RESTORATION OF GORGONIAN POPULATIONS

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October 5, 2006

GORGONIANS (SOFT CORALS, OCTOCORALS)

- Threatened by hurricanes, disease, bleaching, ship groundings, etc.

- Represent an aesthetic & recreational resource.

- Source of pharmaceutical compounds.

- Provide “physical structure” to Caribbean coral reef systems.

  The physical structure of gorgonians serves as:

  - critical habitats for fish
  - substrate for epibiotic organisms (sponges, molluscs, etc.)
  - cover (hiding places) for prey species
  - settlement sites of fish, etc.

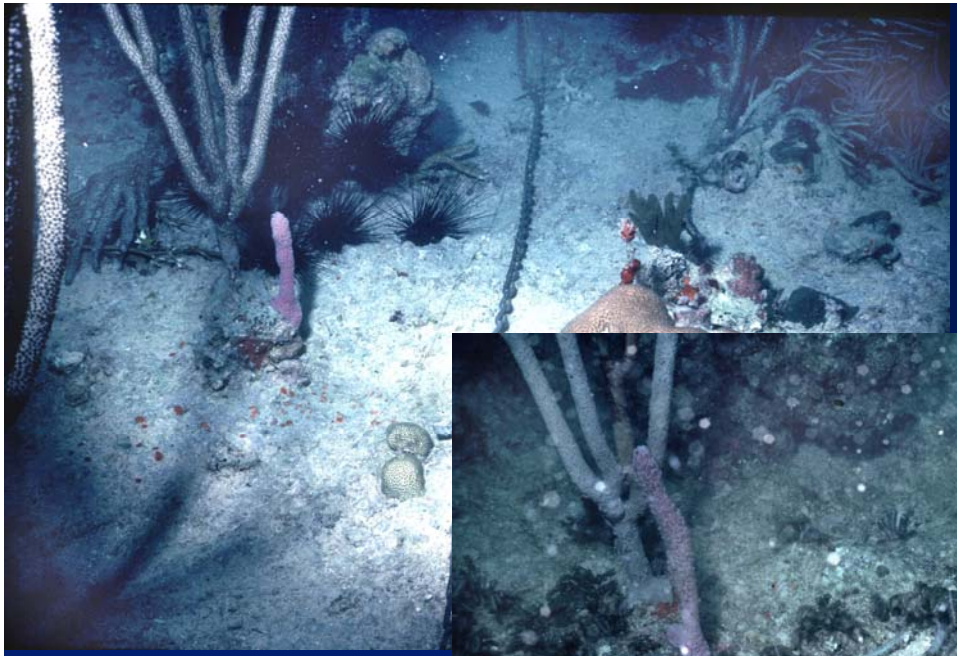
RESEARCH STRATEGY

Use the results of a long-term (1983-present) monitoring study identifying the life cycle stages responsible for the "bottleneck" and "stability" of gorgonians populations.

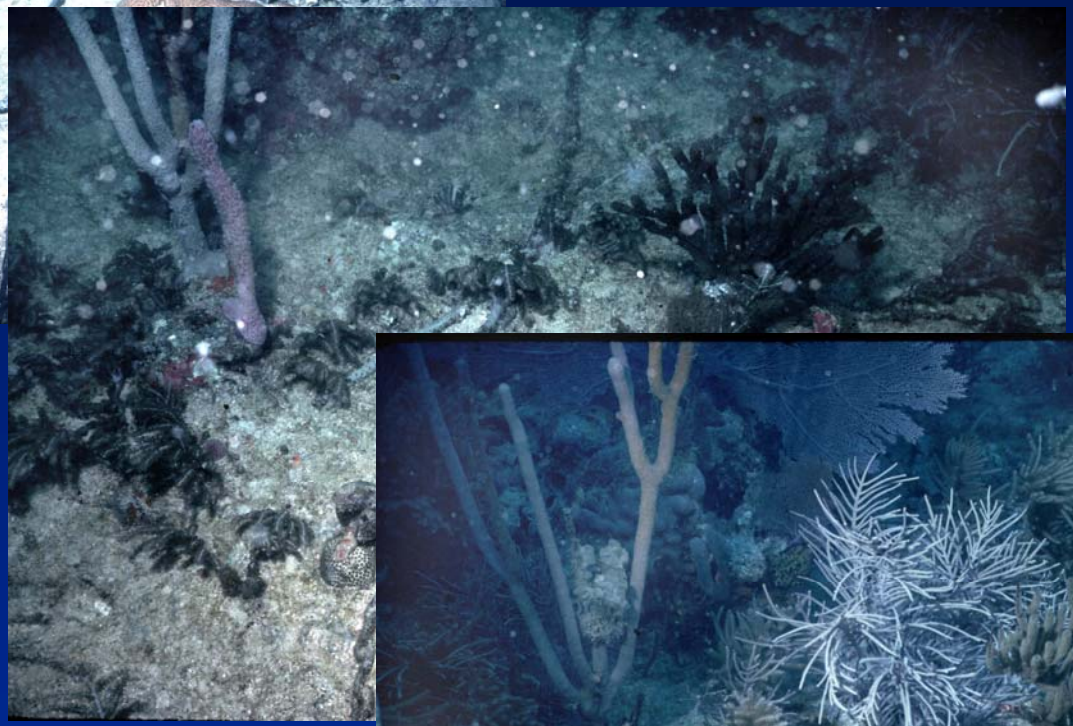
- Population Bottleneck: Gorgonians are "recruitment-limited".

