

# A global invader or a complex of regionally distributed species? Clarifying the status of an invasive calcareous tubeworm *Hydroides dianthus* (Verrill, 1873) using barcoding



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A calcareous tube worm *Hydroides dianthus* (Verrill, 1873) is a common fouling invader. Originally described from off Massachusetts, USA, this species has been reported along the East coast of North America down to Florida and Grand Caribbean, and nowadays extends its distribution range to Brazil, China, Europe, Japan, and West Africa (Fig. 1). Unlike most congeners, *H. dianthus* has tolerance for a wide temperature range occurring from temperate to subtropical waters, which casts doubts on the status of *H. dianthus*.

## Aims

- to analyse genetic divergence among *H. dianthus* populations using barcoding gene cytochrome c oxidase subunit I (COI)
- to investigate whether *H. dianthus* is a single species or a species complex

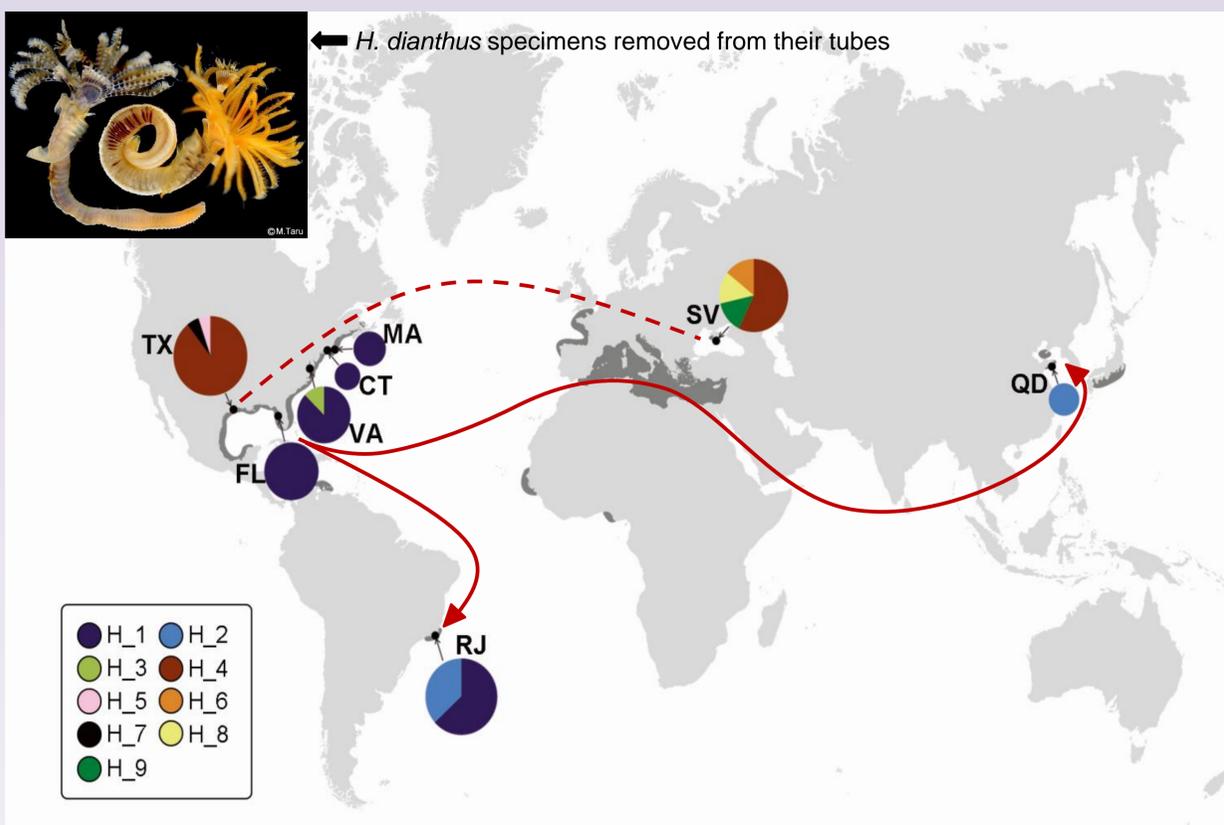


Fig. 1 *Hydroides dianthus* distribution. Black spots indicate sampling locations. Dark grey shadow indicates known distribution of the species. Pie charts on the map represent haplotype frequencies for each locality, the pie size is proportional to sample size. Red curved arrow indicates possible invasive route. CT: Old Saybrook, Connecticut, USA; FL: Tampa, Florida, USA; MA: Woods Hole, Massachusetts, USA; QD: Qingdao, Shandong, China; RJ: Cabo Frio, Rio de Janeiro, Brazil; SV: Sevastopol, Crimea, Ukraine; TX: Galveston, Texas, USA; VA: Hampton, Virginia, USA. H: Haplotype. Photo of *H. dianthus* is from Google by M.Taru.

