NCCOS | NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

A coral of another color: Genetic insights to the diversity and distribution of gorgonian octocorals in the US Gulf of Mexico

Swiftia exserta

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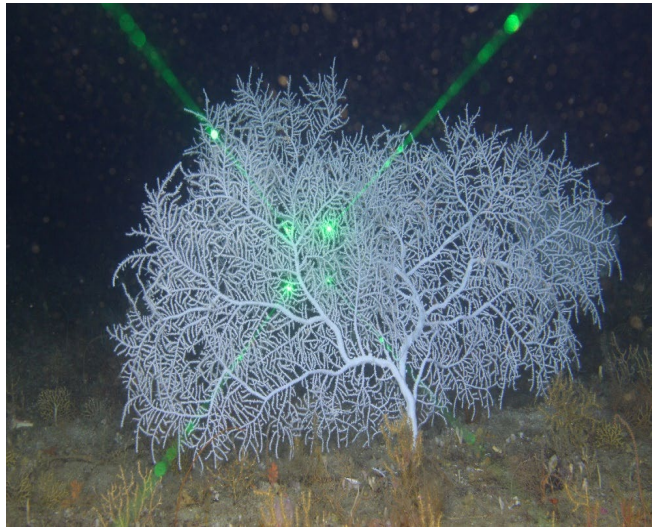


