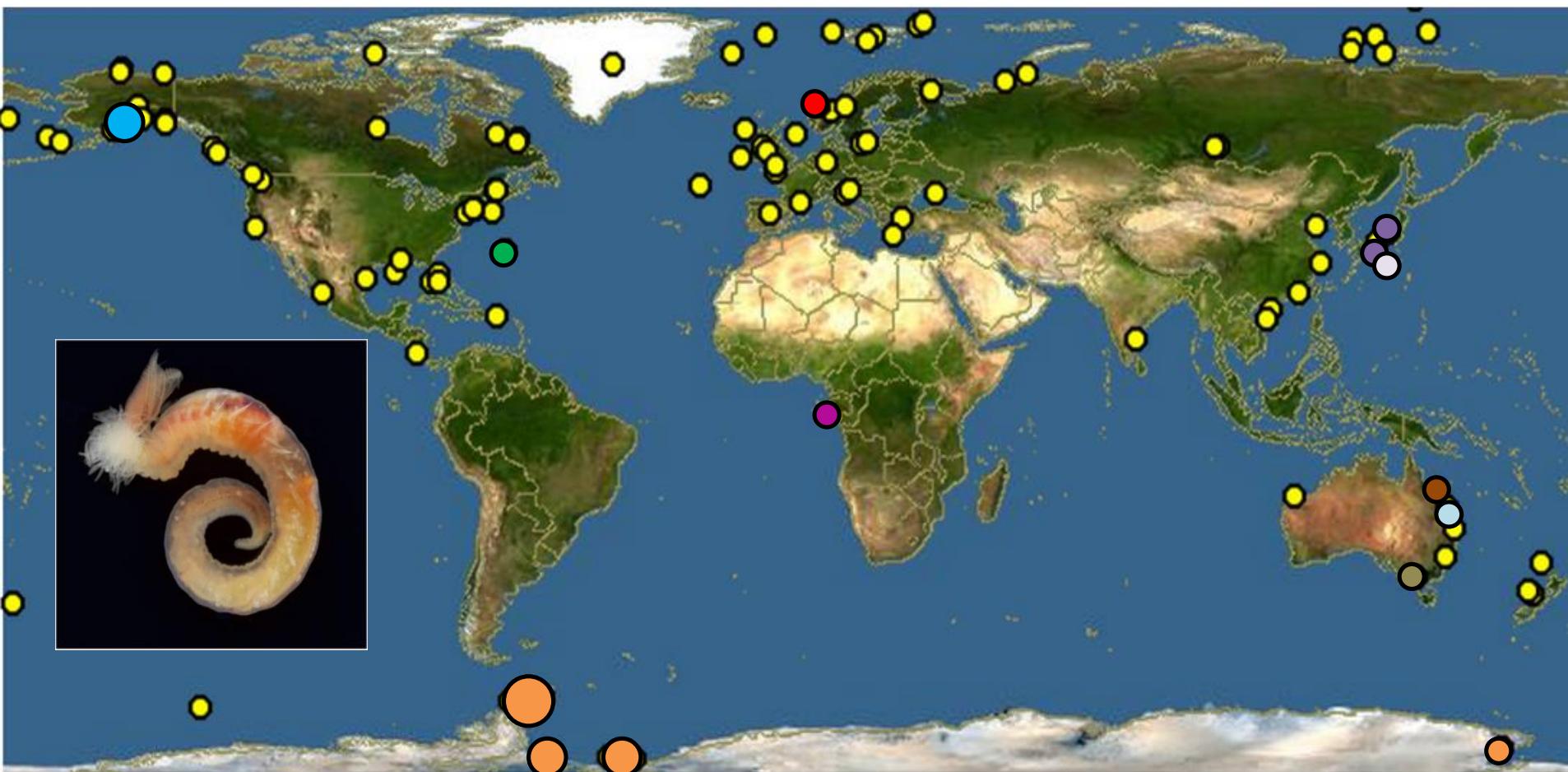


Understanding invasive polychaetes: Integrative taxonomy to the rescue

Elena Kupriyanova, Yanan Sun,
Eunice Wong, Pat Hutchings

Invasive or naturally widely distributed species?

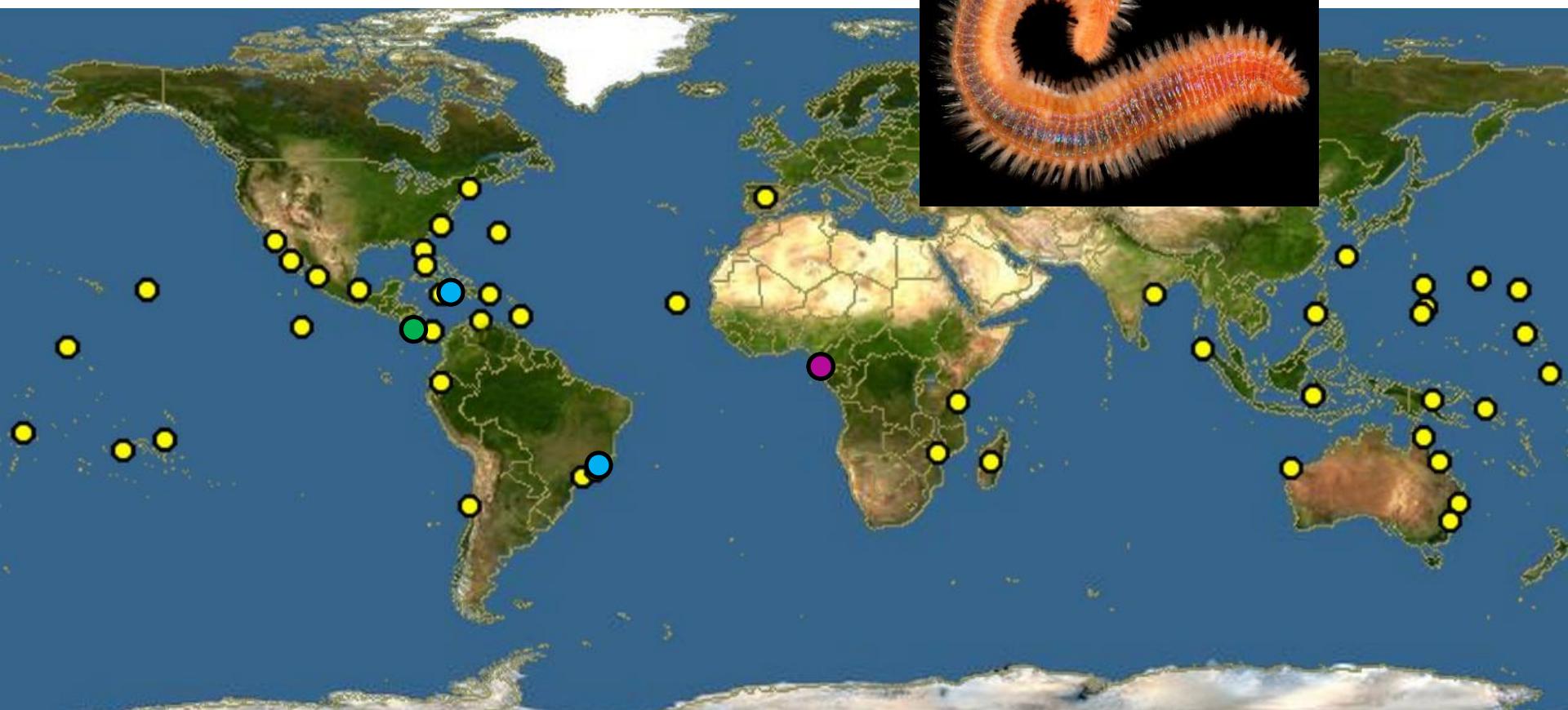
- Insufficient traditional (morphological) taxonomic studies



Terebellides stroemi Sars, 1835 → ~ 10 morphologically distinct species (Hutchings & Peart, 2000)

Invasive or naturally widely distributed species?