- Population Stability: High and constant survival of large (adult) colonies.

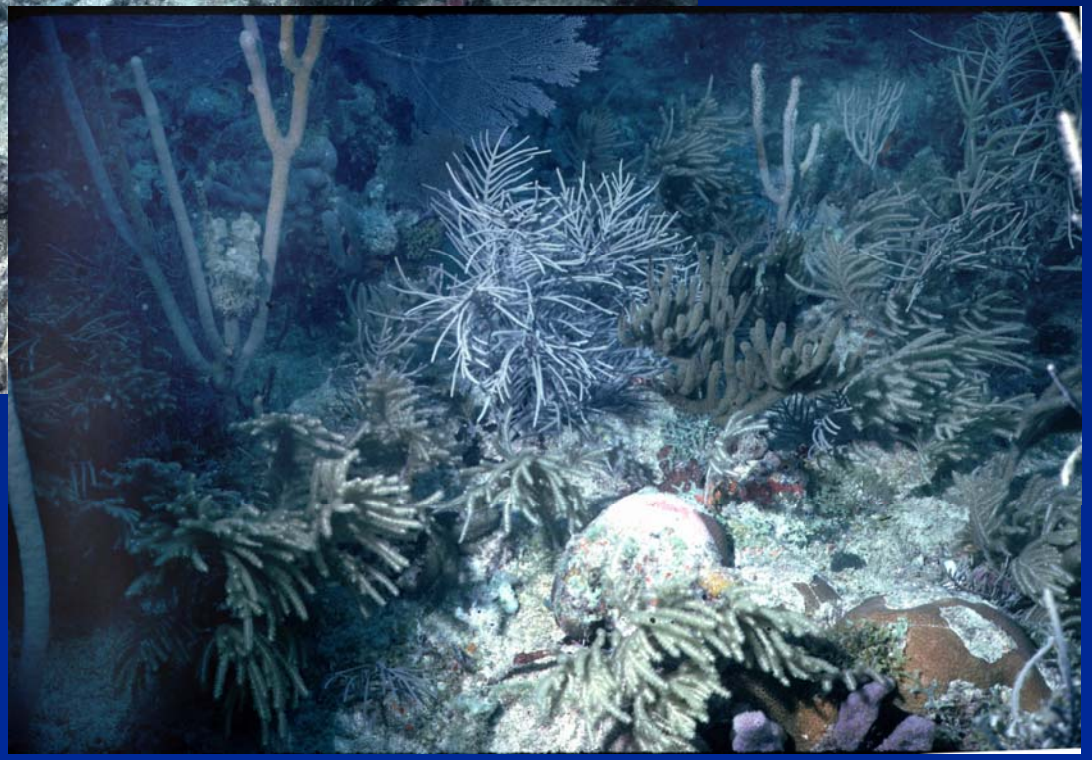
INFERENCE: Transplants of colony branches may bypass the bottleneck and stabilize (restore) gorgonian populations.



