Queen conch, *Lobatus* (*Strombus*) *gigas*, and Marine Protected Areas (MPAs) in the Caribbean

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MPAConnect Peer to Peer
September 2018

Morning Treats

- Conch in the ecosystem
  - *Life cycle*
  - *Ecological Role*
- Conch Management
- Conch Assessment

Conch Species (Family Strombidae) in the Caribbean

Queen conch

Milk conch

Goliath conch

Florida fighting conch

West Indian fighting conch

Hawk-wing conch

Rooster tail conch

Photos from www.gastropods.com

Realistic Sizes

Queen conch

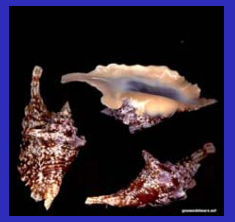
Milk conch

Goliath conch

Florida fighting conch

West Indian fighting conch

Hawk-wing conch



Rooster tail conch

Photos from www.gastropods.com

- The Queen Conch
- *Lobatus (Strombus?) gigas*

Photos credit: J. Doerr NOAA/NMFS

Valuable Meat – Fishing, Protein, Tasty, Easy, Export

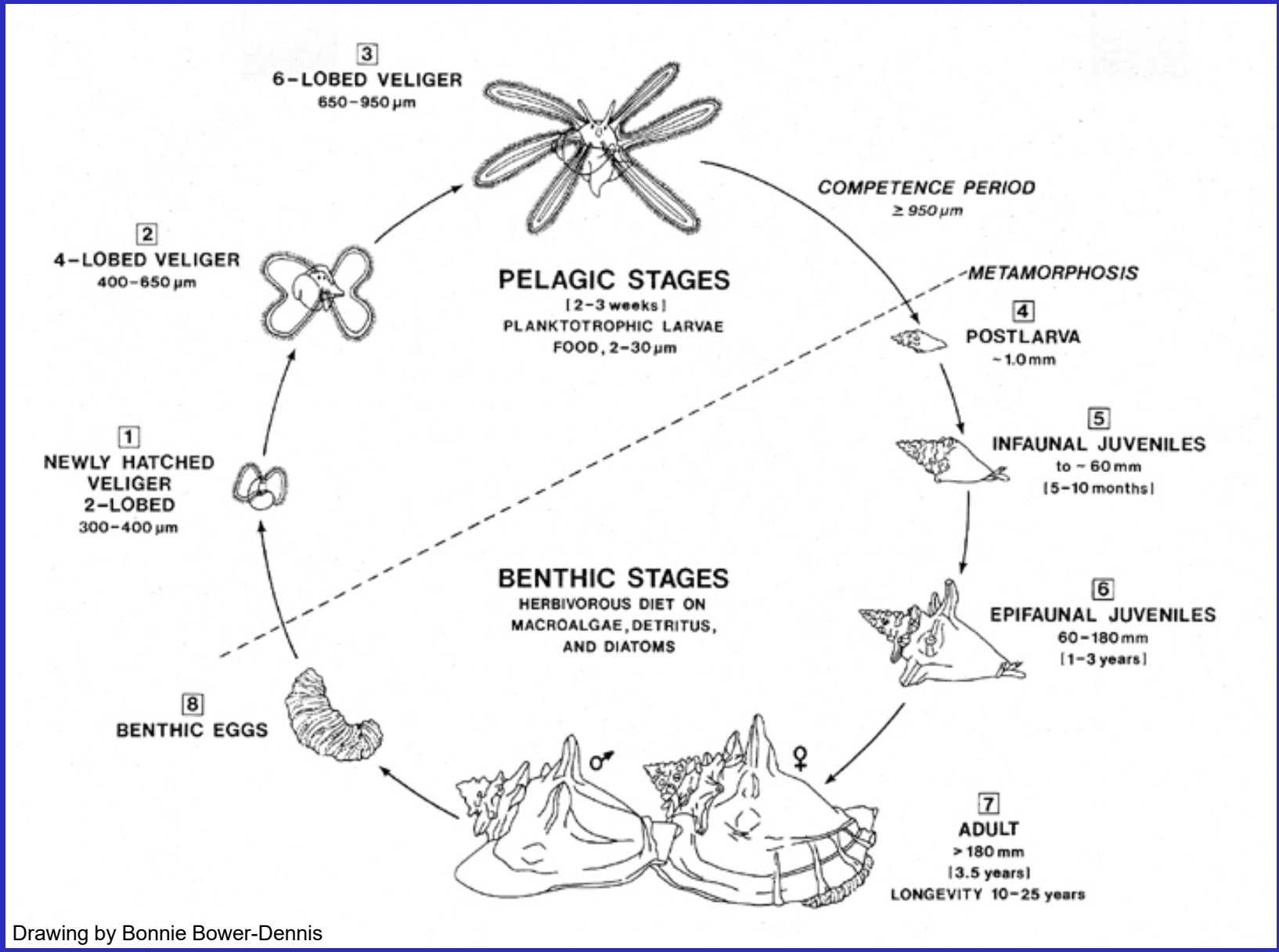
Fisheries

- Commercial fishing-large (Industrial) and small scale (Artisanal)
- Subsistence (also called Recreational fishing)

Fishing: Wading, swimming/snorkel, SCUBA, Hookah

History and Culture

Life Cycle



Drawing by Bonnie Bower-Dennis

Conch Private Parts

Figure 2. External sex organs of Strombus costatus *(a) male and (b) female milk conch, which are similar to those of* S. gigas. *(photograph by Tom Smoyer)*

Mating/Spawning Seasons

Reproductive cycle												Duration (months)	Geographical area	Sources
J	F	M	A	M	J	Jl	A	S	O	N	D			
				◐	⊕	⊕	⊕	⊕				4.5	Florida	Davis et al., 1984
		⊕	⊕	⊕	⊕	⊕	⊕	⊕				7	Turks and Caicos	Davis et al., 1987
			◐	⊕	⊕	⊕	⊕	⊕				5.5	Bahamas	Wicklund et al., 1991
				⊕	⊕	⊕	⊕	◑				4.5	Bermudas	Berg et al., 1992
			⊕	⊕	⊕	⊕	⊕	⊕	⊕			7	Bahamas	Stoner et al., 1992
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕			9	Virgin Islands	Randall, 1964
					⊕	⊕	⊕	⊕	⊕	⊕		6	Venezuela	Brownell, 1977
				⊕	⊕	⊕	⊕	⊕	⊕	⊕		7	Venezuela	Weil and Laughlin, 1984
			◐	⊕	⊕	⊕	⊕	⊕				5.5	St Kitts/Nevis	Wilkins et al., 1987
				◐	⊕	⊕	⊕	⊕	⊕	◑		6	Puerto Rico	Appeldoorn, 1988
			⊕	⊕	⊕	⊕						4	Santa Marta, Colombia	Botero, 1984
					◐	⊕	⊕	⊕	⊕			4.5	San Andres, Colombia	García-Escobar et al., 1992
			⊕	⊕	⊕	⊕	⊕	⊕				6	San Andres, Colombia	Márquez-Pretel et al., 1994.
⊕					⊕	⊕	⊕	⊕	⊕	⊕	⊕	8	San Bernardo, Colombia	Lagos-Bayona et al., 1996
		⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕			9	Alacranes Reef, México	Pérez-Pérez and Aldana-Aranda, 2002

Source: Avila-Poveda OH and ER Baqueiro-Cardenas. 2009. Reproductive cycle of *Strombus gigas* Linnaeus 1758 from archipelago of San Andres, Providence and Santa Catalina Colombia. *Invertebrate Reproduction and Development*. 53(1): 1-12, as referenced and adapted in *Queen Conch, Strombus gigas (Linnaeus 1758) Status Report*

Queen conch egg mass

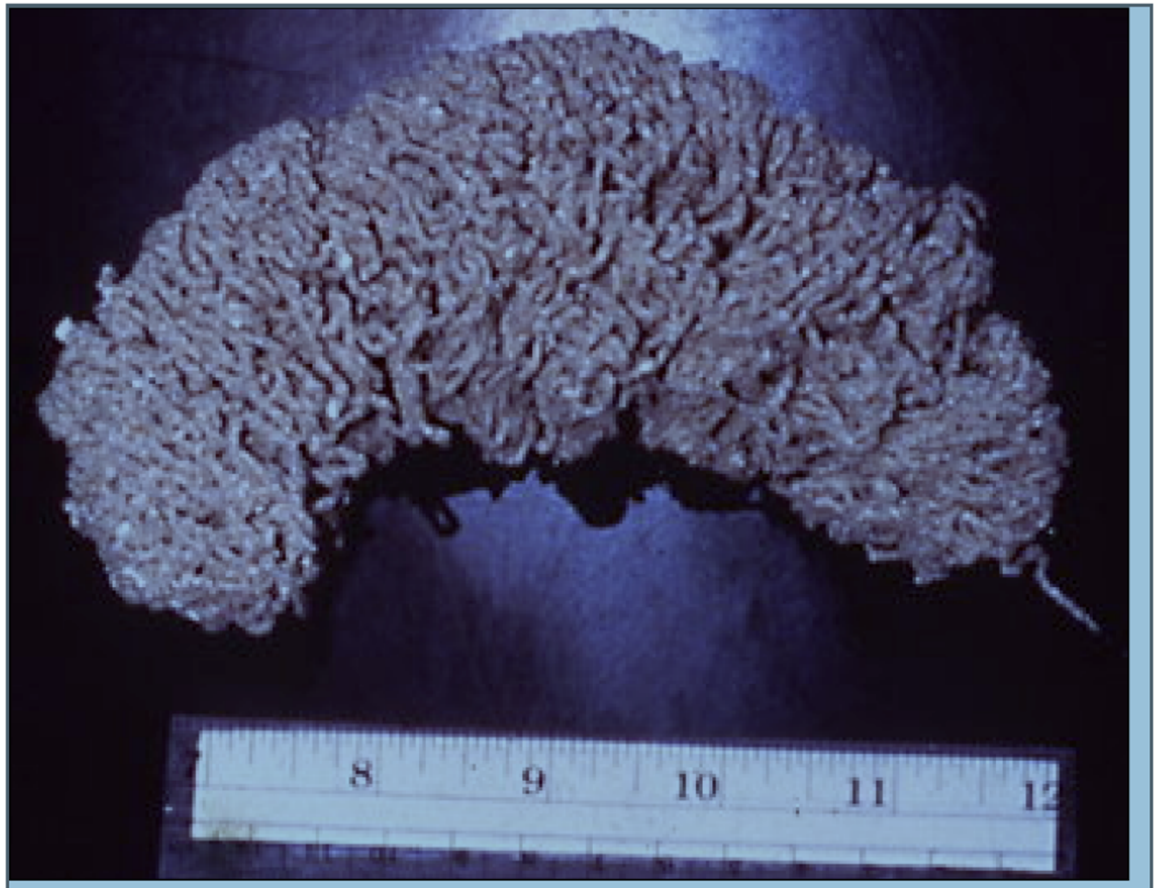


Figure 3. Queen conch, S. gigas*, egg mass. (photograph by LeRoy Creswell)*

Reproduction –

- Seasonal
- Copulation
- Internal fertilization
- Pair-spawning +
- Multiple egg laying after copulation
- Mixed paternity?