- Presence of cryptic species



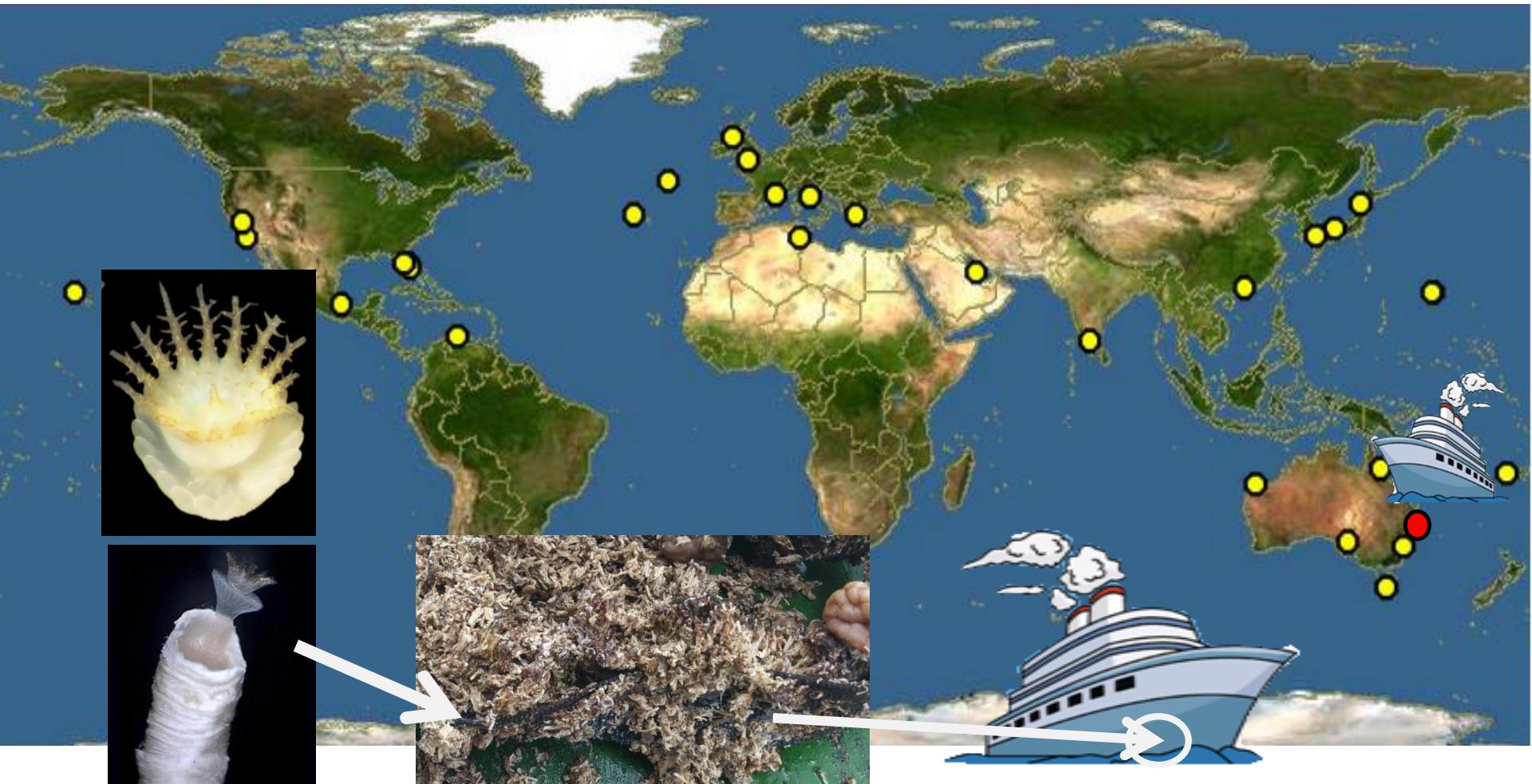
Eurythoe complanata (Pallas, 1766)



at least 3 cryptic species (Barroso *et al.*, 2010)

Invasive or naturally widely distributed species?

- Anthropogenic translocations (invasive tube worms)



Hydroides elegans (Haswell, 1883)

Easily translocated species, species complexes, cryptic species, or all the above?

- **Polychaeta:** 292 species were transported around the world with human-mediated assistance (Çinar, 2013)
- The family Serpulidae includes the highest number (46) of translocated species.

Hydroides spp.



*Hydroides
elegans*

*Hydroides
ezoensis*

*Hydroides
sanctaecrasis*

*Hydroides
diramphus*

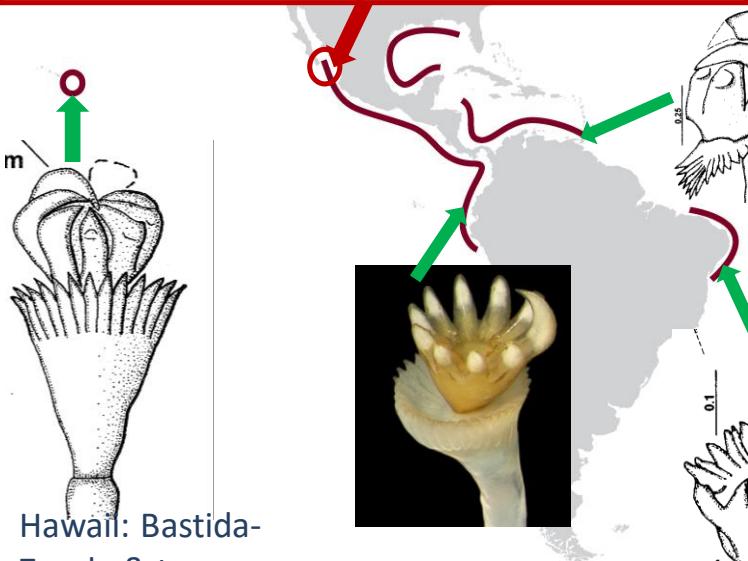
*Hydroides
brachyacanthus*

*Hydroides
dianthus*

*Hydroides
operculata*

Hydroides brachyacantha Rioja, 1941

Type locality (Rioja, 1941)