'Hypnogorgia' pendula

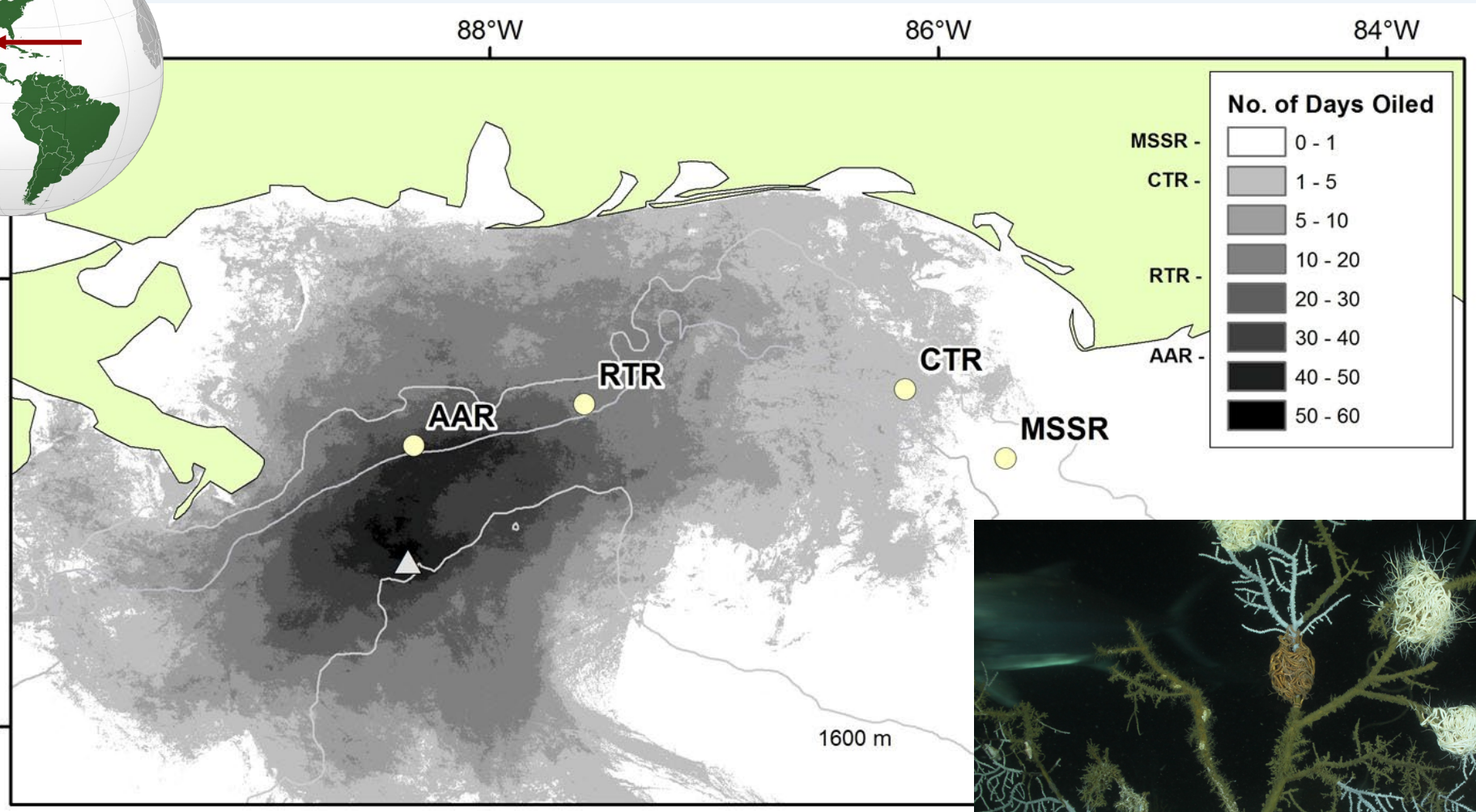
RESTORE SCIENCE PROGRAM

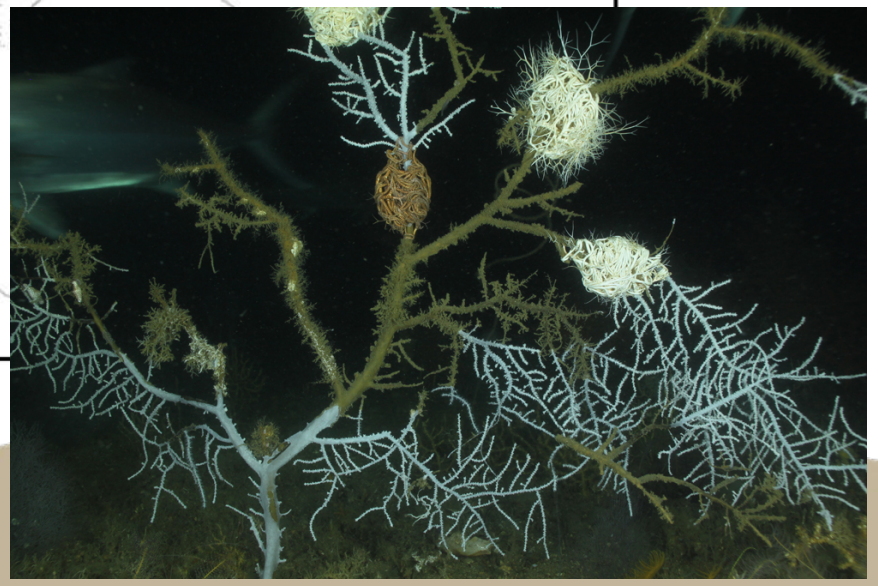
COLLEGE of CHARLESTON 1770

CSS

SCIENCE SERVING COASTAL COMMUNITIES

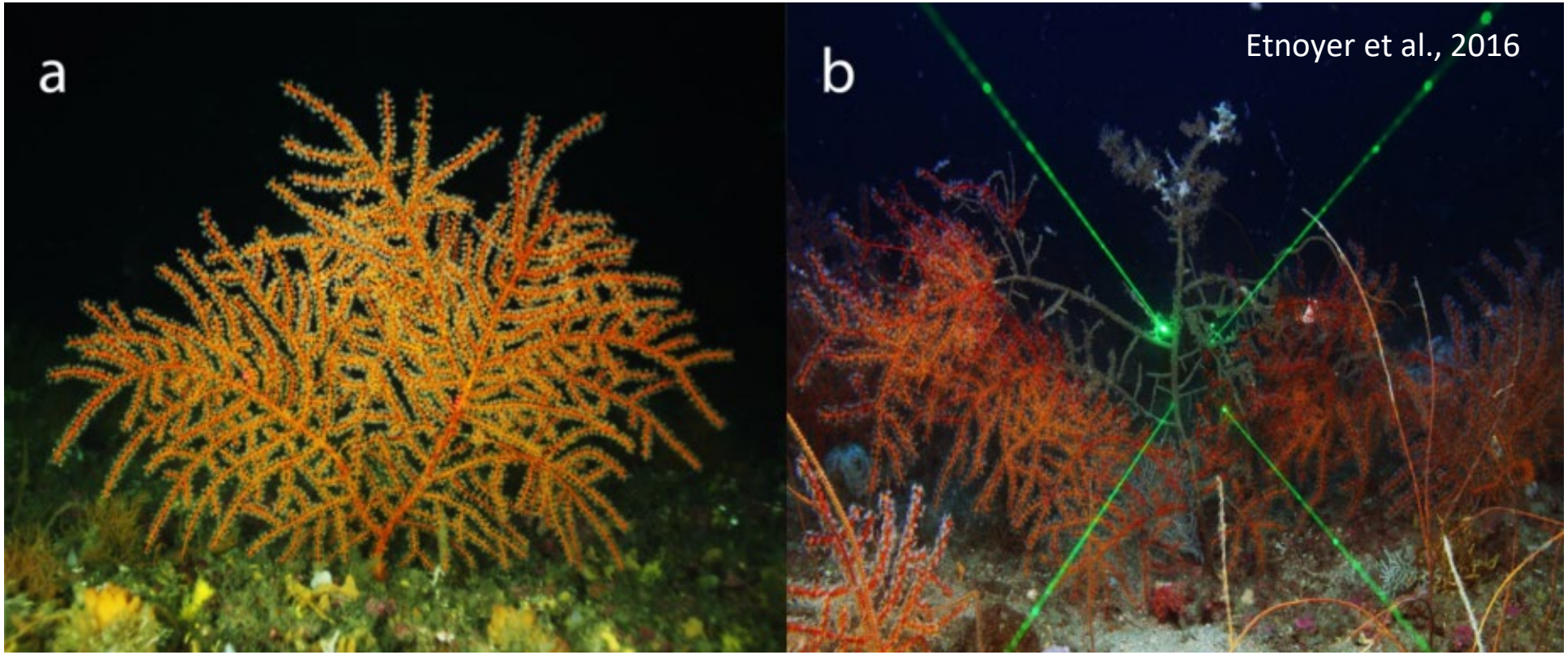
DWH Oil Spill in Northern Gulf of Mexico





Etnoyer et al., 2016. Coral Reefs.

Substantial injury to octocorals



- 40-50% of large sea fans at study sites were found to be injured post-spill
- *Swiftia exserta* and *Hypnogorgia pendula* were most common
- Two of 4 focus species for Population Connectivity study (Herrera et al, RESTORE 2017-2018)

General research questions

(Herrera et al, RESTORE 2017-2018)

How well connected are metapopulations of deep-sea corals?

What forces are structuring these populations, e.g. distance, depth?

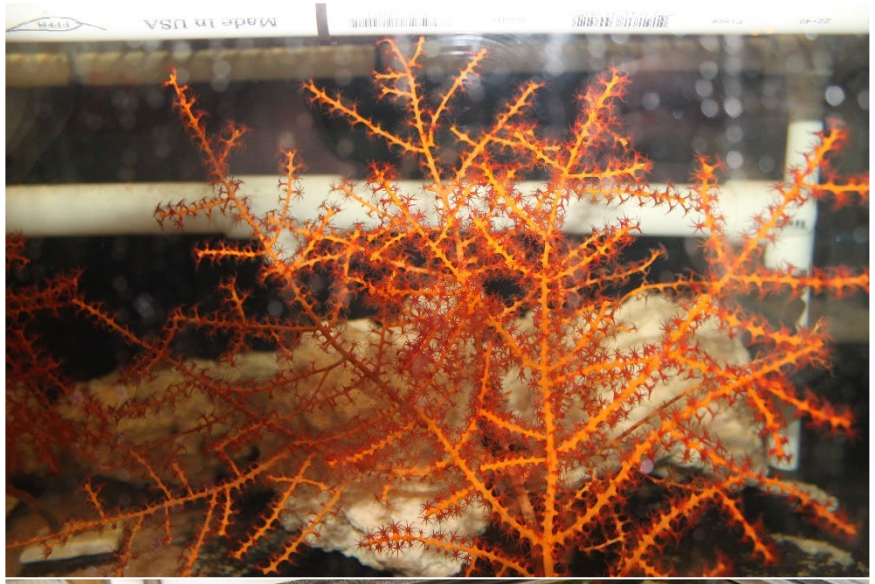
What is the level of genetic diversity within a species?*

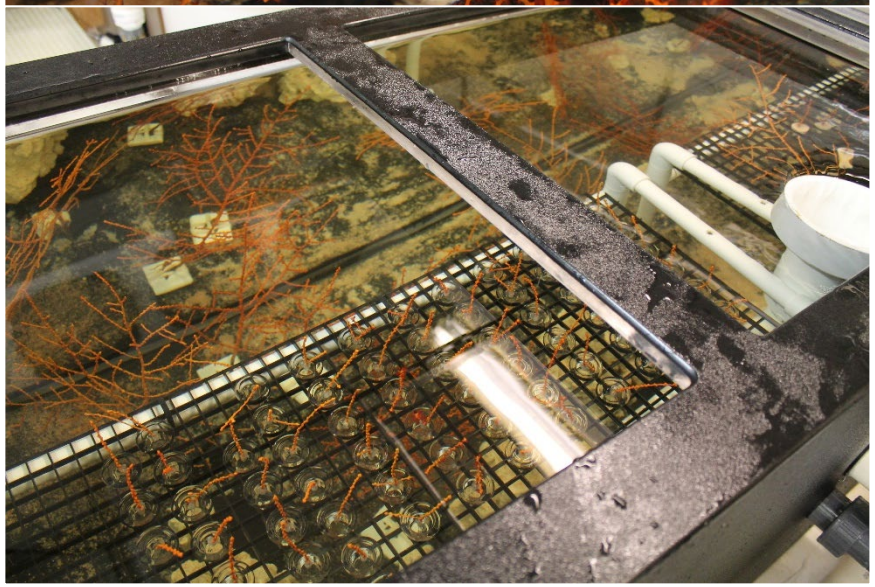
What is the degree of genetic distance among species within a genus?*

Are these the species we think they are?

Are the octocoral systematics supported by genetics?

Great experimental animals!





