

# **Post-settlement Life History of Key Coral Reef Fishes in a Hawaiian Marine Protected Area Network**

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# Background

- In West Hawaii, the most heavily targeted fishes for the aquarium trade are surgeonfishes (acanthurids).
- These abundant herbivores are vital to the ecology of the reef system by controlling algal growth.
- The West Hawaii Aquarium Project (WHAP) has produced a wealth of fish abundance and recruitment data over the past 6 years through its monitoring program of protected and unprotected sites.
- However, knowledge regarding the basic life history and biology of these acanthurid species is lacking.
- The goal of our study is to greatly enhance our understanding of post-settlement processes and the basic life histories of these important fish species.

# Species and priority:

1) yellow tang *Zebrasoma flavescens*

- Largest ornamental fish catch



2) kole *Ctenochaetus strigosus*

- Medium to low catch



3) brown surgeonfish *Acanthurus nigrofuscus*

- Very low catch, if any



# Long-Term Project Goals

- (1) Explore patterns of post-settlement survivorship/mortality and post-settlement movement
- (2) Determine age structure and growth rates
- (3) Estimate age at first reproduction, fecundity and reproductive seasonality
- (4) Determine specific habitat use/requirements of newly settled postlarval fishes

# Research collections:

- Age, reproduction, genetics (collaboration), diet (collaboration)
- Collected all 3 species at 4 sites every ~2 months from November 03 to August 04
- Spread over time to get range of reproductive behavior, and for otolith validation purposes.
- Weighed and measured fish and dissected out otoliths, gonads & guts.

# Study Sites:

- (1) Wawaloli Beach
  - Open, experiences heavy collection
- (2) Ke'ei
  - FRA since 2000, but heavily collected before this designation
- (3) Wawaloli
  - FMA since 1991
- (4) Kealakekua MLCD
  - No take since 1969

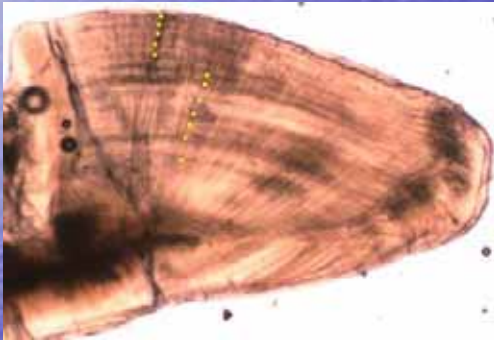
# Otolith annual rings:



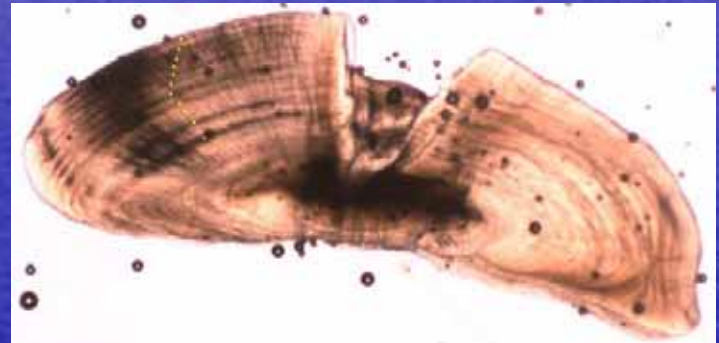
*Zebrasoma flavescens* 6 bands



*Zebrasoma flavescens* 4 bands



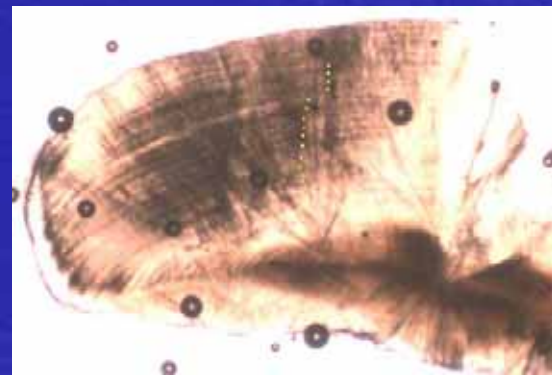
*Ctenochaetus strigosus* 12 bands



*Ctenochaetus strigosus* 11 bands



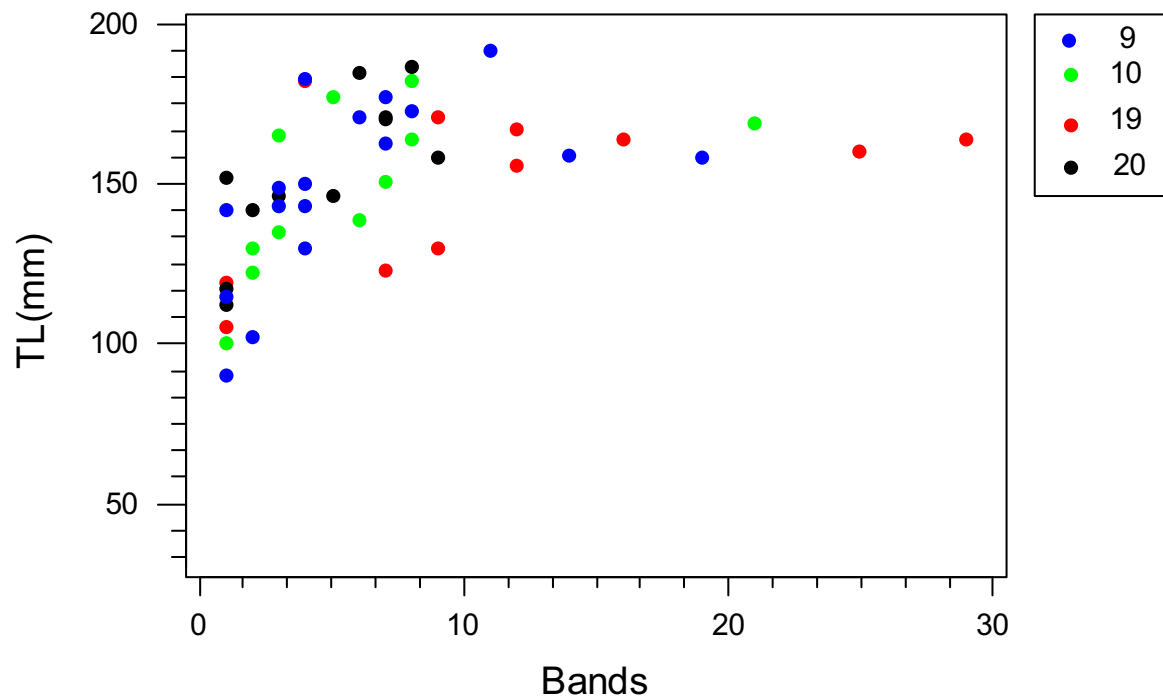
*Acanthurus nigrofuscus* 3 bands



*Acanthurus nigrofuscus* 21 bands

# Age Estimation:

## *Zebrasoma flavescens*

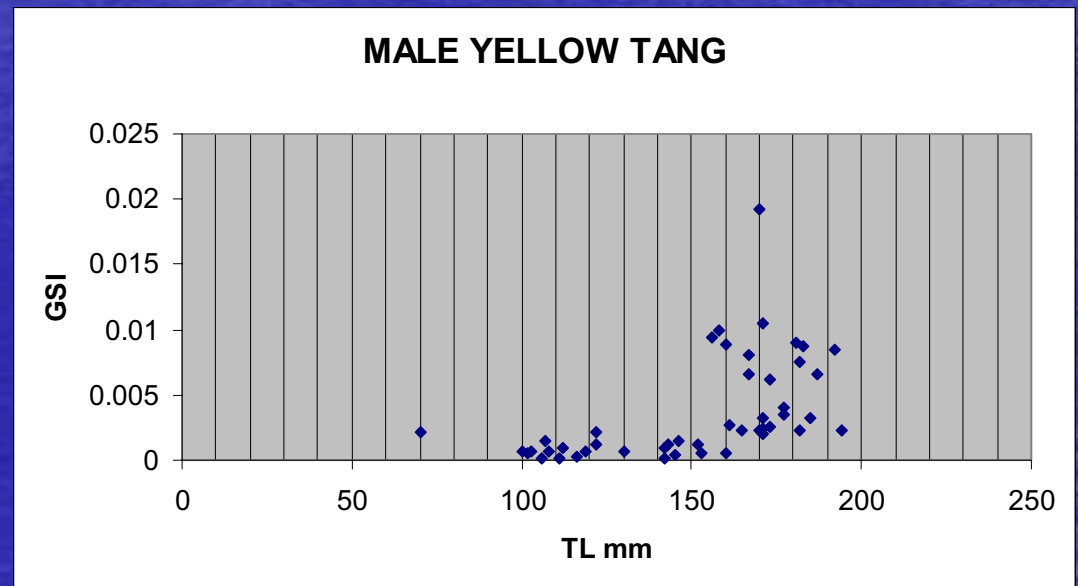
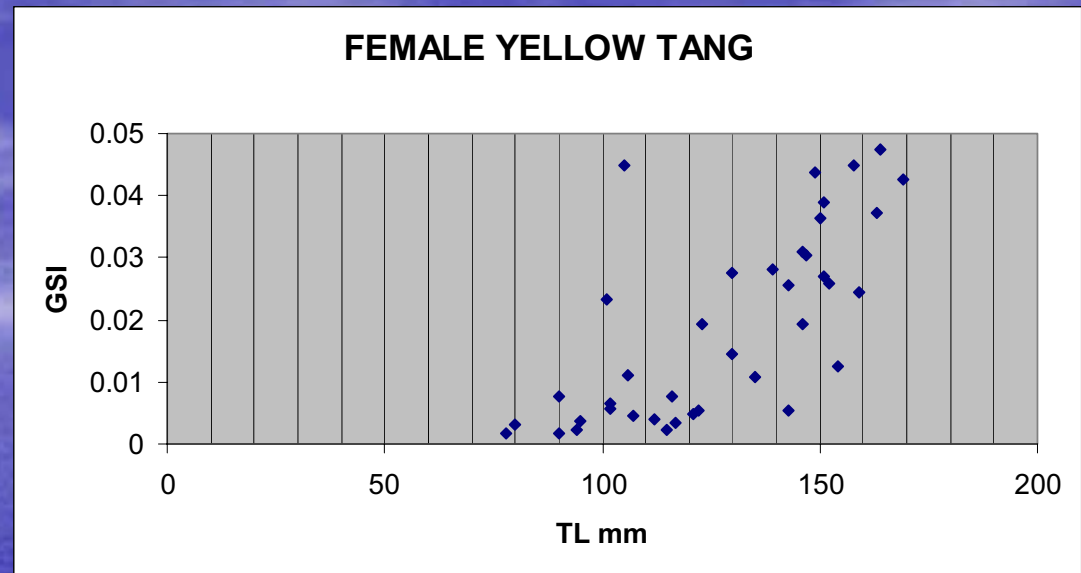


