

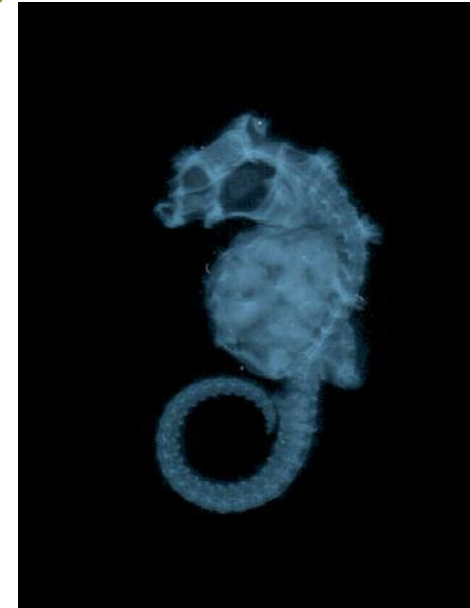
A Multigene Phylogeny of Syngnathid Fishes



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Outline: A Multigene Phylogeny of Syngnathid Fishes

1. Introduction: why syngnathids?
2. Issues in current syngnathid taxonomy
3. Molecular approach to address syngnathid systematics
4. Results: molecular phylogenetic hypotheses, mapping of non-molecular characters
5. Conclusions and next steps

Photos:
David
Harasti



Introduction: Why we study syngnathid fishes

- **Syngnathid fishes: a diverse, unique and charismatic group**
- **over 50 genera and at least 278 valid species of pipefishes, seahorses, sea dragons, and pipehorses**

IUCN Syngnathid listings

	DD	VU	EN	CR
Seahorses	23	9	1	
Pipefishes	5			1
Seadragons	2			
Pipehorses		5		

DD = Data Deficient
VU = Vulnerable
EN = Endangered
CR = Critically Endangered

Syngnathidae are characterized by:

unique gills

absence of pelvic fins

dermal plates in rings

unusual reproductive strategies, including sex role reversal and male brooding, with complex and varied brood-pouch morphology





Hippocampus whitei

Graham Short



Hippocampus abdominalis

Graham Short



*Hippocampus
bargibanti*

Graham Short

Hippocampus pontohi

David Harasti



Weedy Sea Dragon

Phyllopteryx taeniolatus

Graham Short



Leafy Sea Dragon

Phycodurus eques

Graham Short



Pygmy pipehorse

Idiotropiscis lumnitzeri

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Spotted pipefish

Stigmatopora argus

Graham Short





Briggs Crested pipefish

Histiogamphelus briggsi

Graham Short

Bent stick pipefish

*Trachyrhampus
bioarctatus*

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The Problem: Systematic relationships unresolved

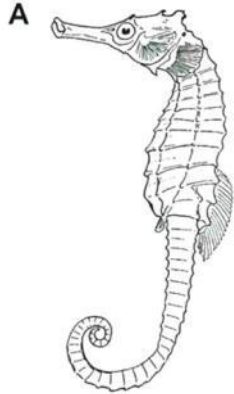
- **Unresolved systematic relationships at multiple levels**
 - **Generic and specific boundaries are often uncertain**
 - **evolutionary relationships at the species, genus and subfamily level are largely unresolved**
 - **order Gasterosteiformes / Syngnathiformes debated**
 - **many new species remain to be described**
- **Many genera are monotypic, yet no study has measured their degree of evolutionary uniqueness**

Conservation and management of syngnathids is undermined by their challenging alpha taxonomy and poorly resolved systematics

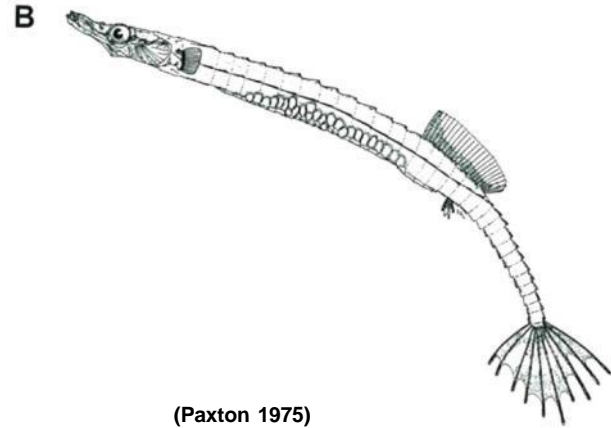


The problem

Only two recognized sub-families, the Hippocampinae and the Syngnathinae



(Whitley, 1952)