Hawaii: Bastida-Zavala & ten Hove 2003



Brazil: Bastida-Zavala & ten Hove 2002

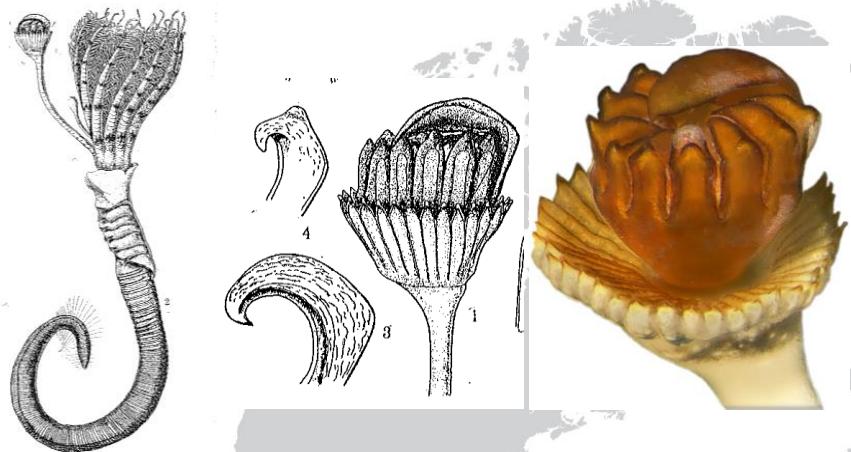


Turkey: Çınar, 2006

Hydroides amri, a new species in *H. brachyacantha* complex

(Rioja, 1941)

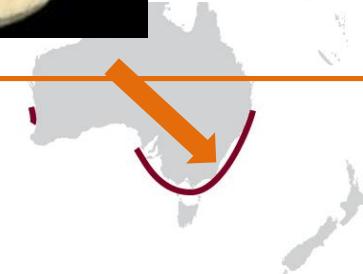
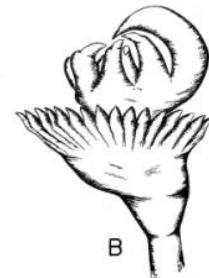
Type locality



