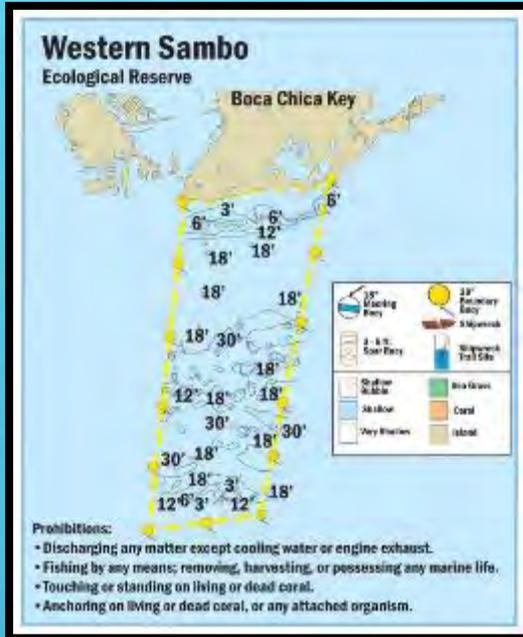


# Performance Evaluation of the Western Sambo Ecological Reserve: Spiny Lobster



## FKNMS Advisory Council

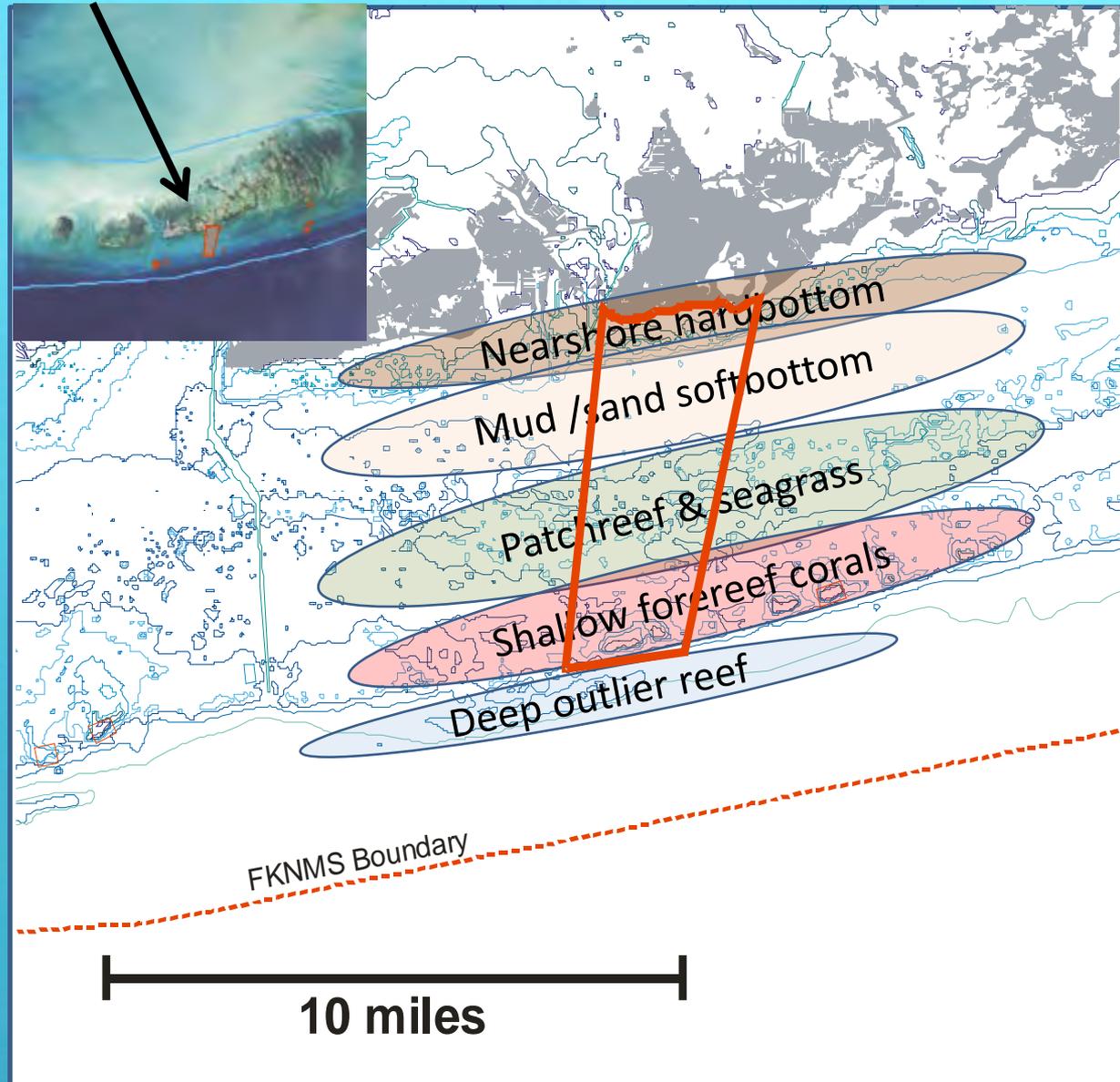
Tuesday, April 16, 2019



Florida Fish and Wildlife Conservation Commission  
Fish and Wildlife Research Institute

# Western Sambo Ecological Reserve

- Established in 1997
- 11.6 square miles
- Intended to protect large areas of contiguous and diverse habitats
- Intended to protect permanent-residence areas for sustainable populations of fish and other marine life

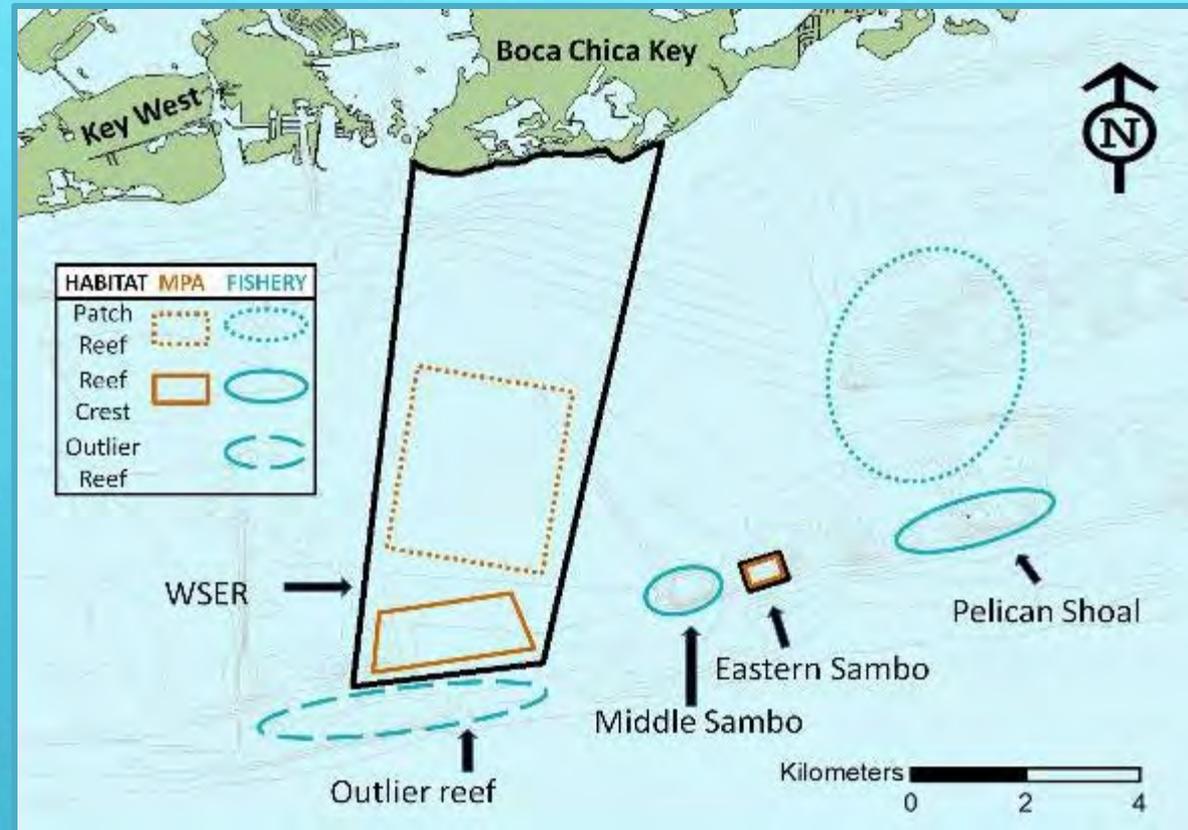


# Overview of lobster research in WSER

- 1997 to 2012. Surveys of lobster inside and outside WSER to collect density, sex ratio, and size data
- 2001 and 2003. Measure lobster age inside and outside WSER
- 2003 to 2012. Evaluate lobster emigration movement within WSER using acoustic telemetry