(Paxton 1975)

A. Hippocampinae: seahorses
includes only one genus with
38 - 50 species (debated)

B. Syngnathinae: all others; is
paraphyletic and includes 54
genera and 233 valid species

- **Seadragons** (Solegnathinae)
- **Tail-brooding Pipefishes**
(original Syngnathinae)
- **Abdominal-brooding Pipefishes**
(Doryrhamphinae and Nerophinae)
- **Pipehorses** (originally included in
Hippocampinae)



Our Approach: Methods

Morphological characters have proven problematic

Molecular studies to date (Wilson *et al.*, 2001 & 2003) suffer from limited taxon and molecular character sampling. WE HAVE ADDED:

20 new genera

- Total of 59 taxa (37 genera)

4 new genetic markers, including 2 nuclear fragments

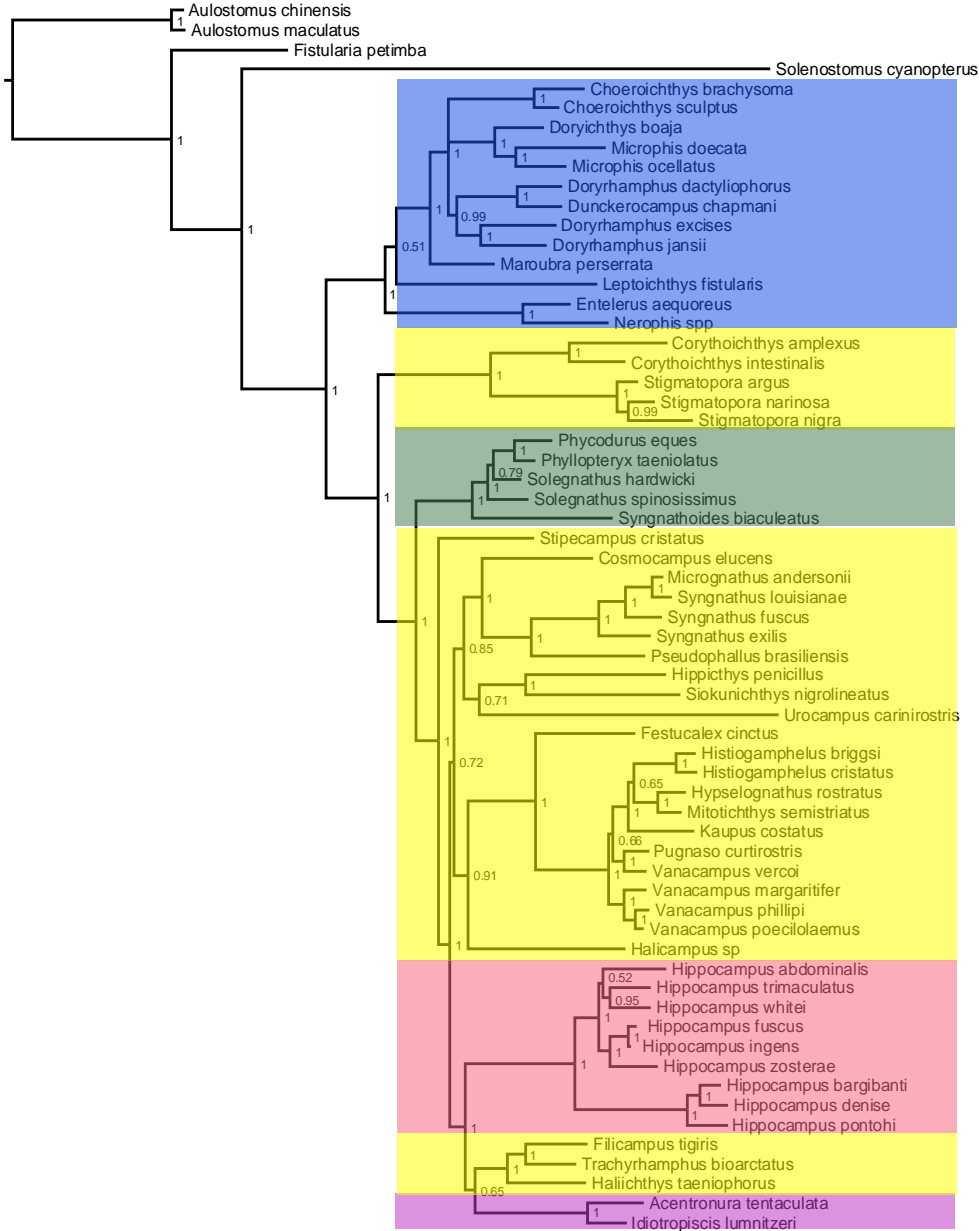
- 6 markers total, ~4500 aligned bps
- Mitochondrial; CO1, ND1, 12s, 16s
- Nuclear; RP1 intron of S7, Myh 6