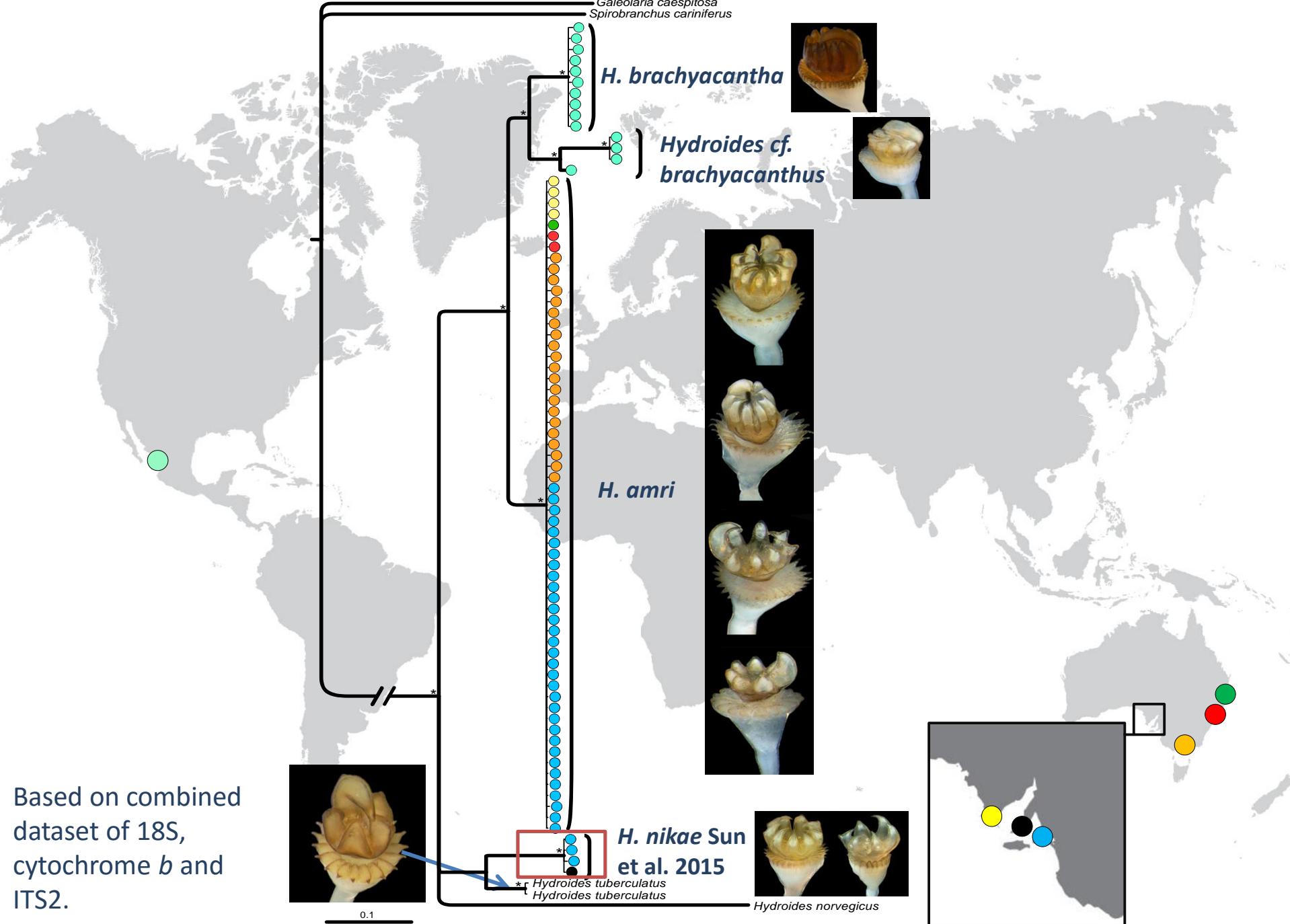
Hydroides amri Sun et al., 2015



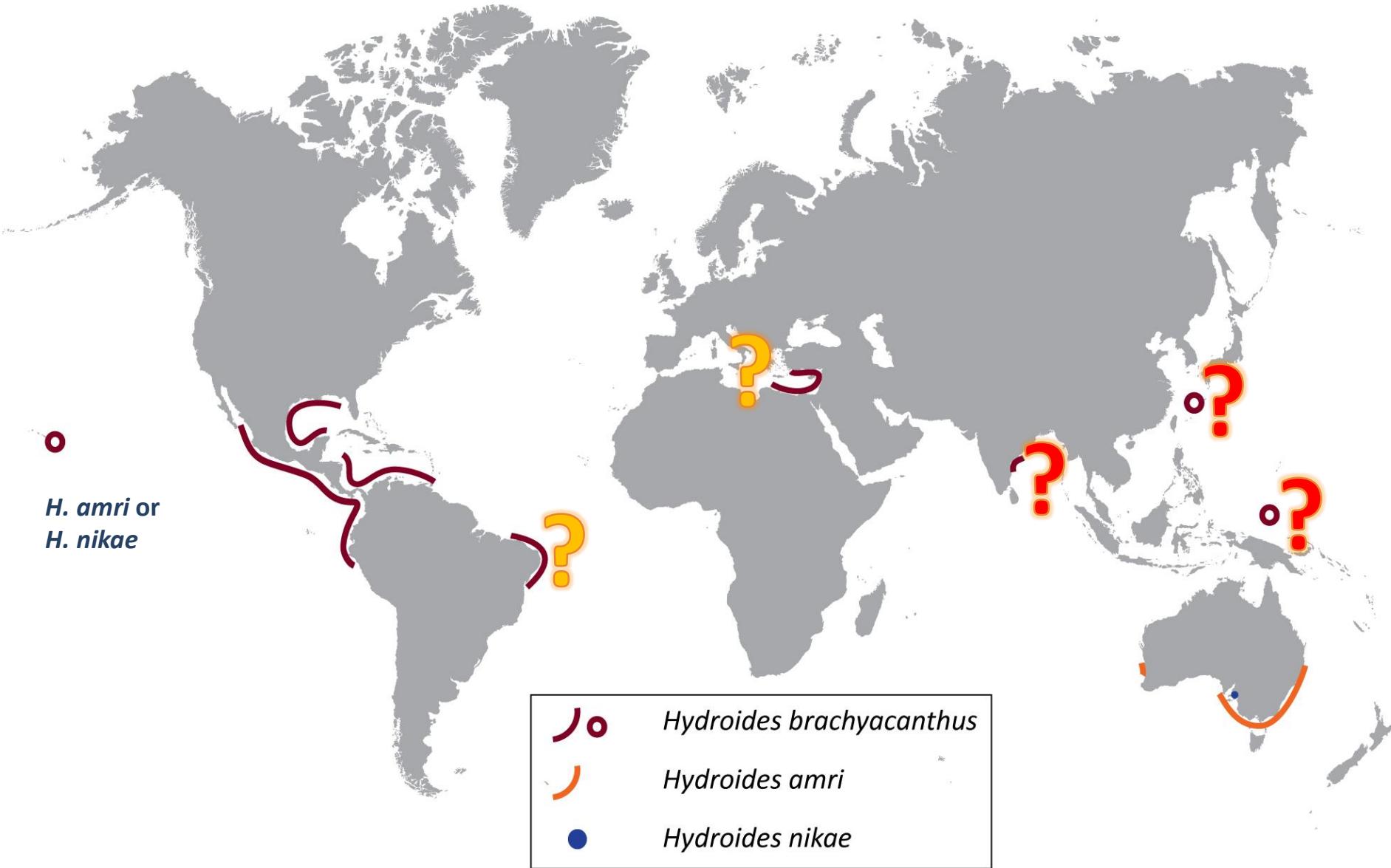
Recorded distribution



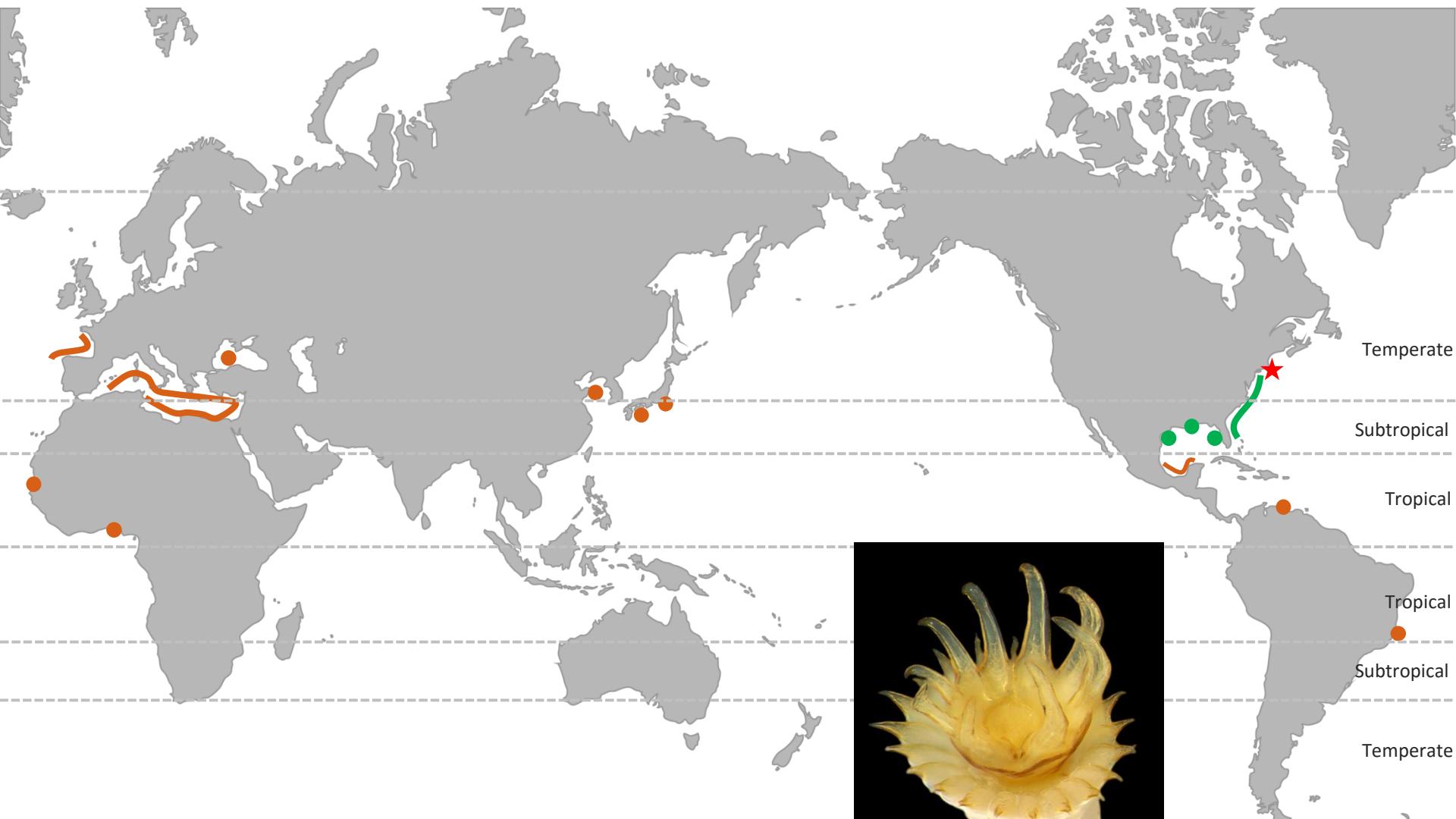
Cryptic species indicated by a analysis of combined fragments of 18S, cytochrome *b* and ITS2



