Fish Aggregations

1

Reproduction in Reef Fish

Reproductive Styles: Aggregations v. Paired Spawning

2

Reproduction in Reef Fish

Groupers: hermaphrodites, thought to be aggregate spawners

Female to Male

Snappers: aggregate in small to very large groups depending on species

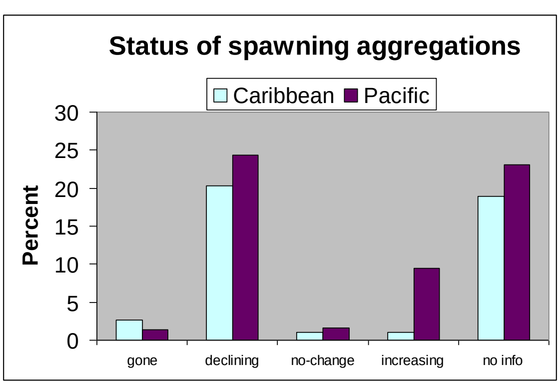
Wrasses: hermaphrodites, spawn in harems of one male and multiple females

3

SPAWNING AGGREGATIONS

1. Predictable timing and location
2. Majority of spawning population participates
3. Primary source of annual reproductive output
4. Extremely vulnerable to over fishing

4



5

Conservation of spawning aggregations

- Illusion of plenty and perceived as fishing opportunity
- Not recognized as vulnerable and in need of management
- Provides an opportunity to protect the spawning stock of a population
- Not typical in conventional fisheries management
- Usually not factored into MPA planning

Species which form spawning aggregations

- **Slow growth rates**
- **Late sexual maturity**
- **Small-large home-range size as adults**
- **Long-distance migrations**
- **Complex life cycle**
- **hermaphroditism**

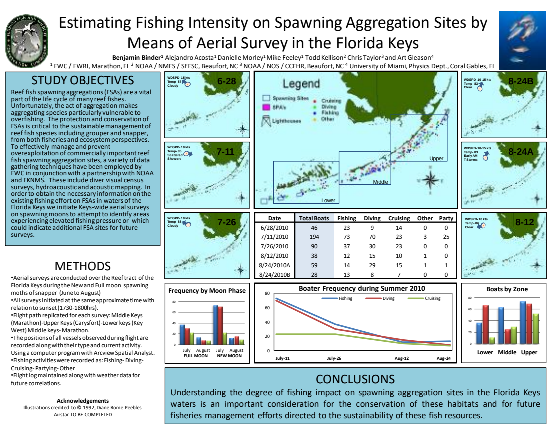
Sadovy, 2010

6

When ?

7

8



Estimating Fishing Intensity on Spawning Aggregation Sites by Means of Aerial Survey in the Florida Keys

Benjamin Binder[1] Alejandro Acosta[1] Danielle Morley[1] Mike Feeley[1] Todd Kellison[2] Chris Taylor[3] and Art Gleason[4]
[1] FWC / FWRI, Marathon, FL [2] NOAA / NMFS / SEFSC, Beaufort, NC [3] NOAA / NOS / CCFHR, Beaufort, NC [4] University of Miami, Physics Dept., Coral Gables, FL

STUDY OBJECTIVES

Reef fish spawning aggregations (FSAs) are a vital part of the life cycle of many reef fishes. Unfortunately, the act of aggregation makes aggregating species particularly vulnerable to overfishing. The protection and conservation of FSAs is critical to the sustainable management of reef fish species including grouper and snapper, from both fisheries and ecosystem perspectives. To effectively manage and prevent overexploitation of commercially important reef fish spawning aggregation sites, a variety of data gathering techniques have been employed by FWC in conjunction with a partnership with NOAA and FKNMS. These include diver visual census surveys, hydroacoustic and acoustic mapping. In order to obtain the necessary information on the existing fishing effort on FSAs in waters of the Florida Keys we initiate Keys-wide aerial surveys on spawning moons to attempt to identify areas experiencing elevated fishing pressure or which could indicate additional FSA sites for future surveys.

METHODS

- •Aerial surveys are conducted over the Reef tract of the Florida Keys during the New and Full moon spawning moths of snapper (June to August)
- •All surveys initiated at the same approximate time with relation to sunset (1730-1800hrs).
- •Flight path replicated for each survey: Middle Keys (Marathon)-Upper Keys (Carysfort)-Lower keys (Key West) Middle keys- Marathon.
- •The positions of all vessels observed during flight are recorded along with their type and current activity. Using a computer program with Arcview Spatial Analyst.
- •Fishing activities were recorded as: Fishing- Diving- Cruising- Partying- Other
- •Flight log maintained along with weather data for future correlations.

