

# LOOKING FOR SACCULINA (RHIZOCEPHALA, CIRRIPEDIA)



18s

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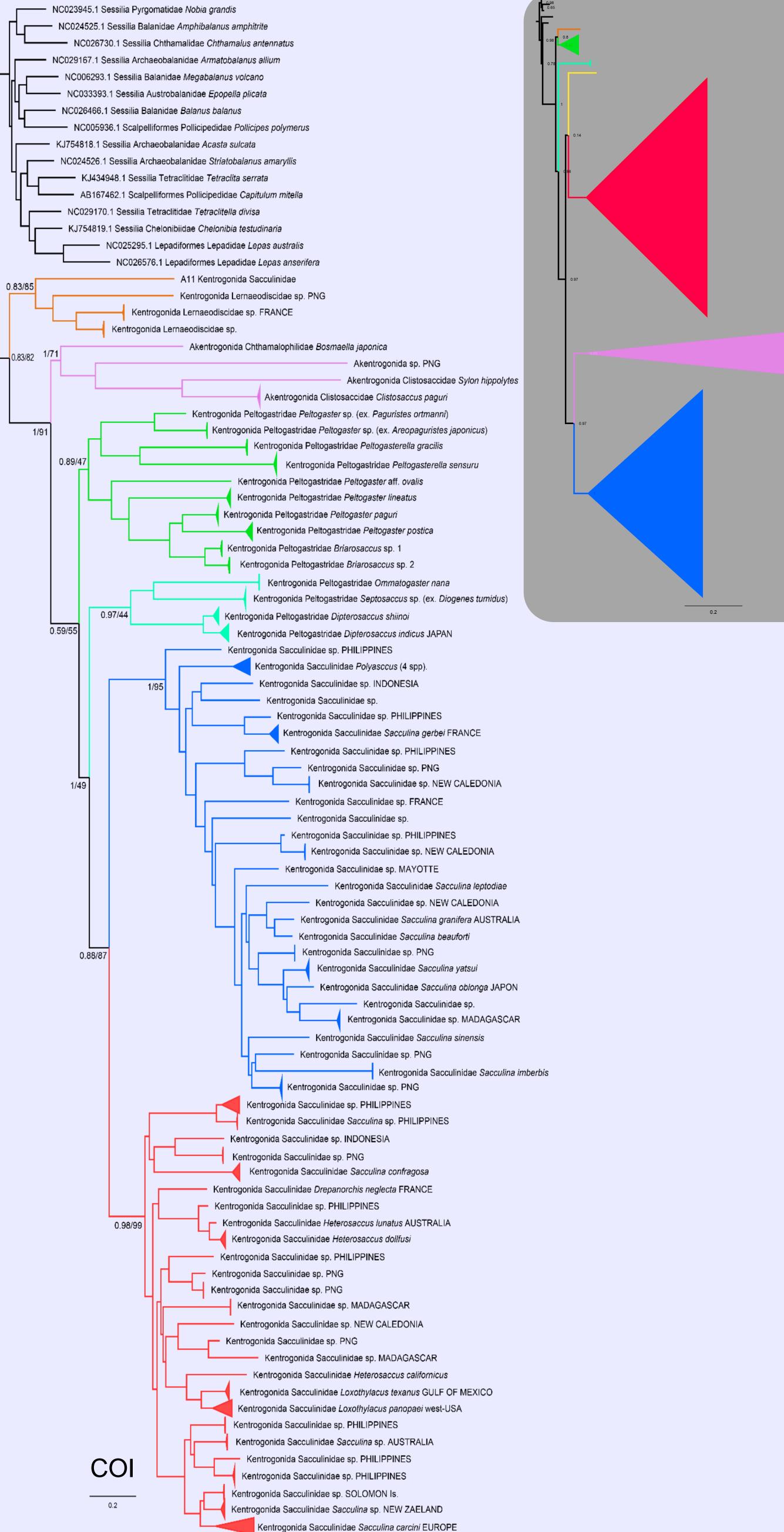
Sacculina is the most common cirriped parasite in marine and brackish waters. It includes 85% of all rhizocephalan diversity although there is not a clear synapomorphy that gathers all these species together.

