

What is “Active Reef Restoration”?

- Oceanographer Baruch Rinkovitch coined the term “Active Reef Restoration” in 2005
- The scientific discipline of active restoration has drawn much attention as it became evident that this ecosystem does not often recover naturally from anthropogenic stress without manipulation.
- Essentially, the choices are either the continuous degradation of the reefs or active restoration to encourage reef development.
- As a result, worldwide restoration operations during the past decade have been recognized as being a major tool for reef rehabilitation.

Historically

- One of the first serious attempts at propagating coral ex situ occurred at the Nouméa Aquarium in 1956.
- At the time it was common for aquarium hobbyists in Germany to create home "mini-reefs".
- Commercial coral propagation began in America in the 1960s but the demand in the hobby industry did not really take off until the early 1980s.

Is it Feasible?

- Worldwide, thousands of Hobbyists have successfully propagated their own reef tanks with fragmented corals for 25 years.
- Marine ornamental companies have cultured corals for the industry (ORA in Florida-100,000 fragments by 2001)
- Now 80 certified coral culturists in Florida alone
- World-wide now hundreds of sponsored restoration projects sites in the field

I *Acropora* Corals

Staghorn Coral



Elkhorn Coral



Branching coral culture was first done in the Caribbean in the mid 90's by Dr. Austin Bowden-Kirby, Ken Nedimyer a sealife collector, and the Coral Restoration Foundation was the first and largest in Florida and by far the most well known culturing of staghorn corals in the field

http://www.youtube.com/watch?feature=player_detailpage&v=KiPnzx5JsY0

Molasses Reef, August 2011



Worlds Largest Coral Restoration program

NOAA-TNC staghorn Restoration with many partners



Threatened Coral Recovery in Florida and the U.S.V.I.

Nursery

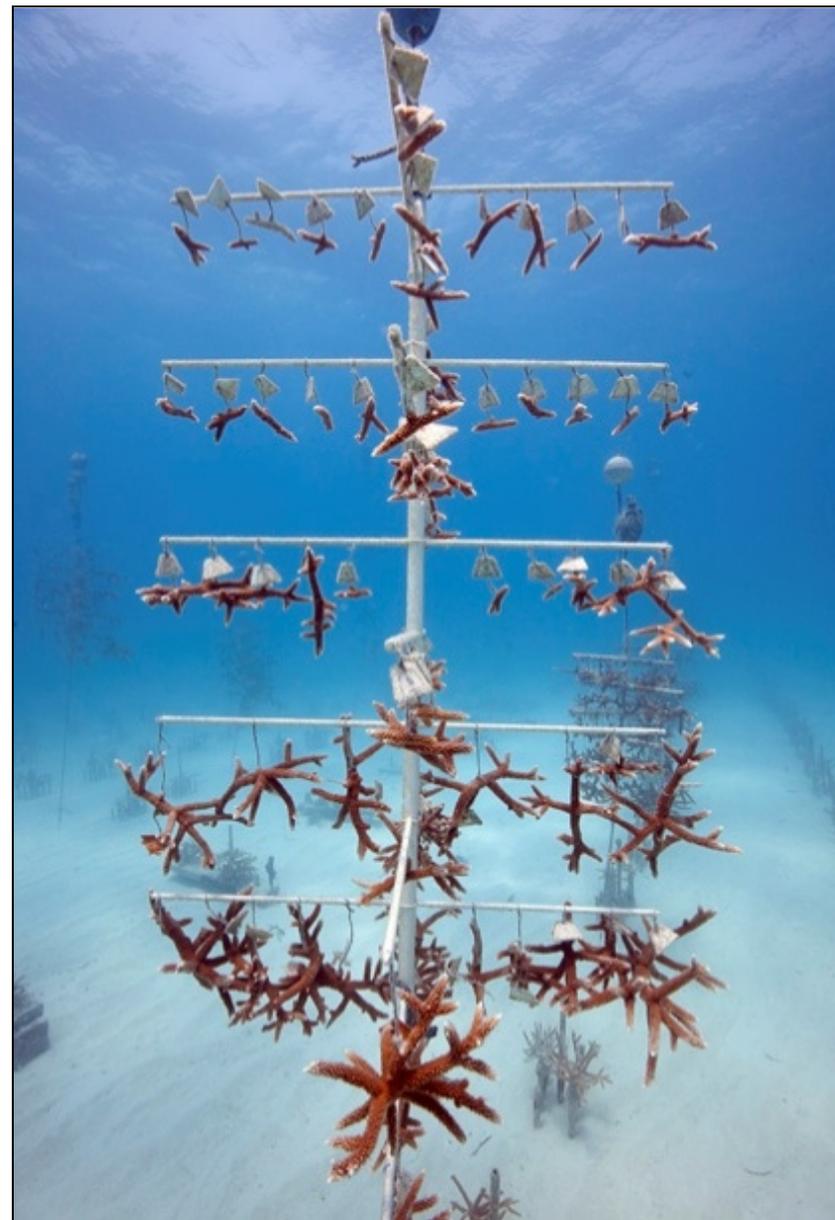


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Prepared by J. E. Knowles
Data
FL Counties (FGDL)
Zones (RSMAS/TNC)
Shoreline (ESRI)
Parks (FNAI)

Partners collect from diverse, **wild** colonies...



Grow them in coral nurseries...



