Shema građe složenog oka: A - uzdužni presek kroz oko i očnu dršku; B - uzdužni presek dve omatidije.



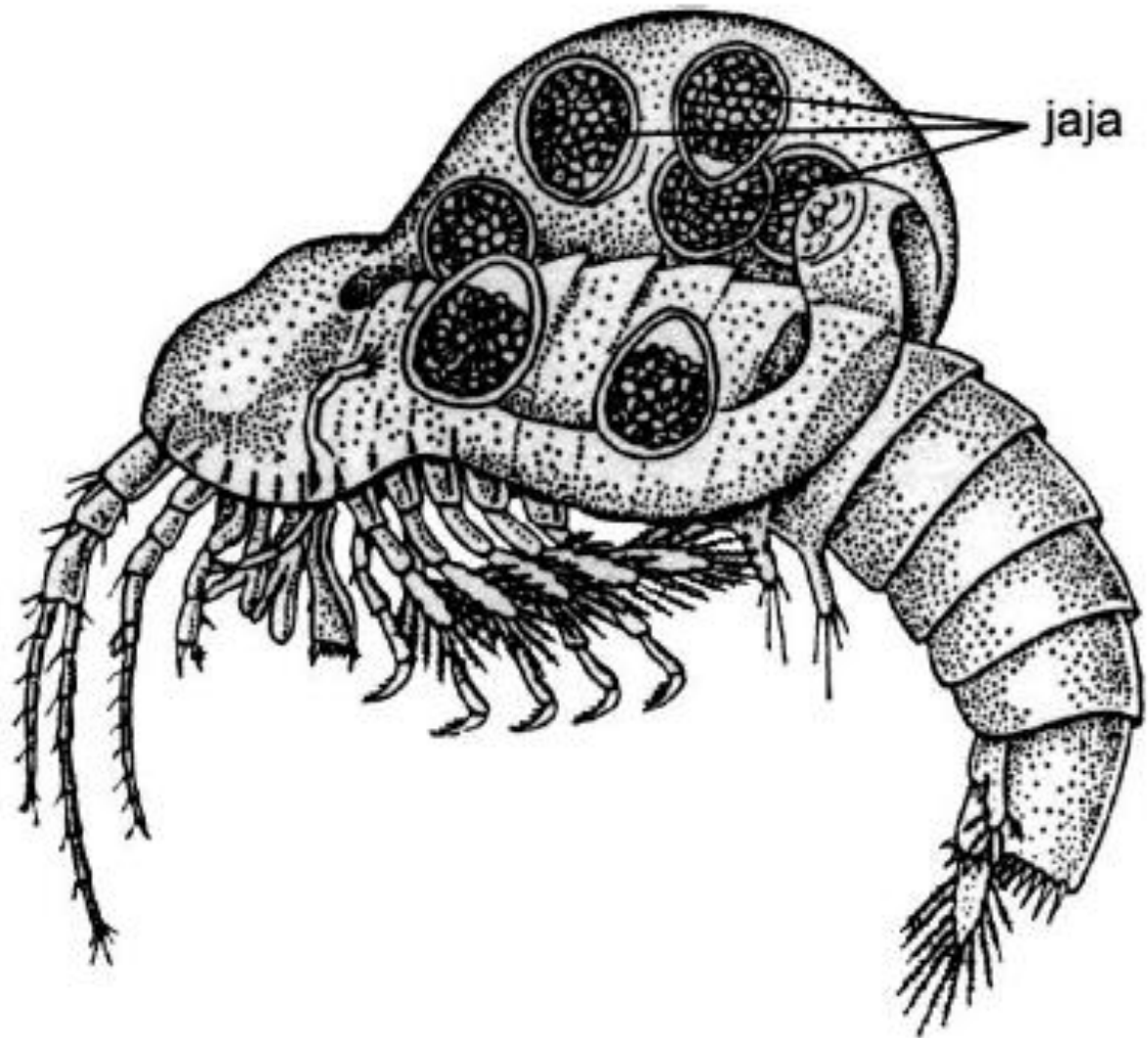
Hemijsko čulo (uzdužni presek kroz antenulu).



Astacus sp., čulo ravnoteže, statocist u osnovi antenula.