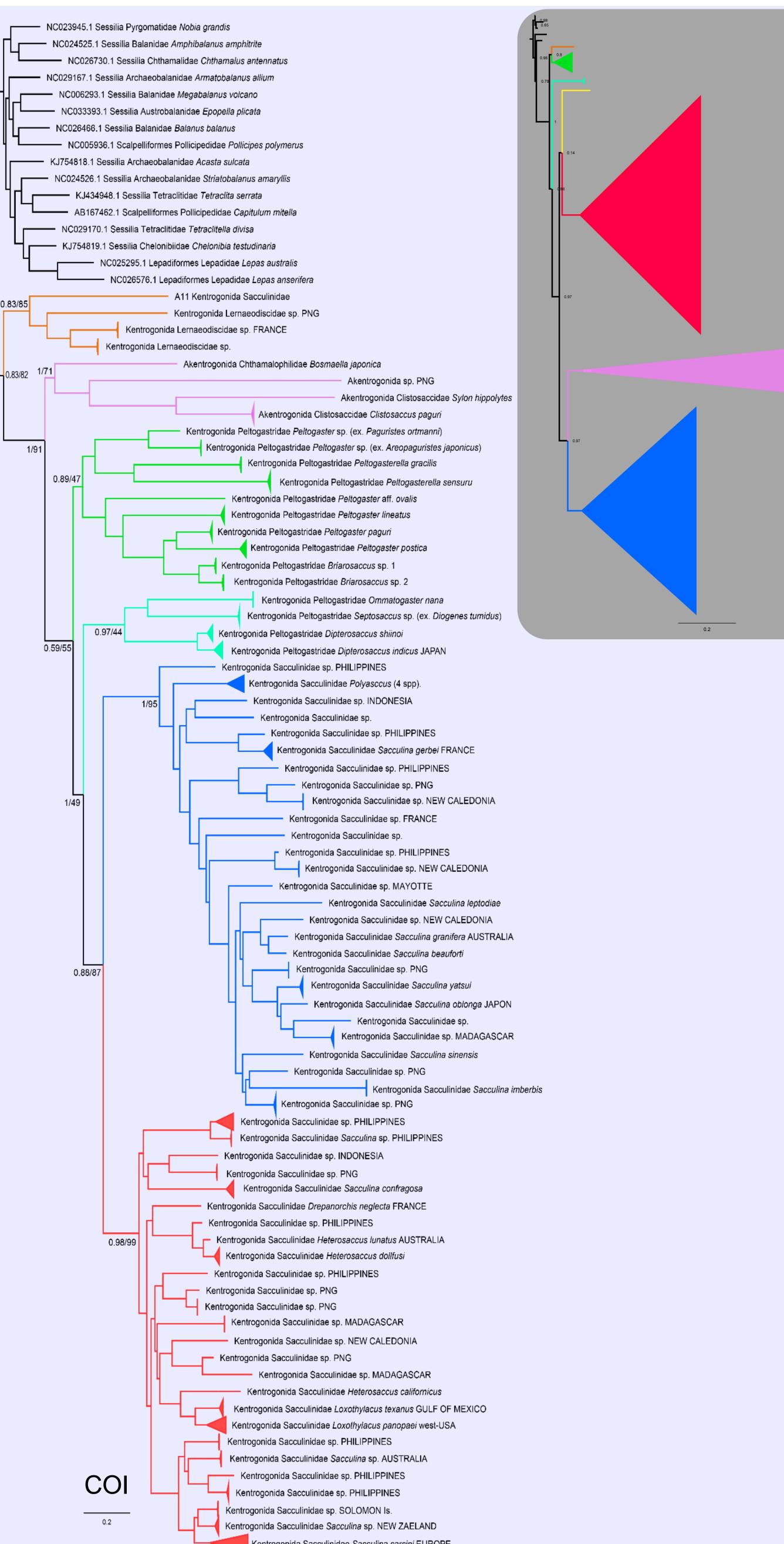
AIM

We revised the phylogenetic relationships within Sacculinidae and stablished limits and contains of genus Sacculina.

## **METHODS**

Cytochrome oxidase I (COI) sequences were obtained from the Sacculinidae collection deposited at the Museum National d'Histoire Naturelle, Paris. All NCBI available sequences was integrated.





The 368 COI sequences were used to estimate a gene tree using Maximum likelihood and Bayesian inferences.

Subsequently, one individual per lineage was sequenced for the 18SrRNA.