Eggs and Larvae


Jennifer Atchison


Megan Davis

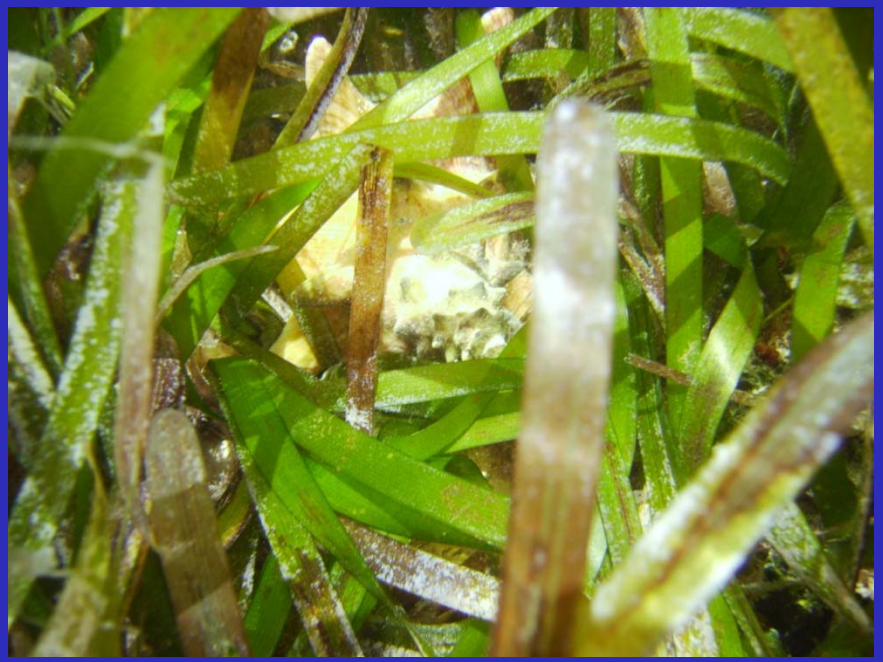

Megan Davis

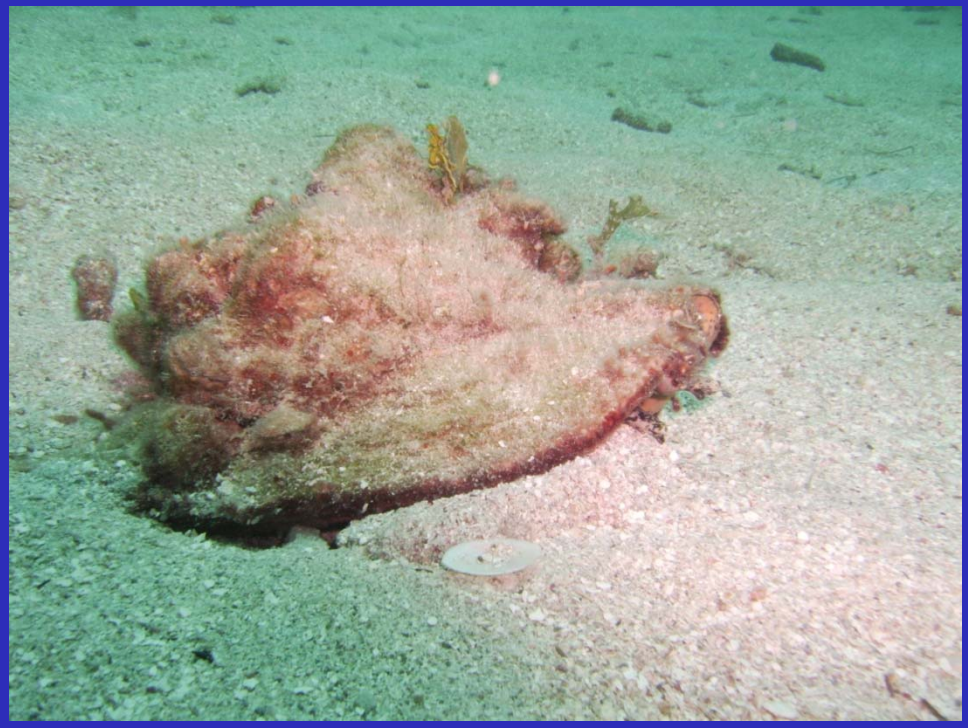

Univ. of Miami

Shell Growth

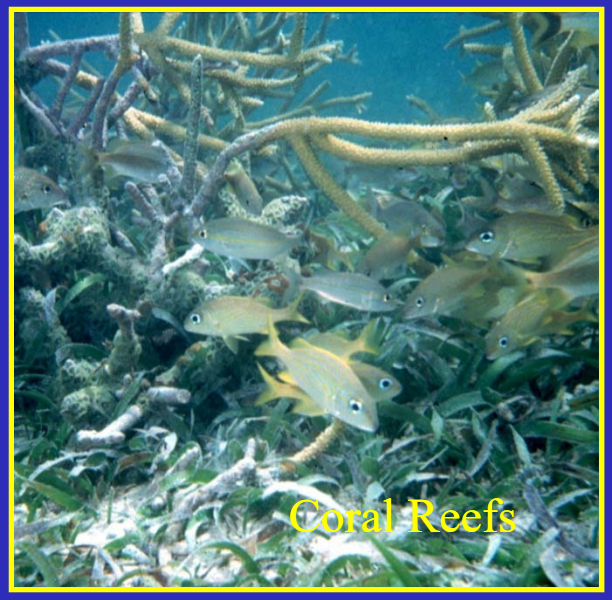
Phenotypic Plasticity

Juveniles and Adults



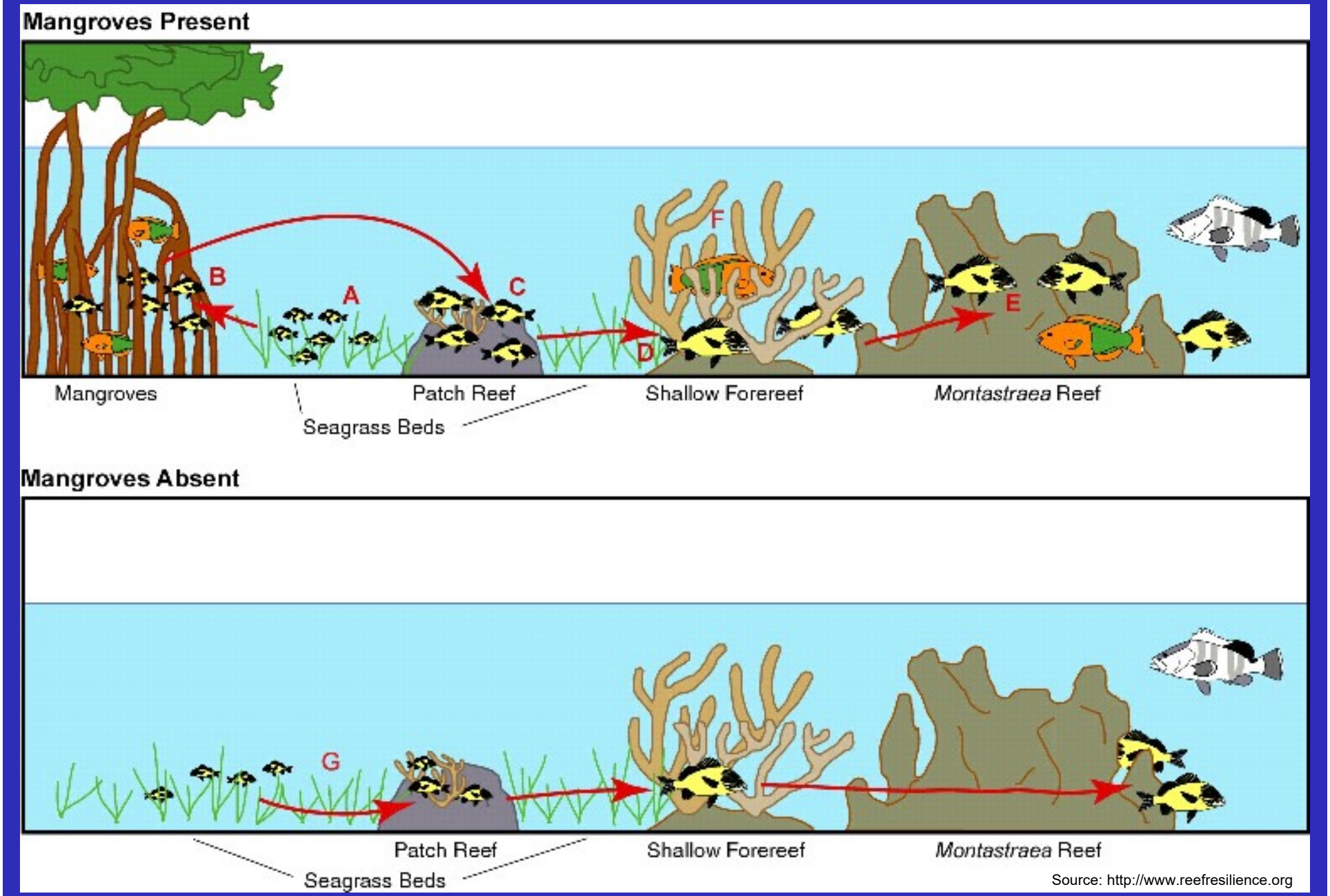


Caribbean Habitat Interactions
Coastal Coral Reef Ecosystems



Connectivity

- Sediment and nutrient filters
- Faunal flux

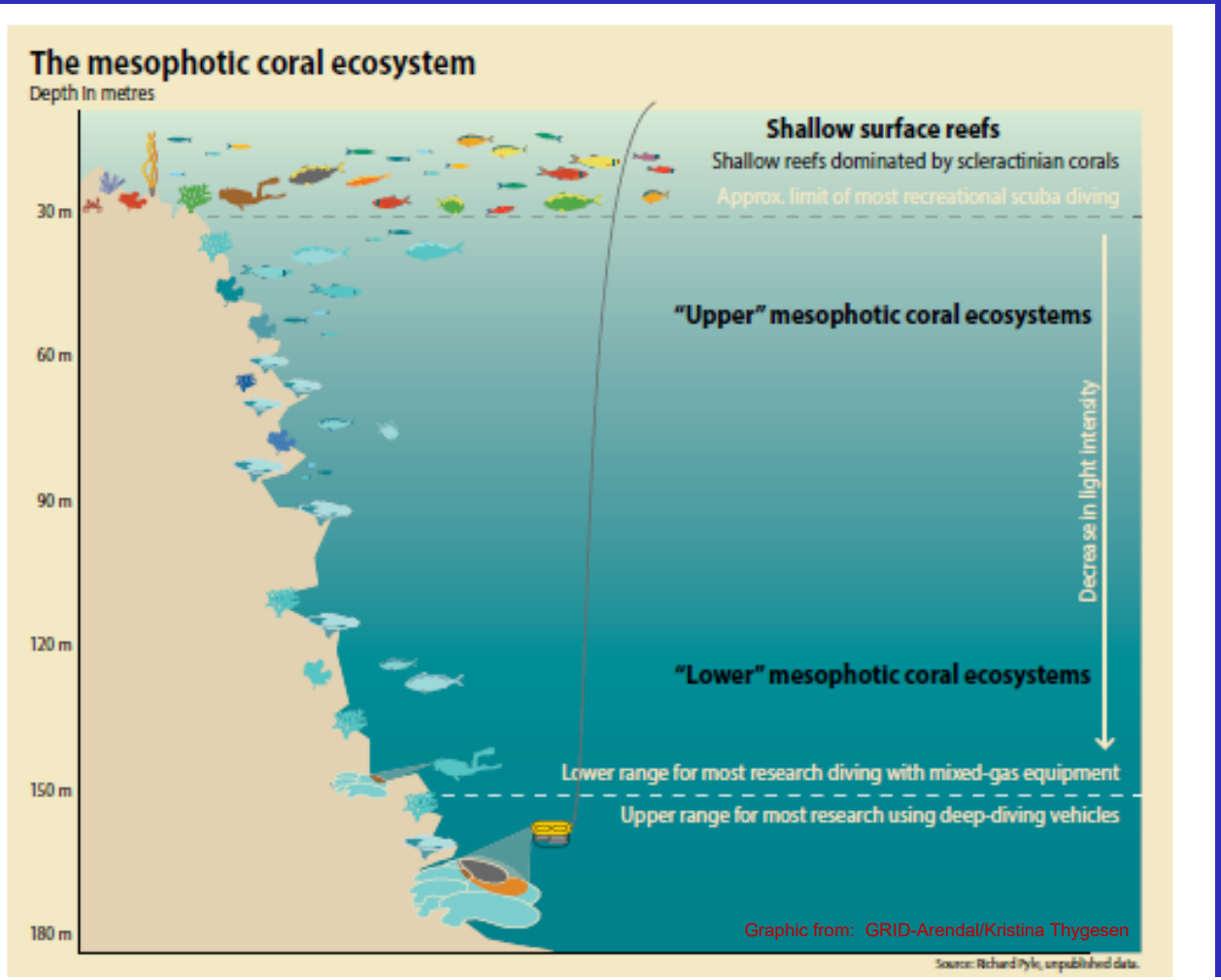

Mangroves Present
A
B
C
D
E
F
Mangroves
Patch Reef
Shallow Forereef
Montastraea Reef
Seagrass Beds
Mangroves Absent
G
Patch Reef
Shallow Forereef
Montastraea Reef
Seagrass Beds
Source: http://www.reefresilience.org

How Low Can We Go?