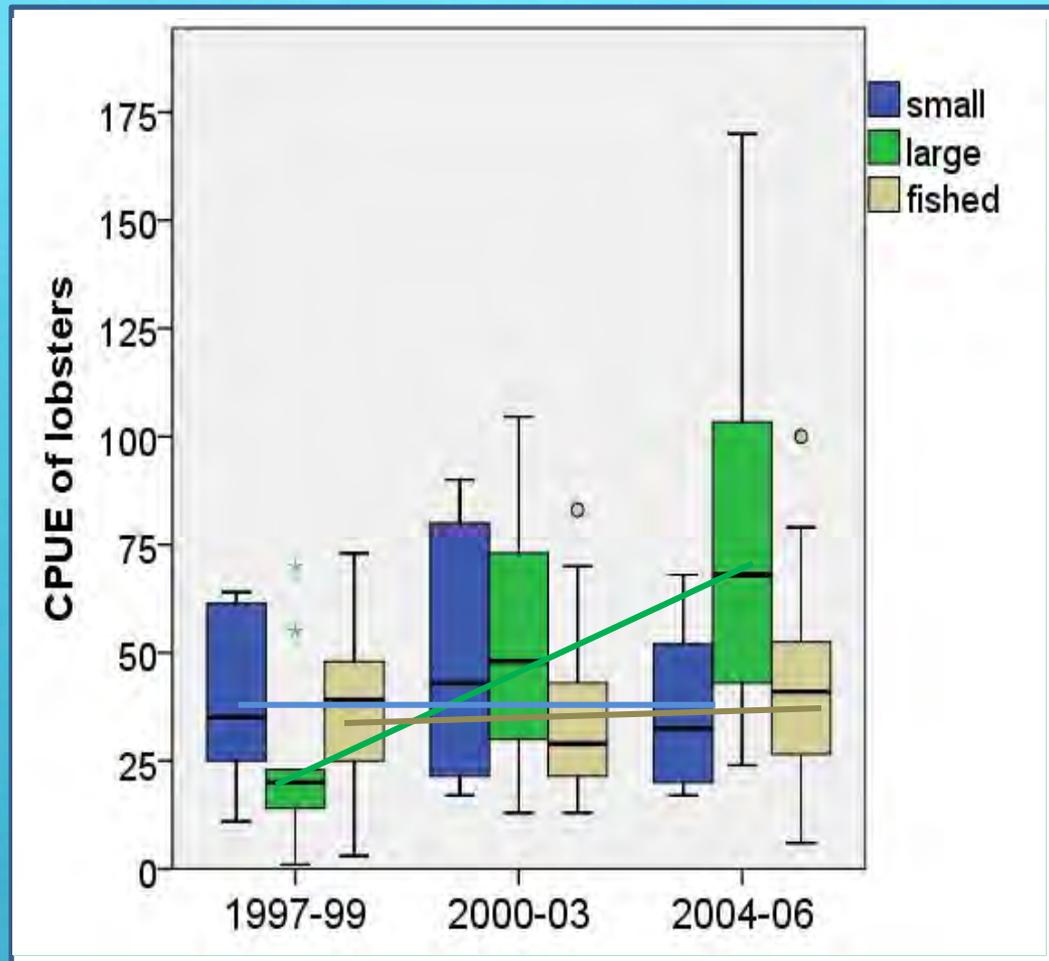
# Lobster survey locations



- Compared spiny lobster density, sex ratio, and size structure in WSER to an adjacent no-take marine reserve and nearby fished areas from 2007 to 2012

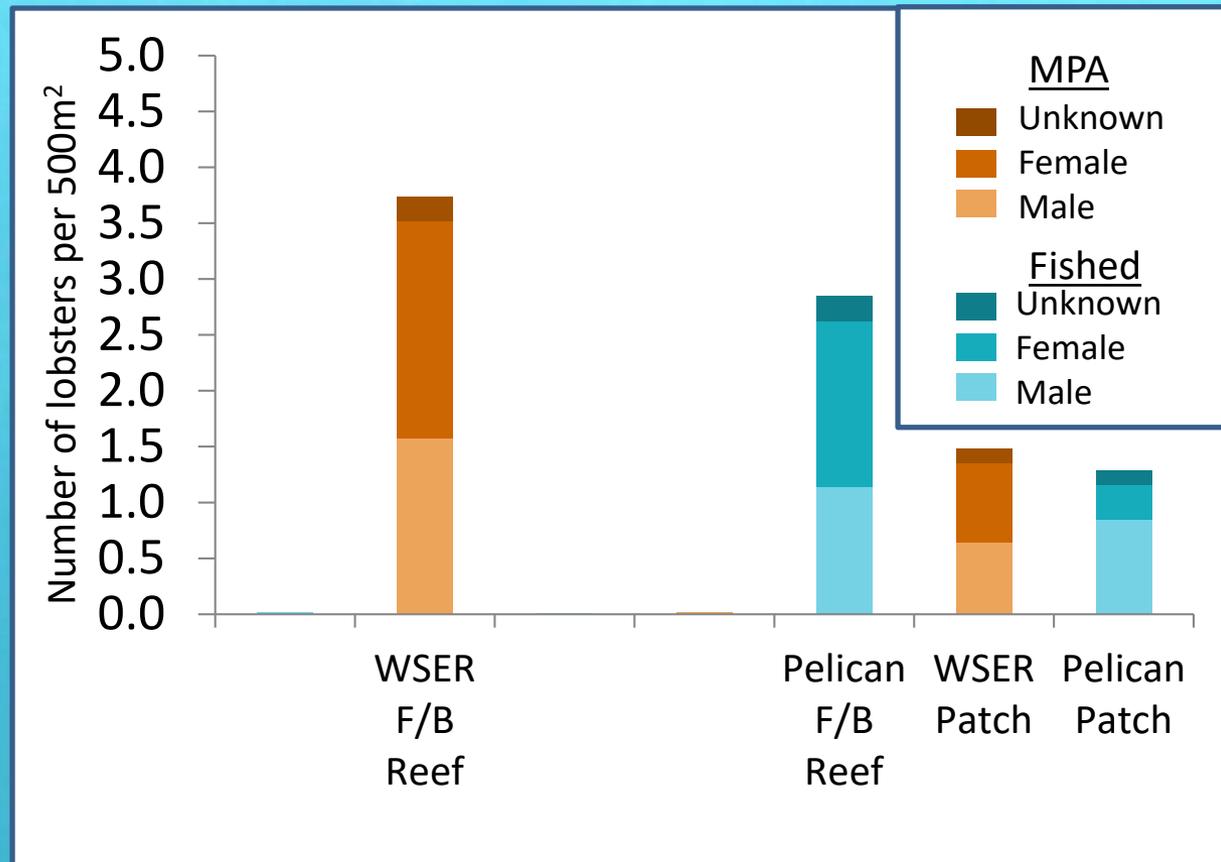
# Lobster abundance after protections

- Abundance of lobster on fore reefs measured by diver catch rate during the closed fishing season.
- Relative abundance of lobsters increased at the in WSER
- No change in lobster abundance in small SPAs or ROs and fore reefs open to fishing
- The size of WSER reserve (31 km<sup>2</sup>) was the major difference with small reserves (0.3-1.2 km<sup>2</sup>),