#### Obj 1. To test Rhizocephala relationship with other Cirripedia Podoplea Cyclopidae sp. Gymnoplea Calanus helgolandicus Trypetesidae Trypetesa lampas Lithoglyptidae Auritoglyptes bicornis Lithoglyptidae Lithoglyptes ivanovi Iblidae Ibla cumingi 0.79 Peltogastridae Peltogaster paguri Peltogastridae Peltogasterella sulcata Sacculinidae Polyascus gregaria Peltogastridae Peltogaster sp.1 Sacculinidae Sacculina carcini Sacculinidae Heterosaccus californicus Sacculinidae Loxothylacus panopaei Balanidae Austromegabalanus psittacus Acrothoracica Balanidae Megabalanus tintinnabulum Archaeobalanidae Conopea calceola Pyrgomatidae Darwiniella conjugatum 0.87/97 Pyrgomatidae Adna anglica Archaeobalanidae Conopea galeata Balanidae Amphibalanus amphitrite Balanidae Balanus glandula

### Thoracica + Rhizocephala

Results

The monophyly of Cirripedia was recovered ✓ The monophyly of Thoracica was not found

- unless if Rhizocephala is included ✓ Rhizocephala emerged as monophyletic
- $\checkmark$  Iblidae appeared as the sister group of Rhizocephala
- Archaeobalanidae Semibalanus balanoides Platylepadidae Platylepas hexastylos Coronulidae *Xenobalanus globicipitis* Coronulidae Coronula diadema Austrobalanidae Austrobalanus imperator Tetraclitidae *Tetraclita achituvi* Tetraclitidae Tesseropora rosea Austrobalanidae Epopella plicata Tetraclitidae Tetraclitella divisa Pachylasmatidae Hexelasma velutinum Chthamalidae Jehlius cirratus Chthamalidae Tetrachthamalus oblitteratus Chthamalidae *Chthamalus bisinuatus* Pachylasmatidae Pachylasma japonicum Catophragmidae Catophragmus imbricatus Catophragmidae Catomerus polymerus Verrucidae Rostratoverruca krugeri Verrucidae Verruca laevigata Calanticidae Smilium peronii Calanticidae Calantica spinosa
  - Scalpellidae Scalpellum scalpellum
  - Scalpellidae Trianguloscalpellum regium
  - Eolepadidae Vulcanolepas osheai
  - Eolepadidae Ashinkailepas seepiophila
  - Oxynaspididae Oxynaspis celata
  - Poecilasmatidae Poecilasma inaequilaterale Poecilasmatidae Octolasmis warwickii
  - Heteralepadidae Paralepas dannevigi
  - Lepadidae *Lepas testudinata*
- Lepadidae Conchoderma virgatum
- Fig. 1. Bayesian and PhyML inferences on a concatenated dataset from 18S, 28S rRNA and H3 gene fragments. GTR substitution model

#### Obj 2. To define Rhizocephalan lineages

0.4

Fig. 3. Gene trees (COI mt, 18S and 28S rRNA) of a comprehensive dataset of Rhizocephla. **Results** 

- ✓ Akentrogonids are confirmed to form a clade, while Kentrogonids were paraphyletic.
- Within the "Kentrogonids", Peltogastridae was found to be paraphyletic.
- ✓ One clade included all species previously considered as Sacculina merged with other genera (ex. Loxothylacus or Heterosaccus), rendering the current concept of "Sacculina" as polyphyletic.

Table 1. Comprehensive dataset of Rhizocephla, abstract of the results

Traditional classification		Genes included		Results		
Order	Family	COI	18S	Order	Family	
Akentrogonida	Chthamalophilidae			Monophyletic	Monophyletic	
	Clistosaccidae				Monophyletic	
	Duplorbidae				?	
	Mycetomorphidae				?	
	Polysaccidae				Monophyletic	
	Thompsoniidae				Monophyletic	
Kentrogonida	Lernaeodiscidae			Paraphyletic	Monophyletic	
	Parthenopeidae				-	
	Peltogastridae				Polyphyletic	
						Septosaccus-clade
	Sacculinidae				Polyphyletic	
						S.gerbei-clade
♣ included Peltogaster paguri and ♠ included Sacculina carcini, type species for each family						

 $\checkmark$  Clearly, the tree showed three mayor diversification events within the Sacculina-clade, and only one (in red) contained Sacculina carcini, the type species of the genus. All other clade would need to be renamed.

### Conclusion

- ✓ Not a clear biogeographic pattern was revealed from the phylogeny. Atlantic and Indo-pacific species can be siblings, and sympatric species may not be closely related, suggesting the occurrence of repetitive colonization events. ✓ Given that different lineages were found to parasitize the same decapod species, this suggests a strong convergence of the Sacculina phenotype traits adapted to parasitism.
- Clearly, the history of life traits of Sacculina are much more complex than expected and classification of this group does not reflect its evolutionary path.