**Processed and read 66 otoliths – not yet validated**

**Range 0.5 to 29.0 bands**

# Reproductive Size

- Indicated by:  
$$\text{GSI} = \frac{\text{Gonad weight}}{\text{Body weight} - \text{gonad}}$$
- Plots based on preserved gonad weight from Feb 04 through June 04 (reproductive period)
- Female SFR\* is estimated at 140 mm
- Male SFR\* is estimated at 155 mm
- Collaboration with OI, further collections this spring. Monthly gonadal cycles.



\* Size at first reproduction

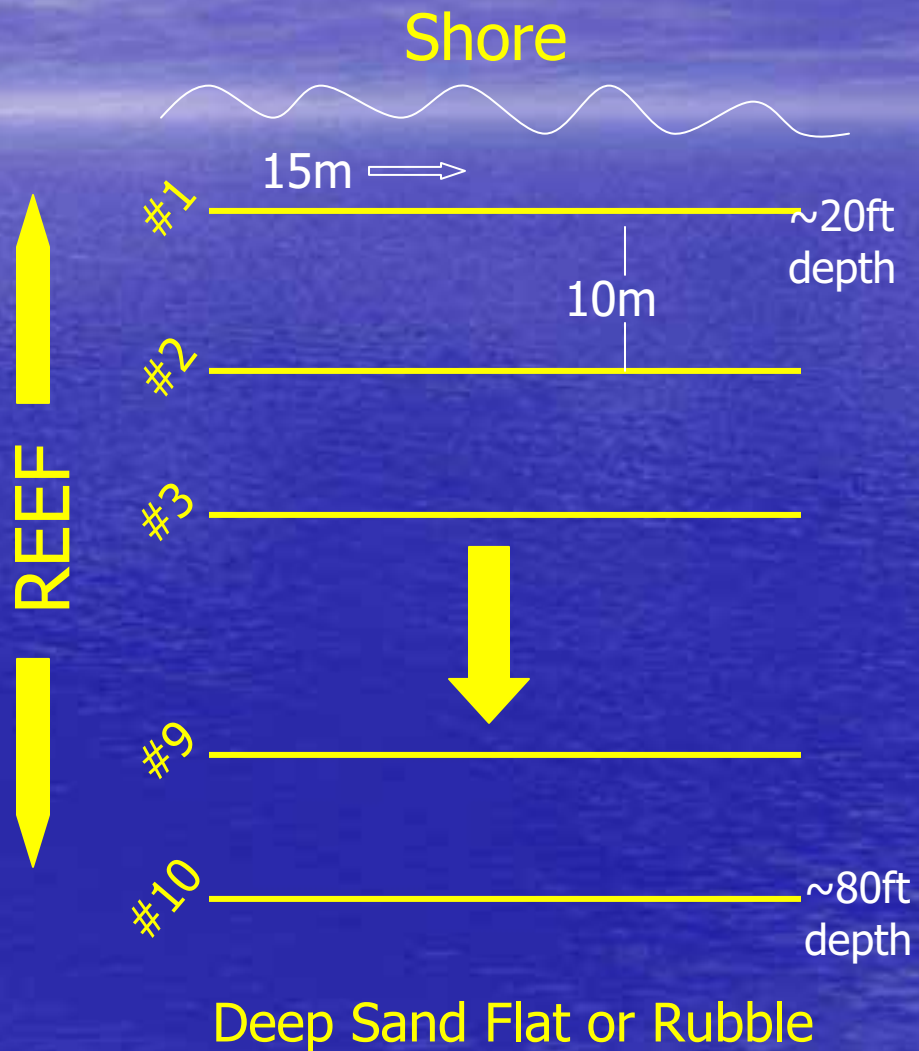
# Plots to Track Recent Settlers:

- monitor settlement, estimate mortality, estimate growth
- 2 sets of 6 plots each at Wawaloli FMA site, ~30m apart
- Placed in areas likely to receive settlers.
- All settlers of focal species, plus *Chaetodon multincinctus*, counted and locations inside and 1m outside plot noted about every other day (Jun-Aug).
- Locations of small settlers within each plot seem relatively constant.



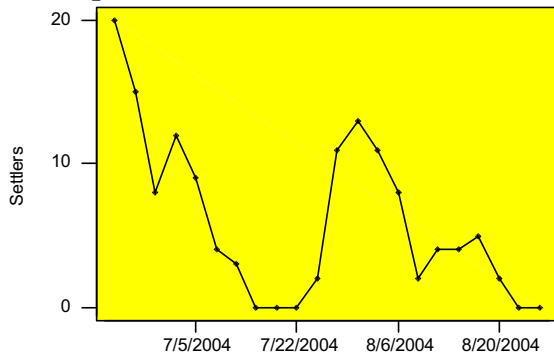
# Fixed Transects:

- monitor settlement and habitat use by various size classes of focal species on scale of entire reef profile.
- 1 set at Wawaloli FMA site  
1 set at Keei FRA site
- Covers reef profile from reef flat or shallow cliff to deep (~80 ft) sand flat or rubble
- All focal species (settlers and adults), plus predators, counted along each transect
- Weekly May-Aug 2004, then once in October and December 2004
- Benthic habitat characteristics (coral type, cover, turf and macro algae, dead coral, rubble, etc) along each transect measured using digital photoquadrats. Also rugosity (chain & transect tape).