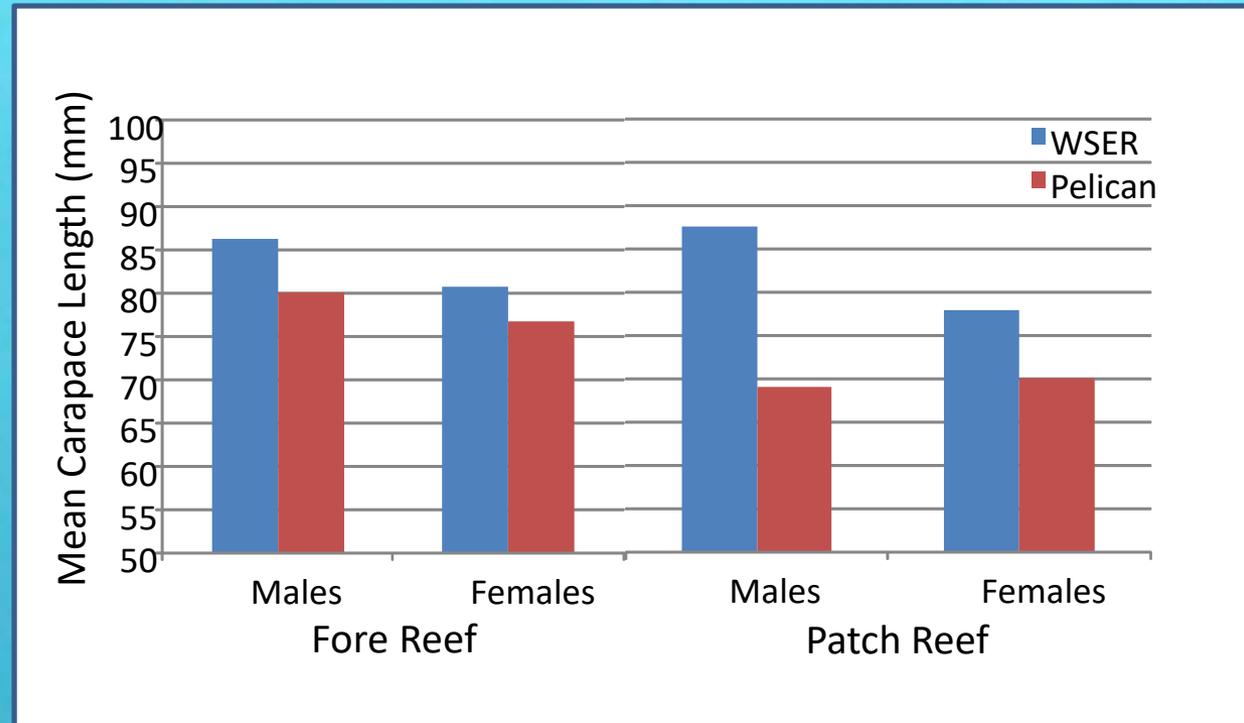
# Lobster abundance after 10 years: 2007 to 2012

- Abundance of lobster on fore reefs seen by divers in a fixed area.
- Lobster abundance varied without trend after 2004 .
- Abundance in WSER 32% and 20% higher
- Small male lobsters more common in Pelican patch reefs



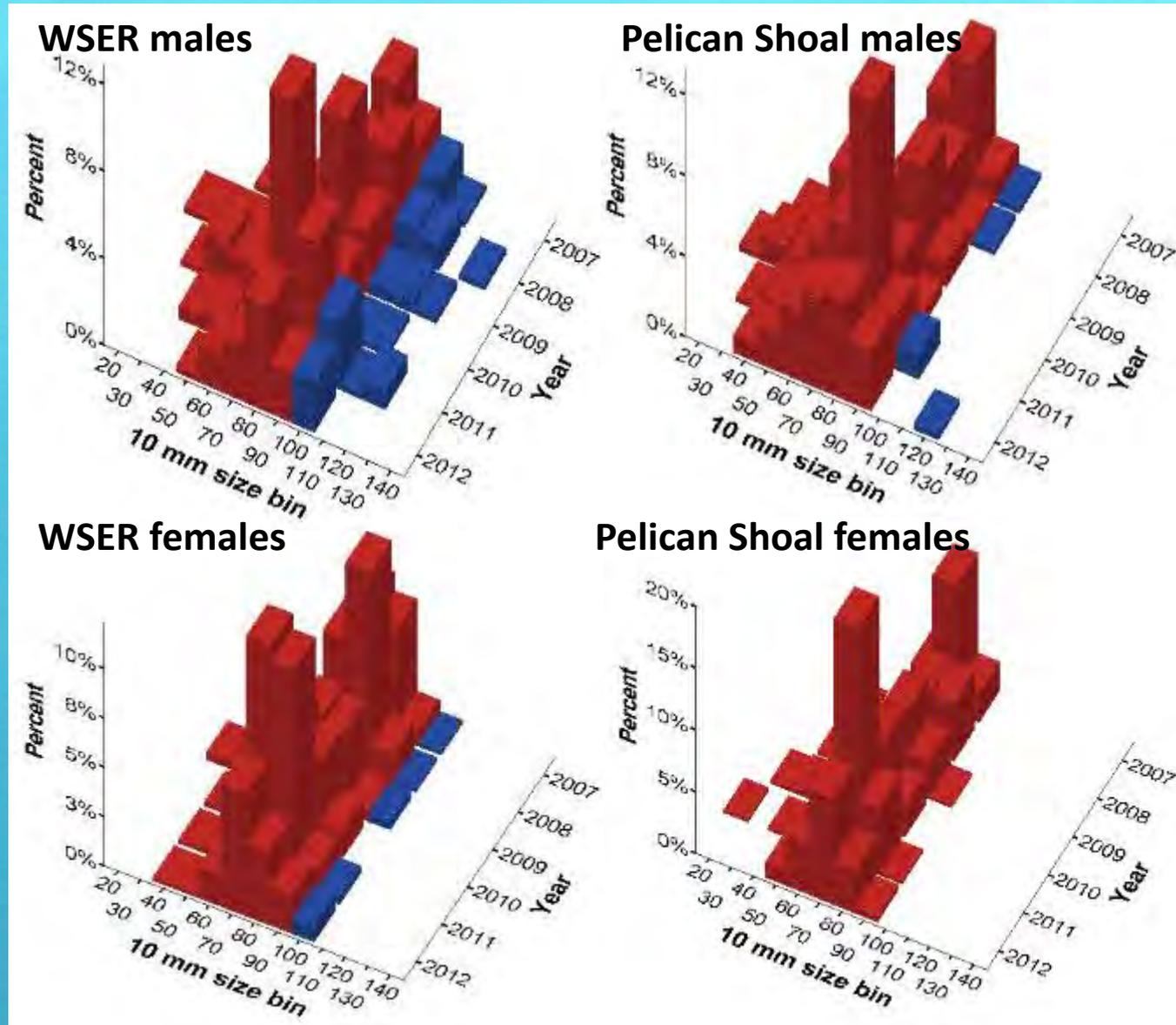
# Lobster Size after 8 to 15 years 2004 to 2012

- Lobsters of both sexes were larger in WSER
- Most lobsters are below legal size.
- Within WSER patch reefs, largest male lobsters were typically observed on patch reefs



# Comparison of size structure in WSER and Pelican Shoal 2007-2012

- Lobsters larger than 100-mm carapace length were more common in WSER
- Size has reached equilibrium
- Large females were uncommon



# Aging lobster with neurolipofuscin

- Neurolipofuscin is undegradable cellular material that accumulates with physiological age, and is thus a hallmark of aging

Maxwell, K.E., Matthews, T.R., Sheehy, M.R.J., Bertelsen, R.D., Derby, C.D., 2007. Neurolipofuscin is a measure of age in the Caribbean spiny lobster, *Panulirus argus*, in Florida. Biol. Bull. 213, 55–66.

Maxwell, K.E., Matthews, T.R., Bertelsen, R.D., Derby, C.D., 2013. Age and size structure of Caribbean spiny lobster, *Panulirus argus*, in a no-take marine reserve in the Florida Keys, USA. Fish. Res., 144, 84-90.