Outplant Monitoring

- Quarterly measurements and cleaning over 7 months



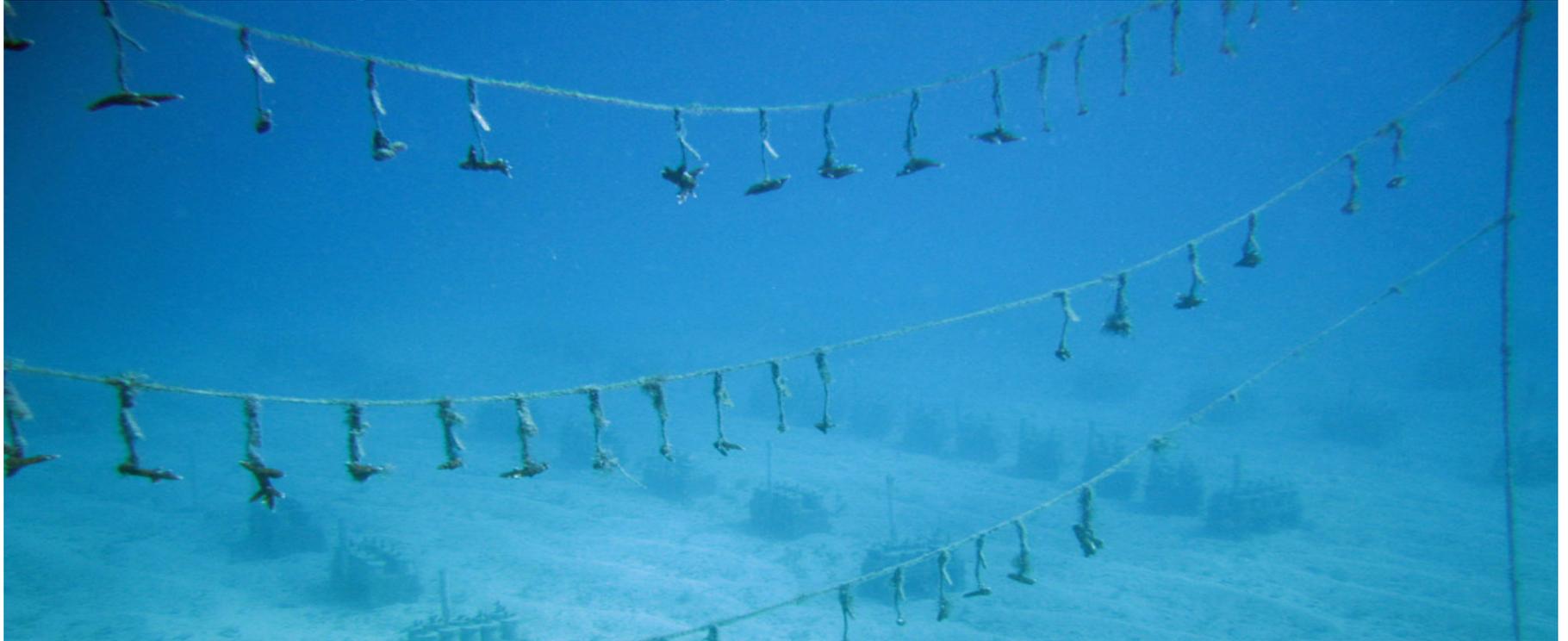
Six of 300 Coral Trees



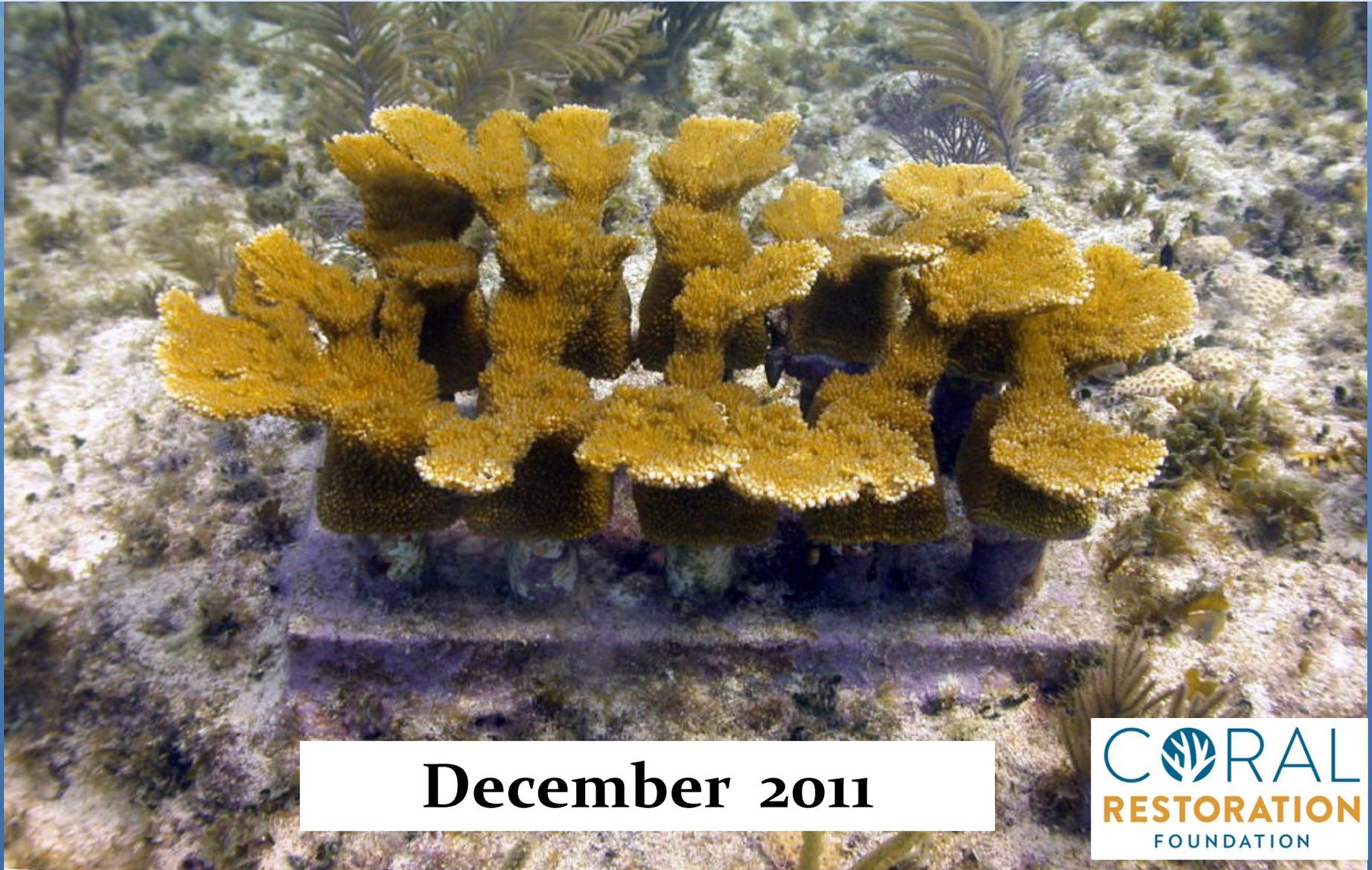
In 2012 the project restored more than 5,000 corals at 34 reefs in Florida, with thousand still to out-plant



NOAA-TNC Staghorn Nursery Lower Keys- Mote Marine Lab approx.- 5,000 colonies



A. Palmata Two Year old frags



December 2011

1,200+ second generation corals

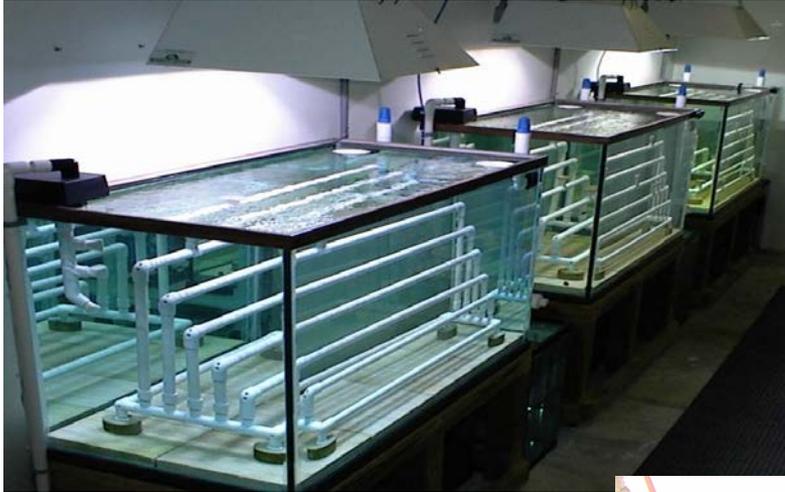


Other Corals from Truman Annex (2005)