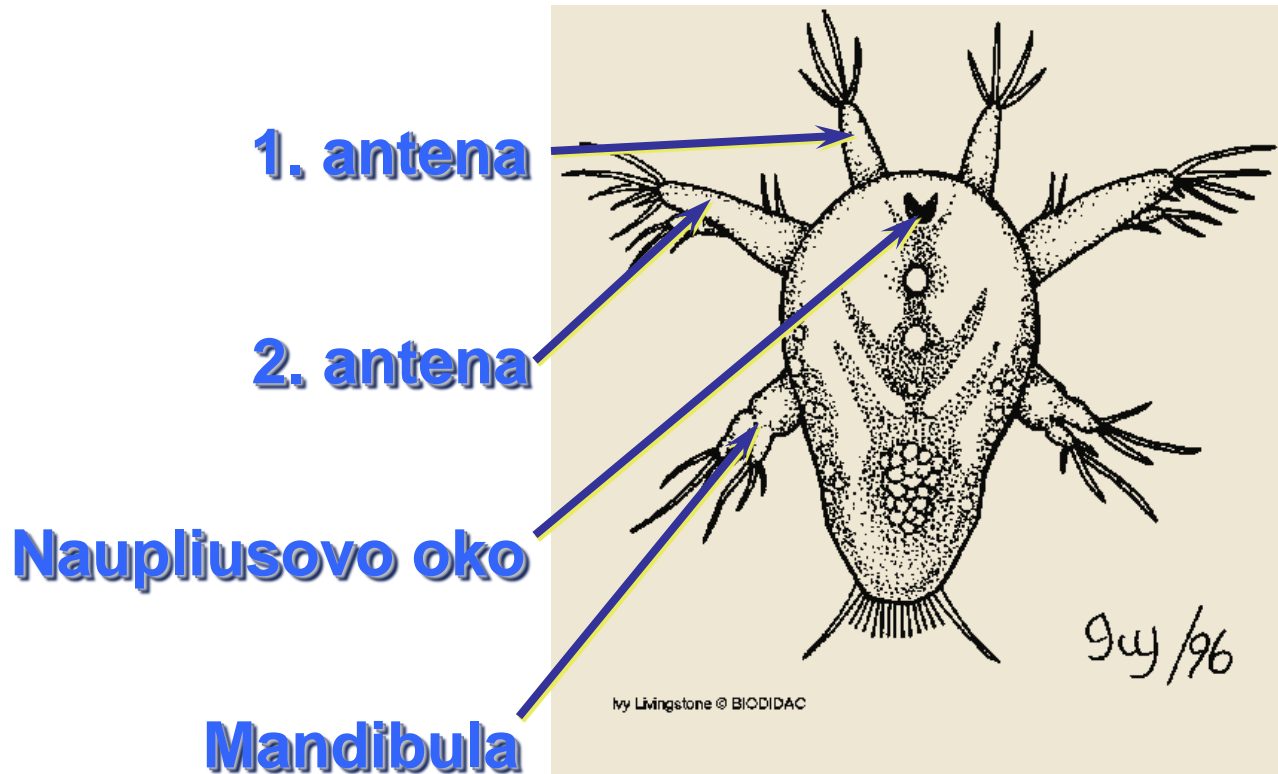


Astacus astacus, polni sistem: levo - muški polni sistem; desno - ženski polni sistem.



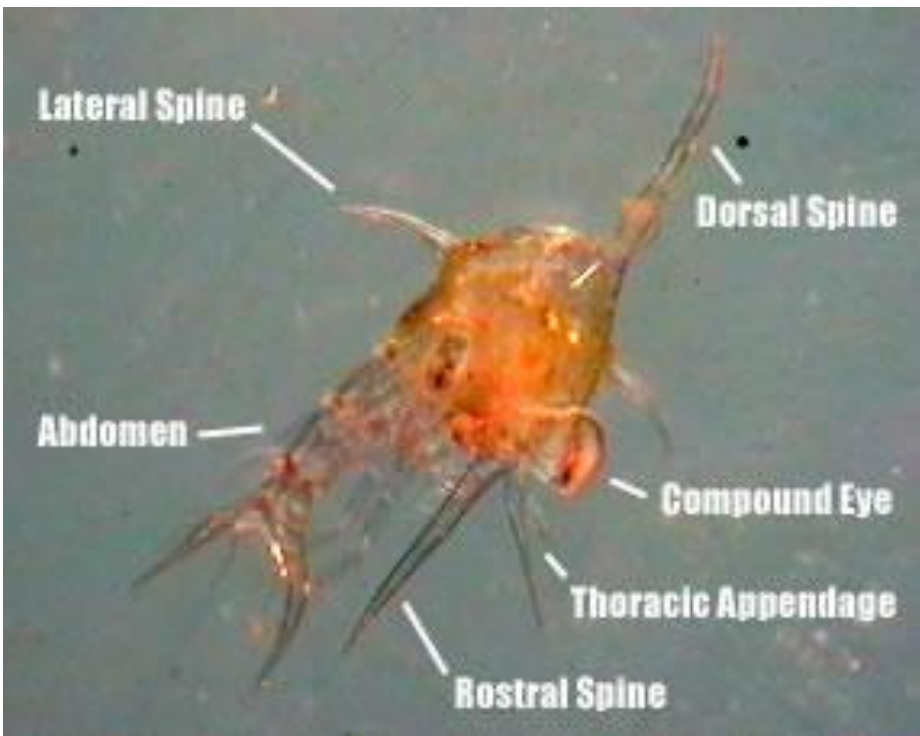
Jaja u marsupijumu na leđnoj strani tela.