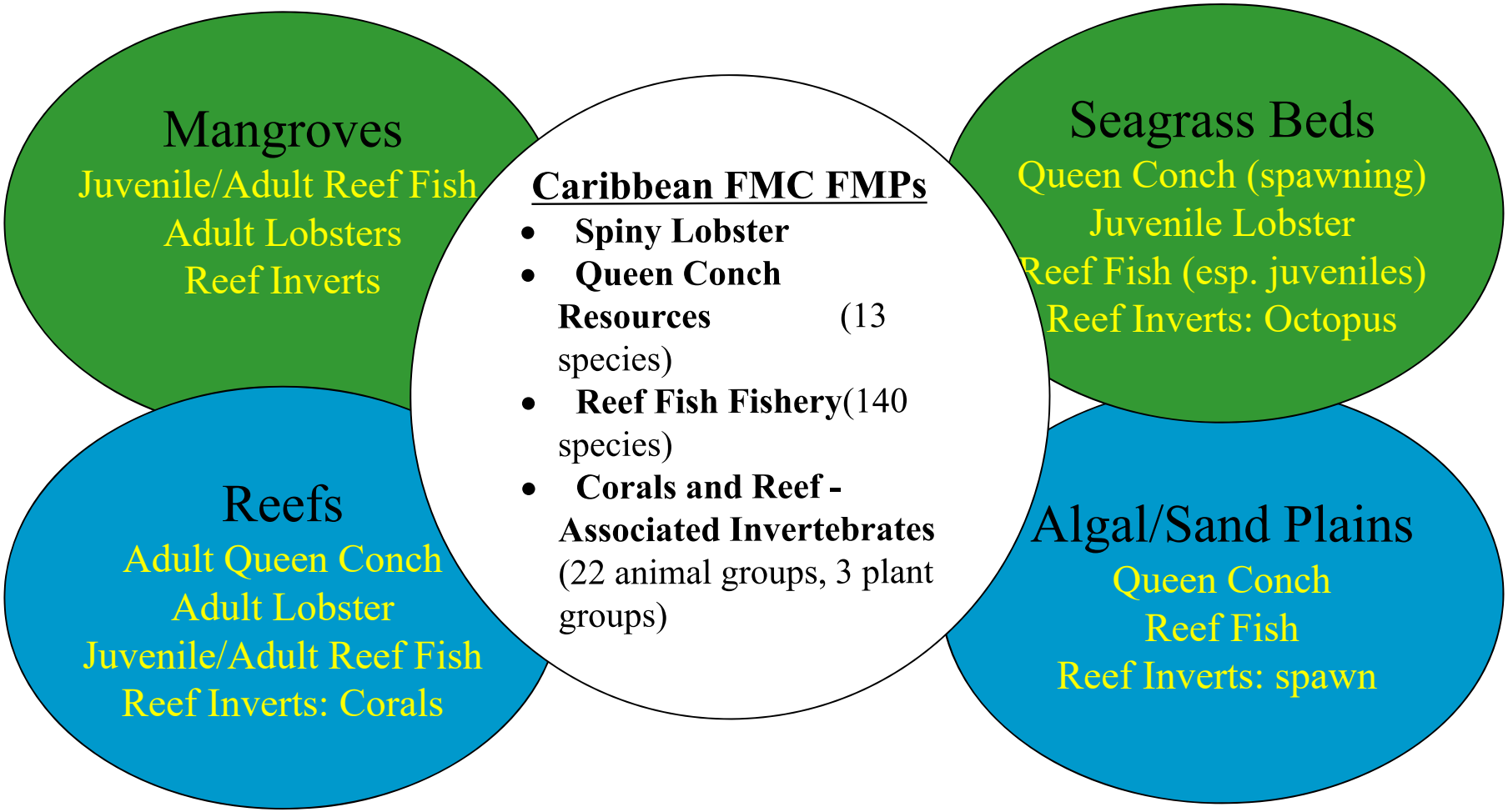
Shallow and Mesophotic Reefs

30 m

150 m



Fishery Ecosystem Management

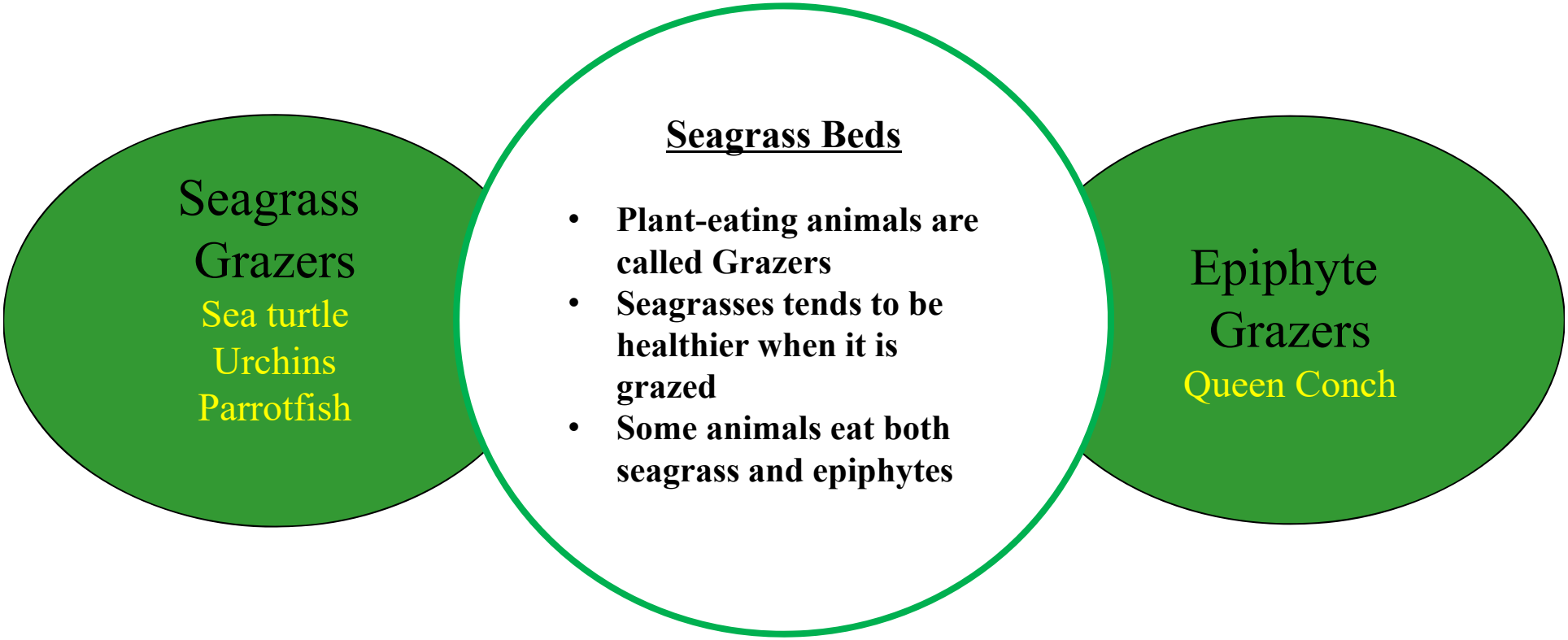


Habitat Overlap & Trophic Interactions

		Habitats (zones)				
		Mangrove	**Seagrass**	**Shallow Reefs**	**Deep Reefs**	**Mesophotic Reefs**
1	Saba National Marine Park					
2	Saba Bank National Park					
3	Statia Marine Park					
4	Bonaire National Marine Park					
5	Port Honduras Marine Reserve					
6	Blue Hole/Half Moon Caye Natural Monuments					
7	South Water Caye Marine Reserve (also Glovers Reef Marine Reserve)					
8	Turtle Harbour/Rock Harbour Special Protection Zone					
9	Monumento Natural Marino Archipiélago Cayos Cochinos					
10	Arrecife Alacranes (Scorpion Reef) National Park					
11	Horseshoe Reef and Hans Creek Fisheries Protection Areas					
12	East End Marine Park					
13	West Caicos Marine National Park (+ Princess Alexandra Land and Sea Park and Columbus					

Who eats whom?

Not all grazers in a seagrass bed or meadow eat seagrass. For some grazers, anseagrass shoot is just the "plate that the food is sitting on."

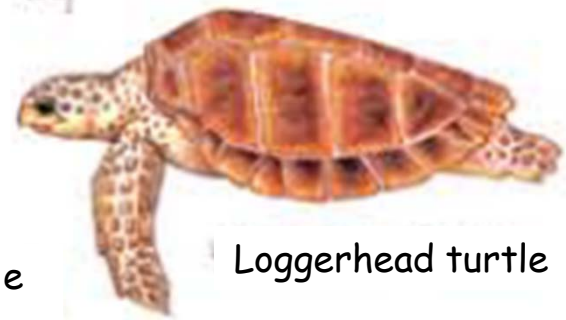


Epiphytes: bacteria, diatoms, small seaweeds, algae, and encrusting animals (e.g. sponges and bryozoans)

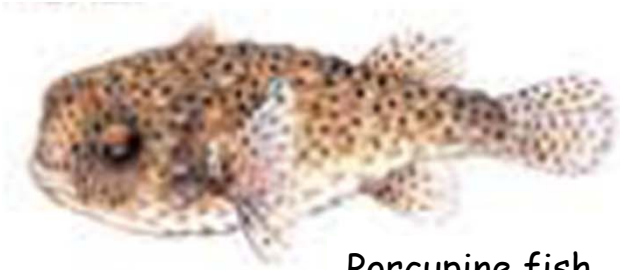
Predators

Southern sting ray

Spotted eagle ray

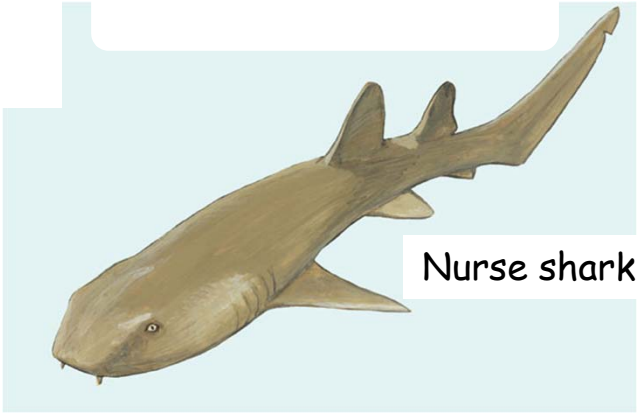


Loggerhead turtle



Porcupine fish

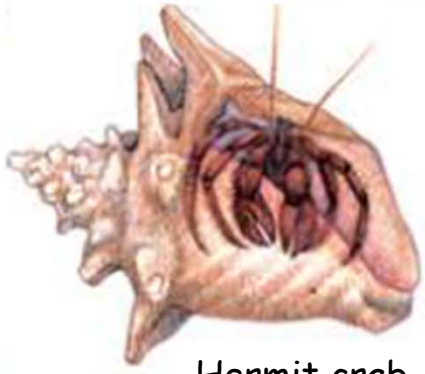
Octopus



Nurse shark

Blue crab

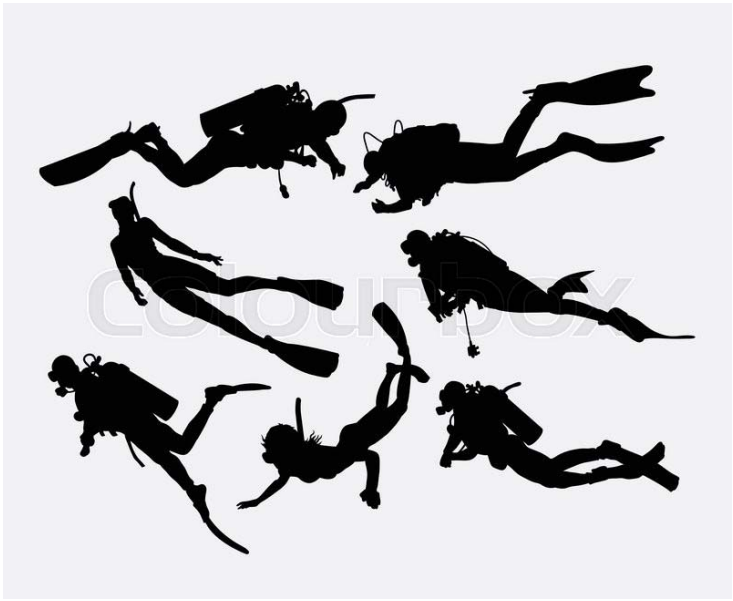
Spiny lobster



Hermit crab

Tulip snails

Drawing by Bonnie Bower-Dennis



For Management...