Pre-1984

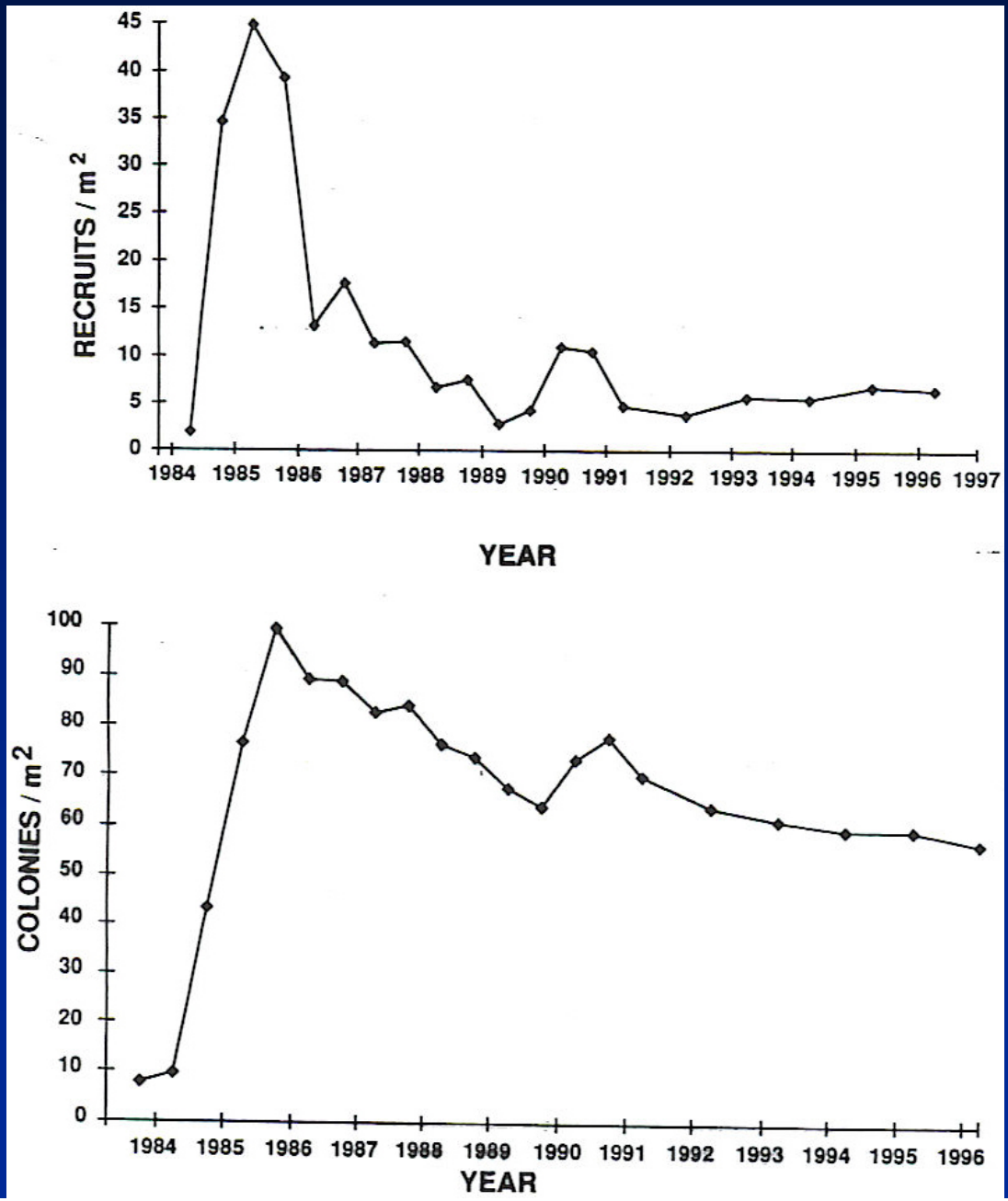


1984-1986

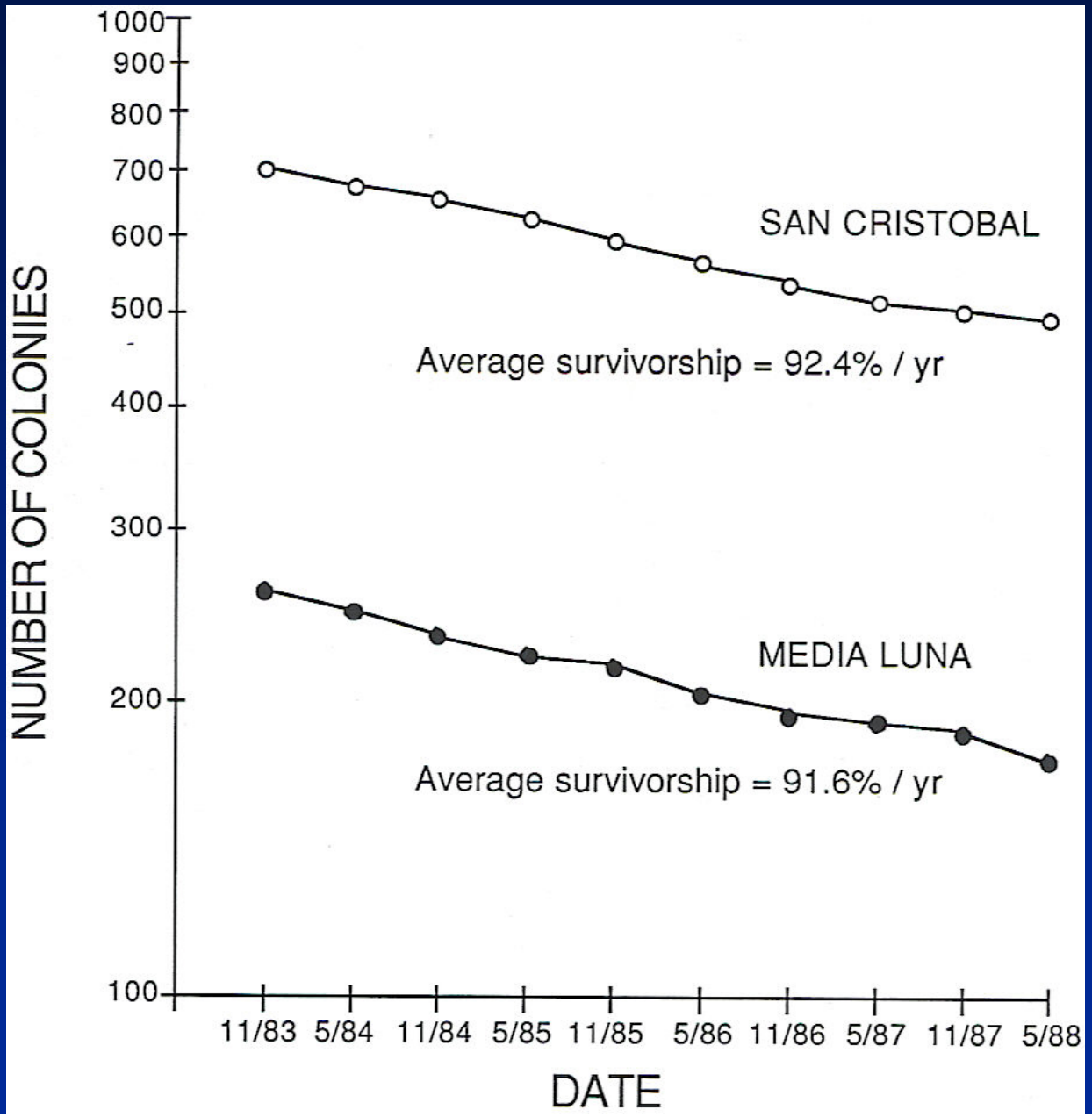


Post-1986

Recruitment and Population Size



Large colony survivorships



SOURCES OF LARGE COLONY MORTALITIES

	Media Luna #Died (%)	San Cristobal # Died (%)
Detachment / Substrate Failure		
Fallen or loosely attached	2 (2.3)	25 (11.9)
Disappeared	32 (37.6)	124 (59.0)
Basal Fracture		
Damaged base (abrasion)	9 (10.6)	10 (4.8)
Damaged base (unknown)	22 (25.9)	27 (12.9)
Undamaged base	8 (9.4)	10 (4.8)
Subtotal	**73 (85.9)**	**196 (93.3)**
Overgrowth		
Millepora	3 (3.5)	3 (1.4)
Algae	6 (7.1)	3 (1.4)
Other	3 (3.5)	8 (3.8)
Subtotal	**12 (14.1)**	**14 (6.7)**

Detachment (substrate failure) and basal fracture are the major sources of large colony mortalities.

RESEARCH OBJECTIVE

Restore gorgonian populations by bypassing the population bottleneck.