Janessy Frometa works on her MS thesis research at Hollings Marine Lab in Charleston

Two morphotypes of *Swiftia* in GoMx

Swiftia exserta
Southeastern Florida
Red/orange polyps

Swiftia cf. *exserta*
Northern Gulf of Mexico
White polyps

Methods for Molecular Barcoding

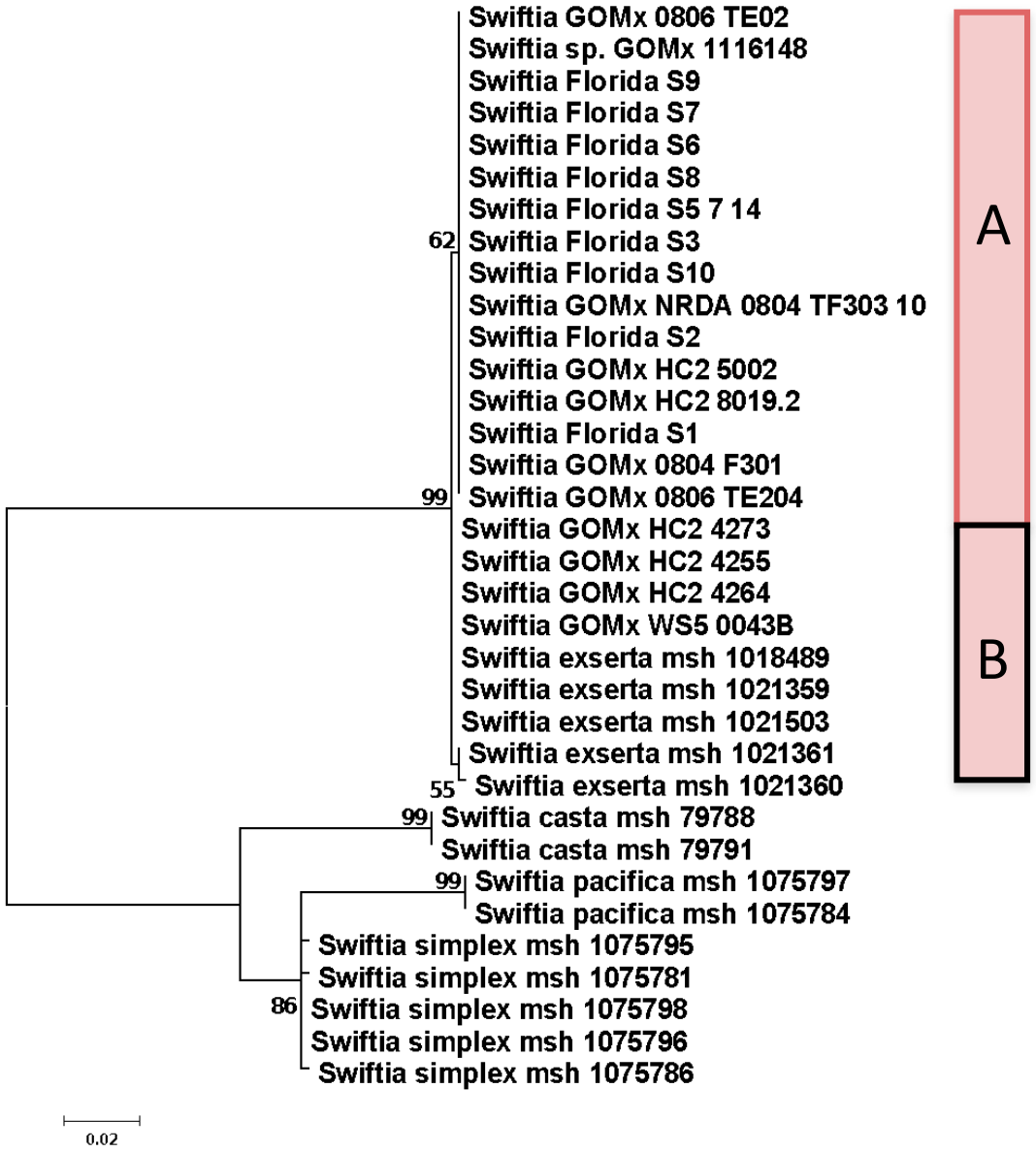
- Amplified & sequenced mt MutS gene region
  - ➢10 *Swiftia* sp. from Northern Gulf of Mexico
  - ➢9 *S. exserta* from Southeastern Florida
- 584 base pairs
- Maximum Likelihood
- Tamura-Nei model w/ gamma

Frometa et al, 2018. Mar Poll Bull.

- Inc. sequences from Smithsonian NMNH
  - ➢5 *S. exserta* from Caribbean, other *Swiftia* spp.

Wirshing et al, 2005. Marine Biology.

Haplotypes by region



All *S. exserta* grouped into one clade, separate from other *Swiftia*

Florida red polyps and same as GoMx white polyps

No correlation between *S. exserta* haplotypes and phenotypes

Two haplotypes in GoMx, A & B

J. Frometa, 2016. MS Thesis.

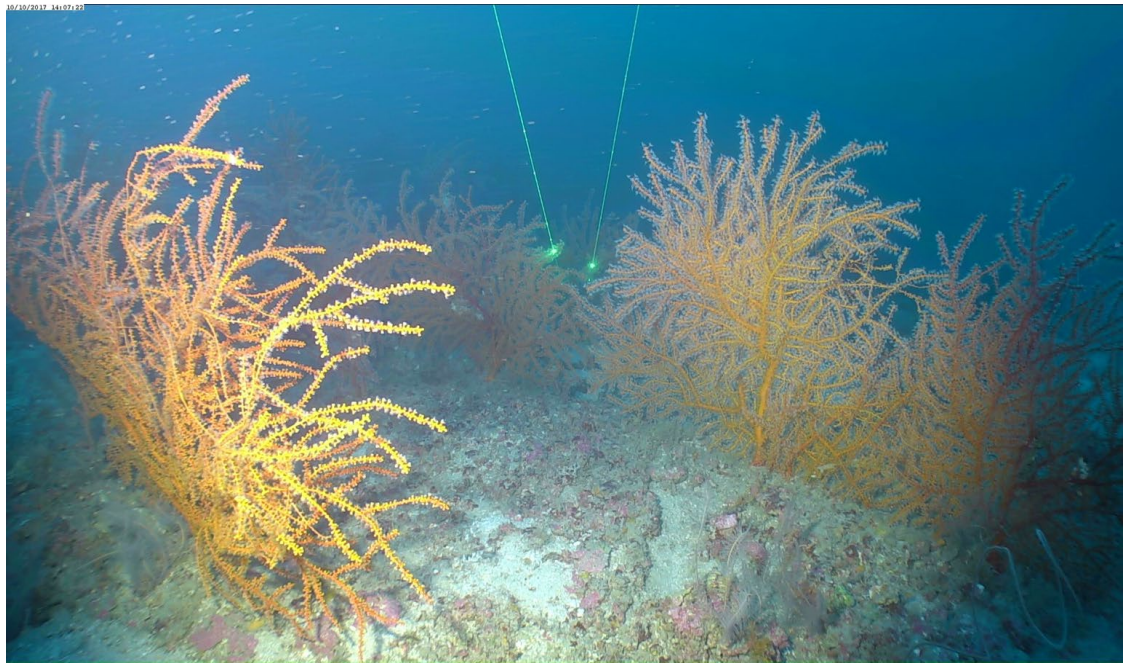
RESTORE Samples

171- *Swiftia exserta* samples collected in 2016-2017 (Herrera et al.)