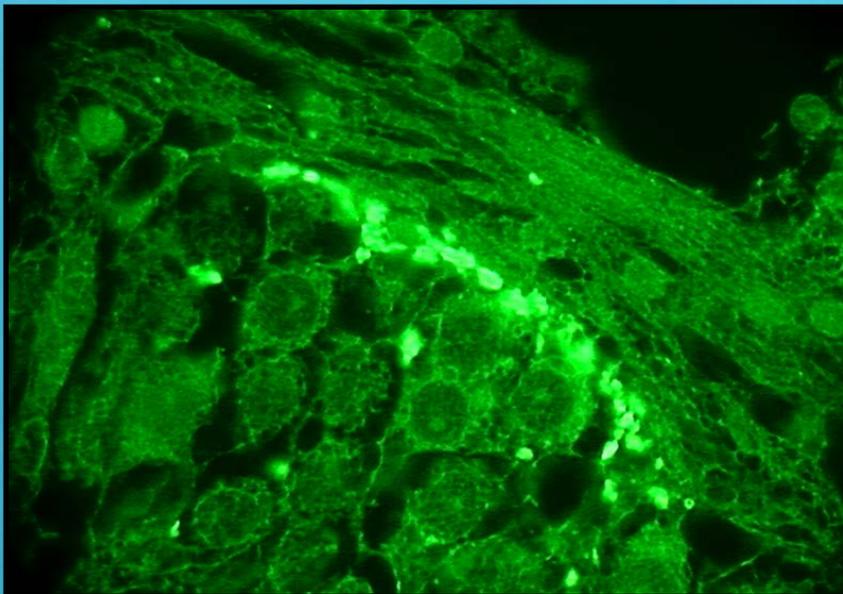
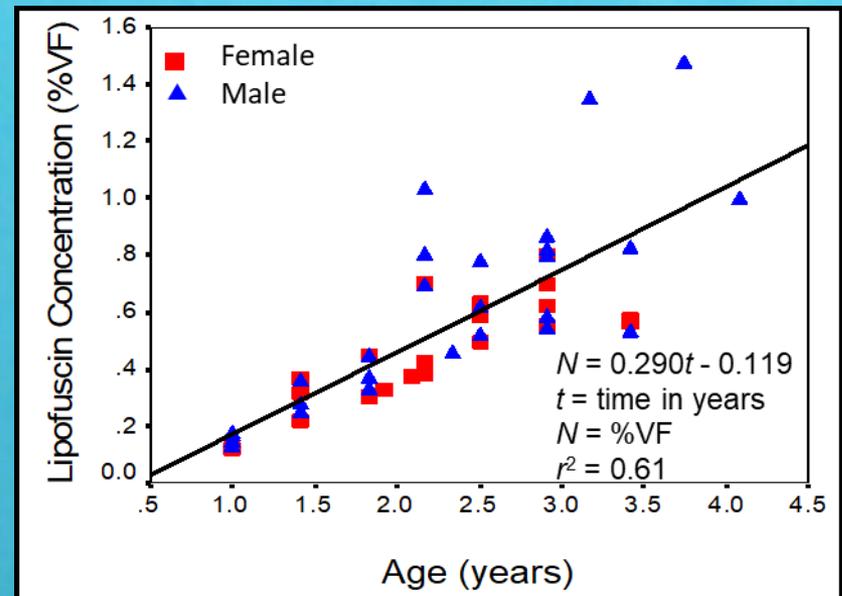