METHODS

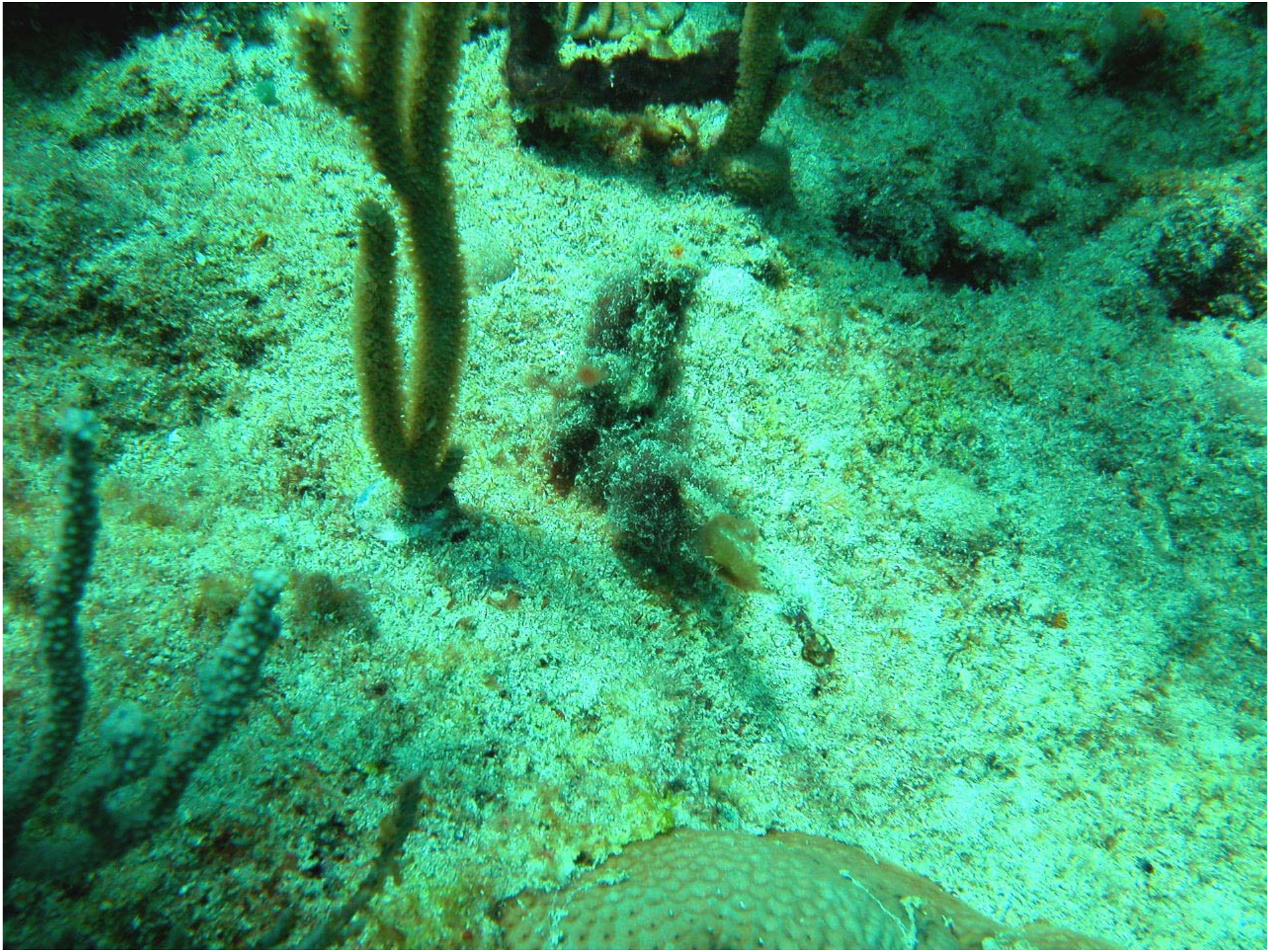
Transplants of large (>15 cm tall) gorgonian branches of *Plexaura flexuosa* and *Pseudoplexaura* spp.