New status map of *Hydroides brachyacantha* complex

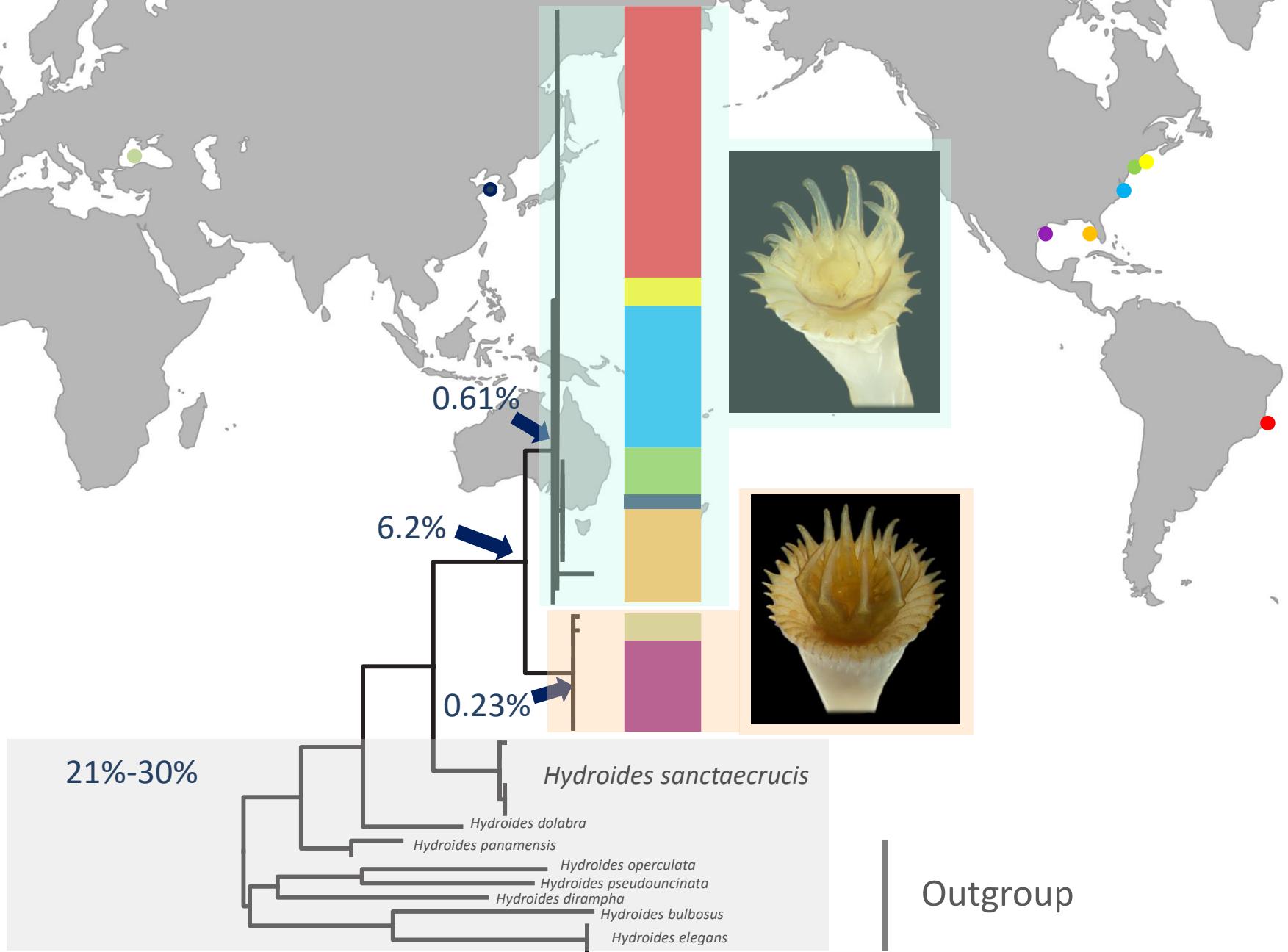


Hydroides dianthus (Verrill, 1873)