151- coded to *Swiftia exserta* with local database searches, but no close homology returns in GenBank

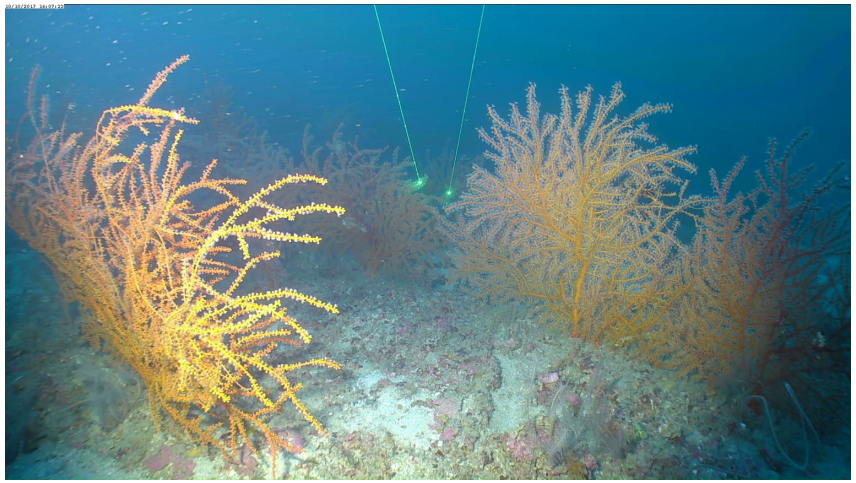
No previous barcode!

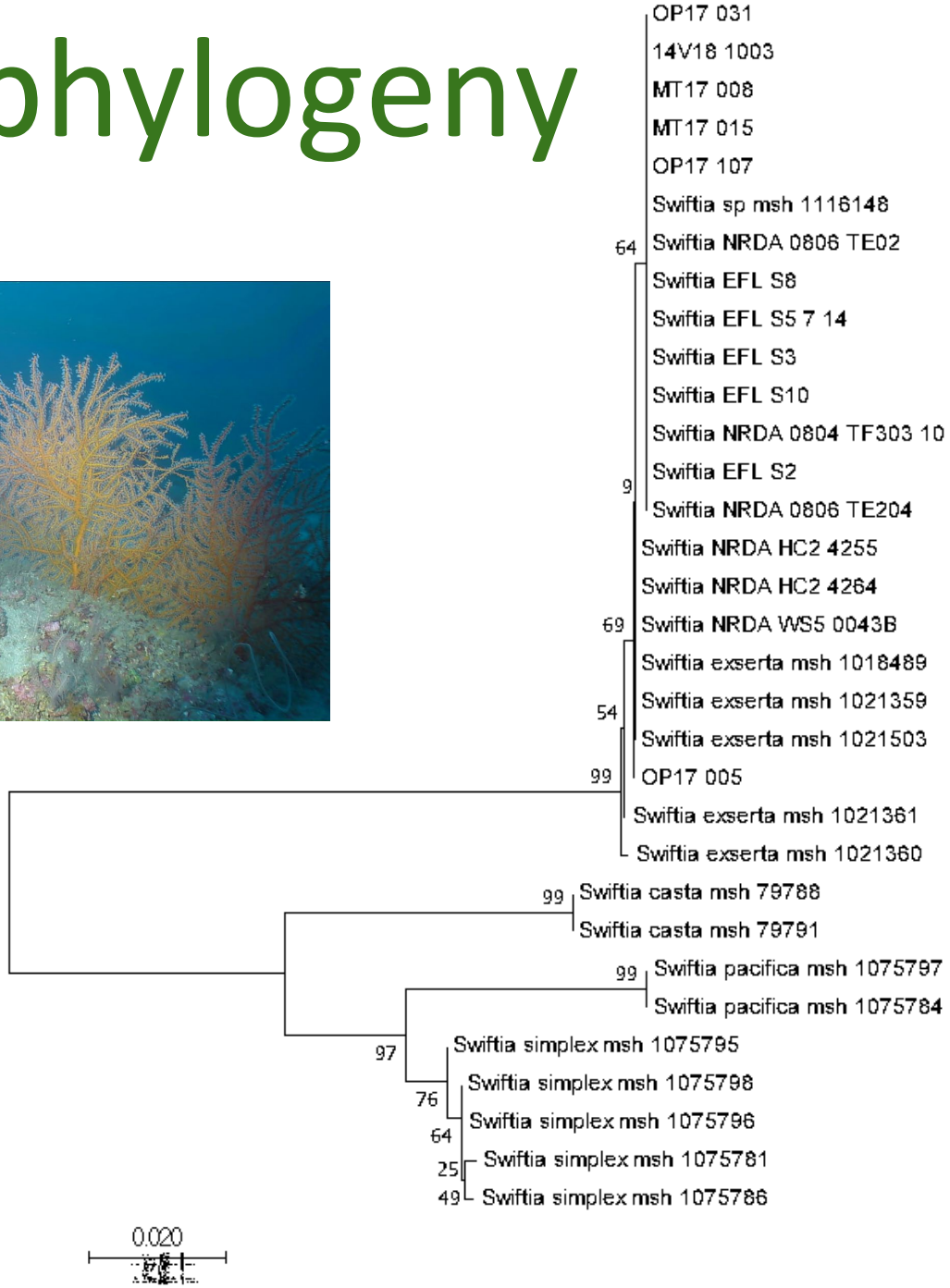
Collected new samples from USVI, Edisto Reef in SC, Cuba



Swiftia phylogeny

mutS





GoMx RESTORE samples
SEUS Edisto SC samples
GoMx NRDA samples
SEUS East FL samples
NMNH samples