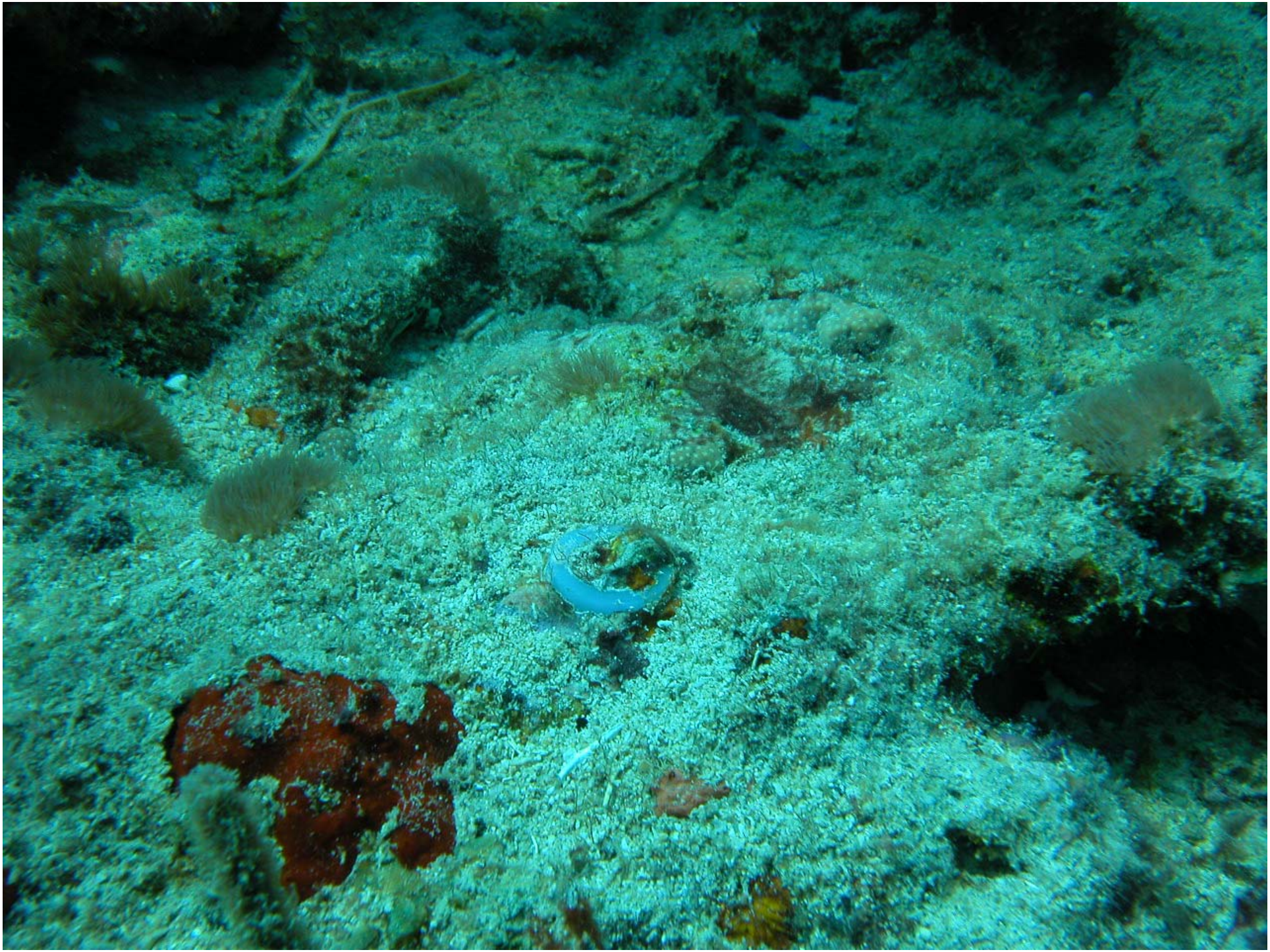
Test effectiveness of procedures to minimize skeletal fracture and detachment.

- **Epoxy/Cement branches in holes chiseled/drilled into the substrate.**
- **Collars to protect colony bases.**

GOAL

Match natural survival rates (91% /year) of gorgonians at the Media Luna study site.





INITIAL DETACHMENT OF TRANSPLANTS

	% Detached	(n)	% Not Detached	(n)
Plexaura flexuosa	5.8	(12)	94.2	(194)
Pseudoplexaura spp.	32.5	(63)	67.5	(131)

$p<0.005$

Cause: Movement of transplants from water motion during hardening of cement/epoxy.