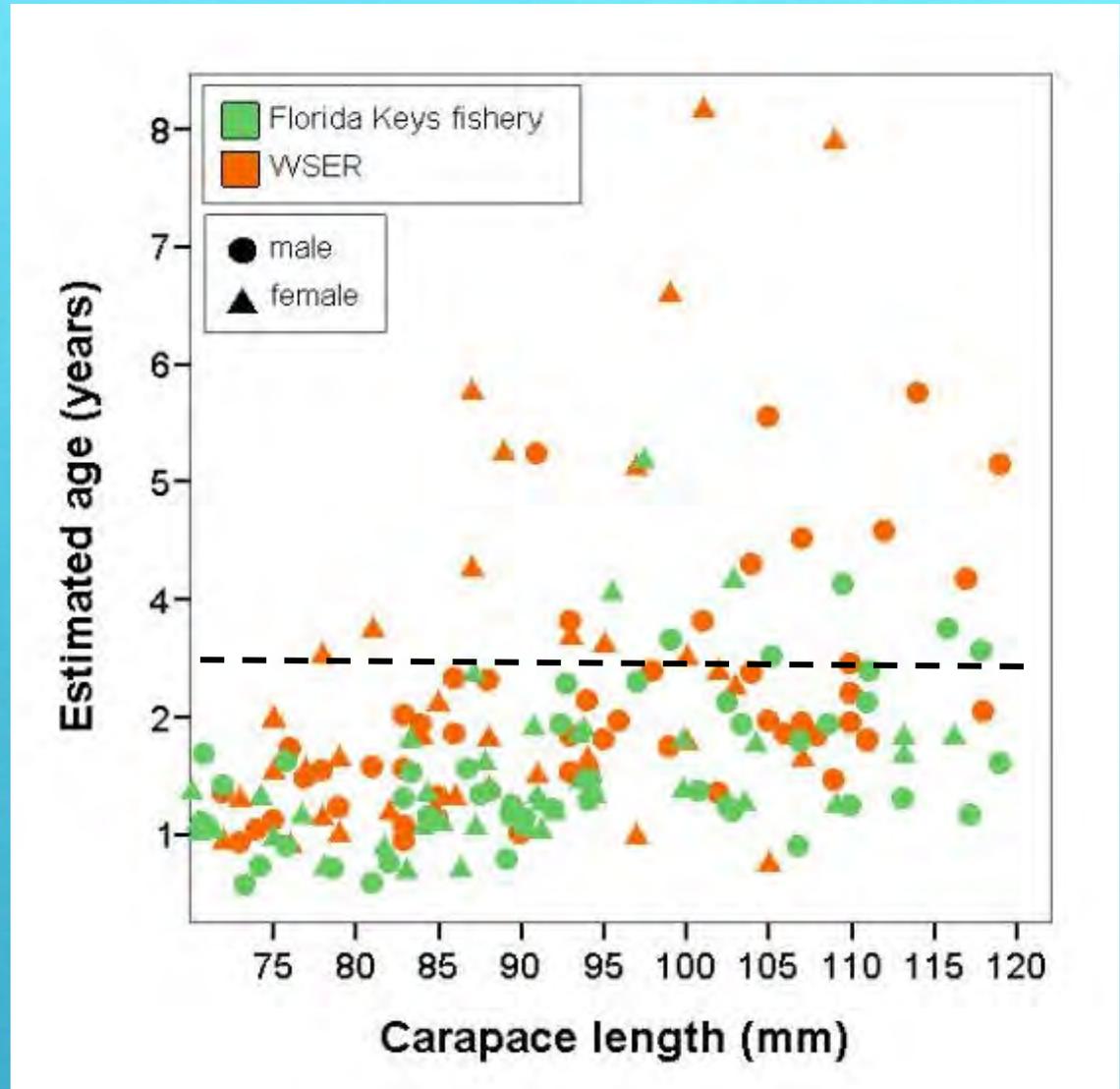
Image of fluorescing neurolipofuscin



Age : Neurolipofuscin relationship

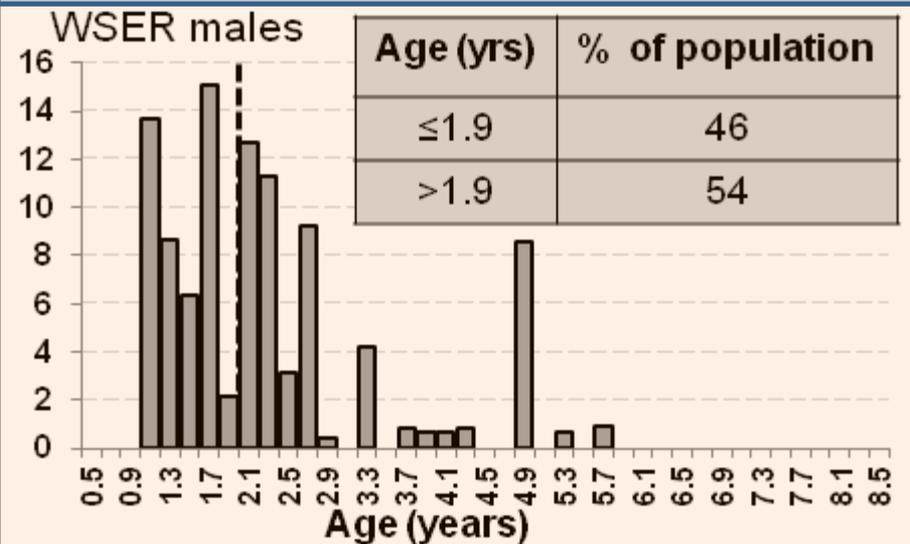
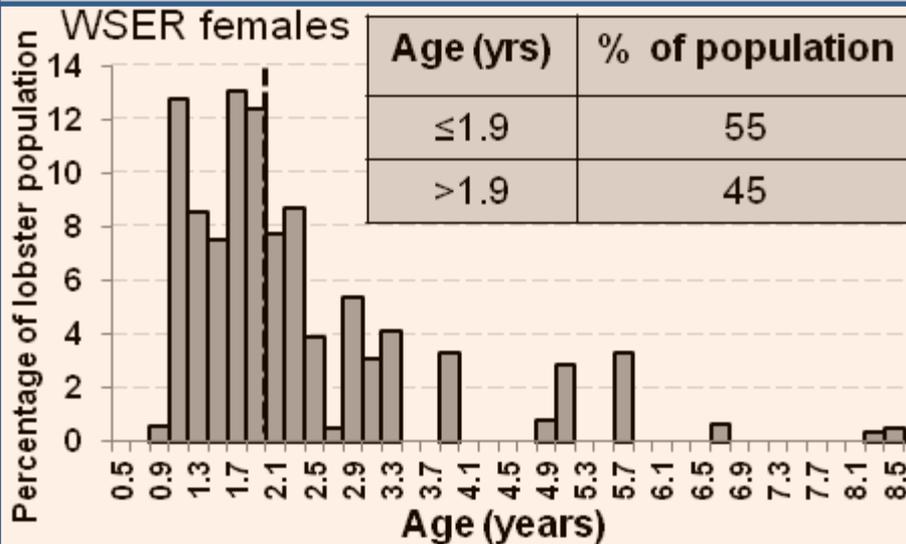
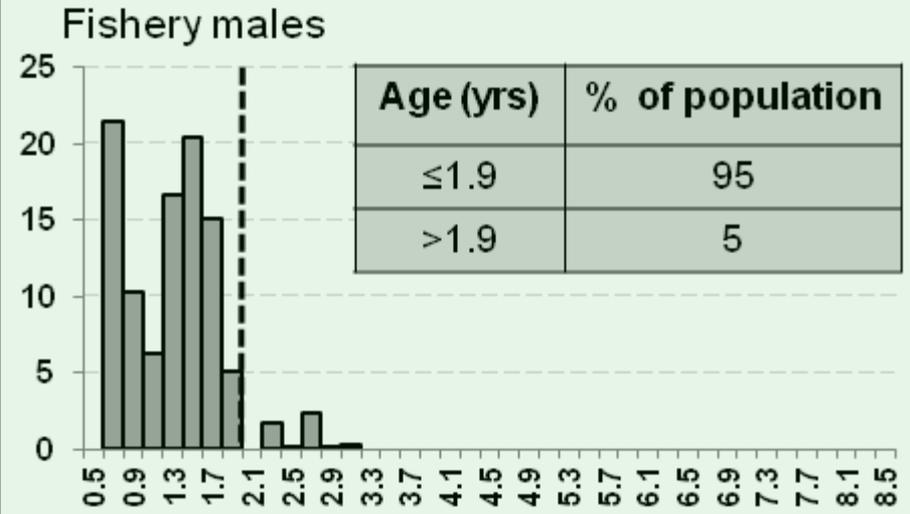
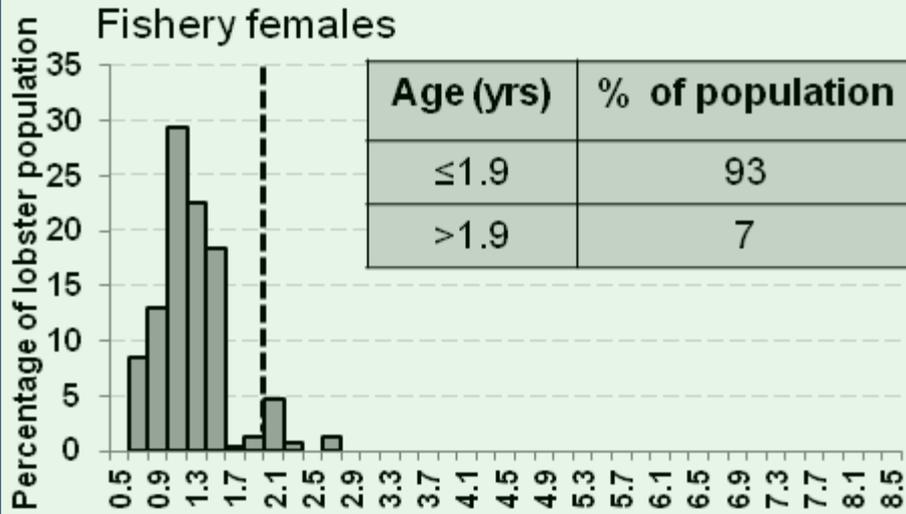
# Lobster Age and Size in 2003

- WSER lobsters were significantly older than fishery lobsters
- Most lobsters are less than 3 years age at all locations
- Lobster >3 years age 3x more abundant in WSER

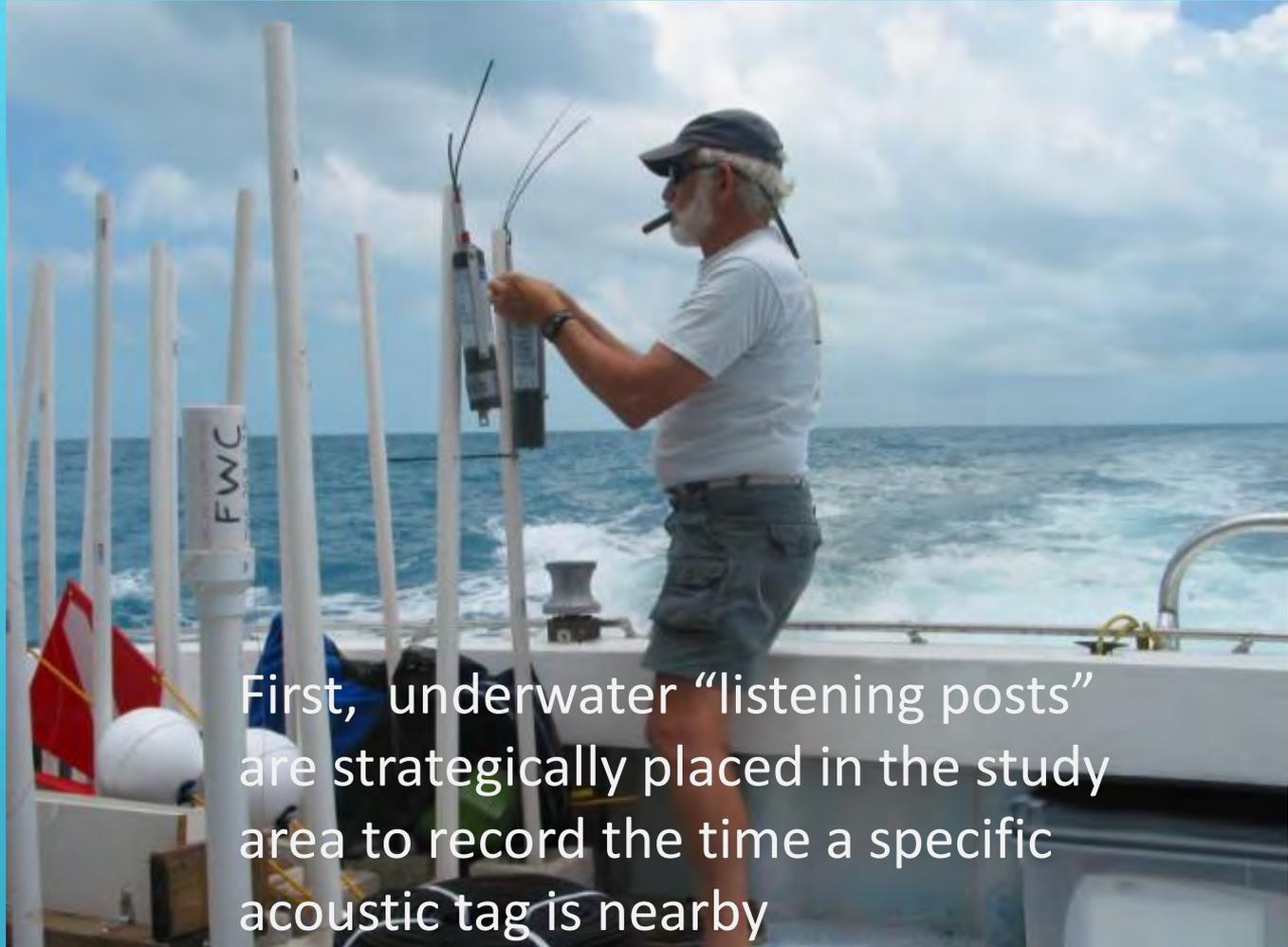


Location	Average est. age	Standard Deviation
WSER	2.33	1.46
Fished areas	1.56	0.78