Source: *Yvonne Sadovy de Mitcheson. 2009.* Chapter 2 Biology and Ecology Considerations for the Fishery Manager in: *A Fishery Manager's Guidebook,* KL Cochrane and SM Garcia (eds)

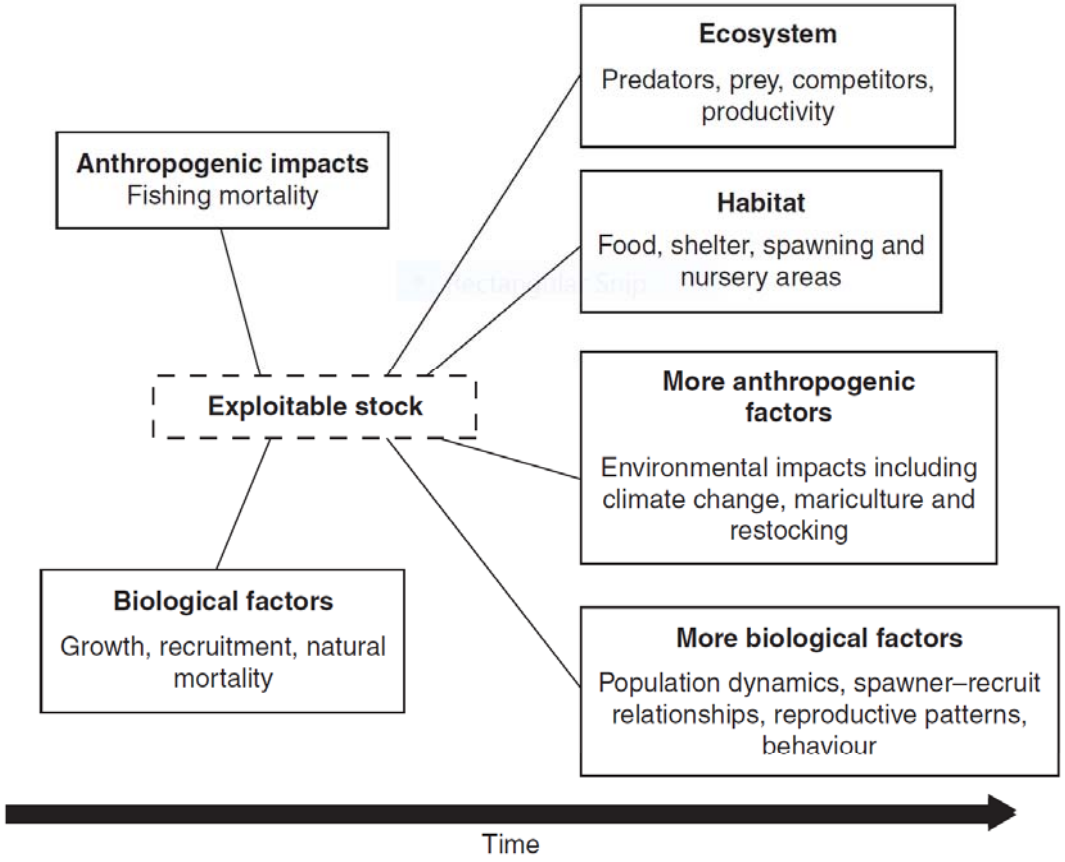


Figure 2.1 Historical and present-day perspectives on biological and ecological parameters and information of relevance for the sustainable management of aquatic natural resources. The time axis moves from the past (left) to the present. In the early years of fishery science, the information used was catch and effort with no biological or ecological components. As dynamic pool models developed, a few biological parameters shown lower left were applied. Awareness and understanding of the need for more detailed information has resulted in a much wider range of data being necessary for management (boxes on the right).

“Fisheries Studies”

- Species Parameters
  - Growth
  - Survival
  - Recruitment
- Habitat Protection
  - Habitat use (all life stages)
  - Movements
    - Daily
    - Seasonal

Species Ecology

- Mark-and-recapture
  - Capture and tagging
  - Distribution, habitat, movement, growth
  - Population demographics:
    - population growth
    - recruitment and mortality
- Acoustic Tracking
  - Vemco pingers & receivers
  - Habitat use
  - Movement rates
- Fishery Independent Surveys
  - St. Croix
  - 10-m radial surveys
- Environmental Contaminants (SARI)
  - Ecological effects
  - Human health effects

Caribbean Journal of Science, Vol. 47, No. 2-3, 251-259, 2013

University of Puerto Rico, Mayagüez

Home range, movement rates, and habitat use of queen conch, *Strombus gigas*, in St. John, U.S. Virgin Islands

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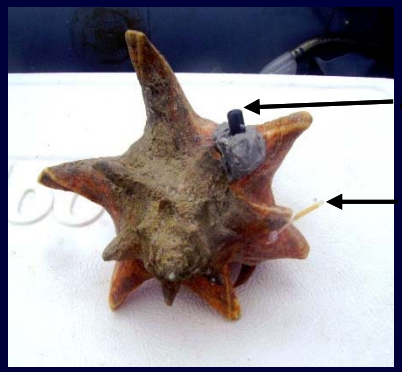
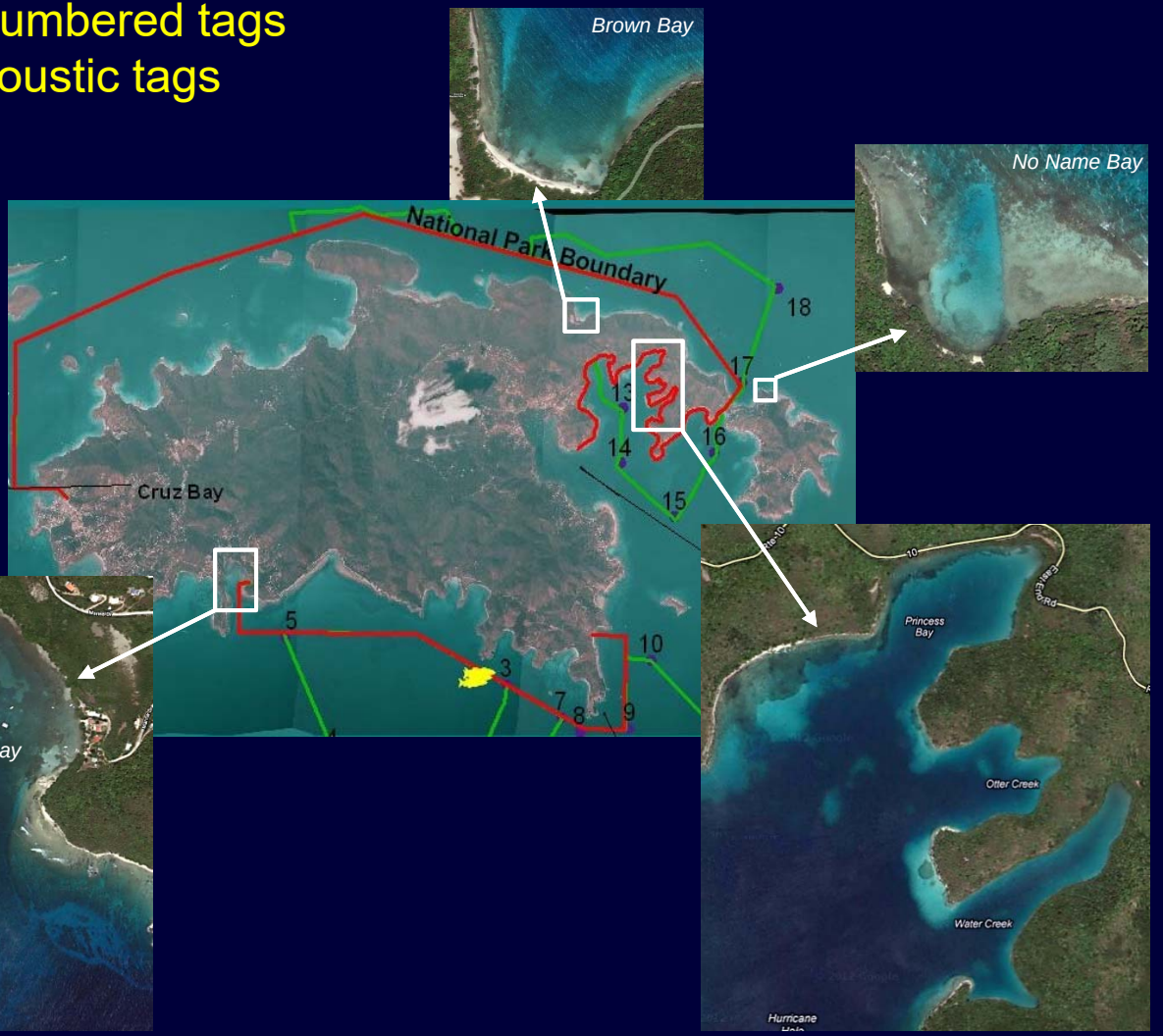
*Corresponding author: Jennifer.Doerr@noaa.gov

St. John Queen Conch Research

- 7153 numbered tags
- 155 acoustic tags





- Habitat use, fine-scale and island-wide movements
  - numbered tagging and acoustic tracking
  - mark and recapture (growth, survival, ingress/egress)
  - territorial, National Park, National Monument

…also, Fish Bay

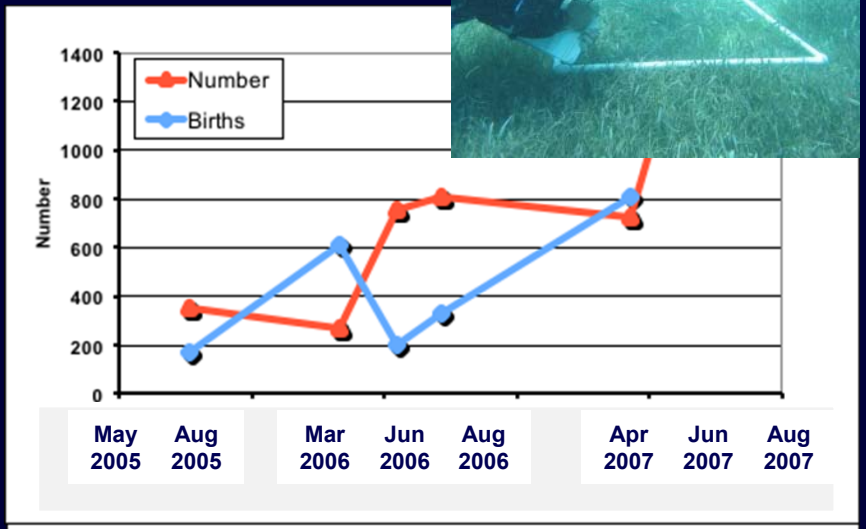
Recovery of Queen Conch Populations in the US Virgin Islands