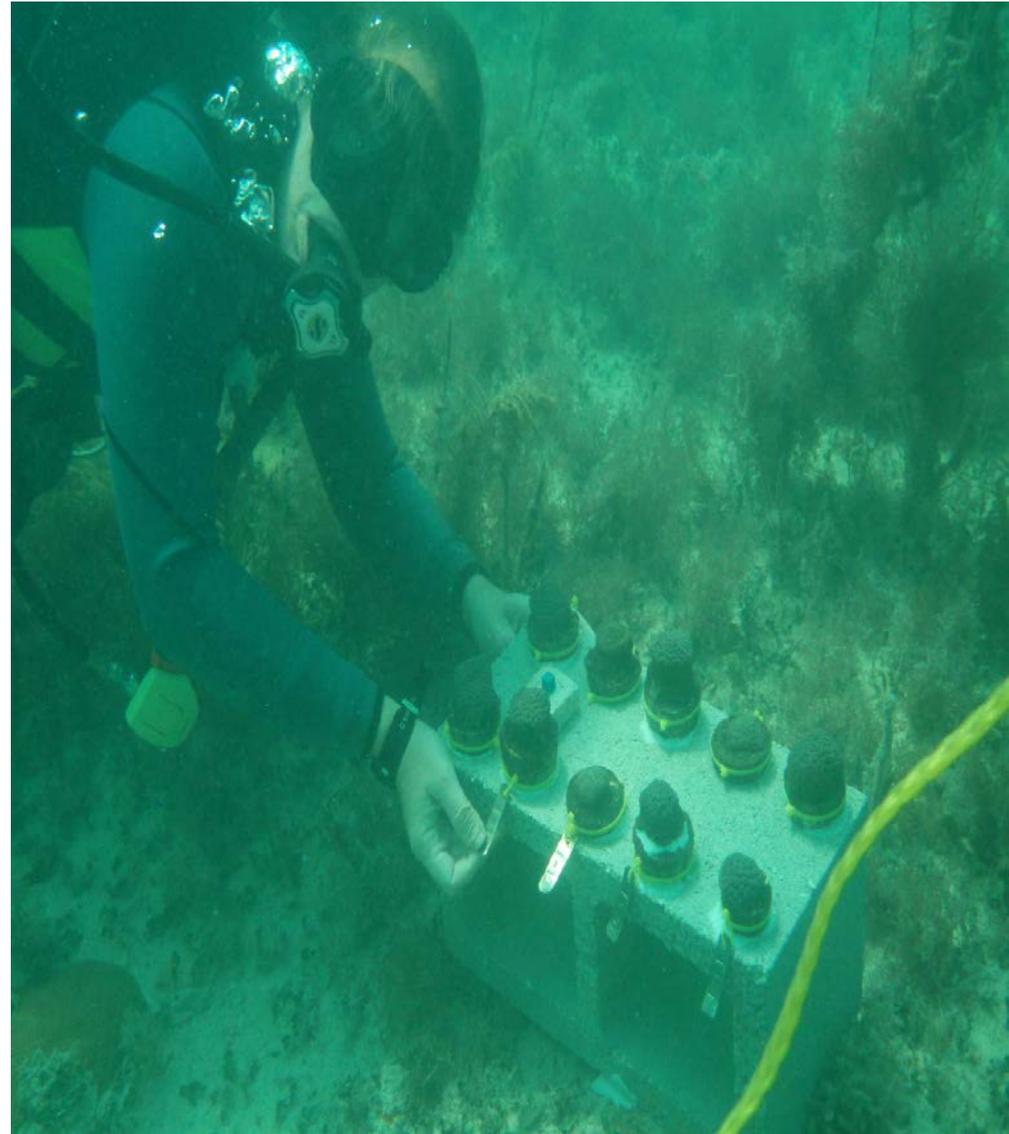
(Coral Reef Foundation, U of F, Florida
Aquarium and Mote Marine Lab)



Objective: Maintain & Monitor Survival of Corals in Seed Bank indoors and outdoors

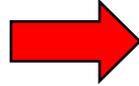


Tagged and transplanted to field 90% survival



Expanded Production

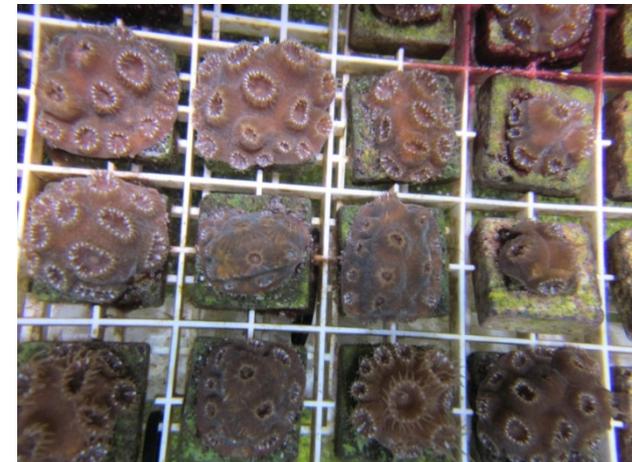
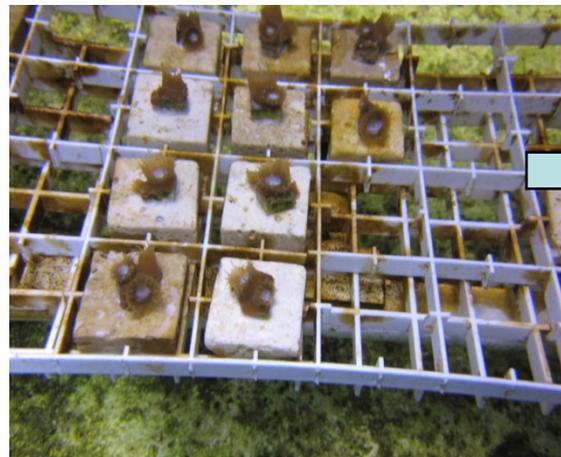
- Major paradigm shift occurring at Mote-TRL
 - Shift from large fragments to microfragments
- Significance of changes
 - Optimize growth and increase the rate of production
 - Allows coral to integrate with dead reef structure much faster upon outplant