## Results

- Nine haplotypes from all eight localities detected based on COI gene (Fig. 1)
- Two clades (A & B) supported by both haplotype network analysis and phylogenetic reconstruction (Fig. 2 & 3)
- High genetic homogeneity present at the continental scales in each clade (Fig. 1)

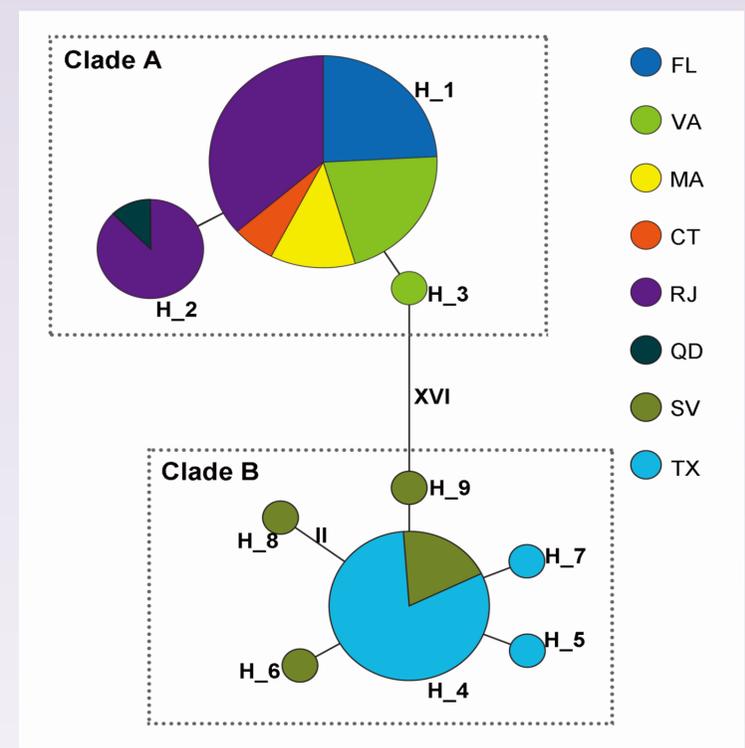
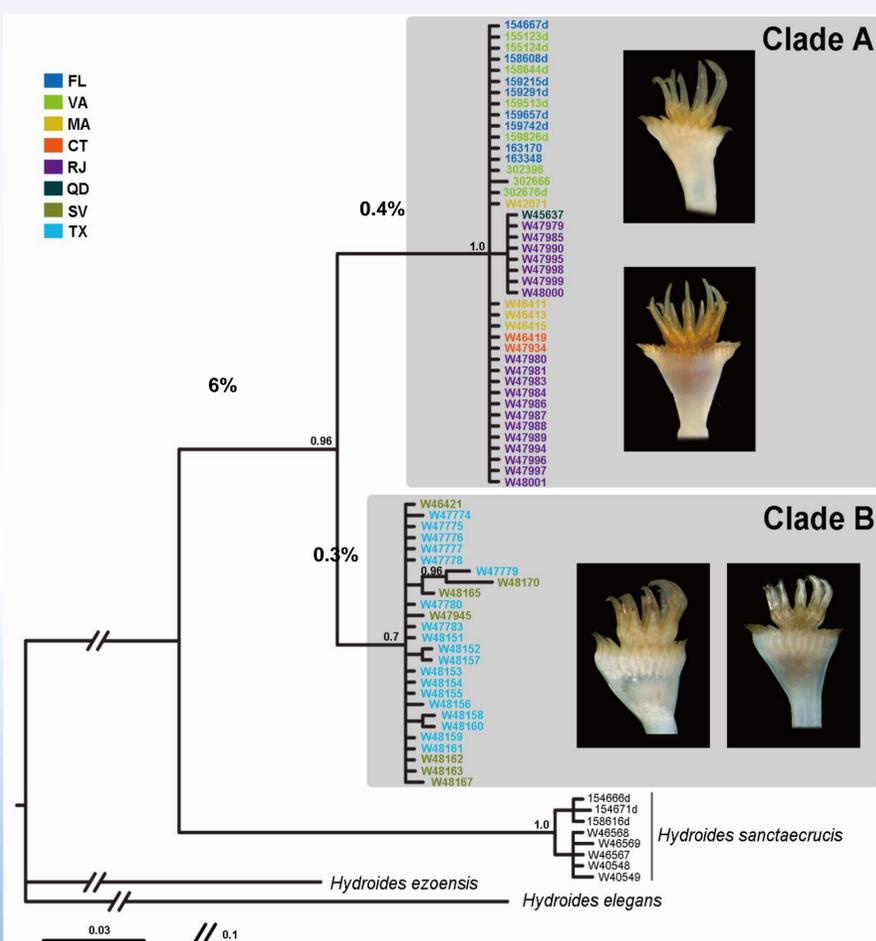


Fig. 2 Haplotype network for *Hydroides dianthus* from COI data. Haplotypes are marked as H\_1 to H\_9. Lines between circles represent one mutational step unless marked with roman numerals.



## Conclusions

- *Hydroides dianthus* is a species complex consisting of two cryptic species with high invasive potential.
- Human-mediated transport plays an important role in *H. dianthus* dispersal. RJ and QD population are introduced from FL population, while SV population is likely introduced from the Mediterranean directly.
- With increasing shipping activity, *H. dianthus* is likely to extend its distribution range to new localities such as e.g., Australia.
- Further large-scale barcoding of *H. dianthus* populations could provide additional evidence on the origin and bioinvasion pathways in this species.

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Fig. 3 Bayesian consensus tree of *Hydroides dianthus* based on COI sequences. Two main clades are highlighted. Values represent posterior probabilities (pp) > 0.7. Interclade and intraclade genetic distance of clade A and B based on p-distance marked above branches.