# Age Distributions for Fishery and WSER

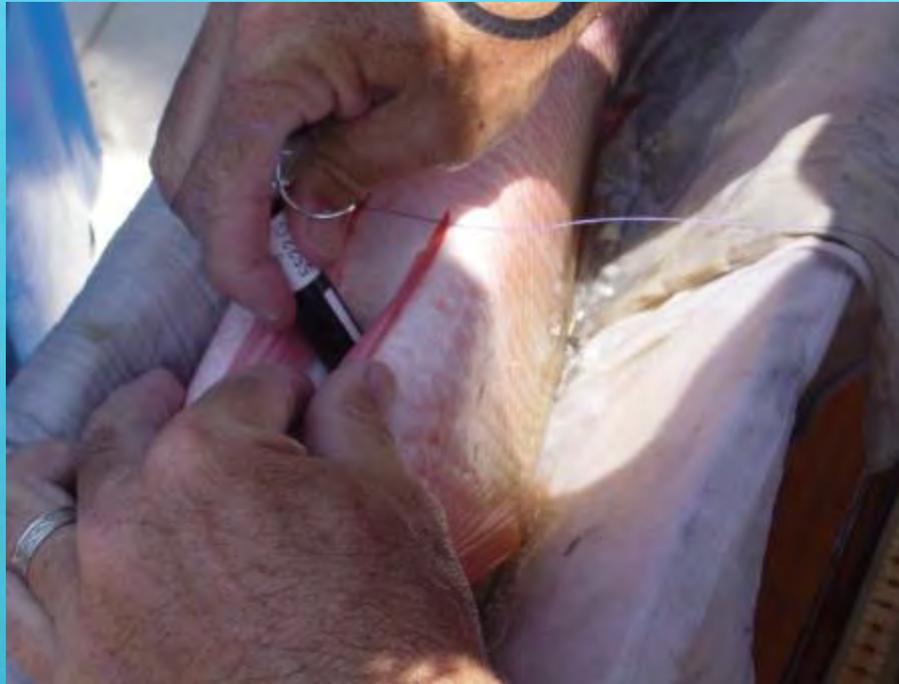


# Acoustic Tracking of Caribbean Spiny Lobsters and Fish in WSER



First, underwater “listening posts” are strategically placed in the study area to record the time a specific acoustic tag is nearby

# Acoustic Tracking of Caribbean Spiny Lobsters and Fish in WSER



Then, acoustic tags are placed externally on the back of lobsters; surgically inserted internally in the abdominal cavity of fish