“Reskinning” bare reef structure

- Designed to carry out restoration of stony corals at a much larger scale

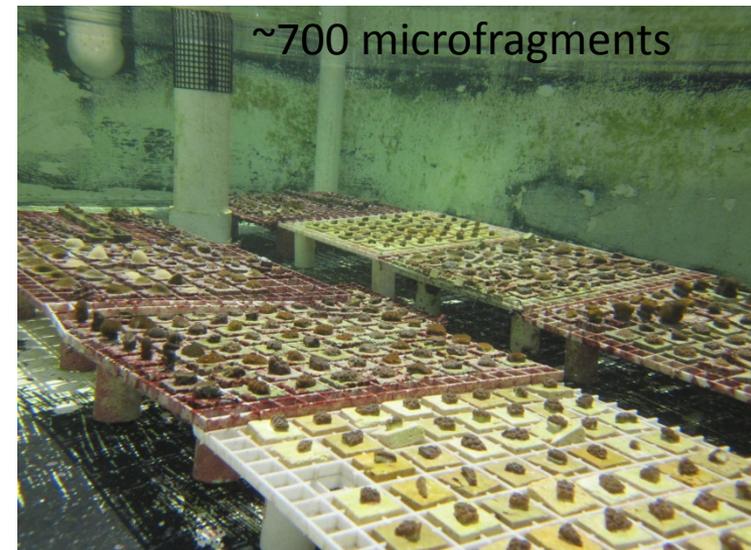
Address Cold event
A. palmata

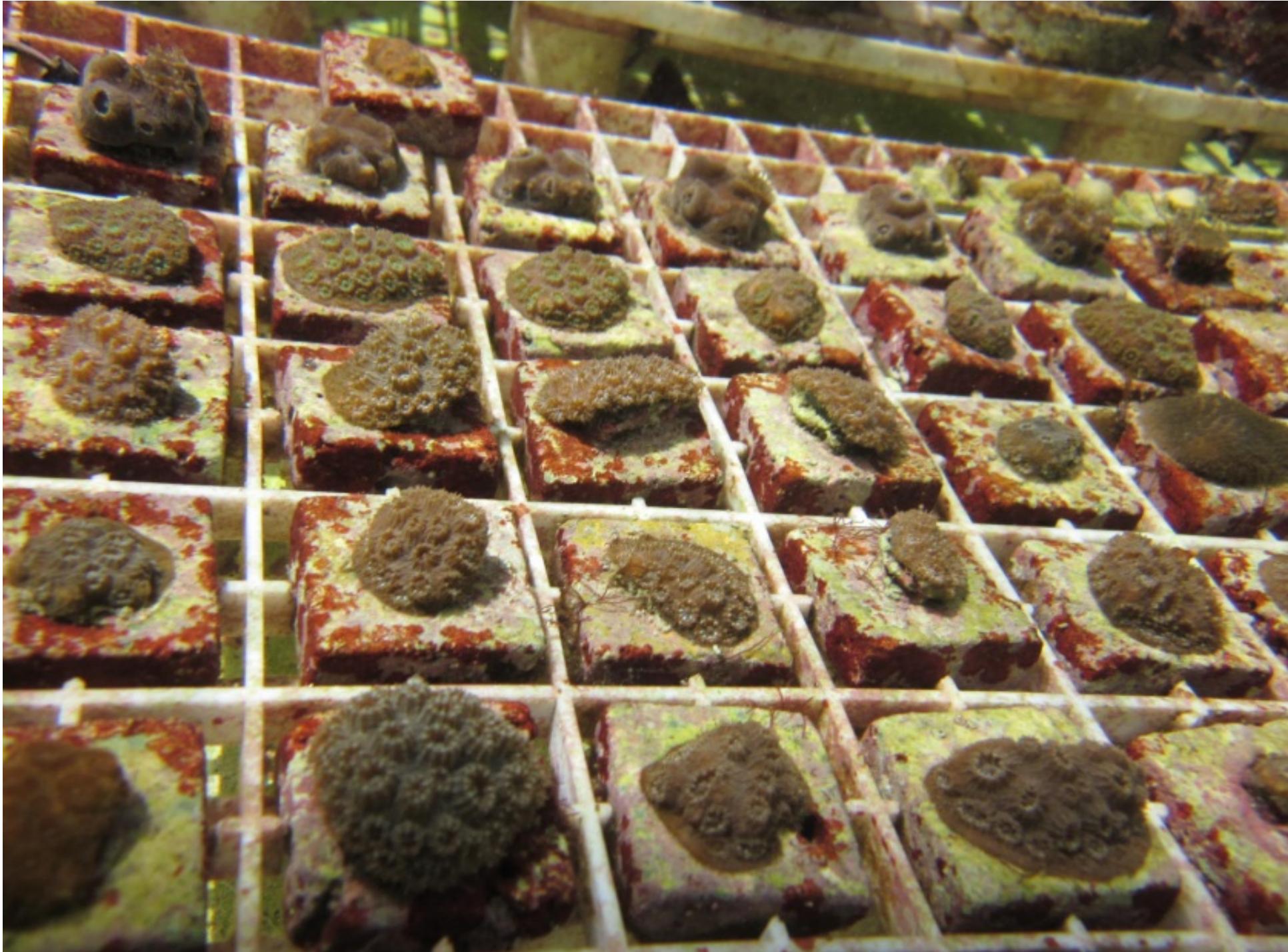


Land Based Coral Culture Inventory

Land Based Coral Inventory (13 species)

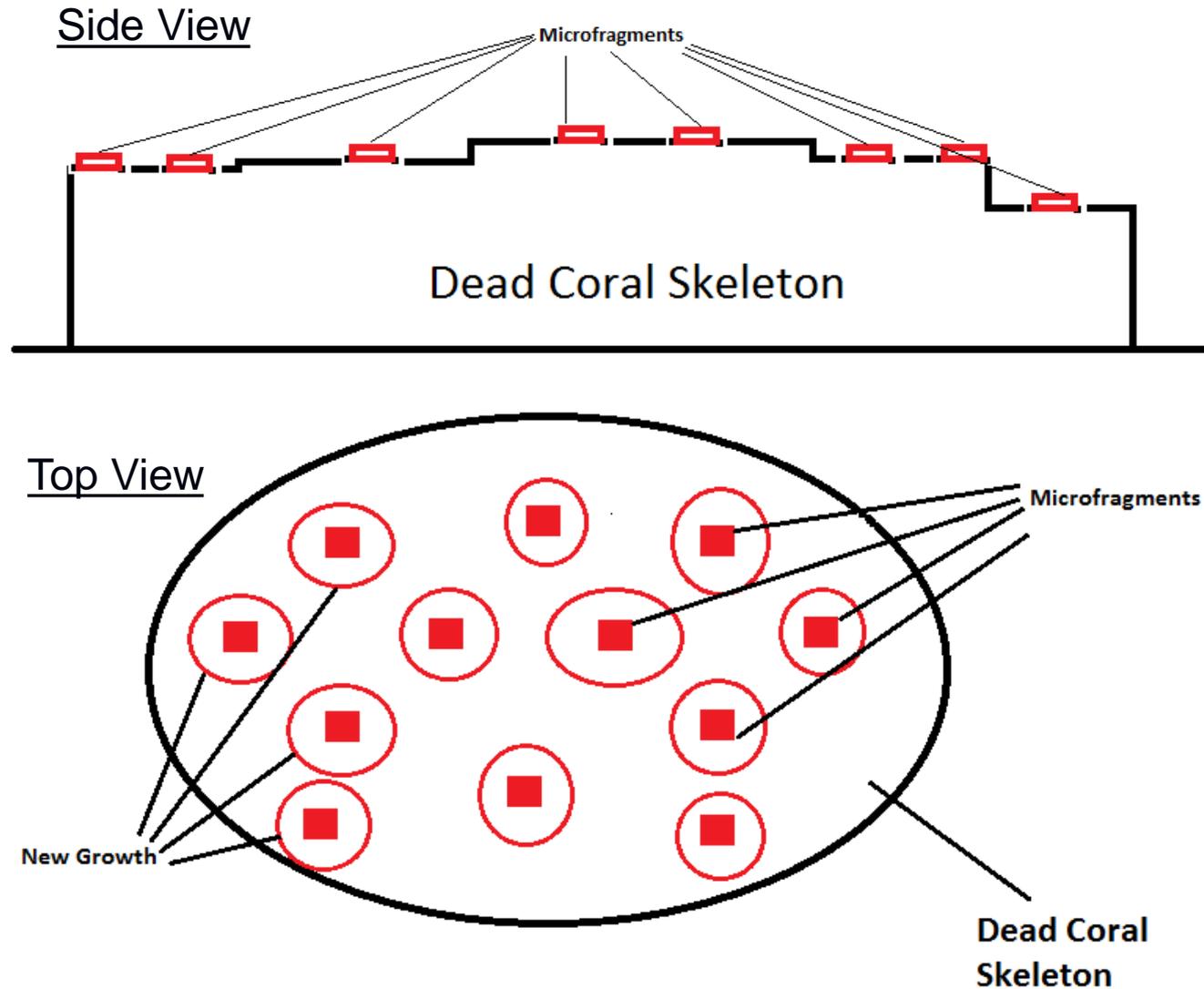
	colonies	microfragments	Total
<i>M. annularis/faveolata</i>	189	424	613
<i>Montastrea cavernosa</i>	124	159	283
<i>Stephanoceonia intersepta</i>	43	9	52
<i>Siderastrea siderea</i>	30	12	42
<i>Oculina robusta</i>	91	5	96
<i>Oculina diffusa</i>	53	0	53
<i>Diploria strigosa</i>	50	8	58
<i>Dichoceonia stokesi</i>	10	0	10
<i>Solenastrea hyades</i>	21	17	38
<i>Porites porites</i>	4	20	24
<i>Porites astreoides</i>	12	39	51
<i>Colpophyllia natans</i>	11	0	11
<i>Eusmilia fastigiata</i>	5	5	10
Total	643	698	1341