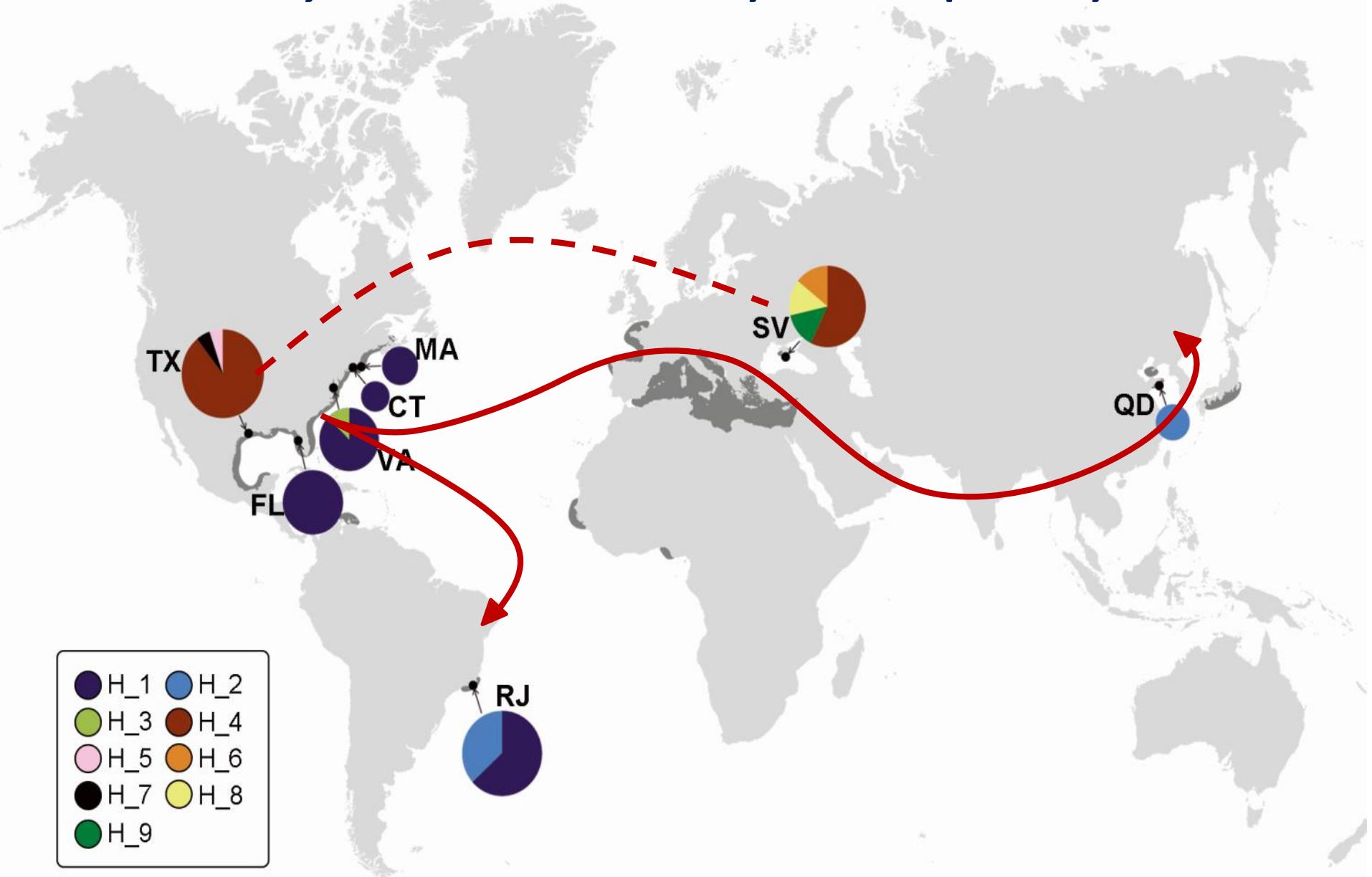


- Wide temperature range

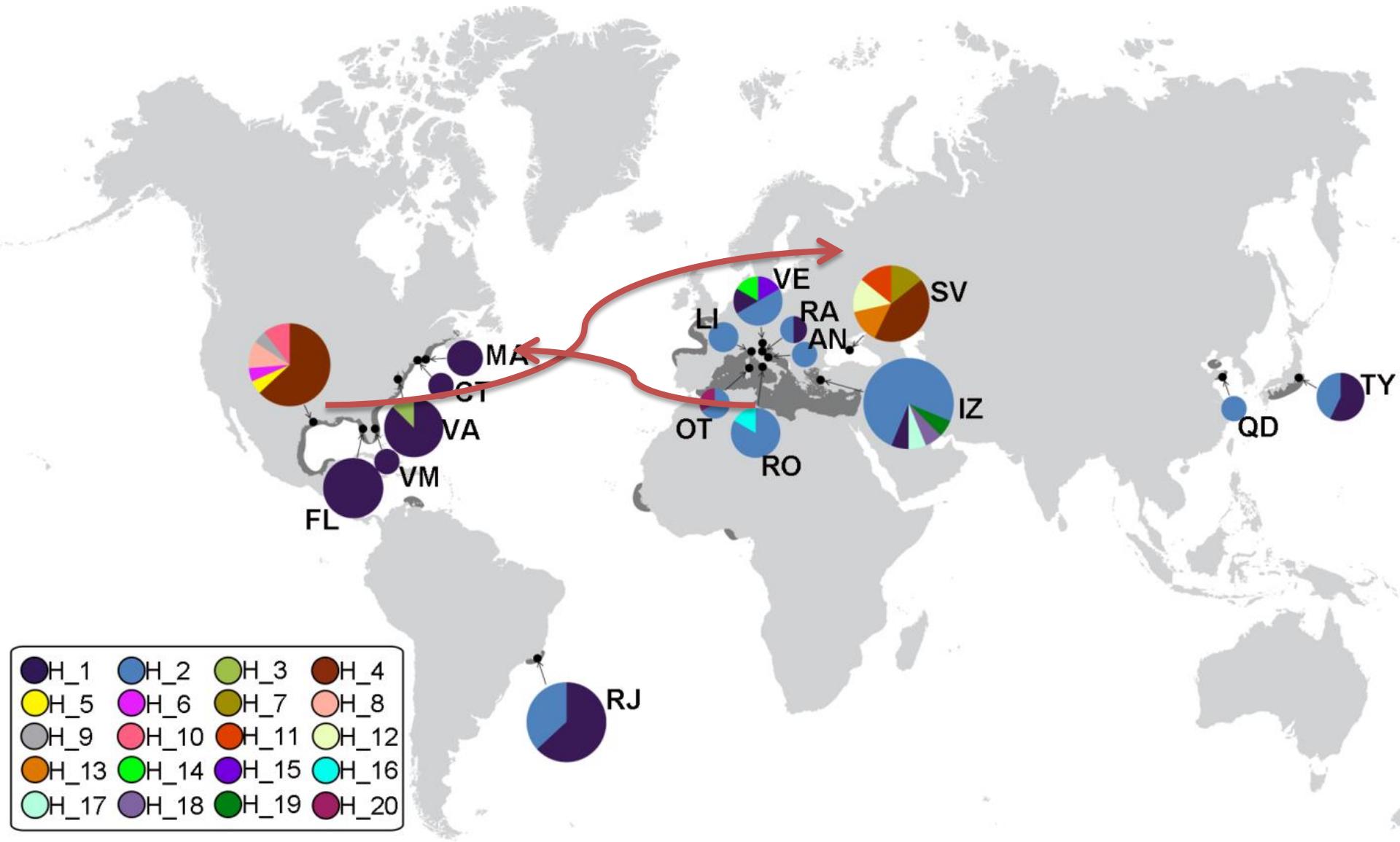
Barcodeing of *Hydroides dianthus*: 2 cryptic species



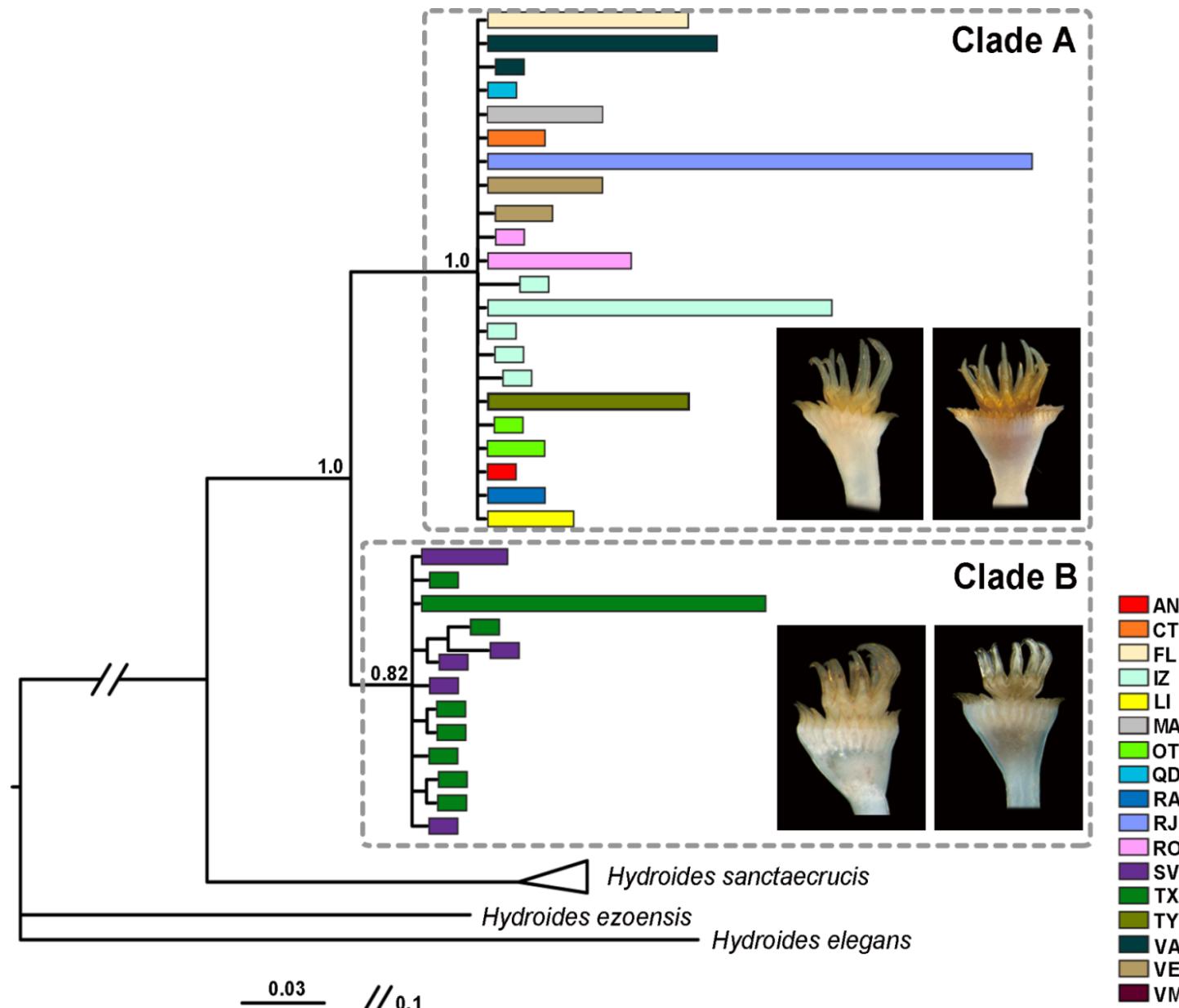
Hydrodides dianthus: likely invasion pathways