GoMx RESTORE samples
GoMx NRDA samples
NMNH samples

Observed two haplotypes previously identified and frequency remained consistent

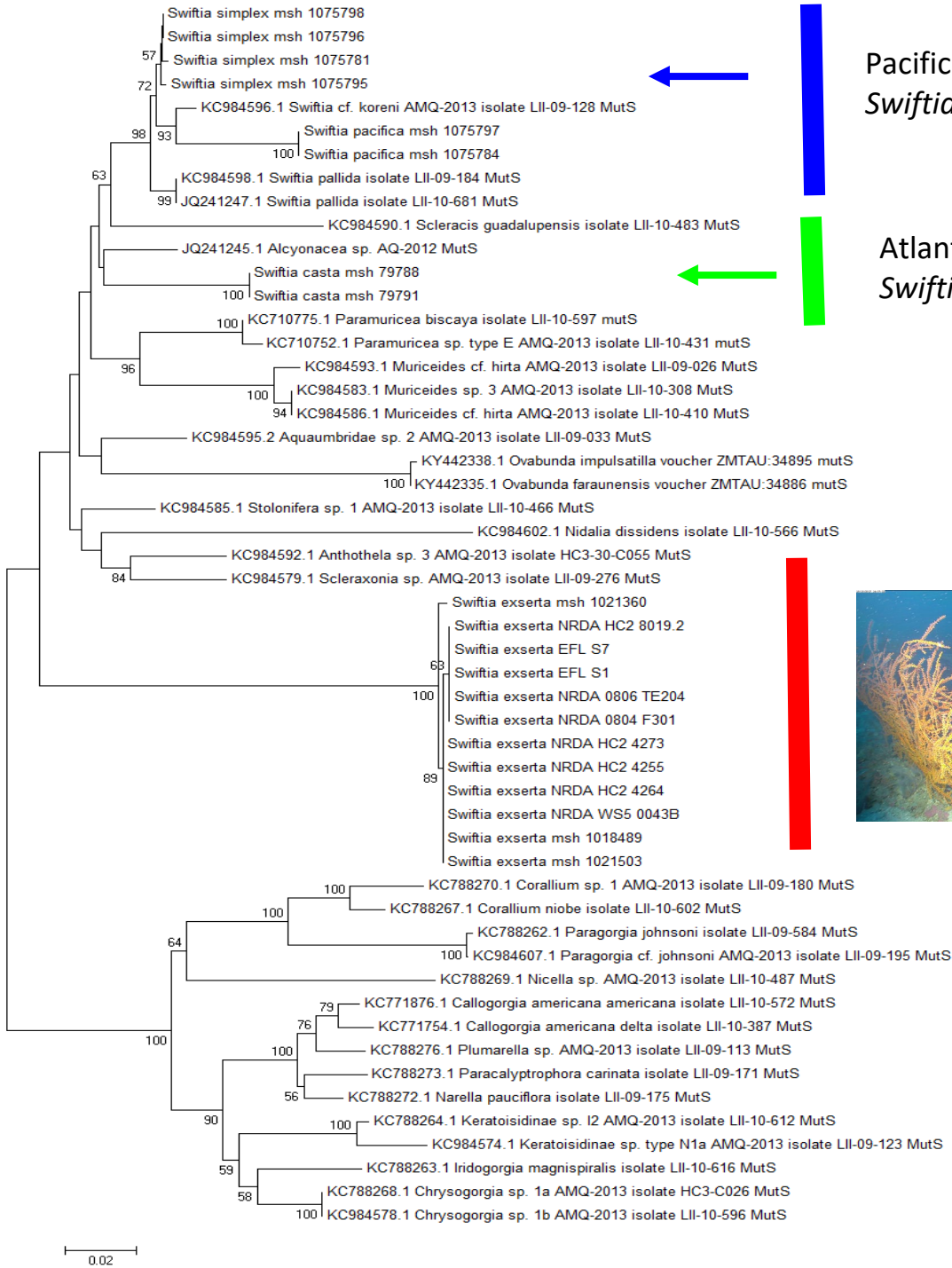
85%-15%

Swiftia exserta placement

S. exserta is highly derived

Swiftia is mostly likely a polyphyletic grouping.

Appear to be three clades of *Swiftia - S exserta, S casta, S pacifica/simplex*



Swiftia exserta

List of 19 valid *Swiftia* species in WoRMS

Year	Scientific name	Author	Region
1786	*Swiftia exserta**	(Ellis & Solander, 1786)	West Atlantic
1855	*Swiftia miniata*	(Valenciennes, 1855)	South Pacific Ocean
1883	*Swiftia casta*	(Verrill, 1883)	West Atlantic
1887	*Swiftia rosea*	(Grieg, 1887)	North Atlantic
1889	*Swiftia koreni*	(Studer, 1889)	West Atlantic
1909	*Swiftia kofoidi*	(Nutting, 1909)	North Pacific Ocean
1909	*Swiftia simplex*	(Nutting, 1909)	Northeast Pacific
1909	*Swiftia spauldingi*	(Nutting, 1909)	Northeast Pacific
1909	*Swiftia torreyi*	(Nutting, 1909)	Northeast Pacific
1910	*Swiftia sibogae*	(Nutting, 1910)	Northeast Pacific
1910	*Swiftia studeri*	(Nutting, 1910)	Northeast Pacific
1912	*Swiftia pacifica*	(Nutting, 1912)	Northeast Pacific
1919	*Swiftia africana*	(Kükenthal, 1919)	Unknown
1929	*Swiftia dubia*	(Thomson, 1929)	Mediterranean
1930	*Swiftia borealis*	(Kramp, 1930)	North Atlantic
1936	*Swiftia pourtalesii*	Deichmann, 1936	West Atlantic
1970	*Swiftia pallida*	Madsen, 1970	North Atlantic
2015	*Swiftia comauensis*	Breedy et al, 2015	Eastern Tropical Pacific
2016	*Swiftia farallonesica*	Williams & Breedy, 2016	Eastern Tropical Pacific

most of the early types have an Atlantic origin

( ) means history of revision & synonymy

Barcoding *Hypnogorgia*

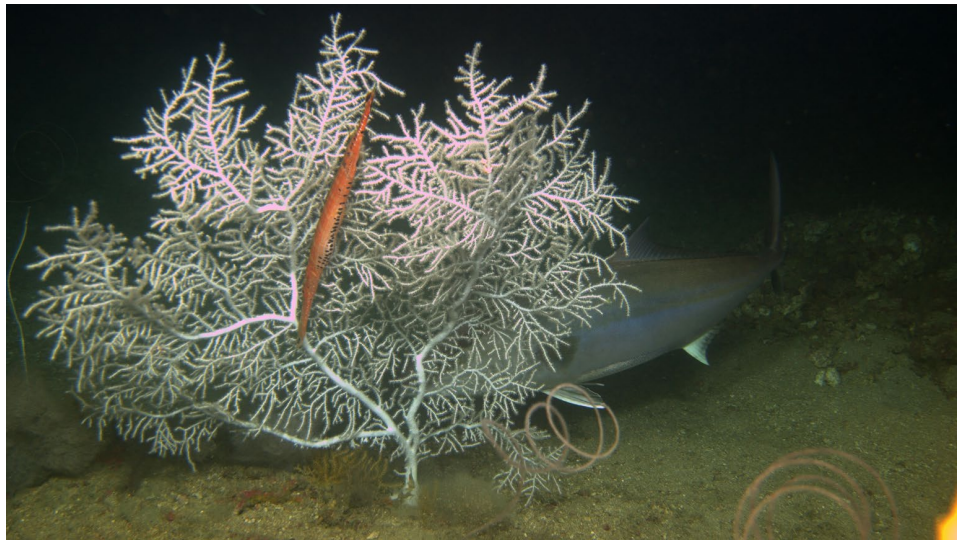
165 GoMx field samples identified as *Hypnogorgia pendula*