Next phase/Future Work

The “reskinning” of reef building coral skeleton:
A novel Approach in
Response to Mass
Mortality and
Increasingly Acidic
Conditions



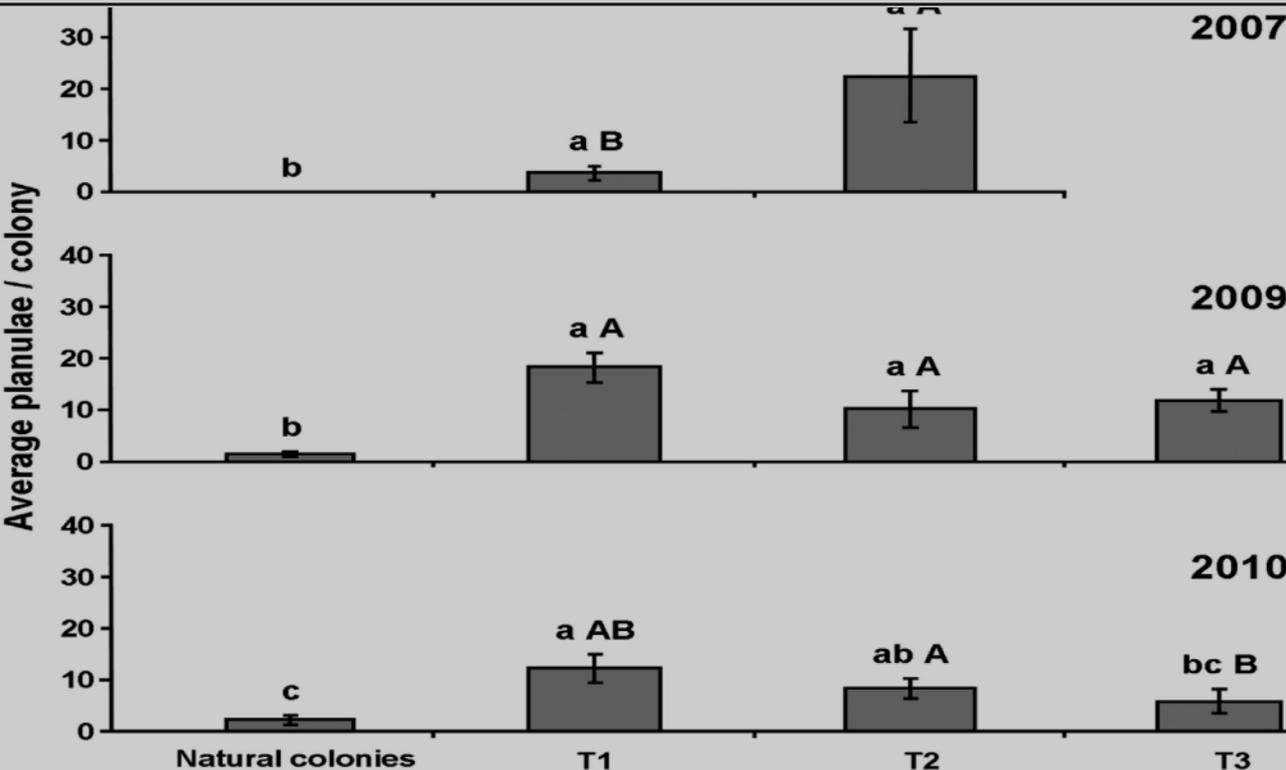
Striking Difference and more reproductive potential!



Transplanted Stylophora colonies release significantly more larvae than natal colonies, now, at least for 8 years following transplantation

Year	Sampled months	Colonies	Colony diameter (cm)	Reef dwelling period (years)	Colonies examined (n)	Planulae-releasing colonies (%)	Planulae collected	
							Total (n)	Range/colony
2007	June	Natal	6-9	3-5	10	0	0	0
		T1	8-9	1.5	10	80	37	0-15
		T2	6-7	0.15	10	100	225	1-96
2009	May-June	Natal	8-24	4-12	40	32	57	0-17
		T1	22-24	3.5	15	93	275	0-46
		T2	10-14	2.15	15	100	153	2-55
		T3	8-11	0.67	14	100	164	1-28
2010	April-May	Natal	9-24	5-12	19	47	41	0-17
		T1	22-24	4.5	18	100	216	1-42
		T2	10-16	3.15	18	89	148	0-29
		T3	9-14	1.67	18	89	103	0-45

Horoszowski-Fridman et al. 2011. J Exp Mar Biol Ecol 399, 162-166



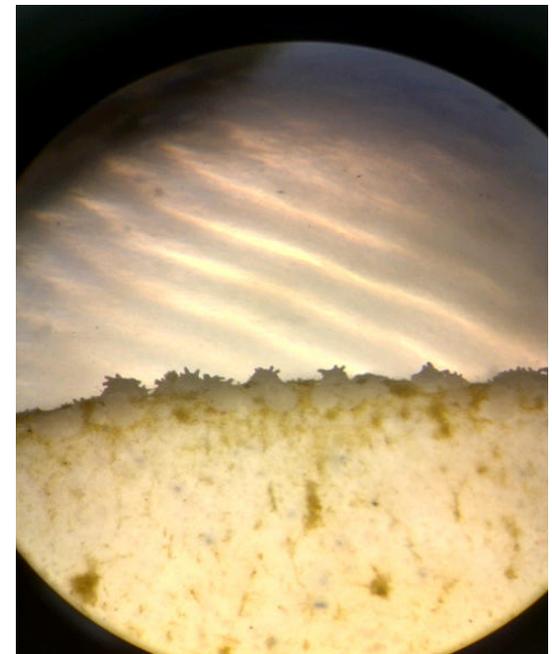
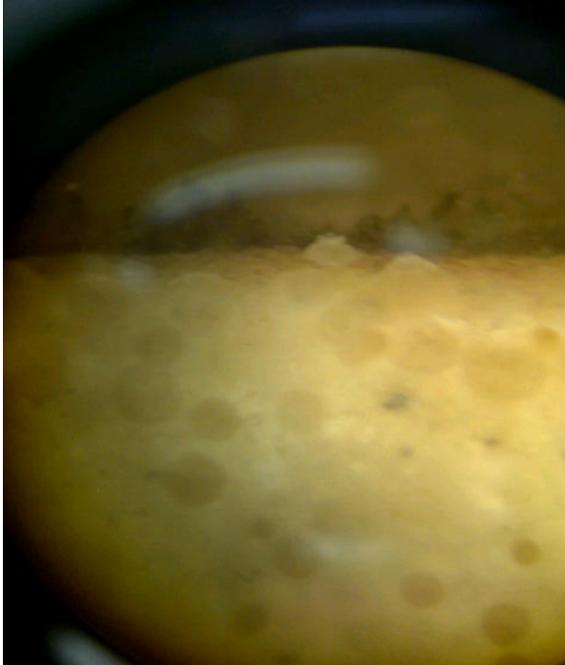
Transplanted reef