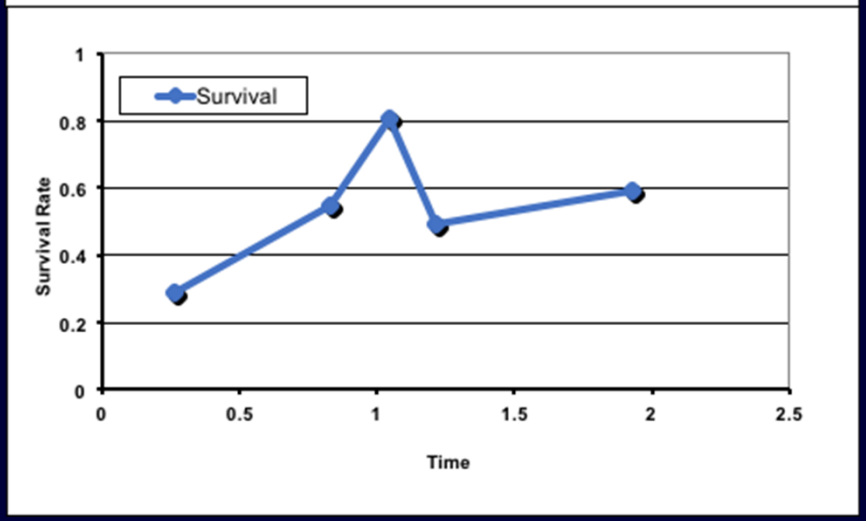
Funding sources (2005-2018):

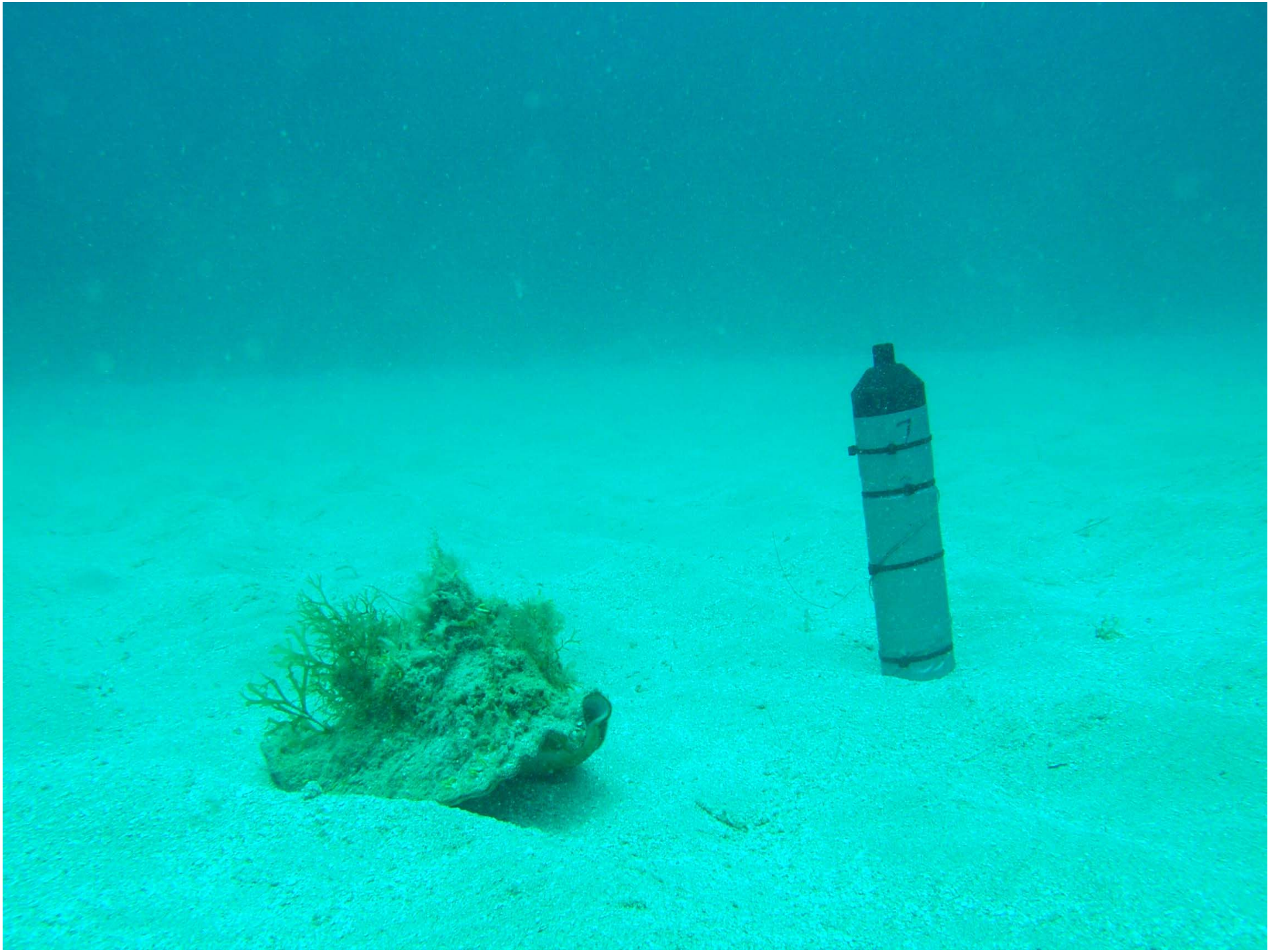
- 2005-8, 2009-11: Coral Reef Conservation Program (CRCP)
- 2008: NMFS Educational Grant
- 2010-11: Internal MARFIN
- 2014-17: CRCP (partnered with NPS)
- 2017+: CRCP (partnered with NPS, NOS)

Mark-and-recapture analysis:

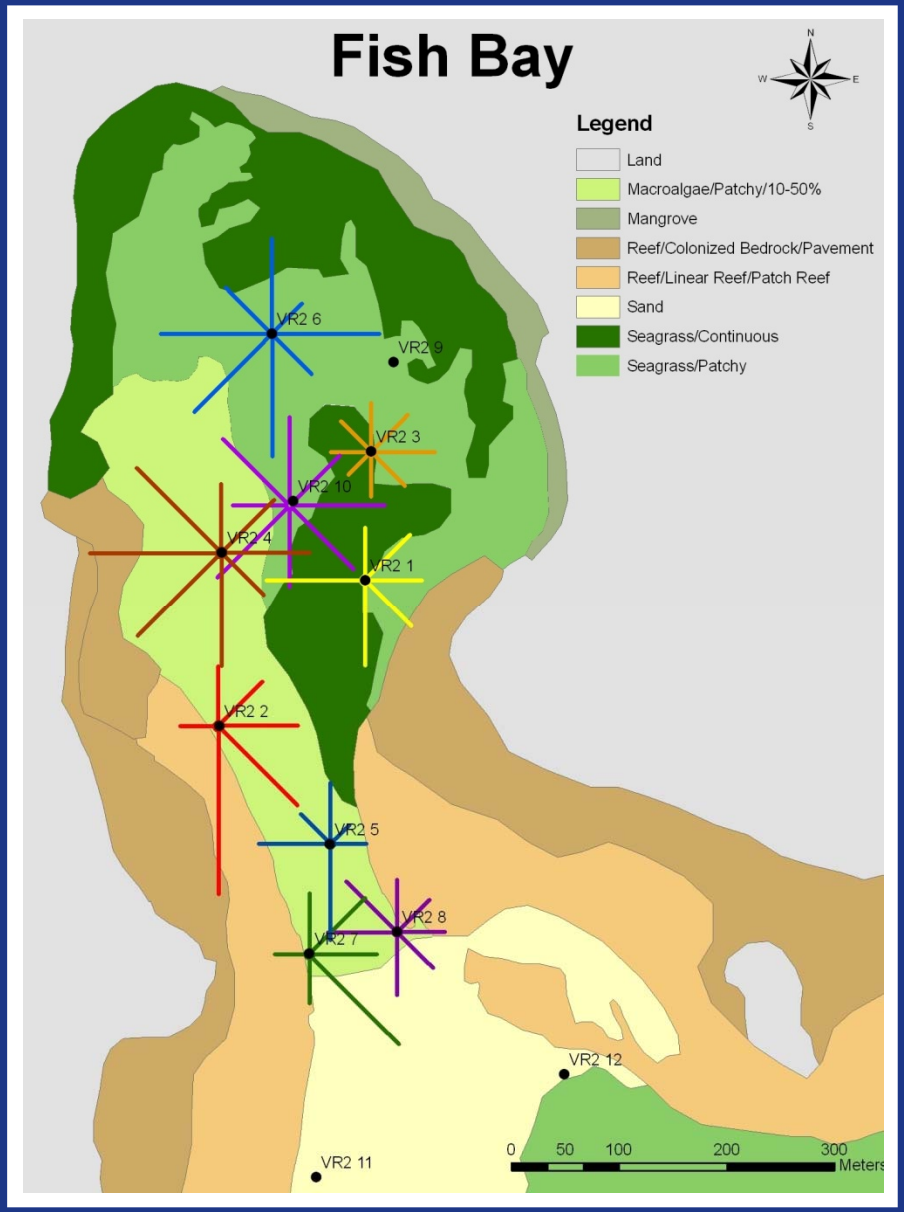
- Abundance/number:
  - Increases
- Births/recruitment:
  - 2 pulses – June ‘06/’07
- Survival rate:
  - Increase with recruitment
  - Too soon to see ‘07
- Final analysis:
  - Additional years (to FY-10)
  - Additional management areas