152 samples genetically coded to '*Hypnogorgia* sp' in Genbank

RESTORE *Muricea pendula* also barcoded to *Hypnogorgia*

However, GenBank sample is most likely *M. pendula*

No *Muricea pendula* in GenBank, until now



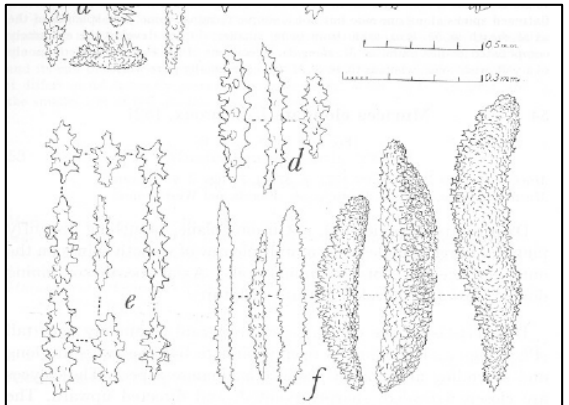
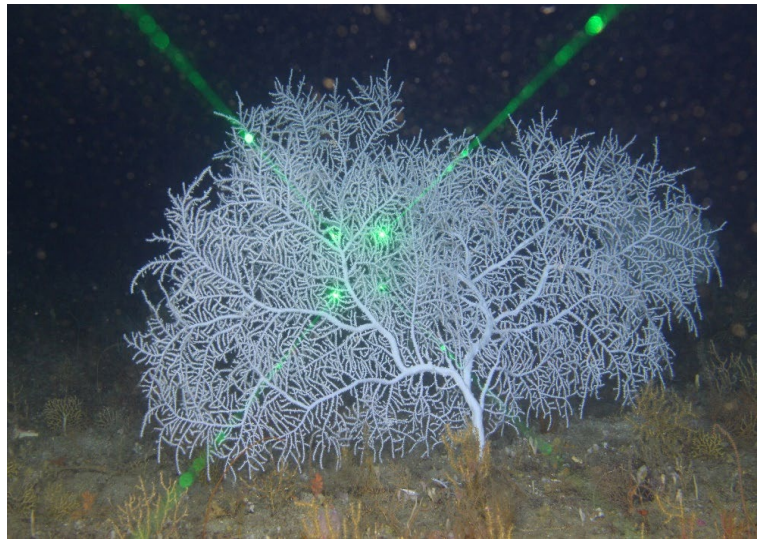
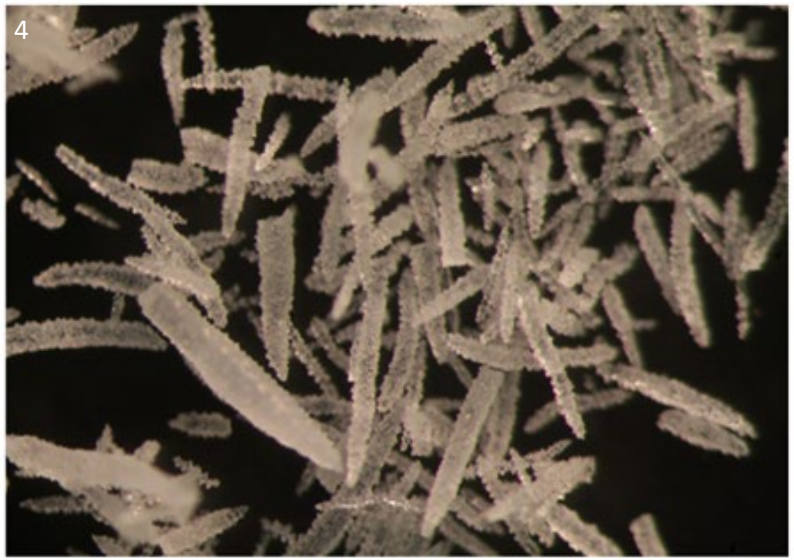


FIGURE 58. *Muricea elongata* Lamouroux, a specimen from Ragged Keys, Florida (USNM 50272): *a*, spicules of calycular walls and rind; *b*, spicules of axial sheath of terminal branch; *c*, spicules of axial sheath of main stem. *Muricea pendula* Verrill, a specimen from North Carolina (49748): *d*, spicules of axial sheath of terminal branchlet; *e*, spicules of axial sheath of main stem; *f*, spicules of calycular walls and rind. (Enlargement of *a* and *f* indicated by 0.5 mm. scale below *c*; that of *b–e* by 0.3 mm. scale at right of *d*.)