Coral Spawning and gamete

collection
settled
in
Tanks

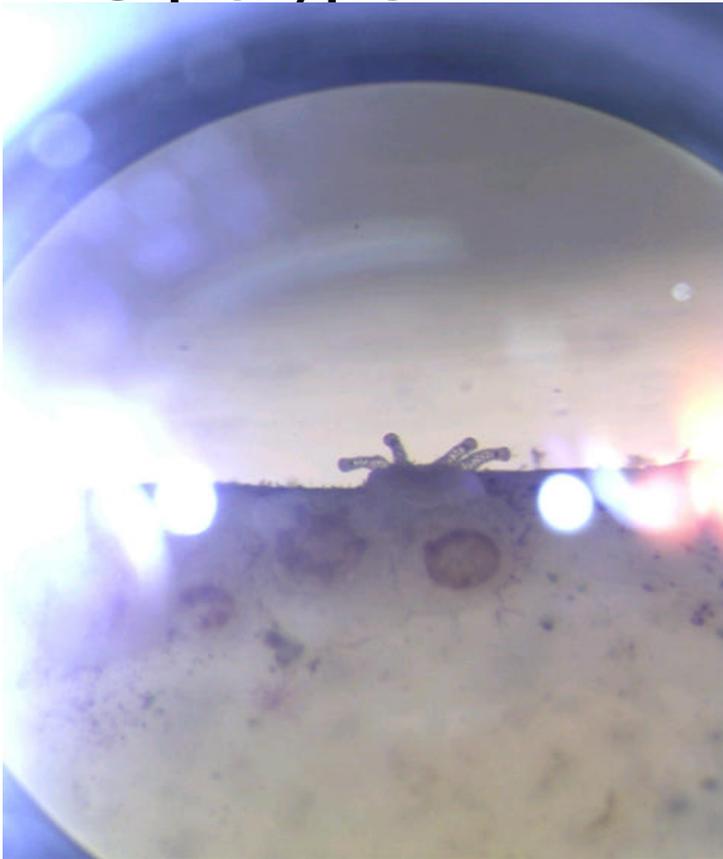


Larvae
Attached
To
Substrate

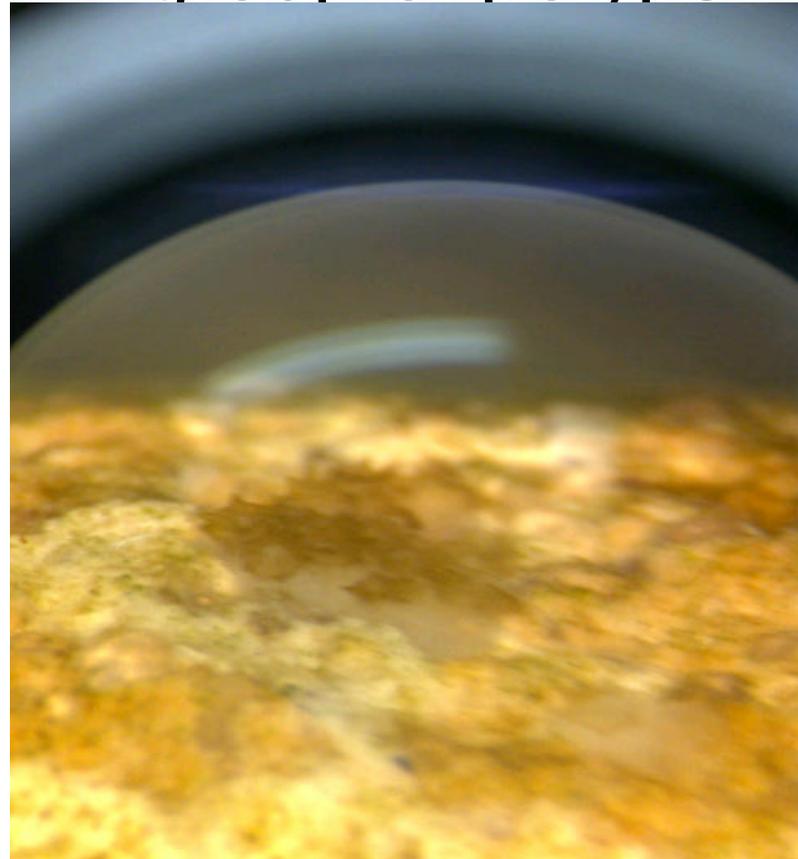


3-10 weeks from settlement

- 3 polyps