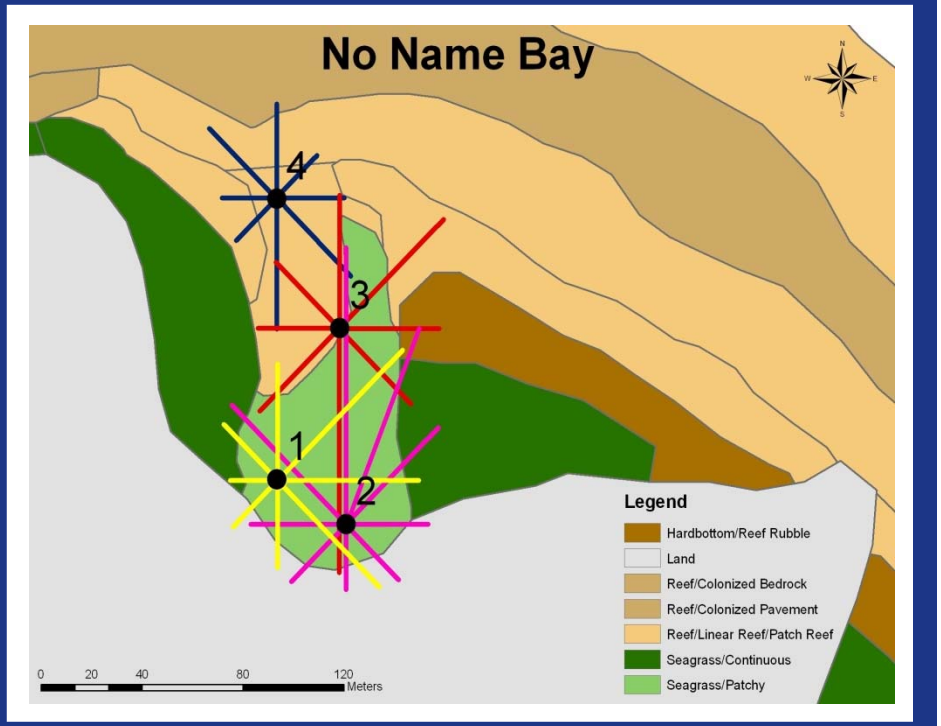




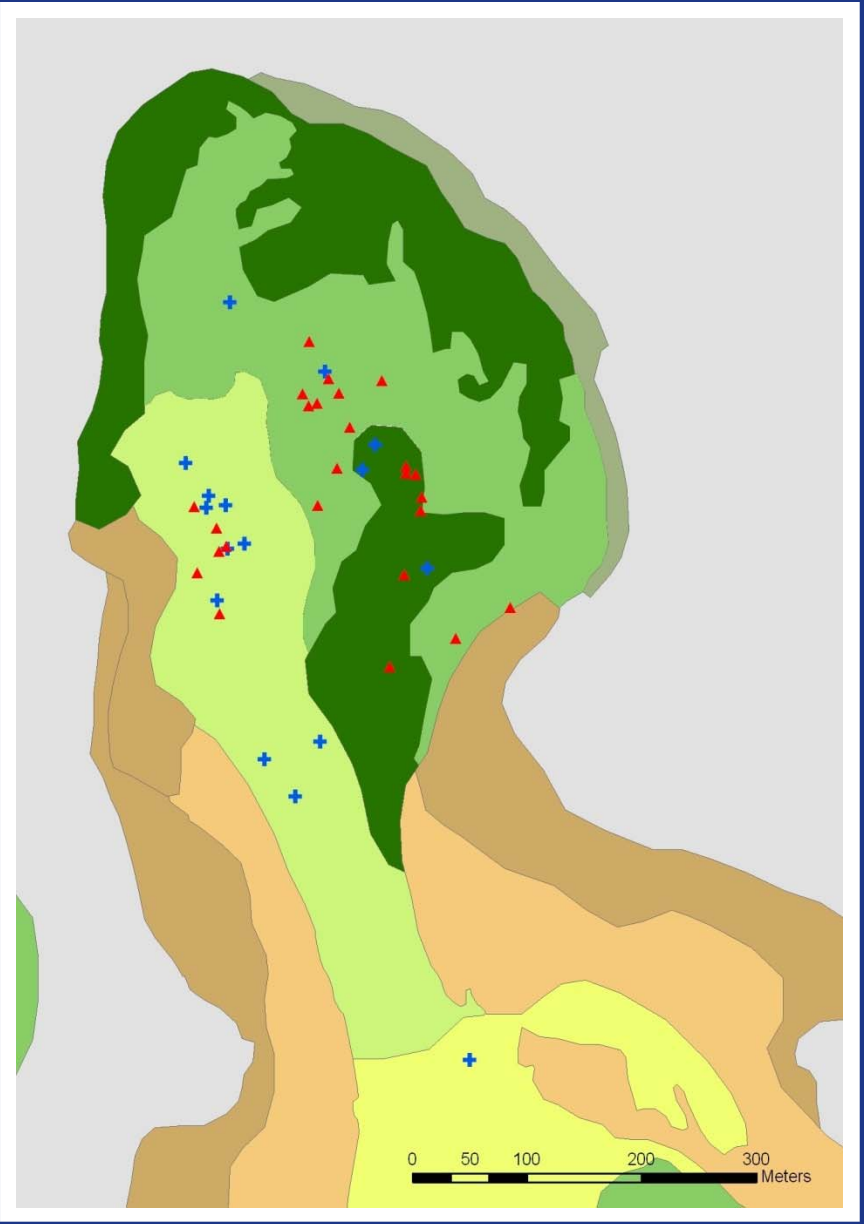


Hydrophone Arrays

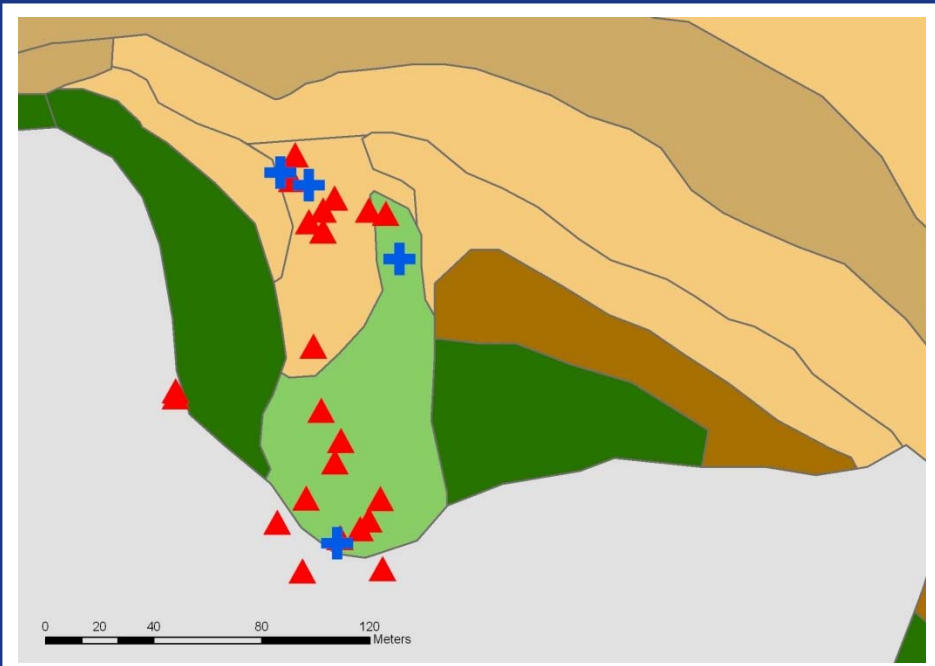




Acoustic Tag Locations



▲ Juveniles
● Adults

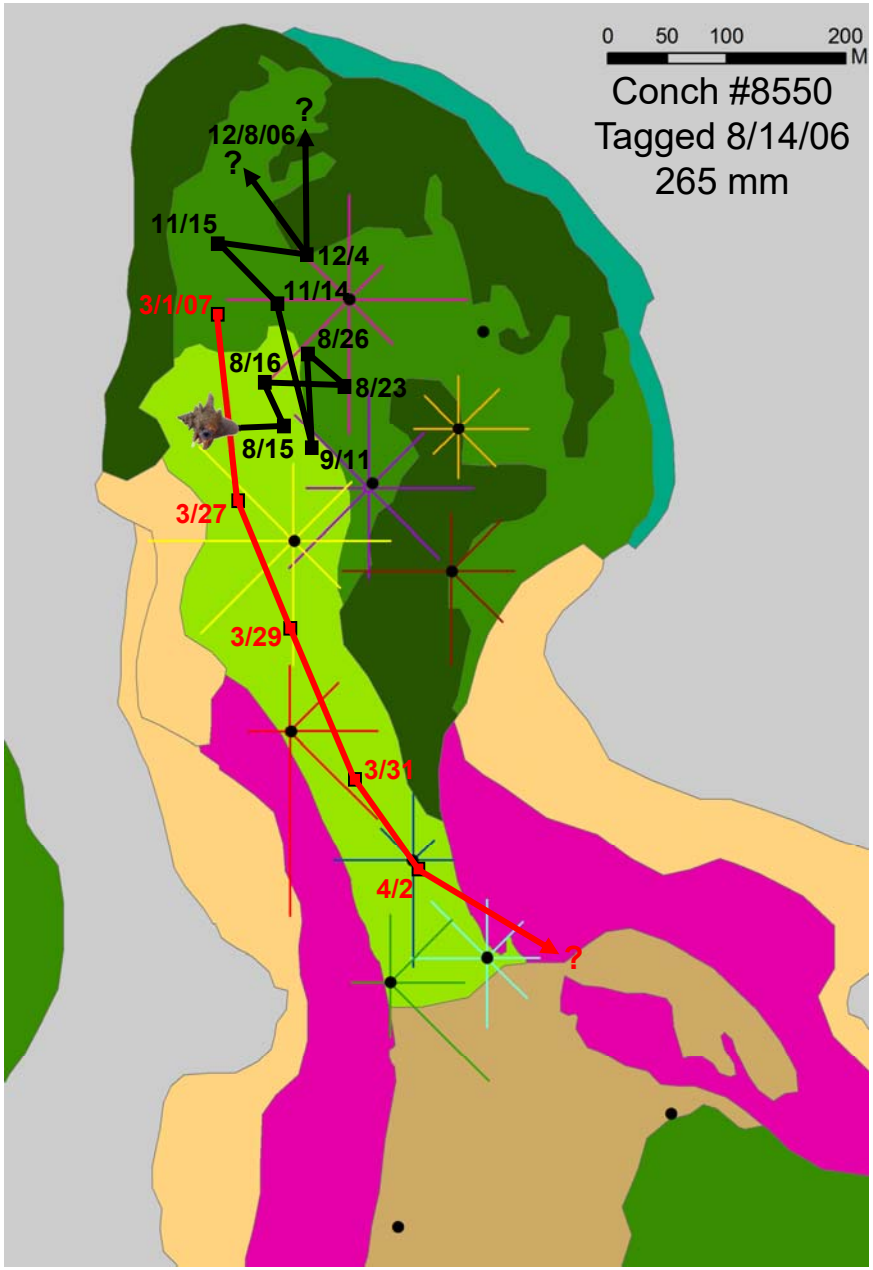


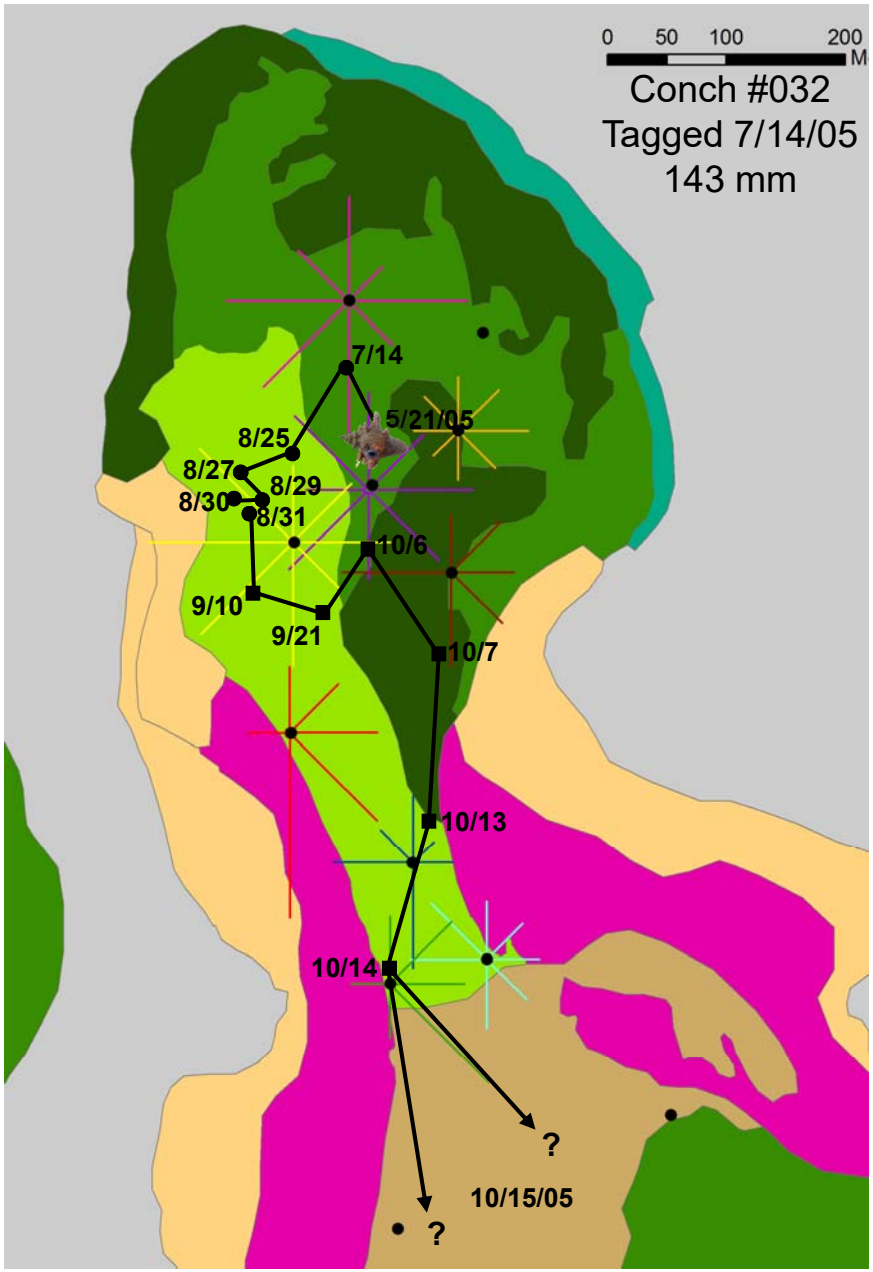
Acoustic Detections

- Fish Bay: 20 juveniles, 13 adults
  - *range 1 – 302 days (mean = 65.4)*
  - *213,677 detections*
- No Name: 21 juveniles, 3 adults
  - *range 0 – 438 days (mean = 85)*
  - *542,229 detections*