Our Approach: Increased Taxon Sampling

Previous Generic Assignment	Species	Wilson (2003)	This Study	Previous Generic Assignment	Species	Wilson (2003)	This Study
<i>Acentronura</i>	5		1	<i>Kimblaeus</i>	1		
<i>Idiotropiscis</i>	1		1	<i>Leptoichthys</i>	1		1
<i>Anarchopterus</i>	2			<i>Leptonotus</i>	3		
<i>Apterygocampus</i>	1			<i>Lissocampus</i>	5		
<i>Bhanotia</i>	3			<i>Maroubra</i>	2		1
<i>Bryx</i>	5			<i>Micrognathus</i>	7		1
<i>Bulbonaricus</i>	3			<i>Microphis</i>	21		2
<i>Campichthys</i>	4			<i>Minyichthys</i>	4		
<i>Choeroichthys</i>	6		2	<i>Mitotichthys</i>	4		1
<i>Corythoichthys</i>	10	3	2	<i>Nannocampus</i>	4		
<i>Cosmocampus</i>	14		1	<i>Nerophis</i>	3	1	1
<i>Doryichthys</i>	5		1	<i>Notiocampus</i>	1		
<i>Doryrhamphus</i>	14	1	3	<i>Penetopteryx</i>	2		
<i>Dunkerocampus</i>	1	1	1	<i>Phoxocampus</i>	3		
<i>Enneacampus</i>	2			<i>Phycodurus</i>	1		1
<i>Entelurus</i>	1	1	1	<i>Phyllopteryx</i>	1	1	1
<i>Festucalex</i>	6		1	<i>Pseudophallus</i>	3		1
<i>Filicampus</i>	1		1	<i>Pugnaso</i>	1	1	1
<i>Halicampus</i>	12		1	<i>Siokunichthys</i>	5		1
<i>Haliichthys</i>	1		1	<i>Solegnathus</i>	5	1	2
<i>Heraldia</i>	1			<i>Stigmatopora</i>	3	4	3
<i>Hippichthys</i>	5		1	<i>Stipecampus</i>	1		1
<i>Hippocampus</i>	45	9	9	<i>Syngnathoides</i>	1		1
<i>Histiogamphelus</i>	2		2	<i>Syngnathus</i>	32	14	3
<i>Hypselognathus</i>	2	1	1	<i>Trachyrhamphus</i>	3		1
<i>Ichthyocampus</i>	2			<i>Urocampus</i>	2	1	1
<i>Kaupus</i>	1	1	1	<i>Vanacampus</i>	4	2	4
			Total	54 genera (16 monotypic)	278 species	16 genera	37 genera