TRANSPLANT SURVIVALS

(Excluding Initial Detachment)

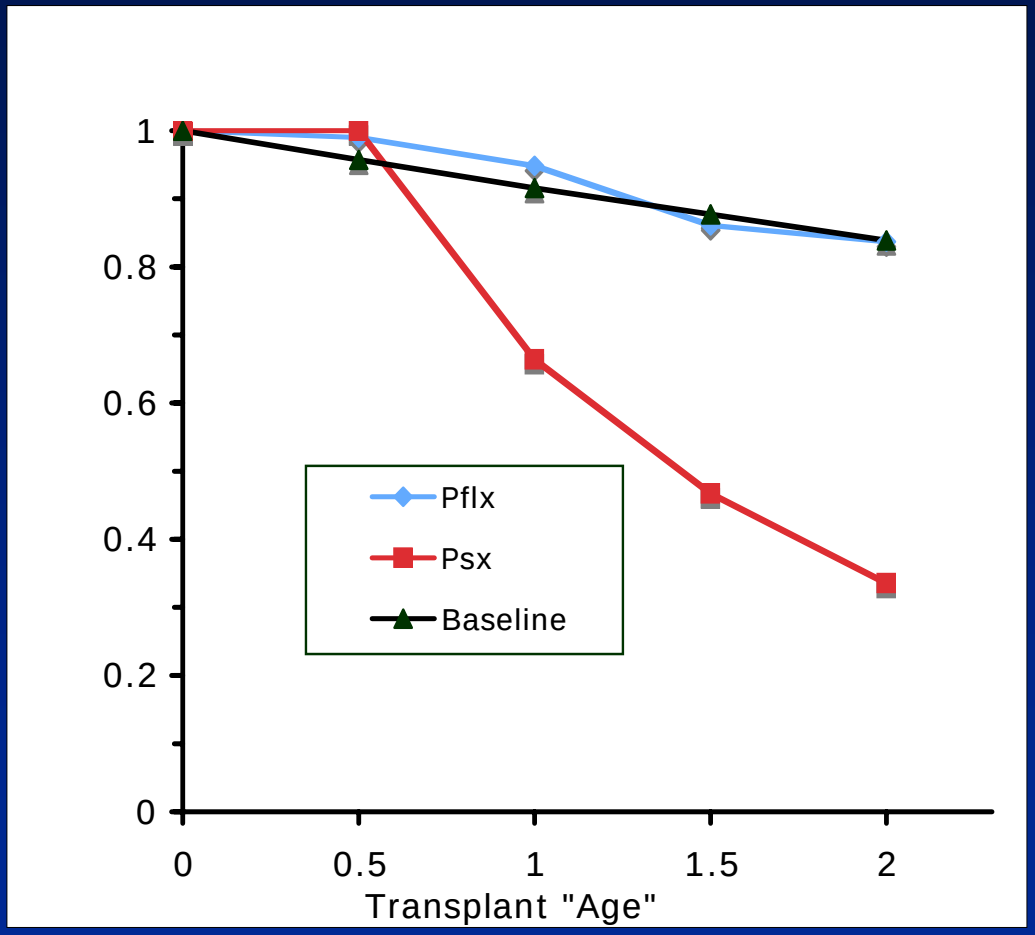
Taxa	%Live	(n)	%Died	(n)	prob
Plexaura flexuosa (Pflx)	84.0	(163)	16.0	(31)	
Pseudoplexaura spp. (Psx)	32.8	(43)	67.2	(88)	<0.005

No consistent differences in survivals between cement vs. epoxy and collared vs. non-collared.

SOURCES OF MORTALITY

	Pflx	Psx
Skeletal fracture	22	59
Late detachment	5	6
Unknown	4	23

L_x (“Age”- specific Survivorship)