Habitat Use

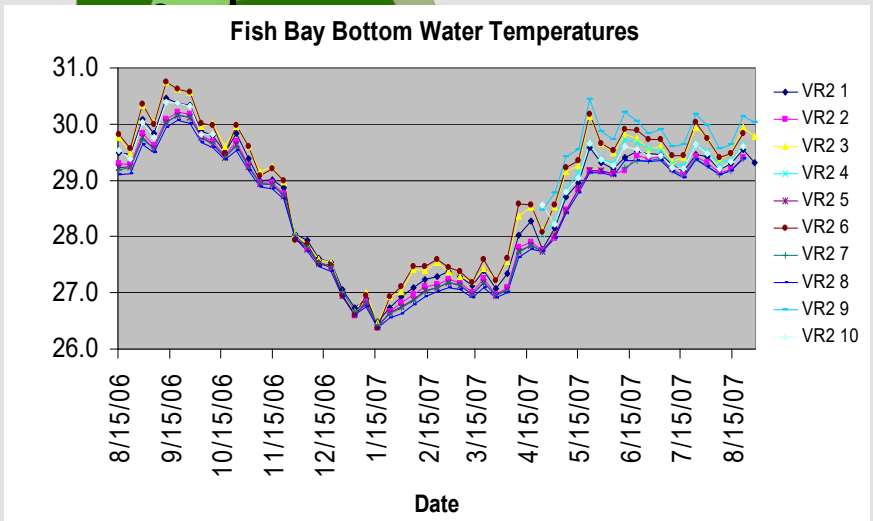
- Juveniles
  - *30% patchy macroalgae*
  - *70% seagrass (45% patchy, 25% cont.) {Thalassia, Syringodium, Halodule}*
  - *1-3 meters depth*
- Adults
  - *69% patchy macroalgae {Halimeda, Penicillus, Avrainvillea}*
  - *2-9 meters depth*

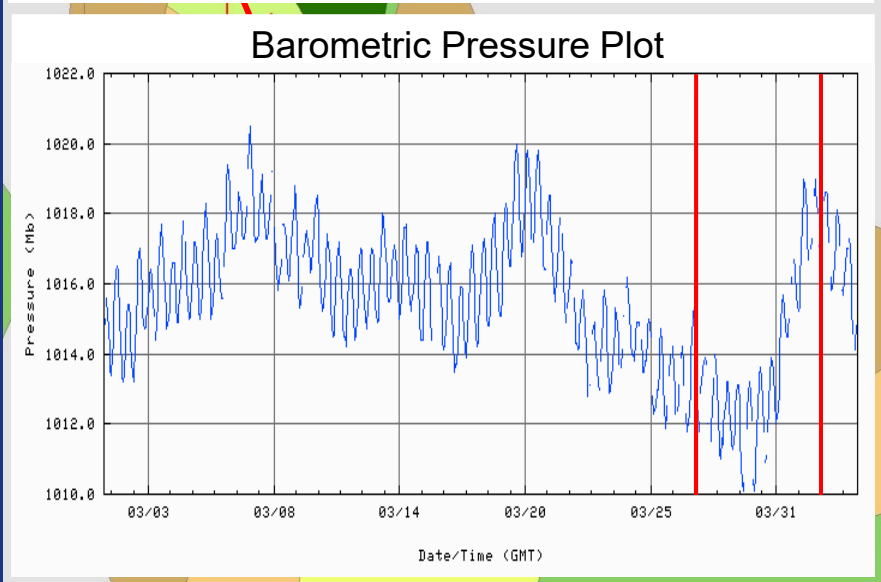

0 50 100 200
M
Conch #8550
Tagged 8/14/06
265 mm
?
12/8/06
?
11/15
12/4
11/14
3/1/07
8/26
8/16
8/23
8/15
9/11
3/27
3/29
3/31
4/2
?


0 50 100 200
M
Conch #032
Tagged 7/14/05
143 mm
7/14
5/21/05
8/25
8/27
8/29
8/30
8/31
10/6
9/10
9/21
10/7
10/13
10/14
?
10/15/05
?

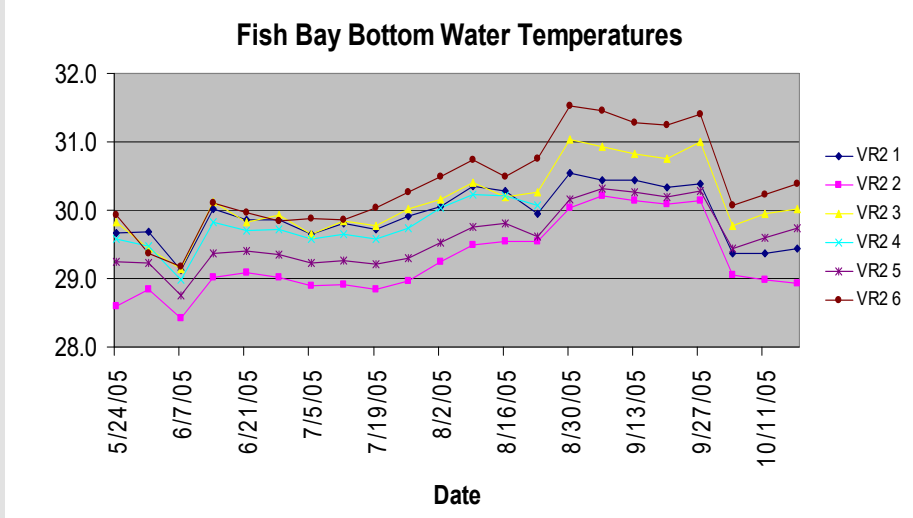
Conch #8550
Tagged 8/14/06
265 mm

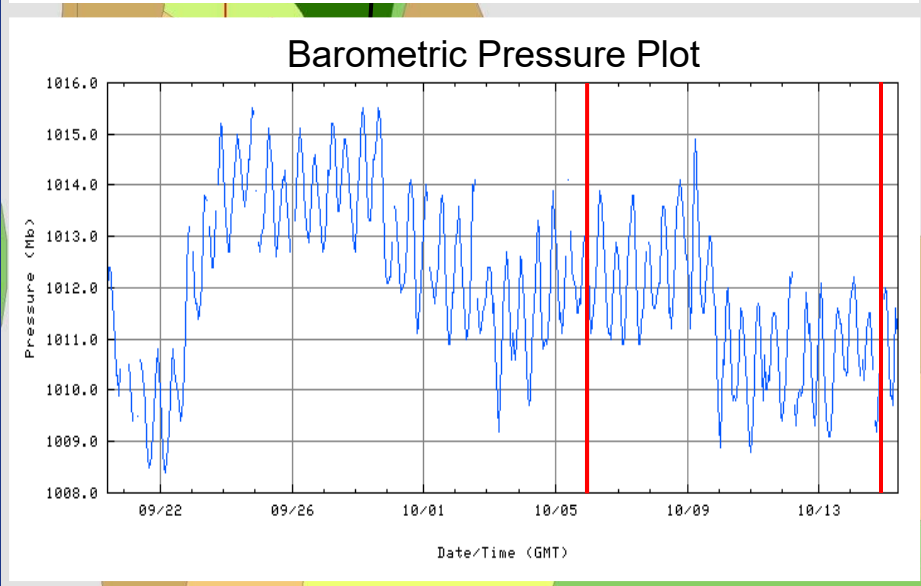
12/8/06 ?