Results: Bayesian consensus tree



Outgroups



Abdominal-brooding pipefish



Seadragons



Tailbrooding pipefish



Seahorses

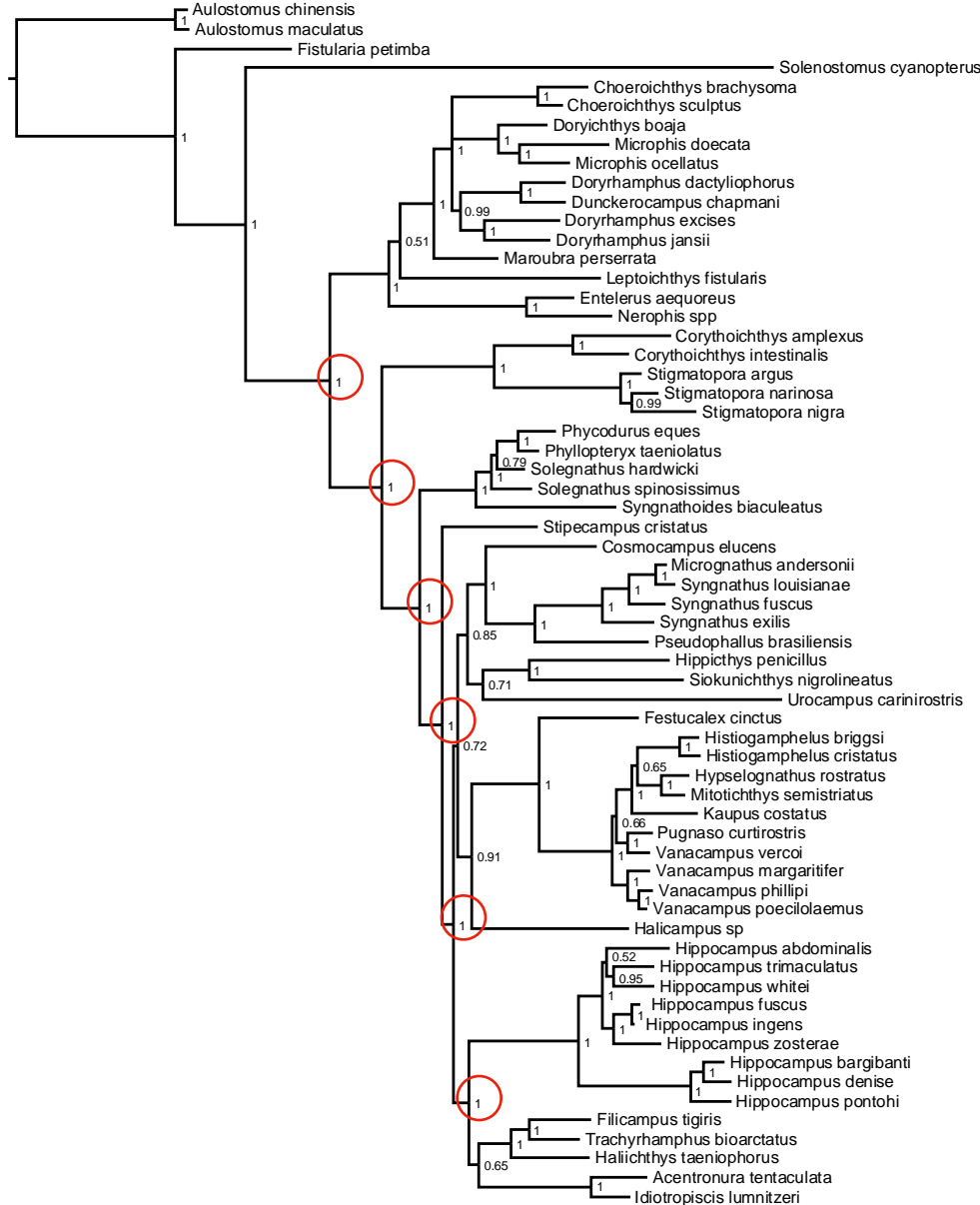