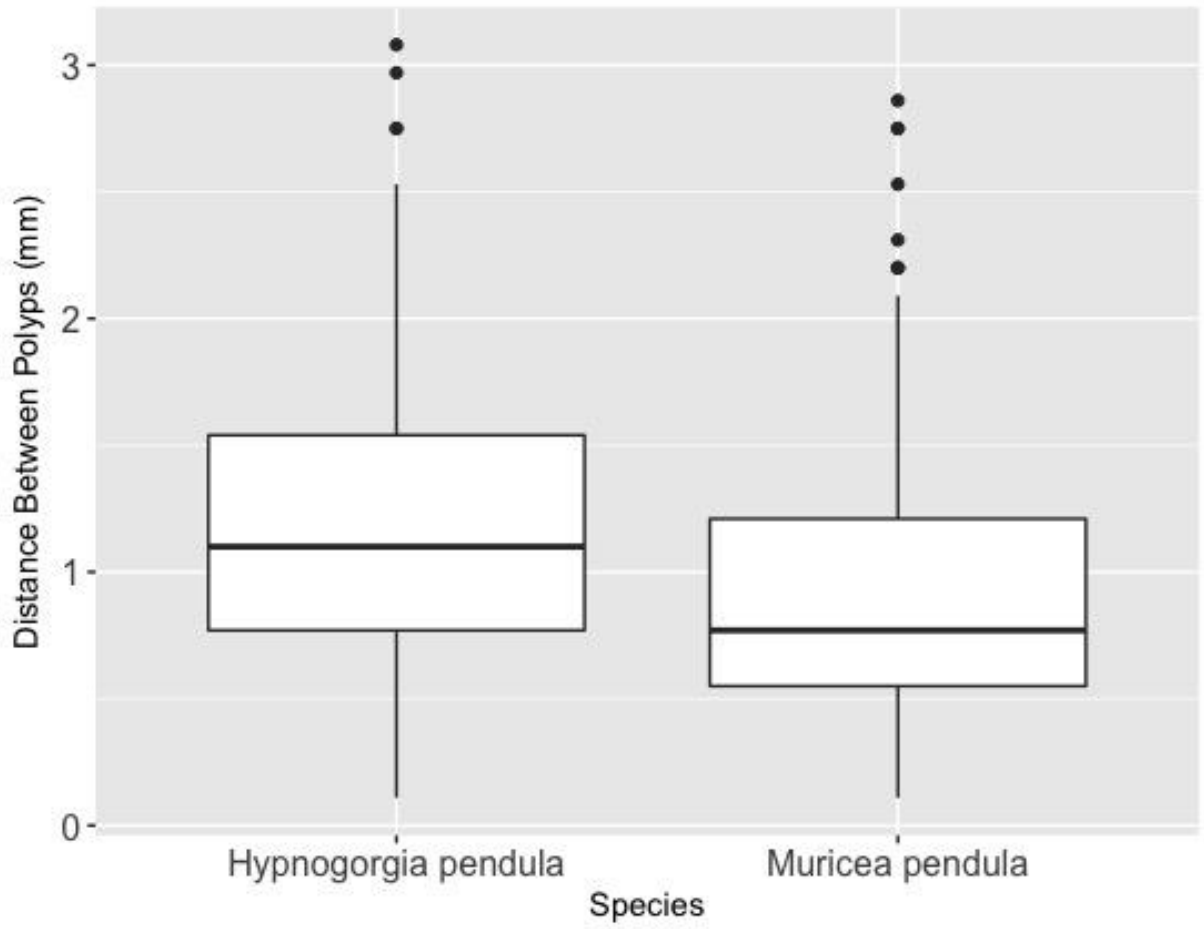


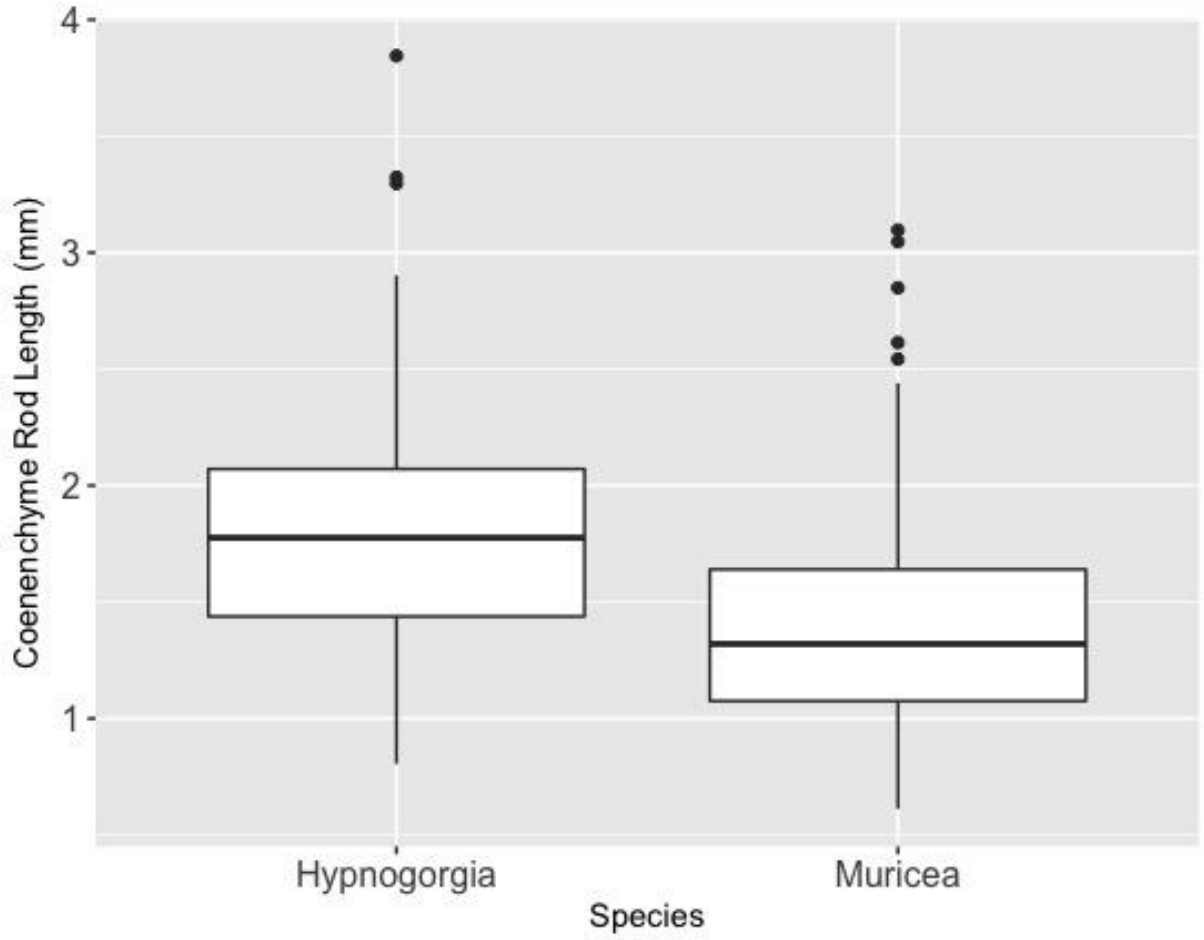
Muricea pendula *'Hypnogorgia' pendula*



Morphological comparison

C. Vill, unpublished data

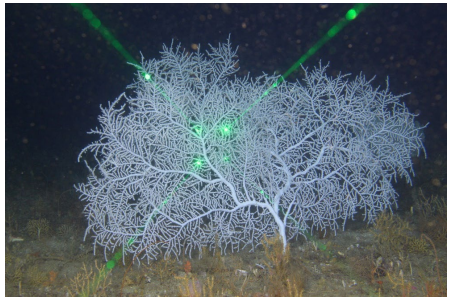




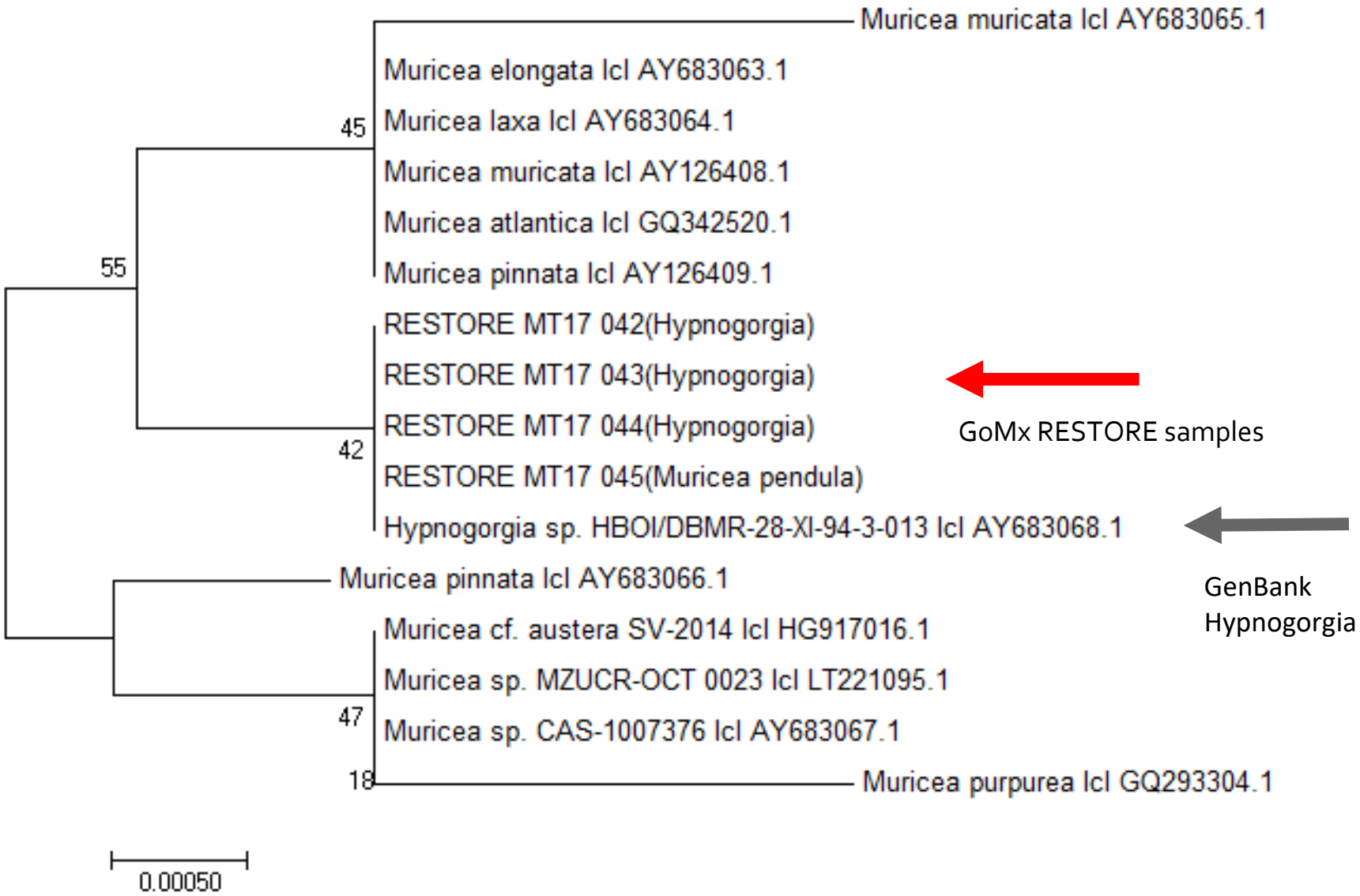
Sample size was n = 10 colonies of each taxa. Three polyps sampled per colony.
No significant difference in distance between polyps, nor coenenchymal rod length (ANOVA, $p > 0.05$).
Bayer's 1981 key invoked polyp spacing and max length of coenenchymal rods to distinguish these taxa

Muricea phylogeny (573 bp mutS, midpoint rooted tree)