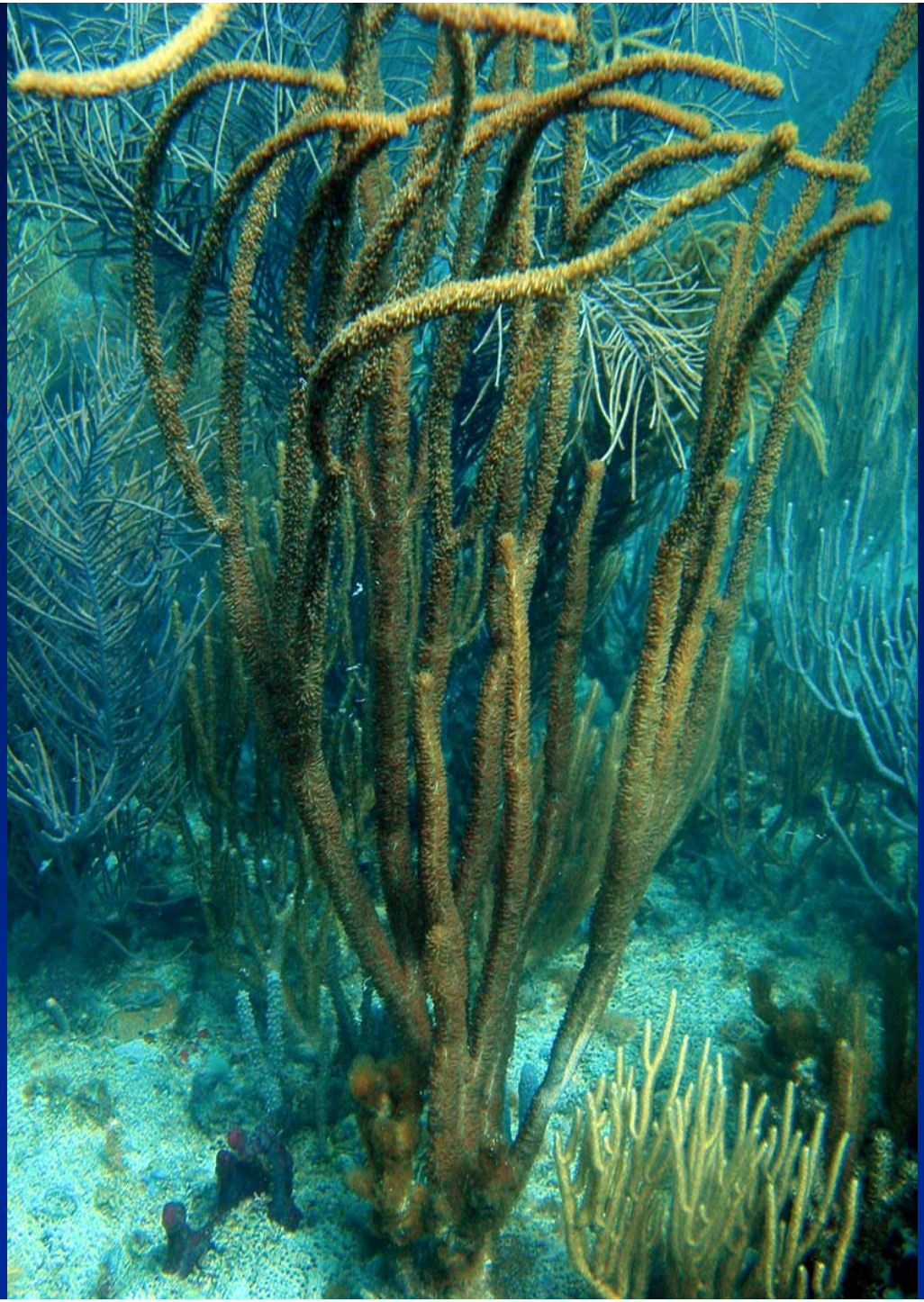


Annual survivorship rates:

“Baseline”: 91.6%/y

Pflx: 91.5%/y

Psx: 55.9%/y



BIOMECHANICAL PROPERTIES

Plexaura flexuosa (multi-branched tips):

- remains relatively stiff with water motion

Pseudoplexaura (singly branched tips):

- bends with water motion
- fractures when immobilized

Cause: Diameter of axial skeleton (15 cm from branch tip)

Plexaura flexuosa: 1.97 $\pm$ 0.17 mm (95% C.L.)
Pseudoplexaura: 1.46 $\pm$ 0.14 mm (95% C.L.)

(Higher detachments for *Pseudoplexaura* because thinner skeletons have decreased surface areas for adherence to cement/epoxy?)

	Psx (multi-branched)	Pflx	Psx (singly branched)
Skeletal diameters:	1.92 mm	1.97 mm	1.46 mm

CONCLUSIONS AND PROSPECTUS

- Transplants are a feasible method to restore gorgonian populations.
- Future improvements in transplant techniques should include a combination of general and species-specific approaches.
- Species-specific approaches will be based on the biomechanical effects of drag on gorgonian colonies.
- Little is known about the biomechanics of gorgonians and other coral reef organisms.

The ecology of coral reefs is highly dependent upon the physical structure provided by gorgonians, corals, sponges and other organisms. Biomechanics play a key (and largely unknown) role in the morphological structure of these taxa.