Pipehorses



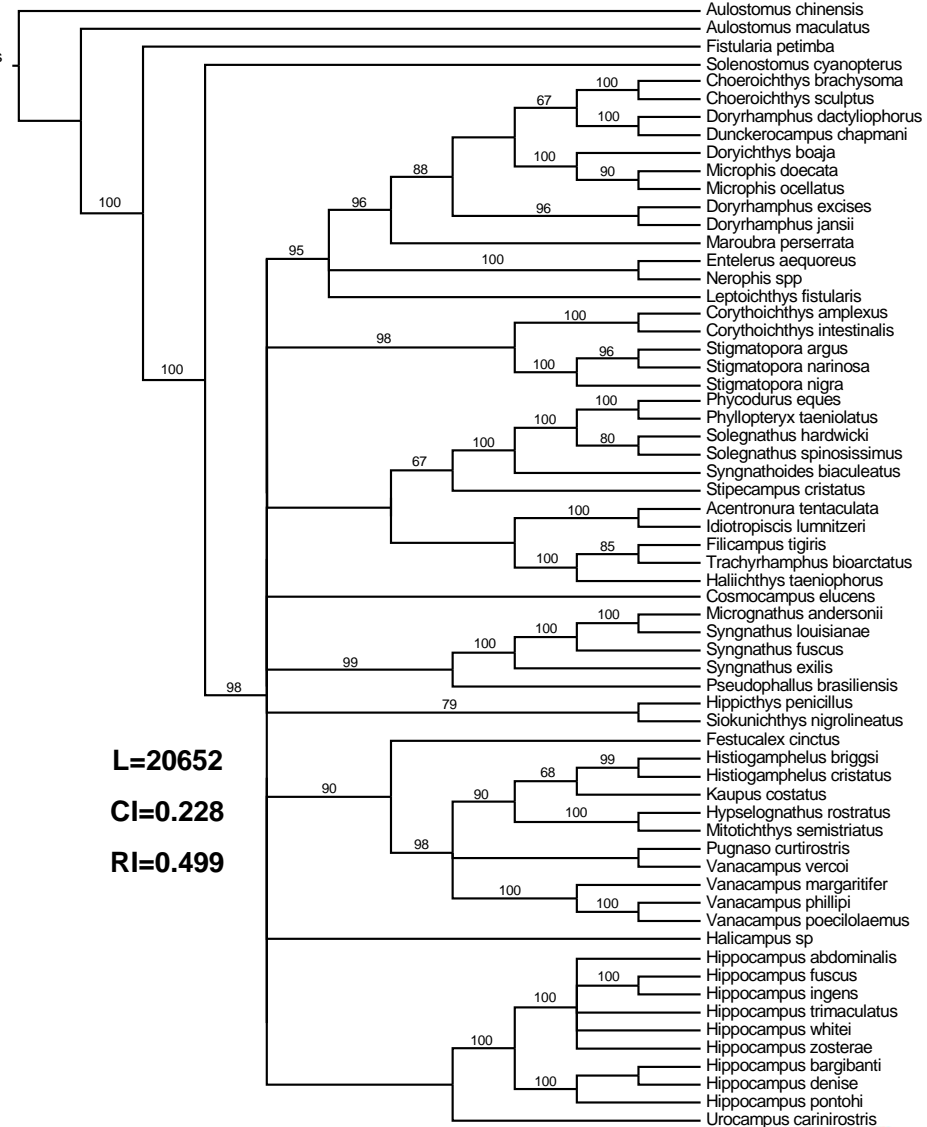
Results

Bayesian consensus tree



0.2

Maximum parsimony strict consensus



L=20652

CI=0.228

RI=0.499

1.1