# Acoustic Tracking of Caribbean Spiny Lobsters and Fish in WSER

Next, the fish and lobsters are released into their habitat

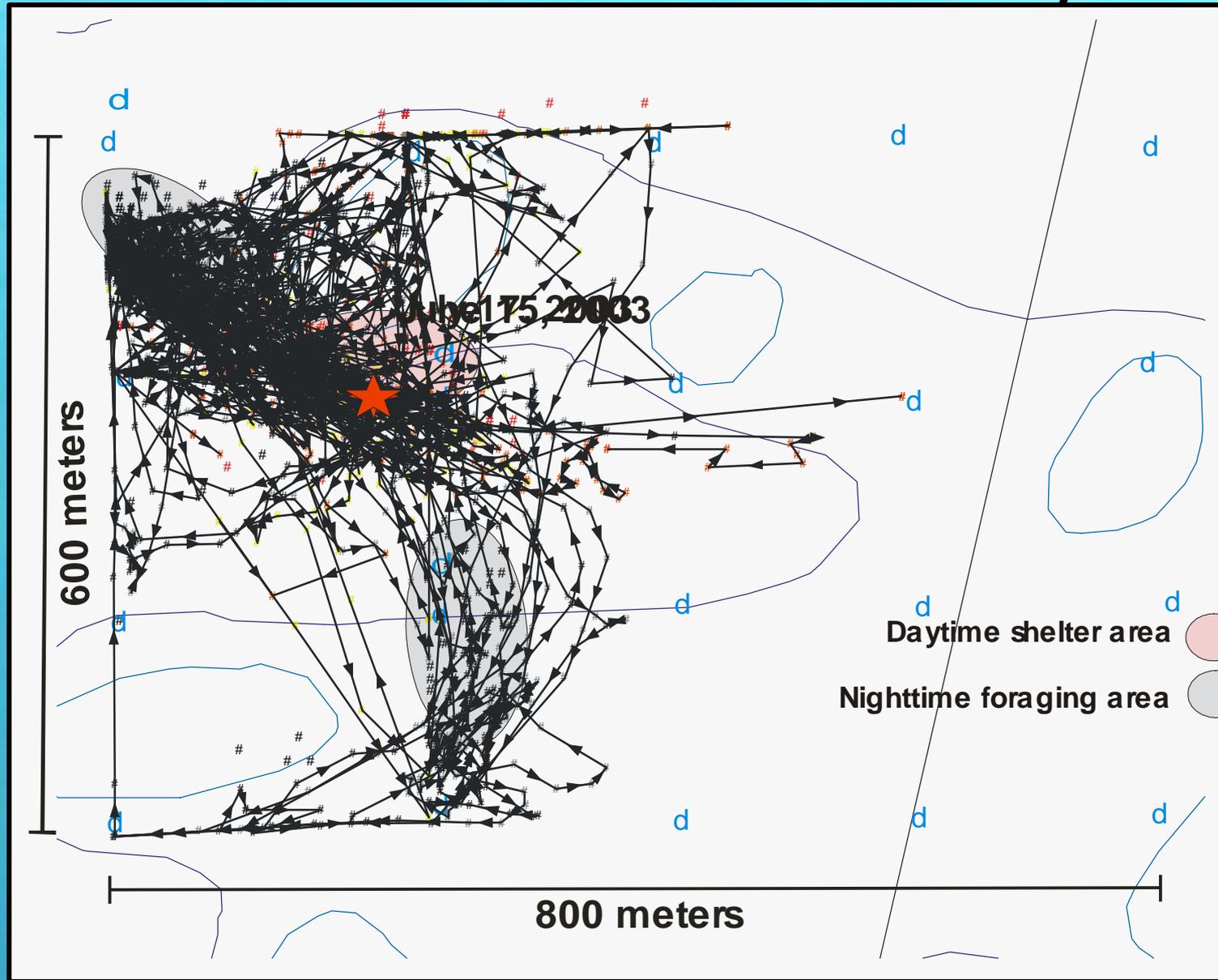


# Acoustic Tracking of Caribbean Spiny Lobsters and Fish in WSER

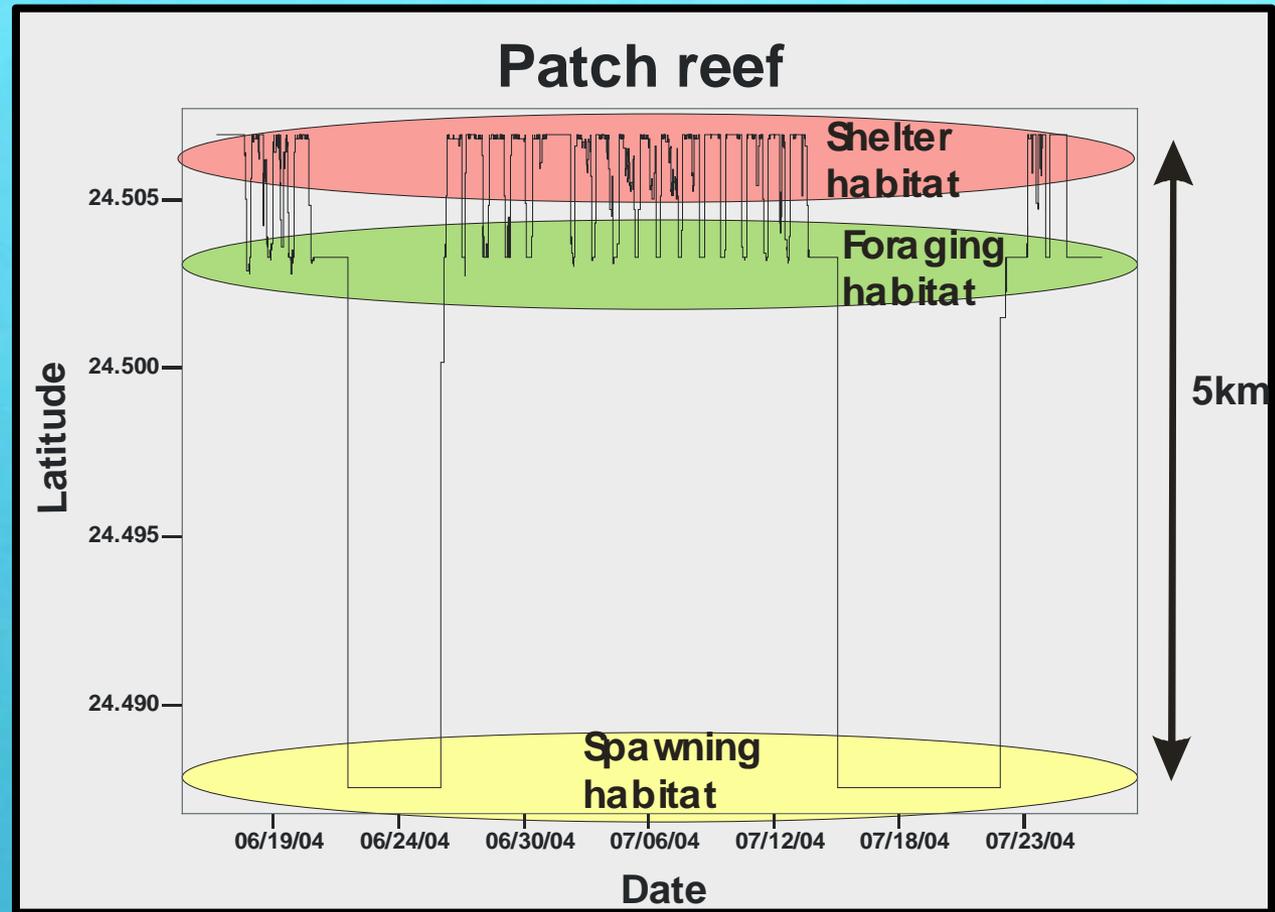
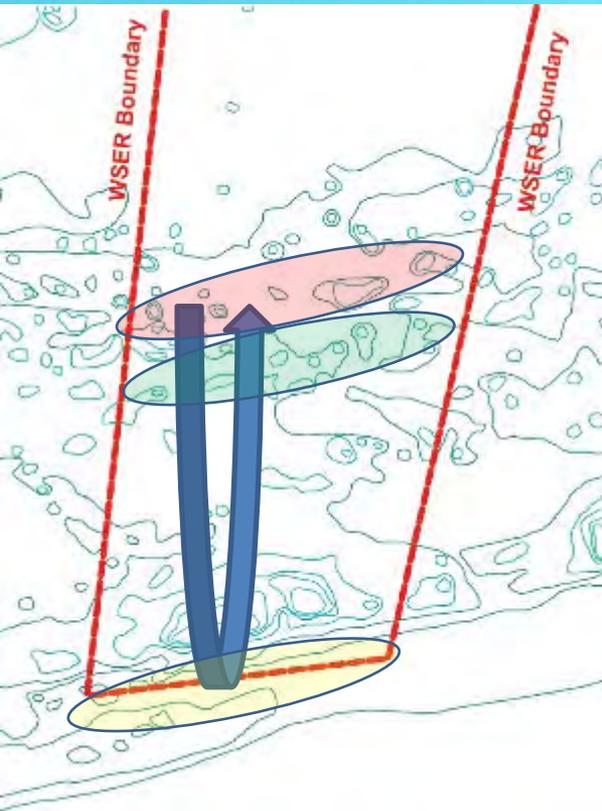
Later, the receivers are recovered to download data