# Peaks in Yellow Tang Settlement:

**All plots totaled – 120m<sup>2</sup>**

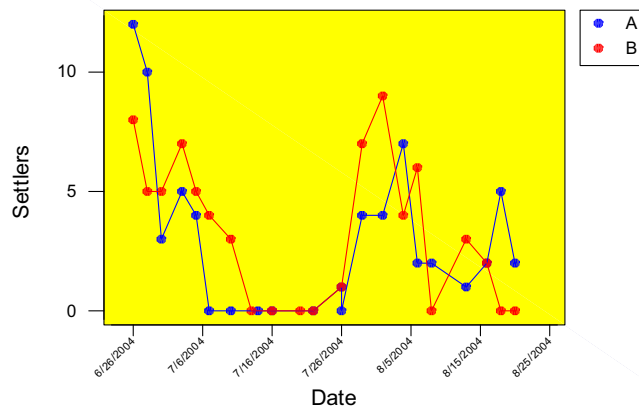


**FULL MOONS:**

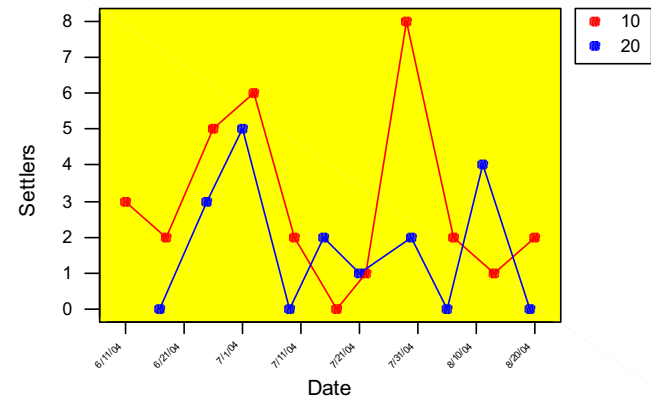
**2 July 2004**

**31 July 2004**

**"A" Plots & "B" Plots 60m<sup>2</sup> each**



**Transects at Wawaloli & Ke'ei**



# Elastomer Fish Tagging

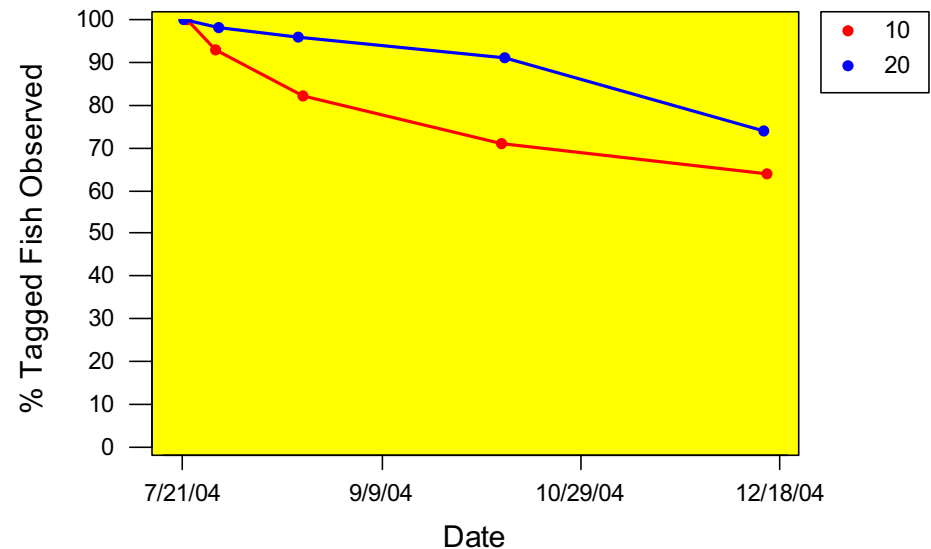


- Caught, measured, and tagged with elastomer all underwater on SCUBA.
- 6 different positions on each side of fish.
- Each mark .5 to 2cm depending on size of fish.



# Tagged Fish:

- July 2004
  - Tagged 54 yellow tang at Ke'e'i
  - Tagged 28 yellow tang at Wawaloli
- Sizes of tagged fish  
6.3 - 15.3 cm total length
  - not biggest fish in roving schools
- Mortality from tagging (if any) is extremely low (3/82 <4%)
- Dec 04 Tagged more fish
  - 20 at Wawaloli
  - 36 at Ke'e'i



# Recapture Growth Rates:

- Yellow tang recaptures:
  - 8 after 1 month
  - 8 after 5 months
- Initial size range 7.5 to 13.7cm
- Monthly growth range .1 to .6cm
- Size, seasonal, location trend?
  - Need increased sample size

Site	Initial TL (cm)	July – Aug (cm)	Monthly July to Dec (cm)
20	8.7	0.4	
20	8.8		0.36
20	9.3		0.26
20	9.7	0.3	
20	9.7	0.2	0.22
20	9.7	0.3	
20	9.8	0.6	
20	10.0		0.1
20	10.7	0.5	
20	11.9	0.4	0.22
20	13.7	0.3	
10	7.5		0.42
10	9.5		0.38
10	10.5		0.22

# What's next for spring 2005?

- Continue monitoring tagged fish for survival/mortality, movement, and recaptures for direct growth measurements.
- Collaboration with OI to monitor reproduction on finer time scale.
- Increase sample size for ageing work at 4 sites – further processing and collection.
- Initial validation of annual bands in otoliths (April 05).
- Presentations at University of Hawaii Tester Memorial Symposium (March 05) & at 7th international Indo-Pacific Fish Conference in Taipei, Taiwan (May 2005).

# Outreach:

- Presentation to West Hawaii Fisheries Council (WHFC) in April 04.
- Participated in WHFC meetings in February, May, June, July and December 2004.
- Elastomer tagging & fish capture workshop with DAR staff in Kona Dec 2004.
- Provided project data and preliminary results to DAR during 2004 for use in preparing the 5-year review of FRAs.

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