Acknowledgements
Illustrations credited to © 1992, Diane Rome Peebles
Airstar TO BE COMPLETED

Date	Total Boats	Fishing	Diving	Cruising	Other	Party
6/28/2010	46	23	9	14	0	0
7/11/2010	194	73	70	23	3	25
7/26/2010	90	37	30	23	0	0
8/12/2010	38	12	15	10	1	0
8/24/2010A	59	14	29	15	1	1
8/24/2010B	28	13	8	7	0	0

CONCLUSIONS

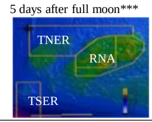
Understanding the degree of fishing impact on spawning aggregation sites in the Florida Keys waters is an important consideration for the conservation of these habitats and for future fisheries management efforts directed to the sustainability of these fish resources.

9

Observations of Mutton Snapper on Riley's Hump

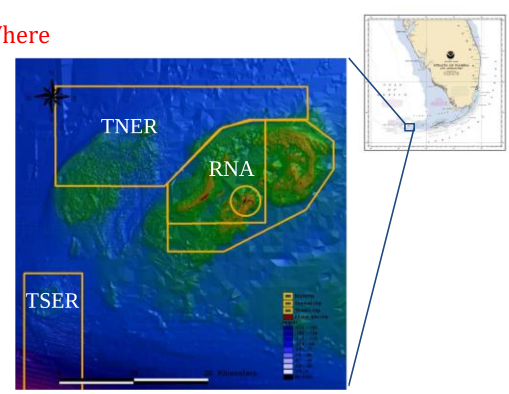
Date and Station	Numbers observed	Moon phase
28 May−1 June 1999	1 fish in 3 of the 11 dives	Full moon May 30*
31 July−3 Aug 2000	1 fish in 5 of the 6 dives	New moon July 30*
17 July 2001 Station 2	10	3 days before new moon*
27 May 2002 Station 2	75 -100	1 day after full moon*
15 June 2003 Station 2	75 -100	1 day after full moon*
15 June 2003 Station 12	200 +	1 day after full moon*
4 July 2004 Station 12	300	2 days after full moon*
3 July 2007 Station 12	100 +	3 days after full moon**
12 June 2009 (1415-1715 hrs)	~4000	5 days after full moon***

•From: Burton ML, Brennan KJ, Muñoz RC, Parker RO Jr (2005) Preliminary evidence of increased spawning aggregations of mutton snapper (*Lutjanus analis*) at Riley's Hump two years after establishment of the Tortugas South Ecological Reserve. Fish Bull 103:404–410.
** Mike Burton's Trip report
*** FWC current study



10

Where



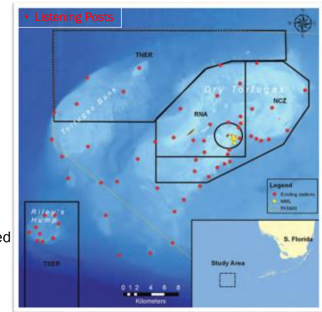
11

Mutton Snapper Spawning at Riley's Hump

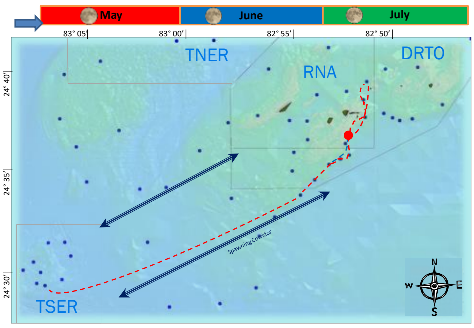
12

Tagging of Mutton Snapper

- *Regional connectivity of fishes within the Tortugas region of Florida*
  - Riley's Hump is a well known mutton snapper spawning aggregation site
  - Mutton snapper were acoustically tagged within the RNA & Riley's Hump and tracked with a network of underwater 'listening outposts'

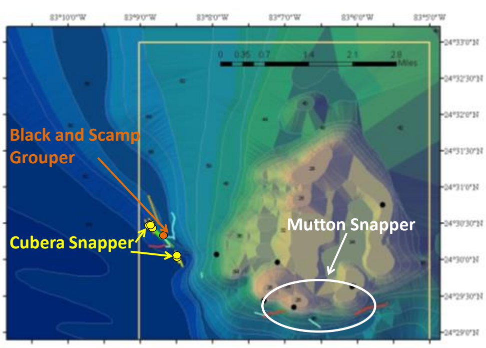


13



15

Utilization of Riley's Hump



16

Multispecies Aggregation Site: Muttons and Triggers

17

Multispecies Aggregation Site: Grouper

18

Multispecies Aggregation Site: Cubera Snapper

19

Functional Migration Area

Spatial and temporal scales of transient spawning aggregations

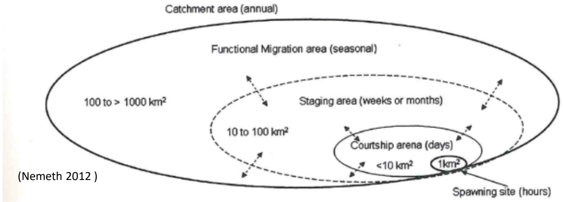
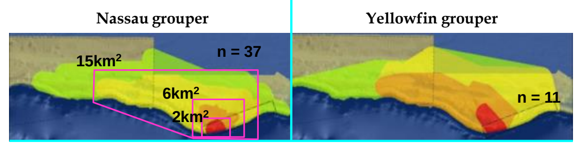