Razmnožavanje i razviće - nauplius larva





nauplius larva

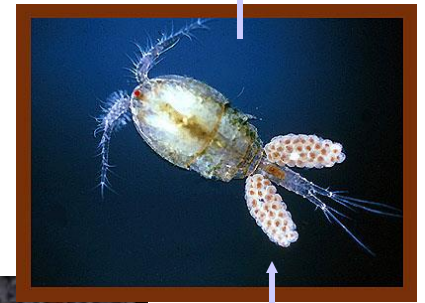
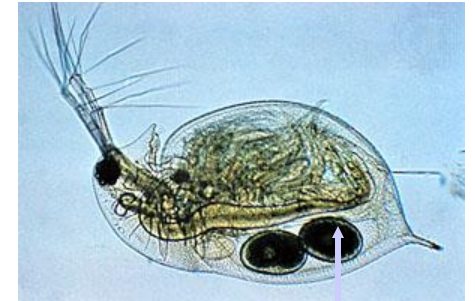


zoea larva Decapoda

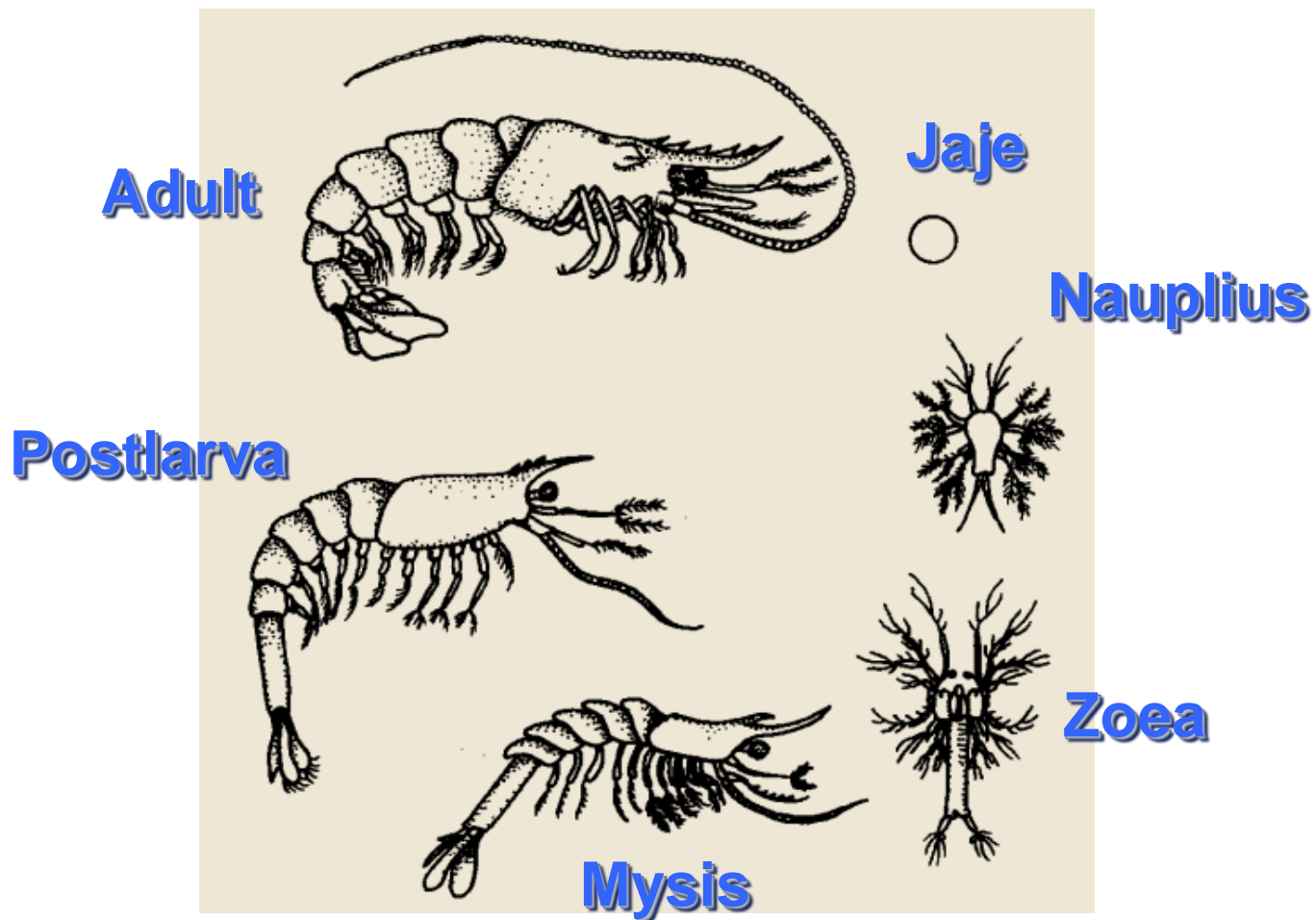


Subphylum Crustacea

- Većina rakova **odvojenih polova**
- **Kopulacija** modifikovanim ekstremitetima mužjaka
- **Spermatozoidi bez bičeva** kod većine
- Ženke vode brigu o jajima (**jajne kese, ekstremiteti, ležajne komore**, itd.)
- **Ciklomorfoza i partenogeneza** - Cladocera