Hydroides dianthus: likely invasion pathways



Barcoding of *Hydroides dianthus*: 2 cryptic species



Hydroides operculata

Hydroides operculata Treadwell, 1929

★ Type localities

Synonymised names :

Hydroides inornatus (Pillai, 1960)

Hydroides basispinosus Straughan, 1967

Hydroides gradata Straughan, 1967



“Australian tubeworm” *F. enigmaticus* (Fauvel, 1923)



HARD WORK: Growth is scraped off the yacht Black Pepper at Goolwa.

ALEXANDRA TREDRE

BOAT owners at Goolwa and Hindmarsh Island are spending thousands of dollars to scrape off a coralline growth from the bottom of their boats.

While boats were yesterday blamed for the growth in the lower River Murray and Hindmarsh Island, a Flinders University marine biologist said its cause was still unknown.

Flinders University senior marine biology technician Sabrina Cittman said the growth was a type of brittlestar, which could be mistaken for a coral because it belongs to a different class of organisms.

"It's been growing over boats and buildings. We've built almost 'reef-like structures' and it's been growing over boats in the River Murray around Goolwa," she said.

"It's very complicated to say what is causing it because we have very little information on it. We have very little information on the scientific community whether this species is native or non-native and where it was introduced from overseas."

Steve Marr, who has a marina with houses at Goolwa and Hindmarsh Island, said the growth they received the growth was coral.

"Just last week I had to hire divers to remove it. It cost him \$1500 to have the 'coral' removed from his 45-foot boat," he said.

Other boat owners reported spending up to \$10,000 to fix the problem.

Mr Marr said he has had a boat at Goolwa for 17 years and that he

CORAL TROUBLE: Sabrina Cittman is amazed by the organisms that have popped up noticed the growth only in the past nine months.

"The Lower River Murray has lived for years as a freshwater area until now, but it's become saltier and more and more it's changing," Mr Marr said. "I have never seen that before."

"Since the water levels dropped there has been more saltwater. It just allows the coral to thrive."

All Hindmarsh Island, which is situated in the middle of the river, brittlestars has also been appearing on boats. Steve White of Tamunda said he first noticed it on his boat six weeks ago. At the same water level as the marina, started dropping.

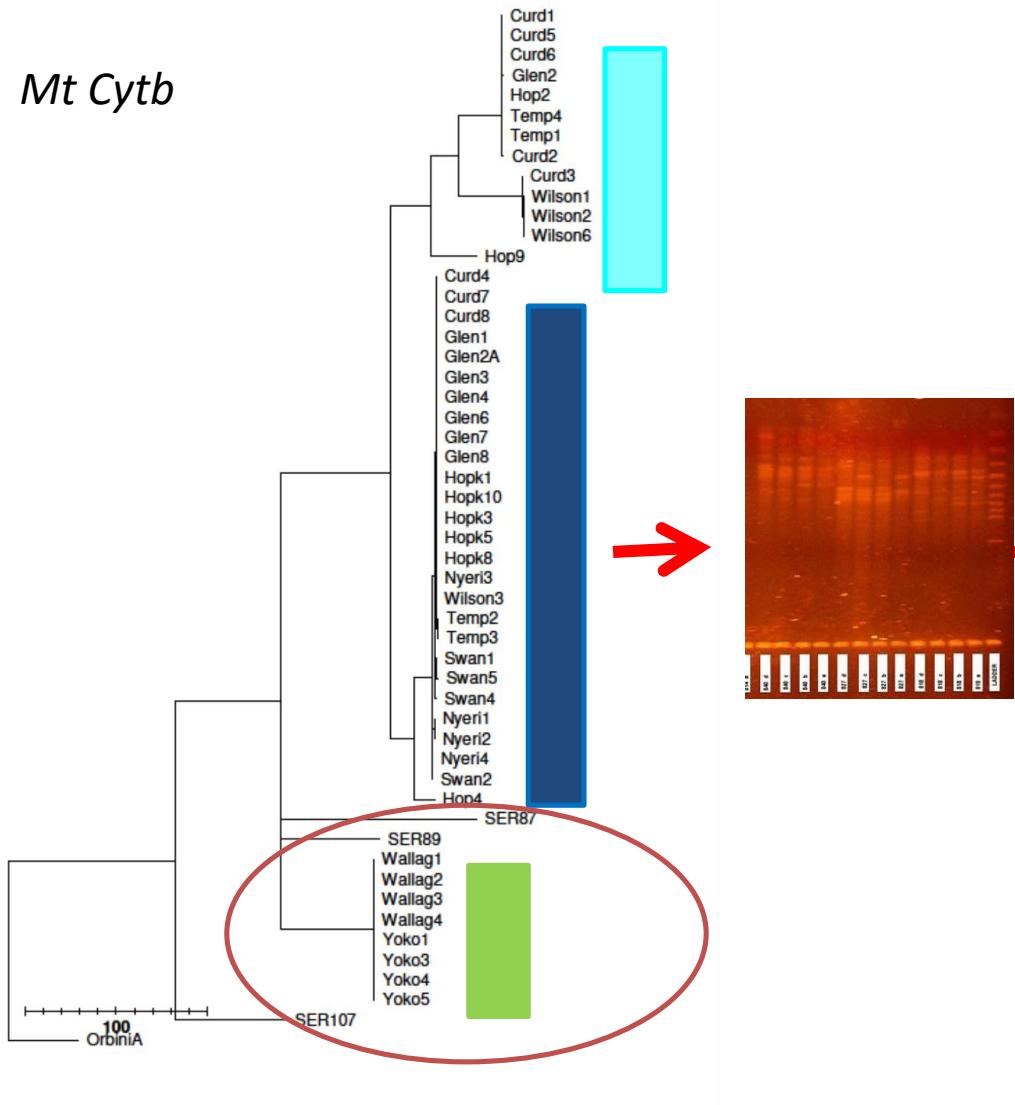
"I brushed it off three weeks ago and it came off easily," he said.