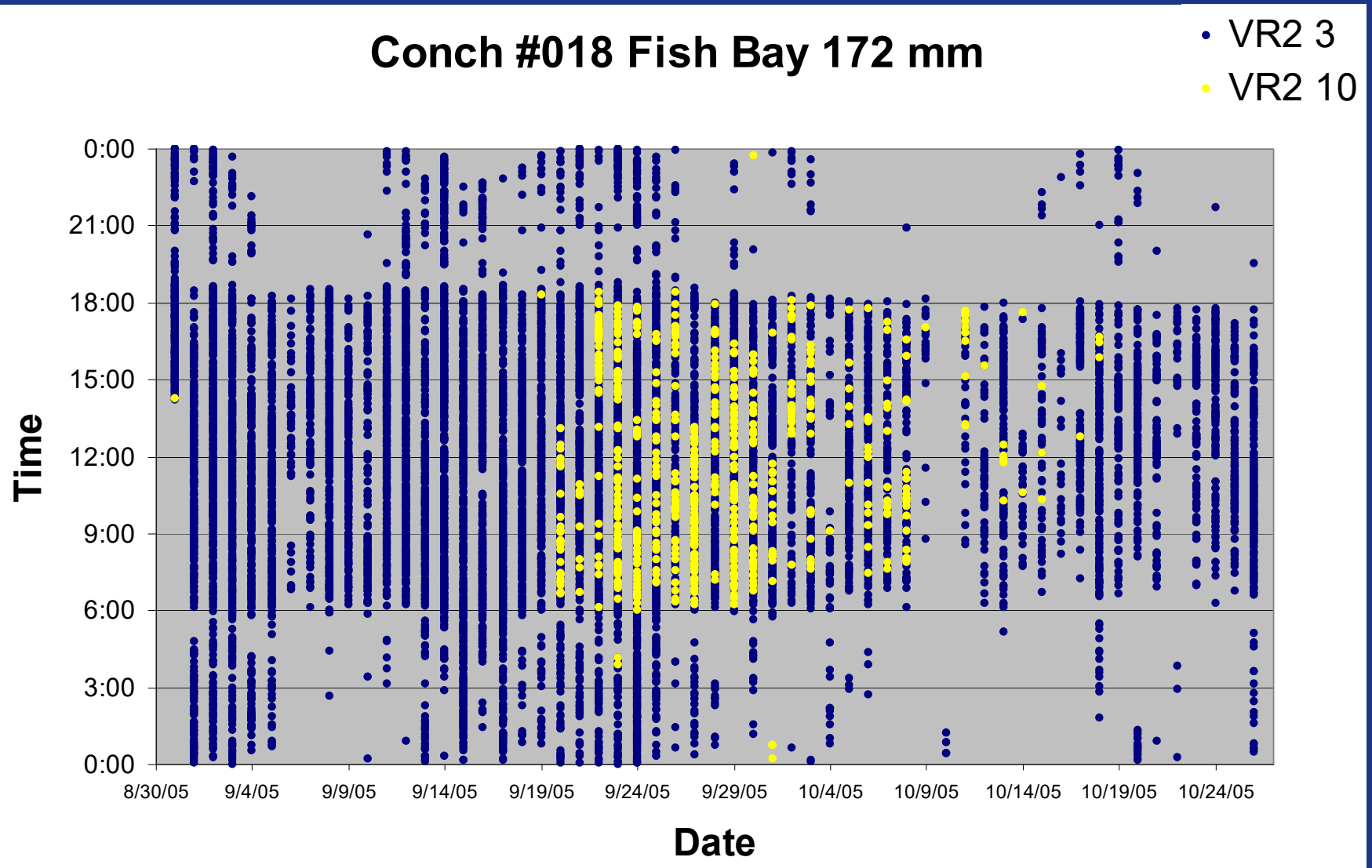


Conch #032
Tagged 7/14/05
143 mm





Diurnal Rhythms



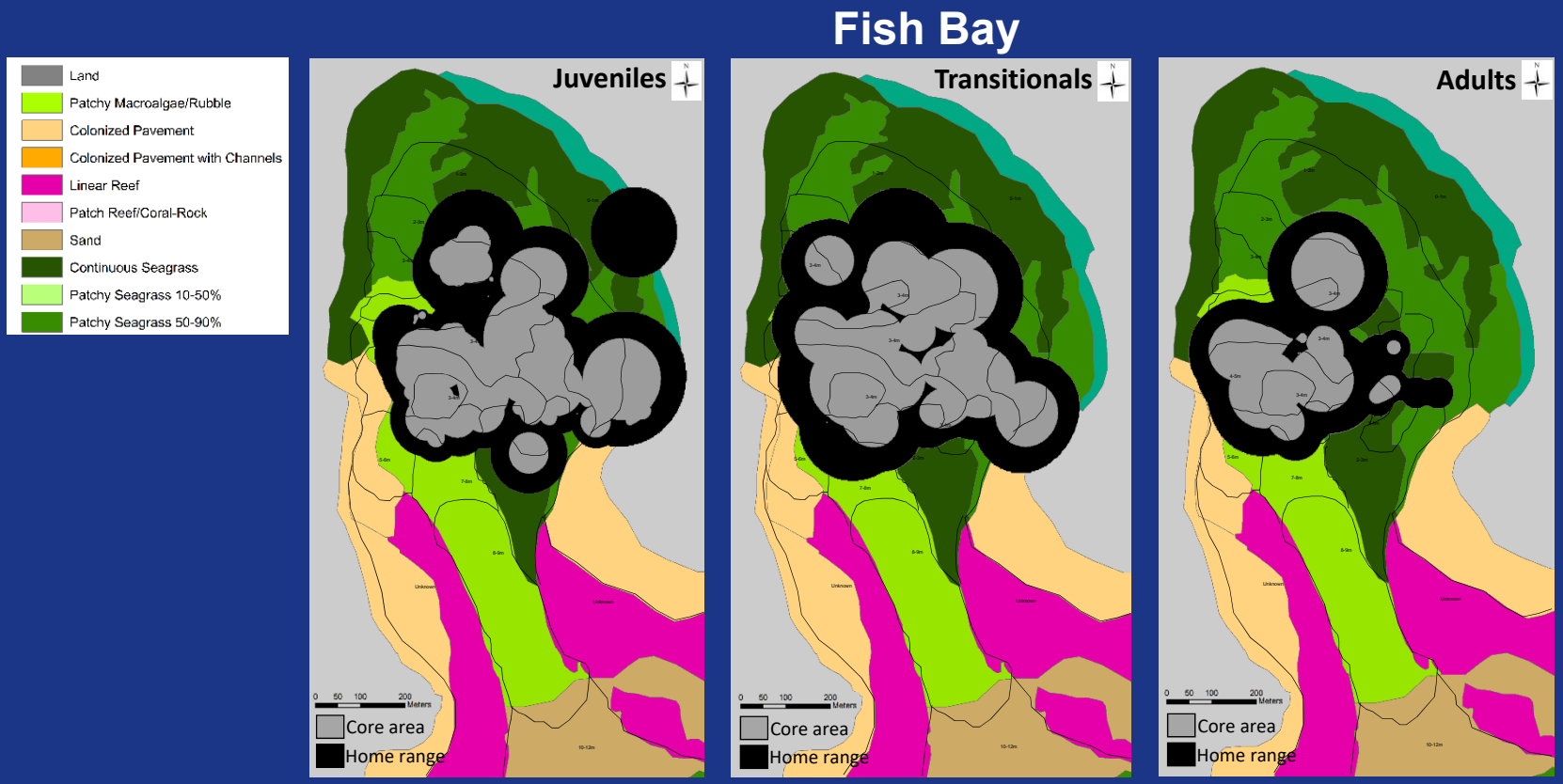
Summary…

- Size-related differences:
  - *54% of tagged adults migrated out*
    - 69% in macroalgae habitats
  - *95% of tagged juveniles remained*
    - 70% in mixed seagrass habitats

- Equipment limitations:
  - *shallow water and benthic animals*
  - *topographic variability*
  - *ambient noise limits tag detections*
  - *tag and hydrophone failure*

Home Range/Habitat Use

- Juveniles: 30% macroalgae, 70% seagrass, 1-3 m
- Adults: 69% macroalgae, 2-9 m
- Shift in habitat use patterns during maturation



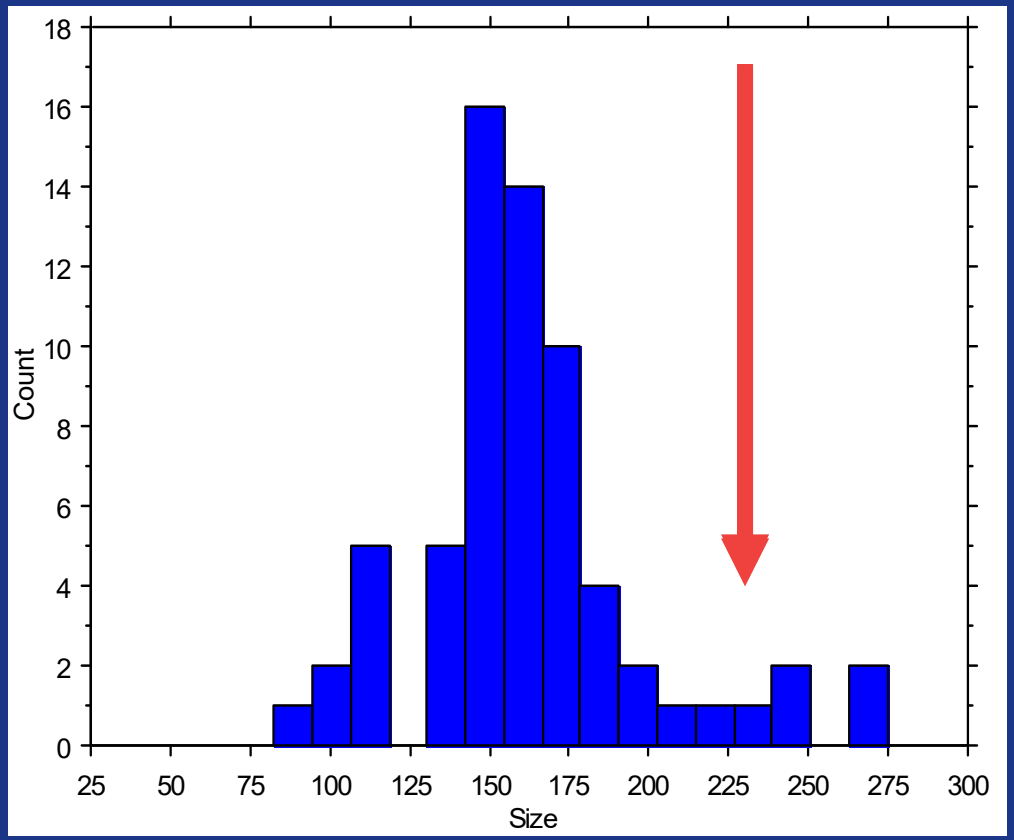


Figure 5. Length frequency of conch tagged in shallow-water habitats of Fish Bay dominated by **seagrasses with patchy macroalgae**. Size is expressed in mm, mean shell length is 161 mm.

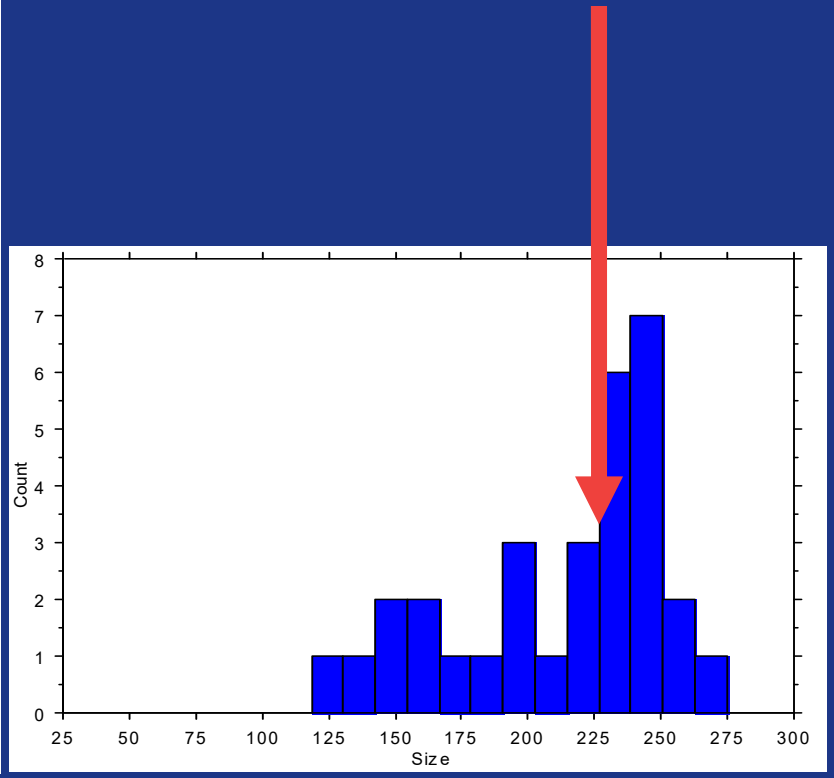
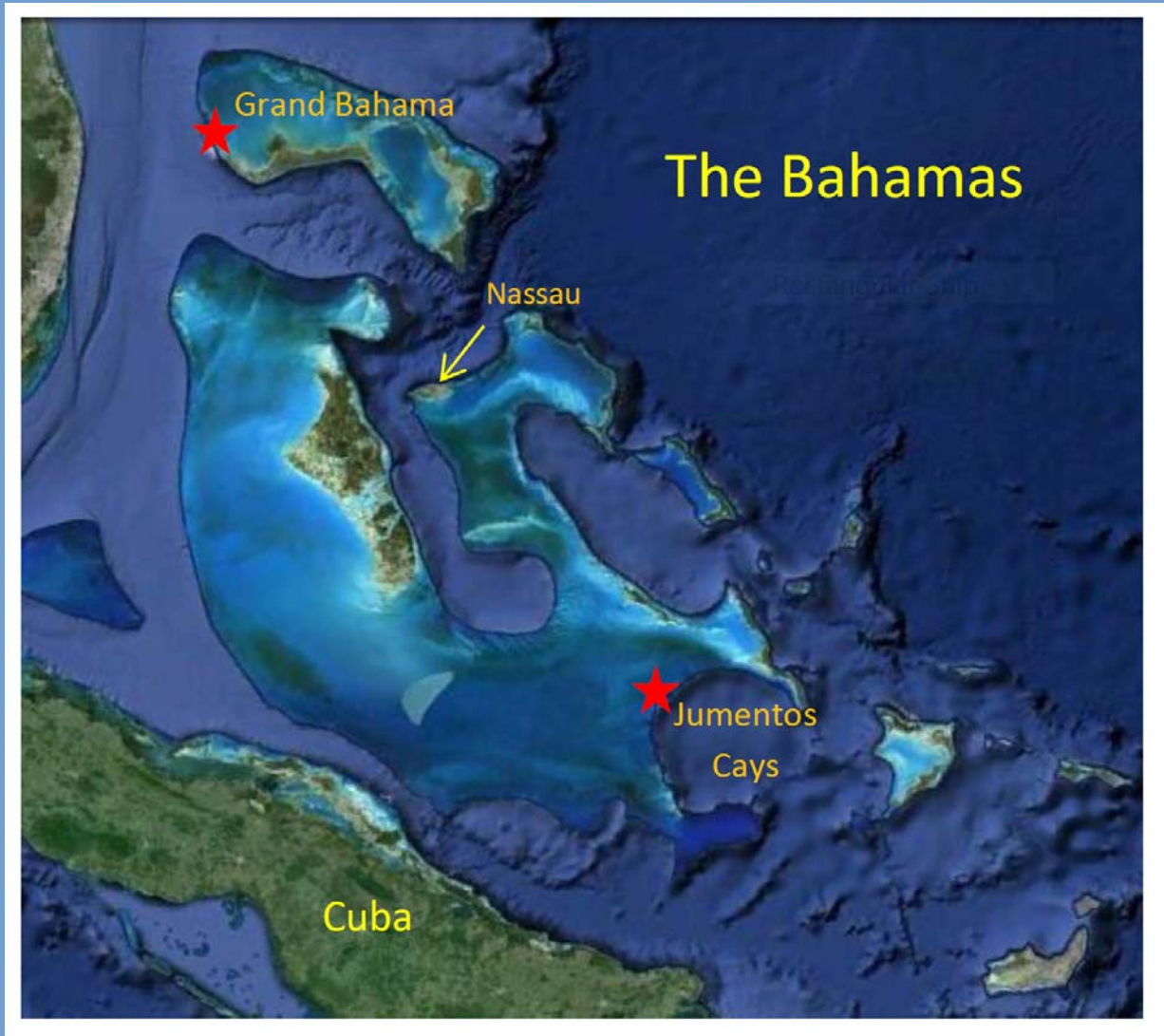


Figure 6. Length frequency of conch tagged in deep-water habitats of Fish Bay dominated by **sand and mixed macroalgae with sparse seagrass**. Size is expressed in mm, mean shell length is 213 mm.

Genetic Structure



Attributed toTruelove et al. 2017