- **Nauplius** - larva većine morskih rakova i nekih slatkovodnih
- **Metanauplius** - Branchiopoda
- **Zoea** - larva viših rakova
- Oko 350 vrsta poznato za Srbiju i Crnu Goru



Životni ciklus rakova



Ciklomorfoza kod Cladocera (*Daphnia* spp.)

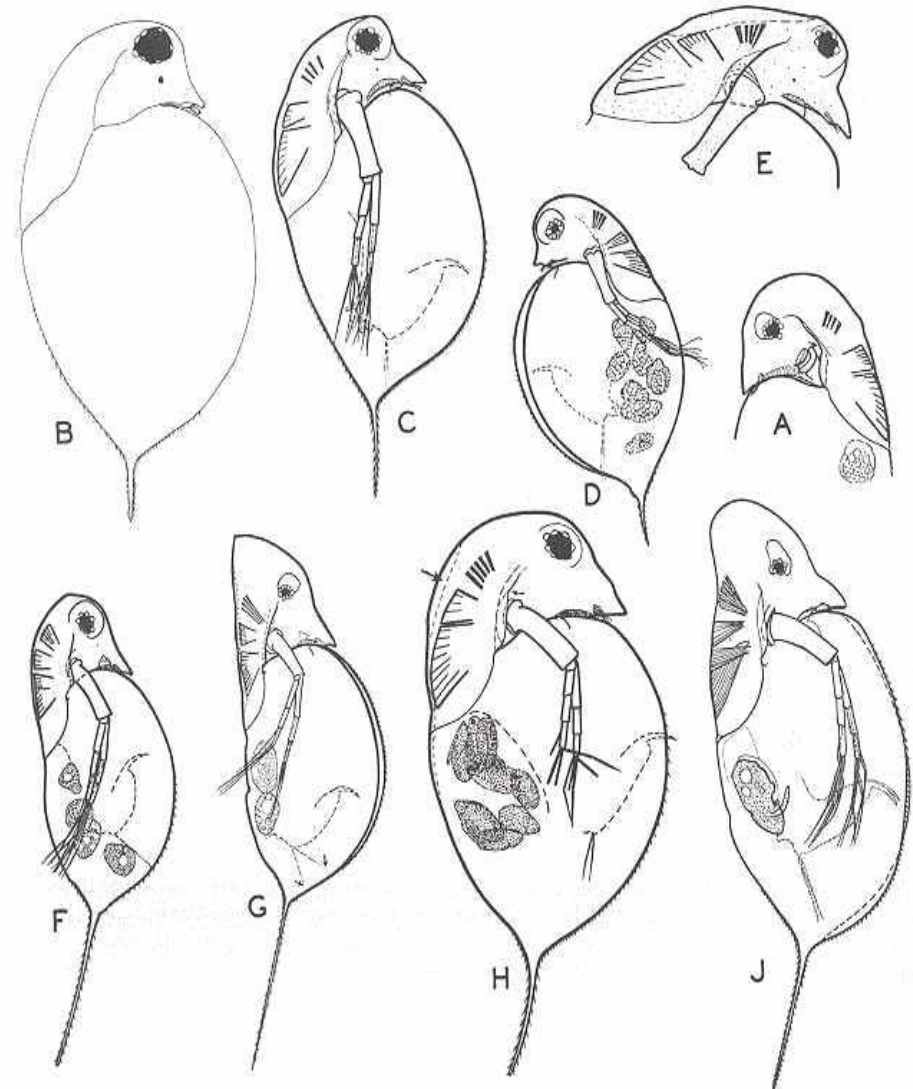


FIG. 15.—Structure of *Daphnia*. A, head of *D. scholleri*; B and C, *D. pulex*; D, *D. parvula*; E, head of *D. middendorffiana*; F, *D. laevis*; G, *D. dubia*; H, *D. rosea*; J, *D. thorata*. (A, C–J from Brooks, 1957; B from Brandlova, et al.)