- Estuarine reef building serpulid
- Locally, increases in abundance, fouling issues
- **Worldwide invader of Australian origin?**

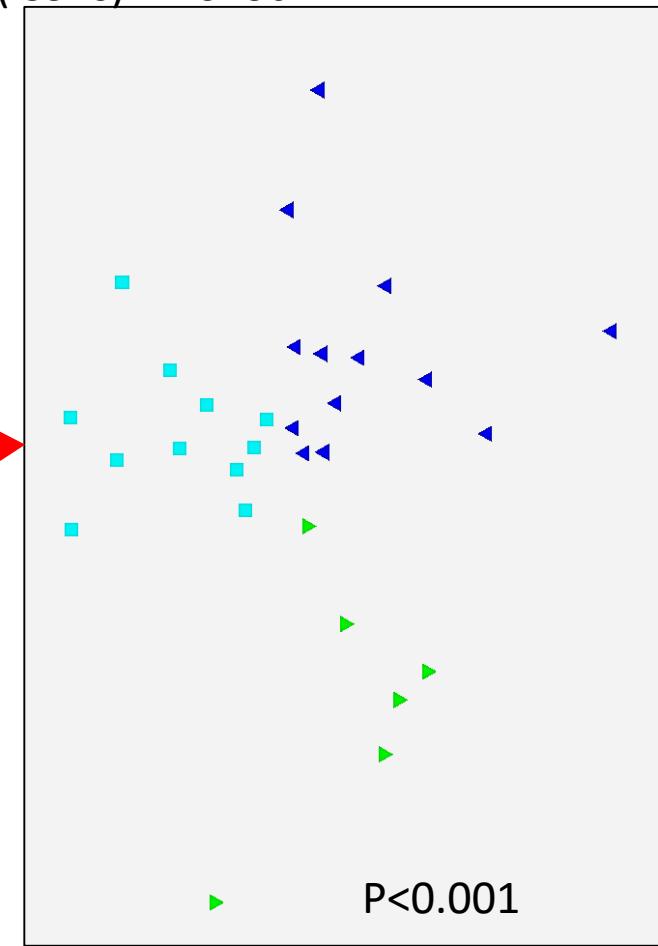


Ficopomatus enigmaticus: 3 cryptic species in Australia

Mt Cytb



Inter simple sequence repeats (ISSRs) – 70 loci



Results: three *Ficopomatus* species with overlapping distributions



- Within each “blue” species – some evidence that WA different to VIC/NSW (mtDNA, ISSRs) → native?
- No obvious morphological differences between “blue” worms in sympatry

Third species from SE NSW is morphologically distinct

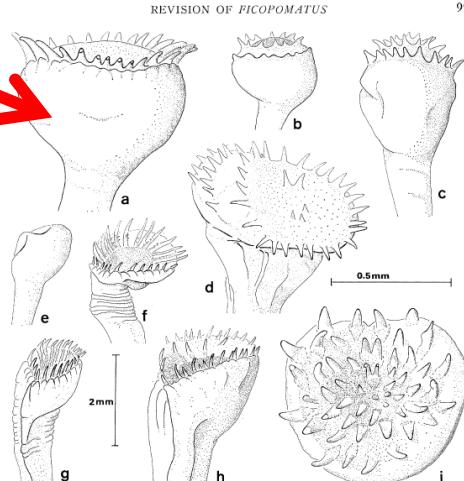
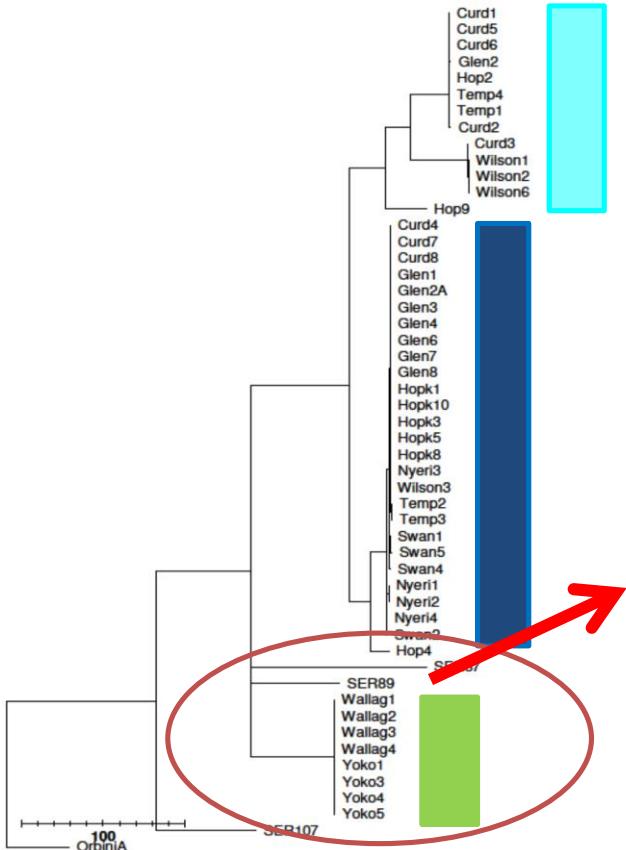


FIGURE 2. Opercula, different orientations. The specimens represented in a-d are *Picopomatus uschakovii*; a-c, from Guadaluana; d, paratype of var. *lingayensis* from Luzon. The specimens in e-i are *F. enigmatus*; e-h, from the Netherlands; i, from Uruguay. Scale in f, g, h is 2 mm; in remaining figures, the scale is 0.5 mm.

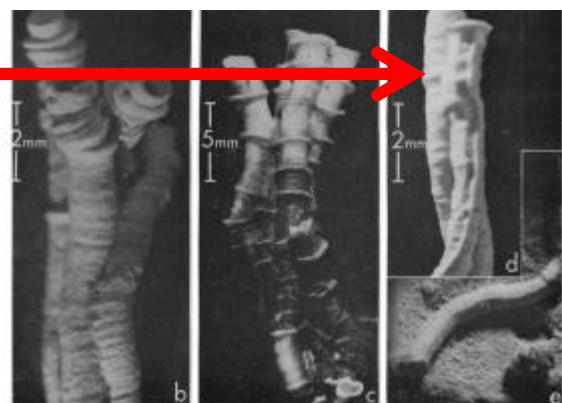


FIGURE 5. Tubes of *Picopomatus*: a, b, *F. meiermanni* from Barbados, showing differences between two populations from Holston river pool and from one-half mile north of Bellairs Institute; c, *F. enigmatus* from the Netherlands; d, *F. uschakovii* from India, showing three longitudinal keels; and e, *F. meiermanni* from Talchi-Sag, showing one longitudinal keel.

Nothing is simple with common invasive tubeworms

- ***Hydroides brachyacantha***: a large complex that includes an unknown number of morphologically distinct and cryptic species
- ***Hydroides dianthus***: includes 2 cryptic invasive species
- ***Hydroides operculata***: a complex of at least 3 cryptic genetically distinct species
- ***Ficopomatus enigmaticus***: a complex of 2 cryptic species across southern Australia and a morphologically distinct one from NSW/Victoria.
- Integrative taxonomic studies should be included in bioinvasion studies