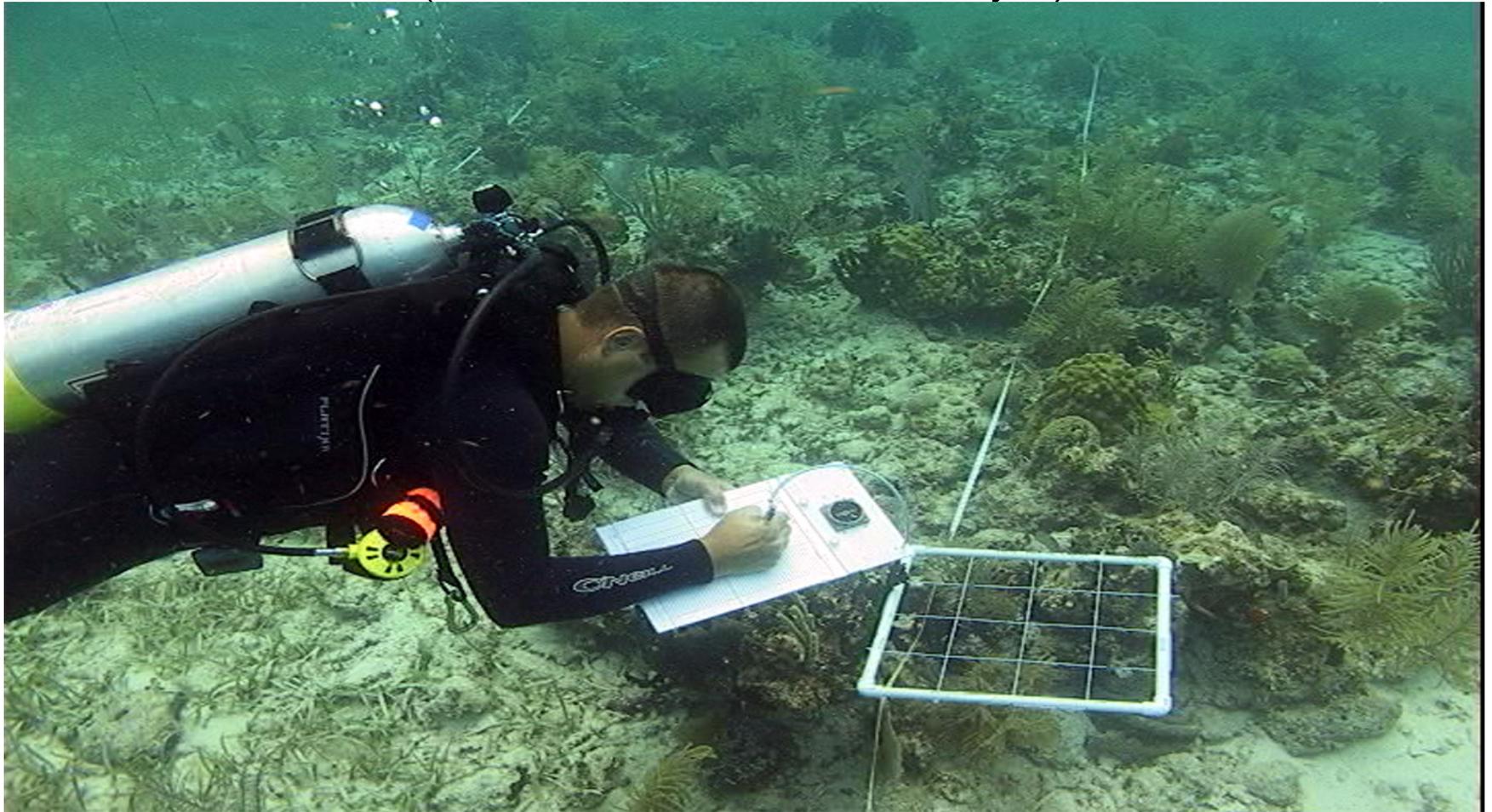
group of polyps



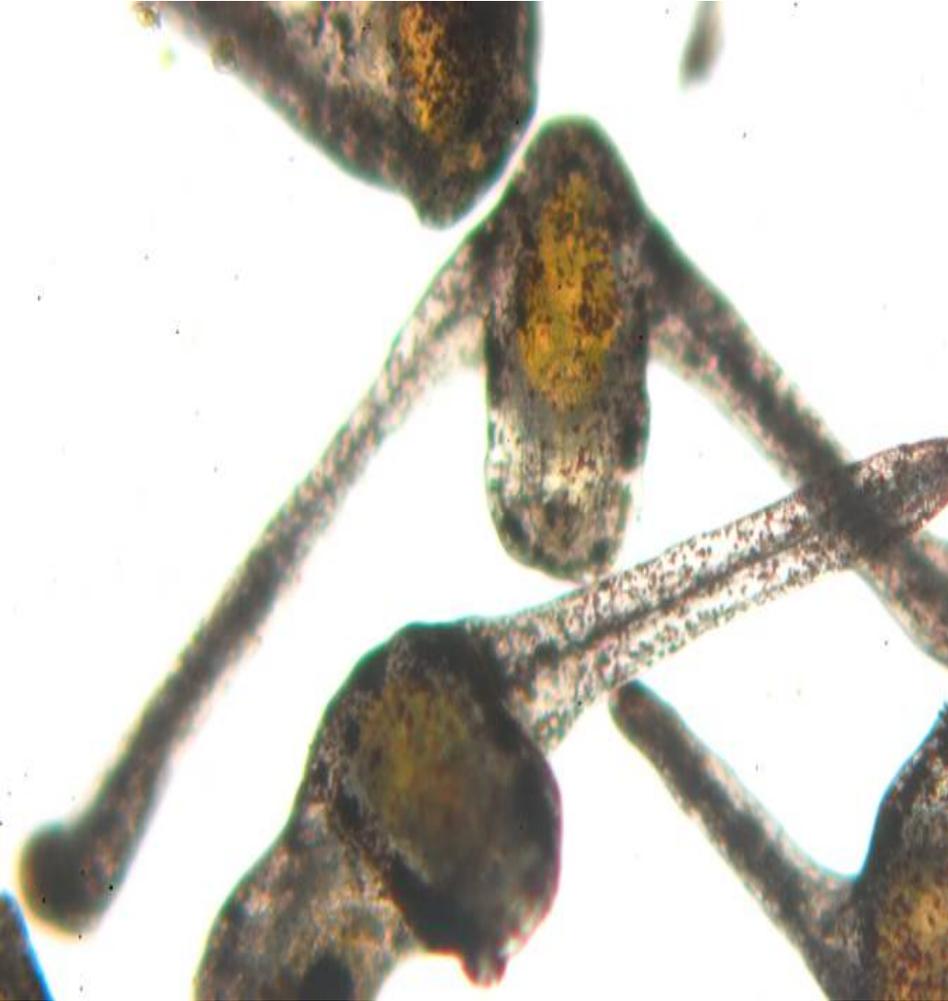
Other candidates

Diadema Field Trials

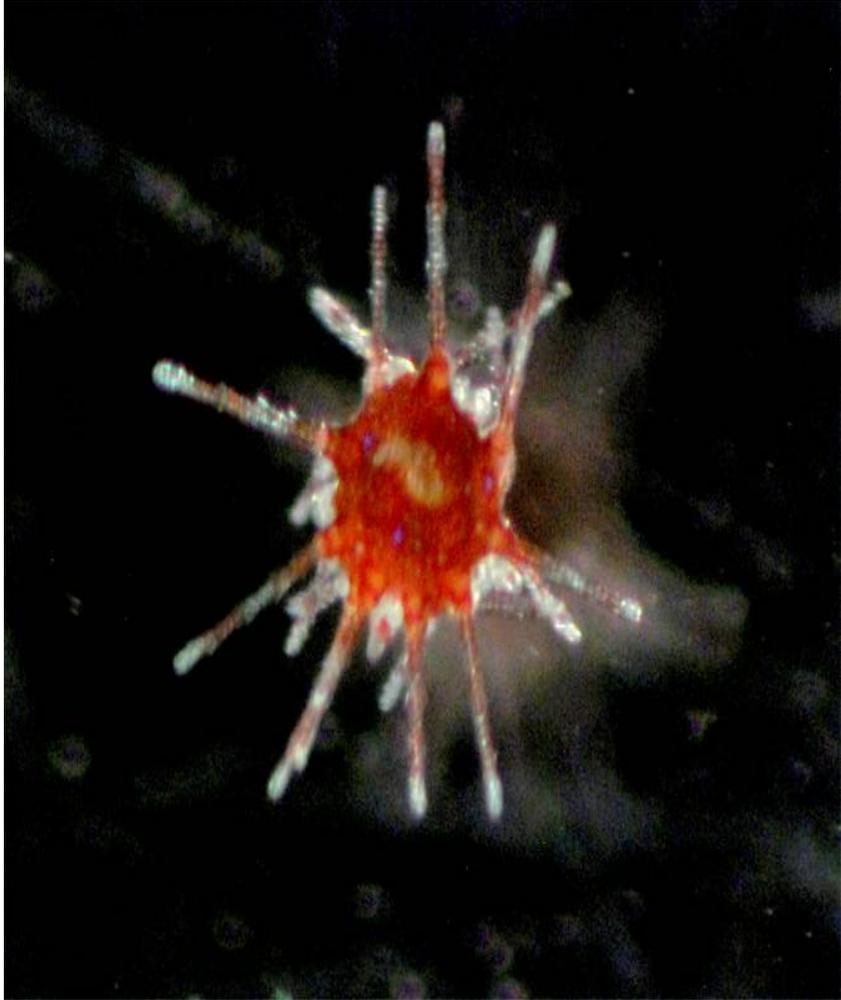
(Martin Moe and Ken Nedimyer)