# Lobster Movement – 32 days

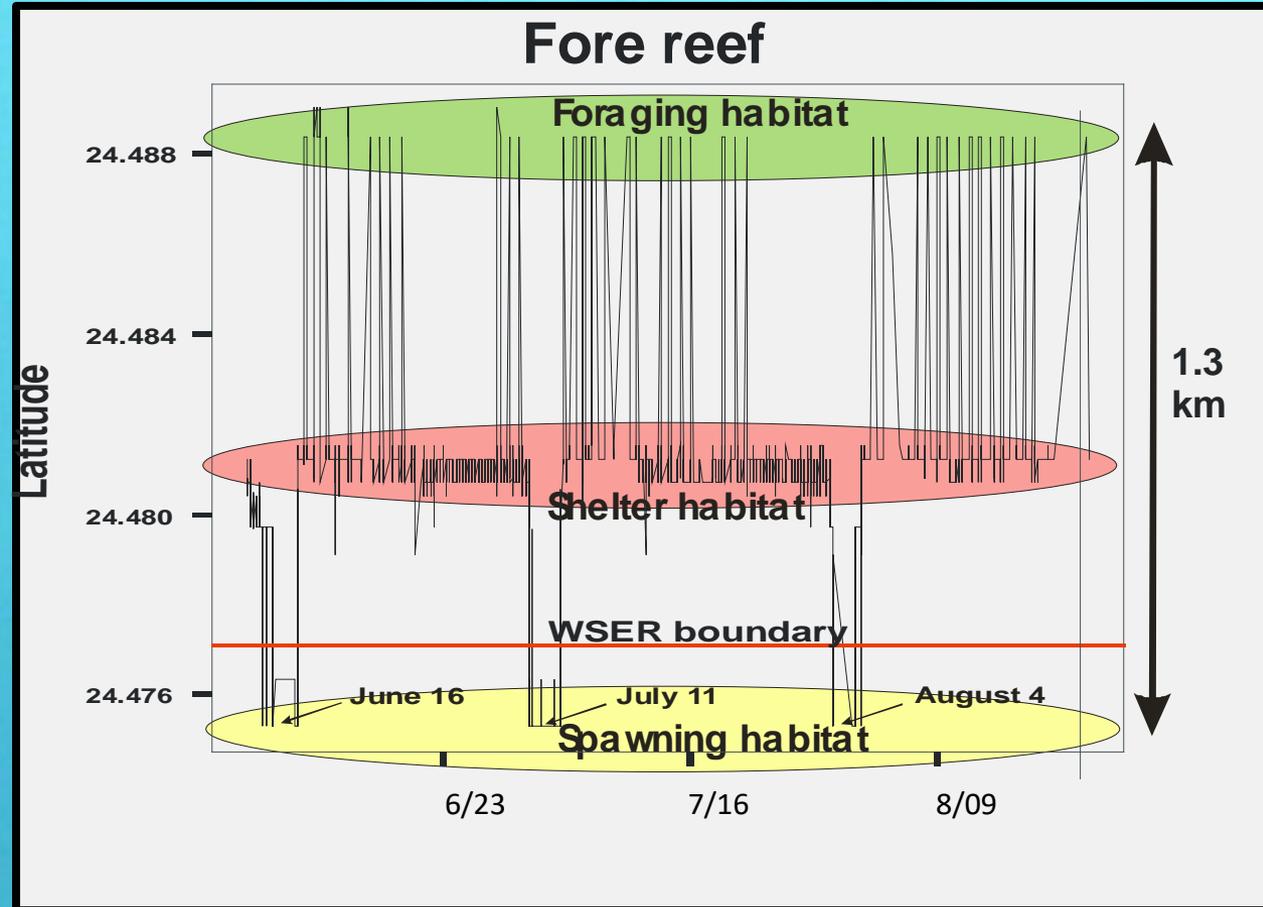


# Patch Reef Connectivity



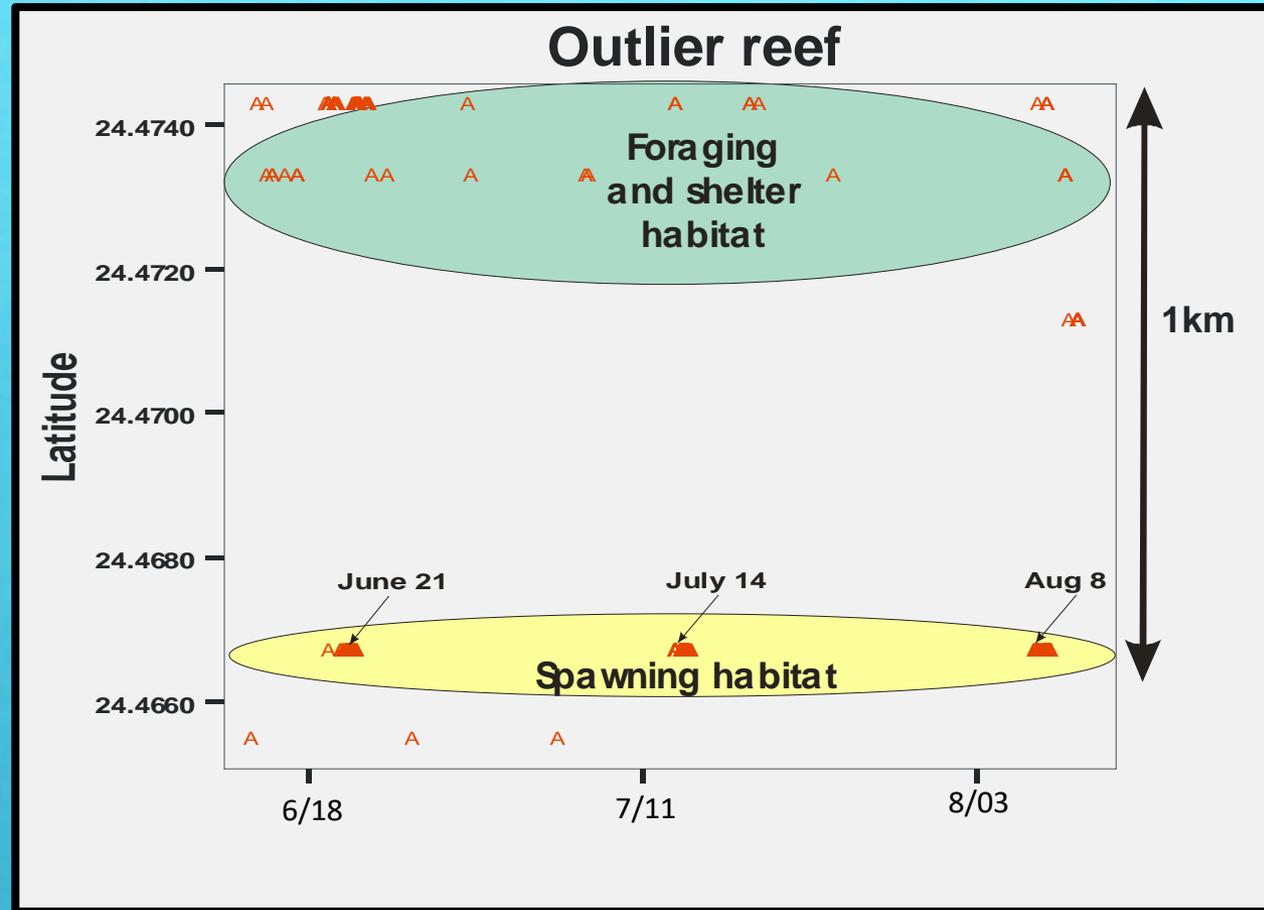
Egg-bearing female lobsters commonly tracked moving to and from sheltering and foraging habitat and periodically offshore to spawn

# Fore Reef Connectivity



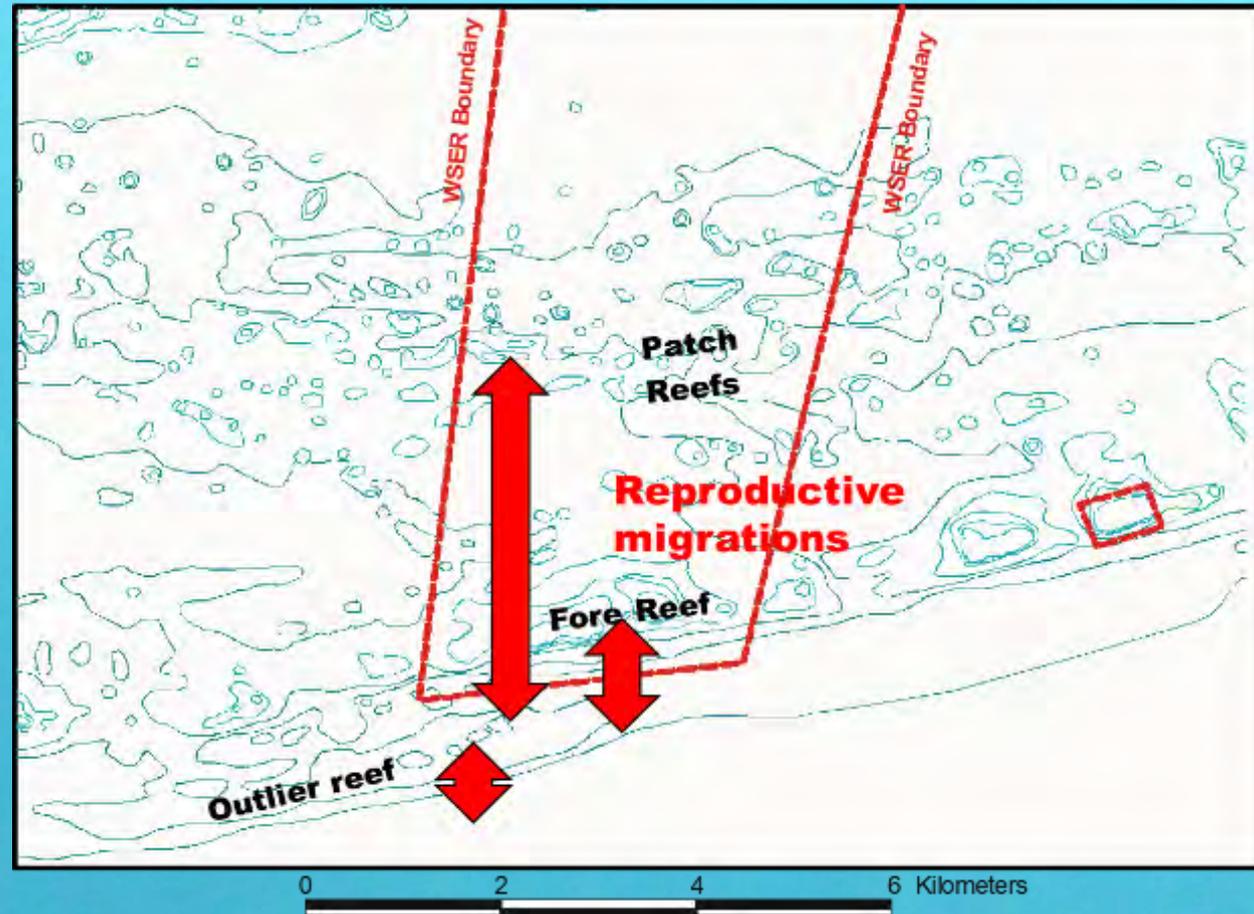
Egg-bearing female lobsters commonly tracked moving to and from sheltering and foraging habitat and periodically offshore to spawn

# Outlier Reef Connectivity



# Summary of reproductive movement

- Female lobsters migrate to more oceanic water to spawn
- Many female lobsters leave the WSER to spawn
- The N-S migration may be related to the increased age of female lobsters.



# Conclusions

- Level of protection provided by the WSER for lobsters was directly related to reserve size, configuration, habitat, and the life history characteristics of lobsters.
- Abundance of lobsters in the WSER remains dependent on annual variation in the Keys wide population
- After 6 years of protection about 30% the lobsters in WSER had received at least 1 year of protection and 17% received 2 to 4 years of protection
- Lobsters utilized multiple habitats for shelter and foraging each day. Additionally, female lobsters utilize offshore habitats for spawning.
- Increased size of male lobsters and increased age of female lobsters results in increased number of eggs per clutch, more clutches per lobster, and earlier spawning.
- Increased size of male lobsters may reduce male abundance during the reproductive season.

# Study Organism

## Caribbean Spiny Lobster