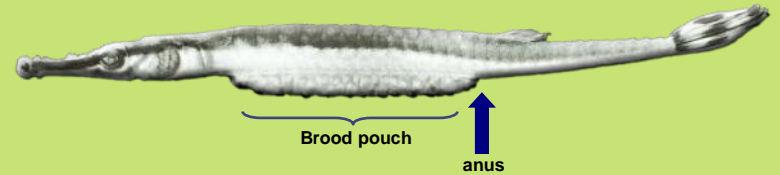


Results: Bayesian consensus tree

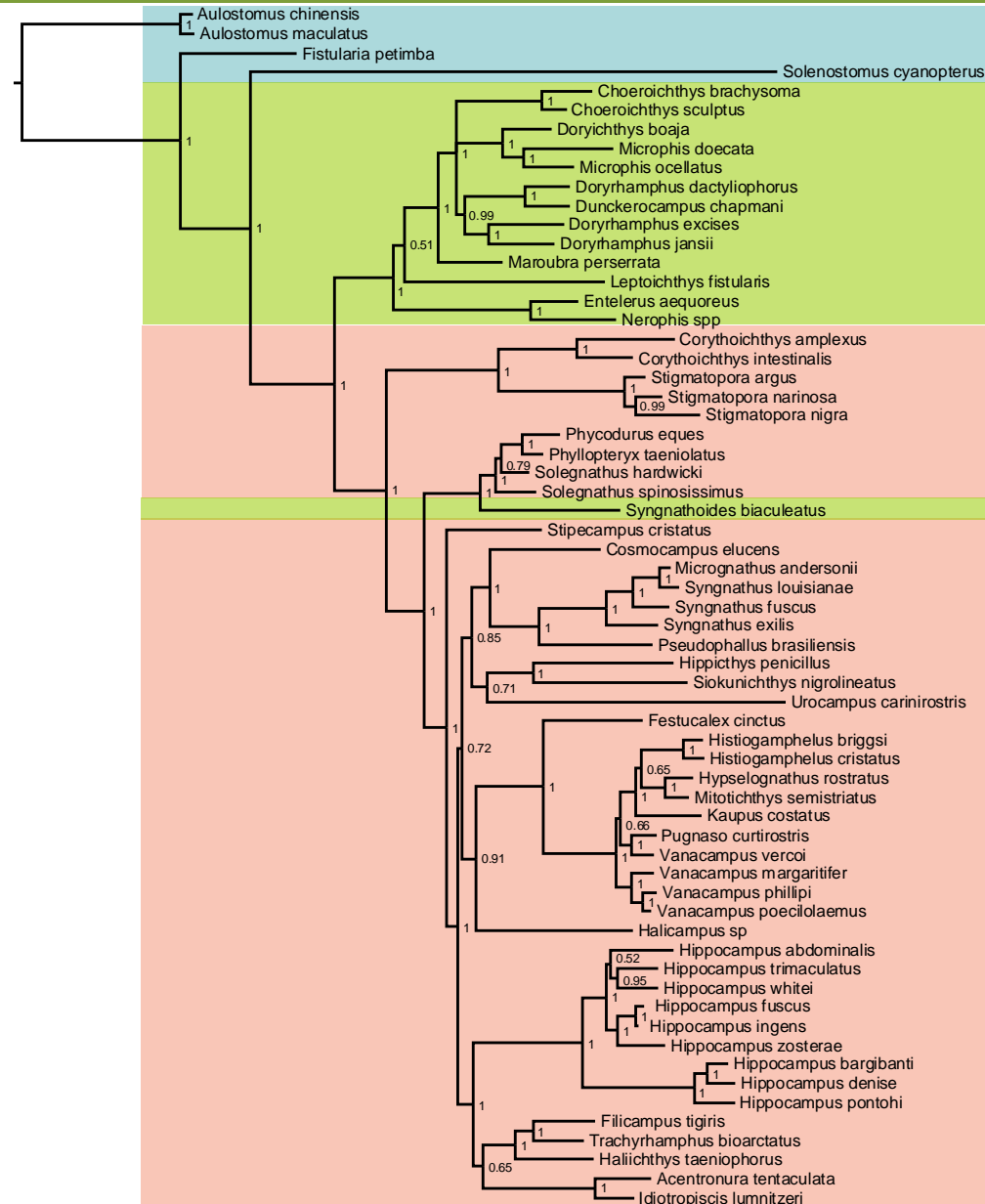
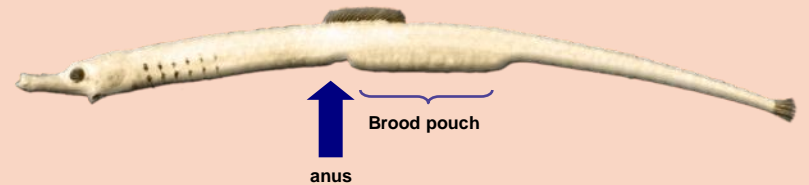
Outgroups