Muricea pendula

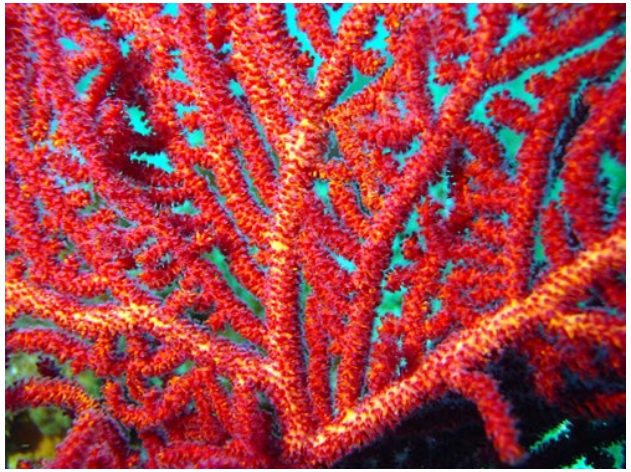


'Hypnogorgia'

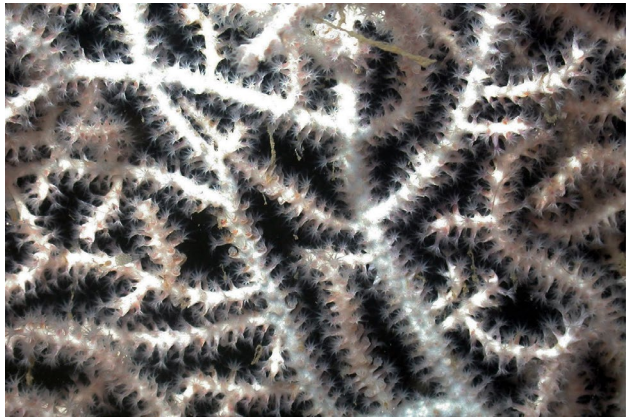


Synonymy is consistent with Wirshing et al 2005. Mar Biol.

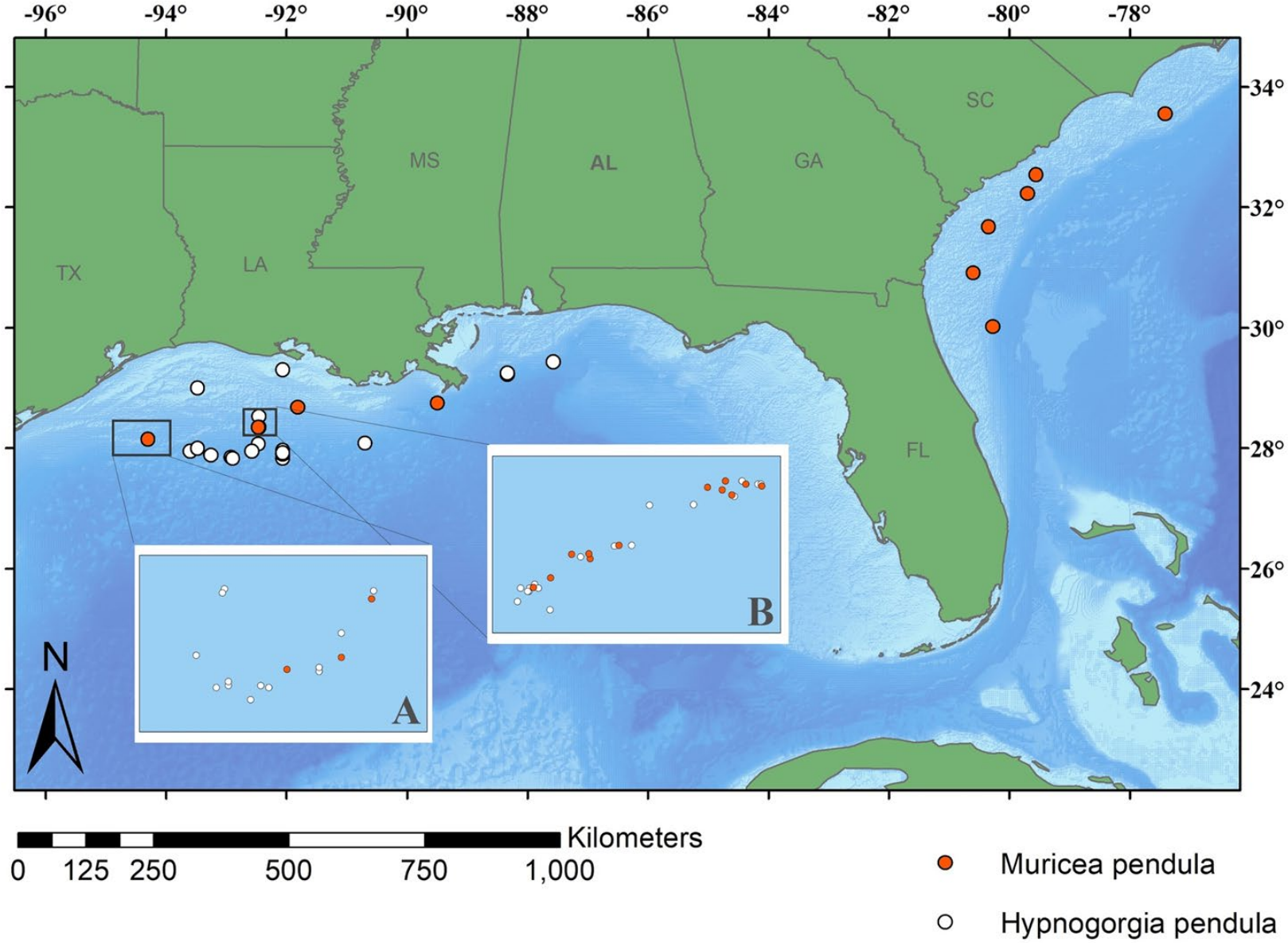
Muricea & '*Hypnogorgia*' samples in-hand



Muricea pendula



'*Hypnogorgia*' *pendula*



Conclusions:

To restore genetic diversity of octocorals injured by DWH, systematics of octocorals are an important first step.

Molecular barcodes are a necessity for octocoral taxonomy, vouchers, video annotation, e-DNA studies, and more

GenBank and other **federal databases need investment** and review.

Much to do. *Placogorgia, Paramuricea, Muriceides,* and *Thesea* need work. Black corals (*Antipathes* and *Stichopathes*) also need work.

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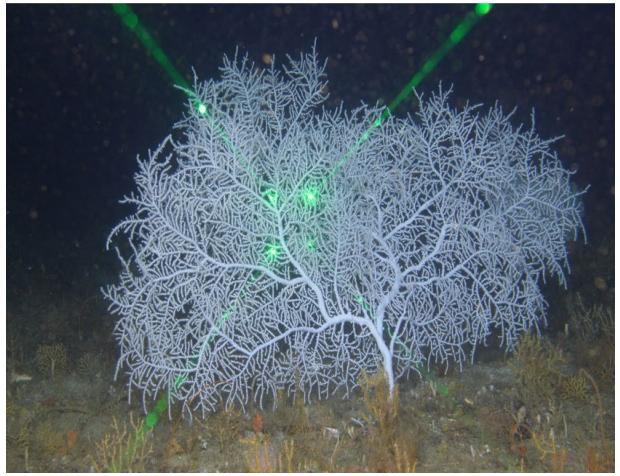
Jason White, Eric Glidden, Lance Horn

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