Fig. 2.3 Spatial scales of movement associated with aggregations of group-spawning species (e.g. species that do not defend spawning territories and spawn in mid-water) showing the functional migration area and the four spatio-temporal phases of the reproductive cycle. Spatial scales include the catchment area, staging area, courtship arena and spawning aggregation site

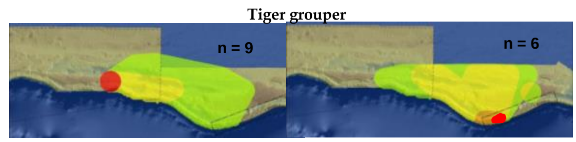
20



Staging area
- feeding
- cleaning stations
- guiding first-time spawners

Courtship arena
- spawning coloration
- courtship behaviors
- aggression

Spawning site (hourly)
- gamete release



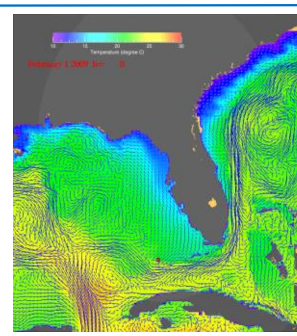
22

Fish Aggregations, Multi-species and Predictable

Species	D	J	F	M	A	M	J	J	A	S	O	N	Source
Black grouper		■	■	■									Domeier and Colin 1997, Eklund et al. 2000
Nassau grouper	■	■	■										Domeier and Colin 1997, Fine 1990, Claro et al 2009
Scamp		■	■										Domeier and Colin 1997
Nassau grouper	■	■	■										Domeier and Colin 1997, Fine 1990, Claro et al 2009
Gag grouper	■	■	■	■	■								Domeier and Colin 1997, Hood and Schlieder 1992
Red hind		■	■	■	■								Domeier and Colin 1997, Beets and Friedlander 1998, Poholek, pers. com.
Goliath grouper	■							■	■	■	■	■	Domeier and Colin 1997, Sadovy and Eklund 1999, NMFS 2006
Yellowtail snapper				■	■	■	■	■	■	■	■		Lindeman et al. 2000, Claro et al 2009
Dog snapper							■	■					Lindeman et al. 2000, RNA report
Mutton snapper					■	■	■	■	■				Domeier and Colin 1997, Lindeman et al. 2000, Claro et al 2009, FWC observations, RNA report
Gray snapper							■	■	■				Domeier and Colin 1997, Lindeman et al. 2000, Claro et al 2009
Schoolmaster							■						Lindeman et al. 2000
Lane snapper						■	■	■					Lindeman et al. 2000, Claro et al 2009, Poholek pers. com.
Cubera snapper						■	■	■	■	■			Domeier and Colin 1997, Lindeman et al. 2000, Heyman et al 2005, Claro et al 2009, FWC observations, RNA report
Permit						■	■	■					Ault et al 2006, RNA report

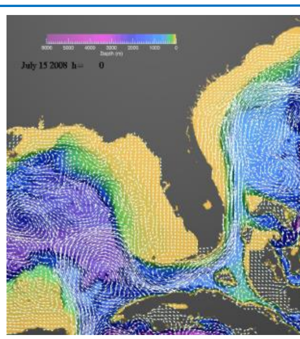
23

Larval Transport in February



24

Larval Transport in July



25

Closing Remarks:

In Florida:

- No take marine reserves in Dry Tortugas have allowed for recovery of fish spawning aggregations
- Larvae produced there supply recruits to the rest of Florida and the SE
- Fish aggregations have been observed at several sites in the Florida Keys
- Although spawning has not been observed at these sites, we have learned today that:

IF YOU BUILD IT THEY WILL COME

26

Importance

- Ecological connectivity
  - Distribution of resources
  - Trophic interactions
  - Source/Sink relationships
- FSAs are essentially year-round “maternity areas” for reef fish, and are thus critically important for the sustainability of commercially important reef fish species and marine biodiversity warranting year round protection

27

Management recommendations

- Changing perspectives on fish spawning aggregations
- Using movement patterns can guide managers to define closed areas and justify boundaries to commercial fishers and other stakeholders.
- Close areas during spawning migration
- For multi-species spawning aggregation site will need to use conservative approach which protects maximum number of species.

28