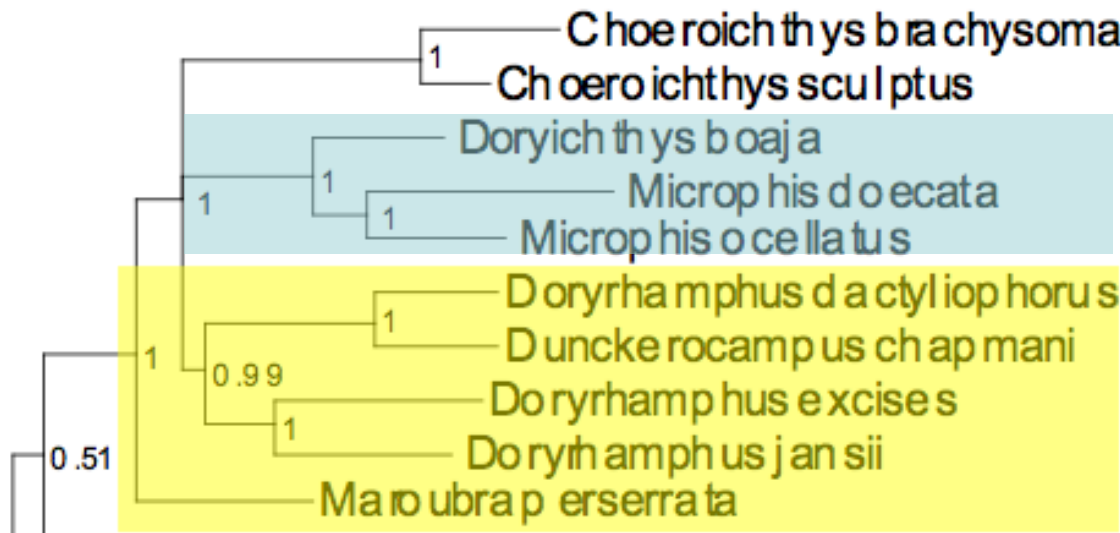
Gastrophori; abdominal-brooding fish



Urophori; tail-brooding fish



Results: “Doryrhamphinae”: Flagtail pipefishes



Mostly freshwater pipefishes

Flagtail pipefishes



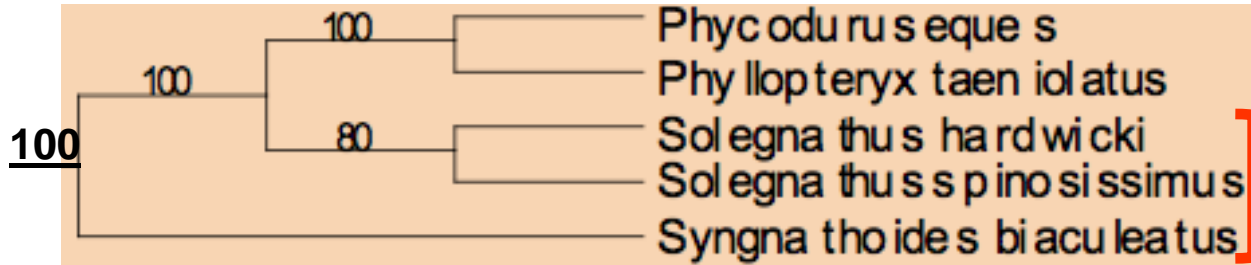
Dunkerocampus



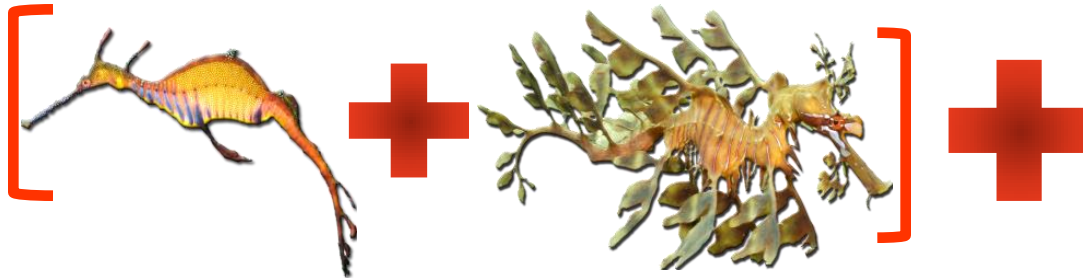
Doryrhamphus



Results “Solegnathinae”: Sea Dragon clade



Prehensile tails



Solegnathus



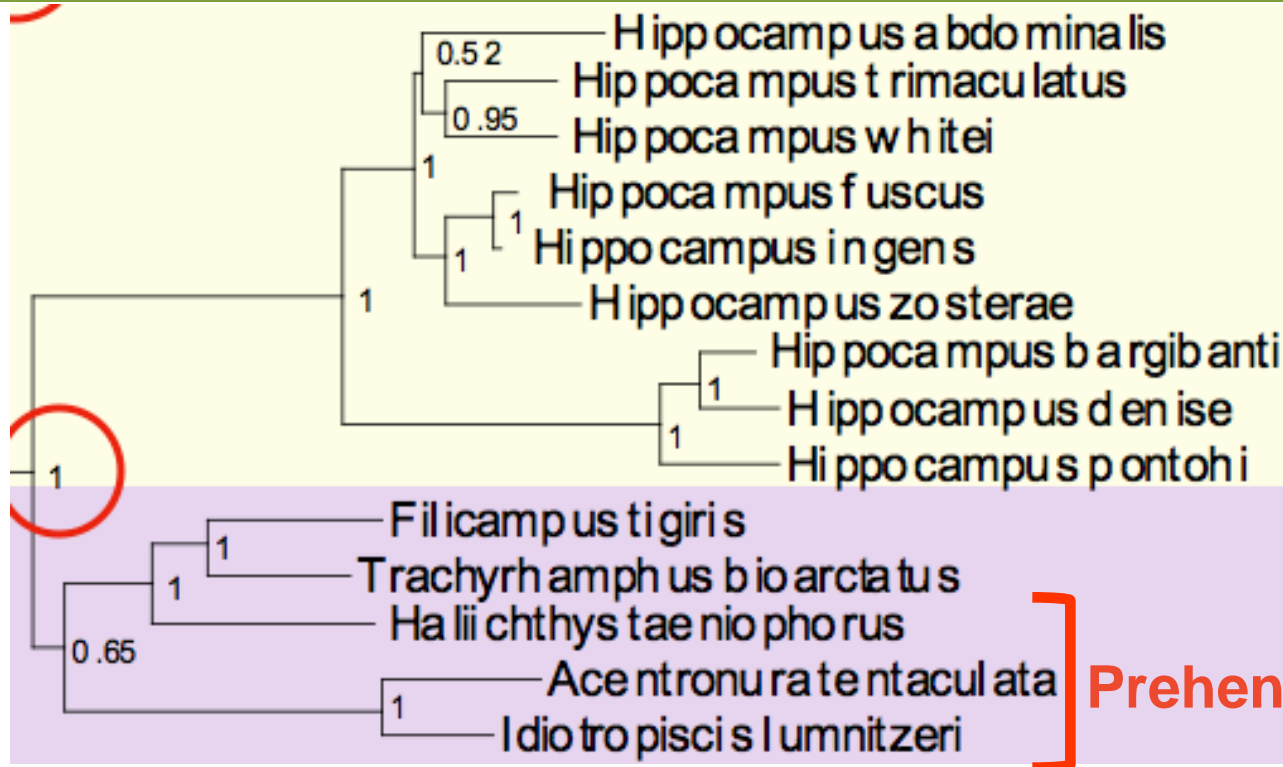
Sygnathoides



Haliichthys taeniophorus
 “Ribboned” sea dragon or pipefish



Results: Who is sister to seahorses?



Haliichthys



Filicampus



Trachyrampus



Conclusions

- **Our molecular phylogeny is in agreement with Wilson(2003). Much revisionary work is needed at multiple taxonomic levels.**
- **The division of syngnathids into sub-families Syngnathinae and Hippocampinae is not supported; Syngnathinae is paraphyletic**
- **Maximum Parsimony and Bayesian phylogenetic analyses reproduce similar sets of clades, but differ in resolution of their arrangement**
- **Multiple origins of characters such as prehensile tails, freshwater habit, and fin presence/absence**
- **The seahorse's sister group is still unresolved**



Future research in syngnathid systematics

- **Further mapping of morphological characters to elucidate their origins and patterns in syngnathids**
- **Broader intraspecific geographic sampling**
- **Additional nuclear markers and increased axon sampling (21 genera to go!)**

These future steps will further advance a sufficiently robust phylogeny to support syngnathid taxonomy, systematics, biogeography, and conservation.



THANK YOU!



*David
Harasti*