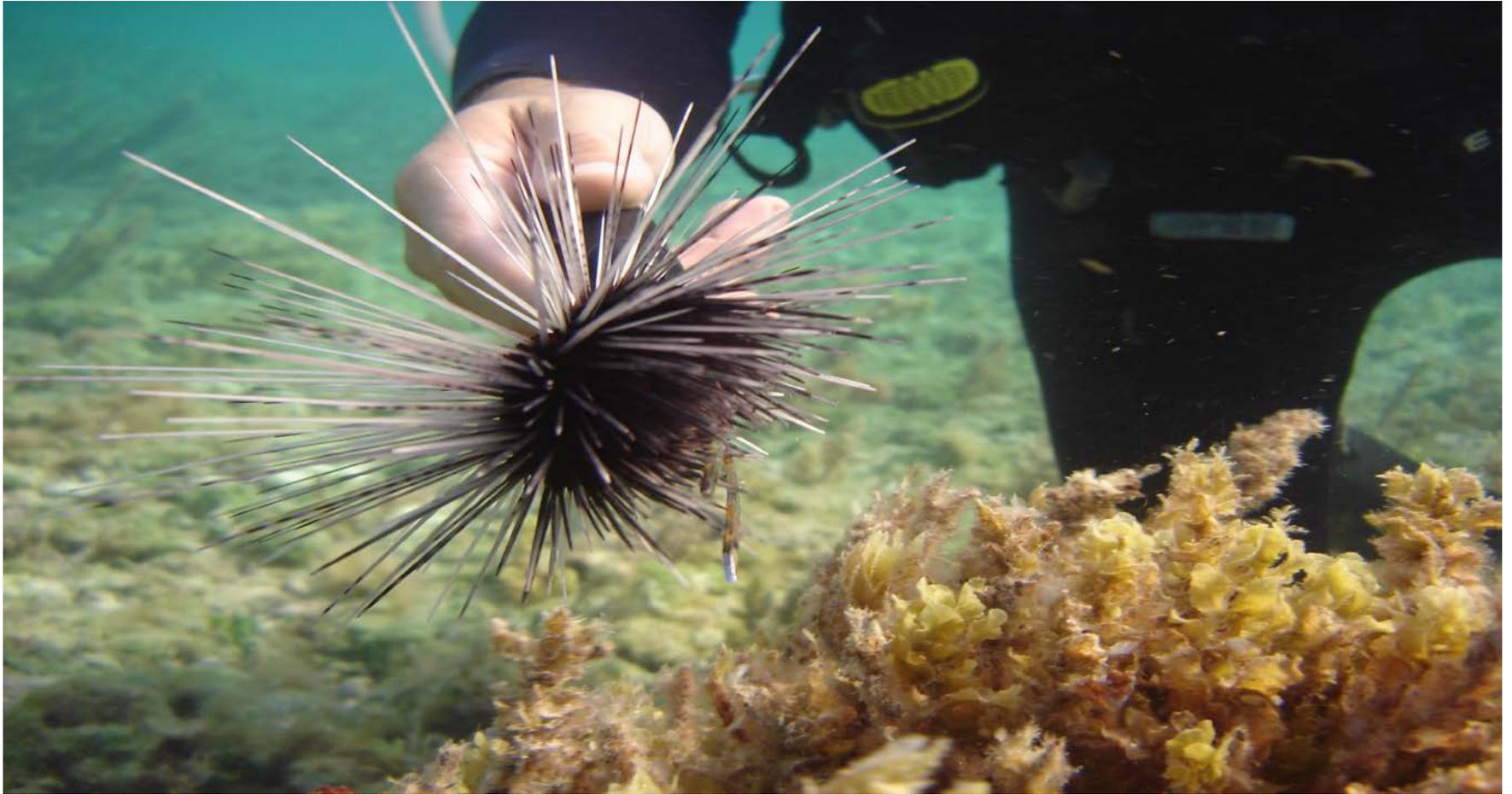
Diadema Larvae



Juvenile



Can we restore the keystone herbivores? (Yes, with future support and R+D)



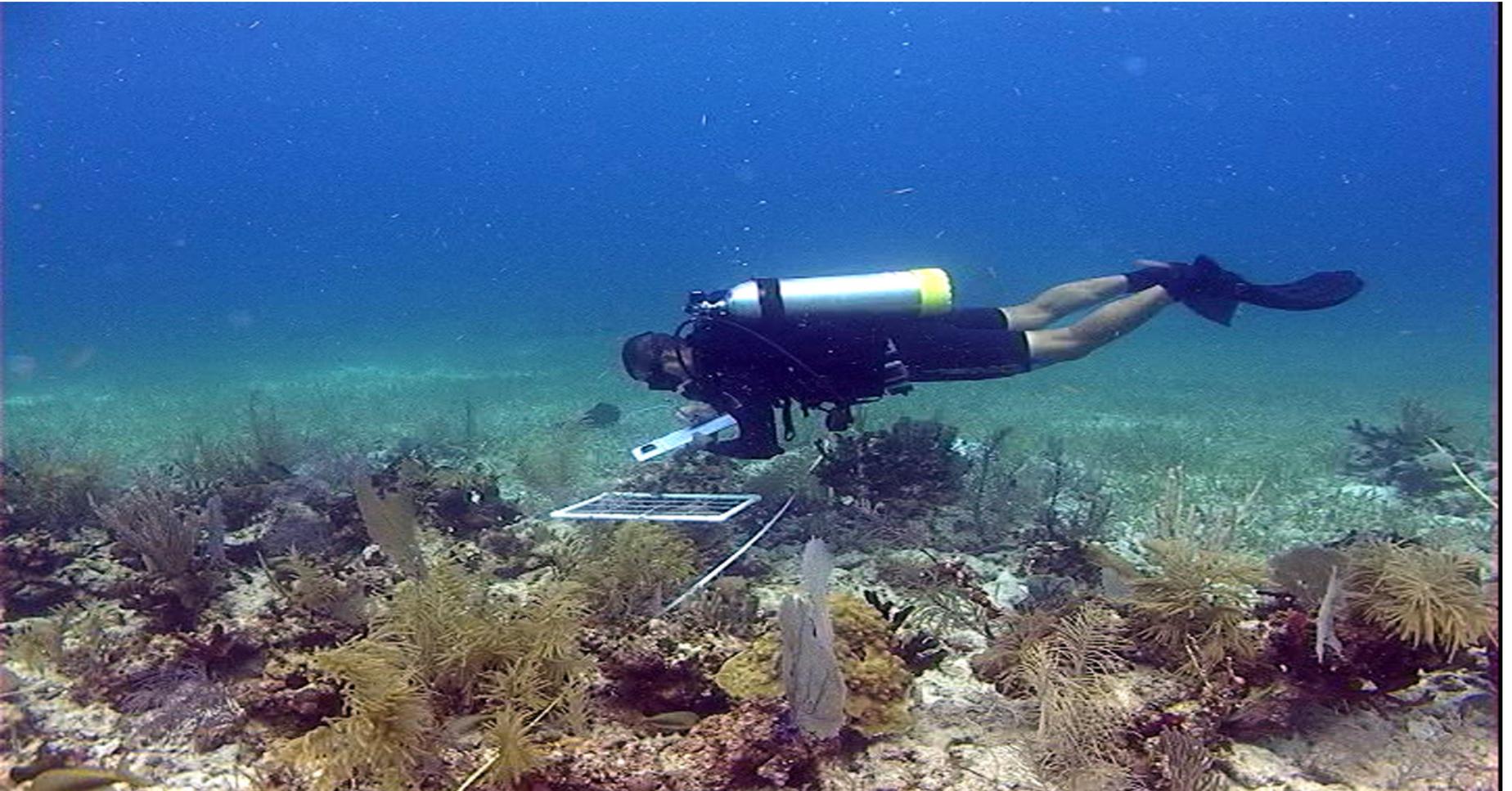
Can Coral Restoration be successful for branching corals?
YES IT CAN!



Can we restore other species of hard corals? Yes we can



Can we restore the coral reef habitat? Yes We Can!!



And restore breeding colonies to degraded reefs.

