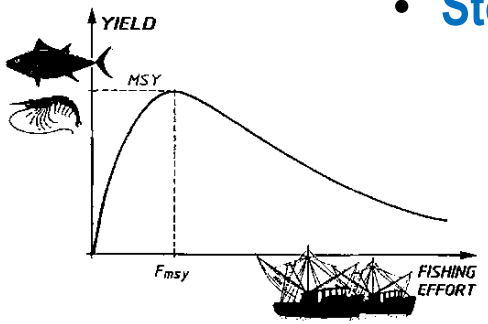
Life History Inputs to Stock Assessments

SEFSC
Beaufort and Panama City Laboratories

SEFSC Science Program Review
June 2013

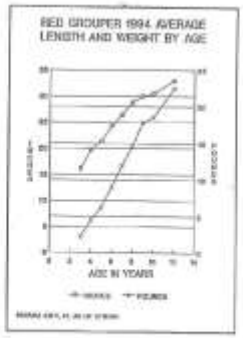
Major Stock Assessment Components

- Catch by gear across years
- Fishing effort across years
- Survey indices of abundance
- Time and geographic area of catches
- **Length and age structure of the fish caught**
- **Age at first spawning**
- **Fecundity or relative reproductive output by age**
- **Natural mortality**
- **Growth rate of the fish**
- **Stock delineation and migration patterns**



Age, Growth, and Reproduction

RED GROUPER - AVERAGE LENGTH AND WEIGHT BY AGE



Goals

- determine the age frequency, growth and longevity of fishery species in the Gulf of Mexico and South Atlantic
- determine basic reproductive strategies and maturity parameters estimating reproductive potential via fecundity and adult condition

SEDAR Species Processed by SEFSC

(Major Species X)

Species	Beaufort	Panama City
Red snapper	X	X
Vermilion snapper	X	X
Red grouper	X	X
Gag	X	X
Gray triggerfish	X	X
Greater amberjack	X	X
Black sea bass	X	
Red porgy	X	
Blueline Tilefish	X	
Tilefish	X	X
Snowy grouper	X	
Yellowedge grouper		X
King mackerel		X
Spanish mackerel		X
Mutton snapper	X	
Yellowtail snapper	X	
Cobia	X	

Age, Growth, and Reproduction

Activities and Processes

Production Ageing

- Sample receipt and login
- Database management
- Sample preparation
- Age estimation
- Sample archiving
- Calibration workshops

Reproductive Biology

- Sample processing, histology
- Sample reading
- Oocyte stages and counts

SEDAR Support

- Workshop participation
- Report preparation

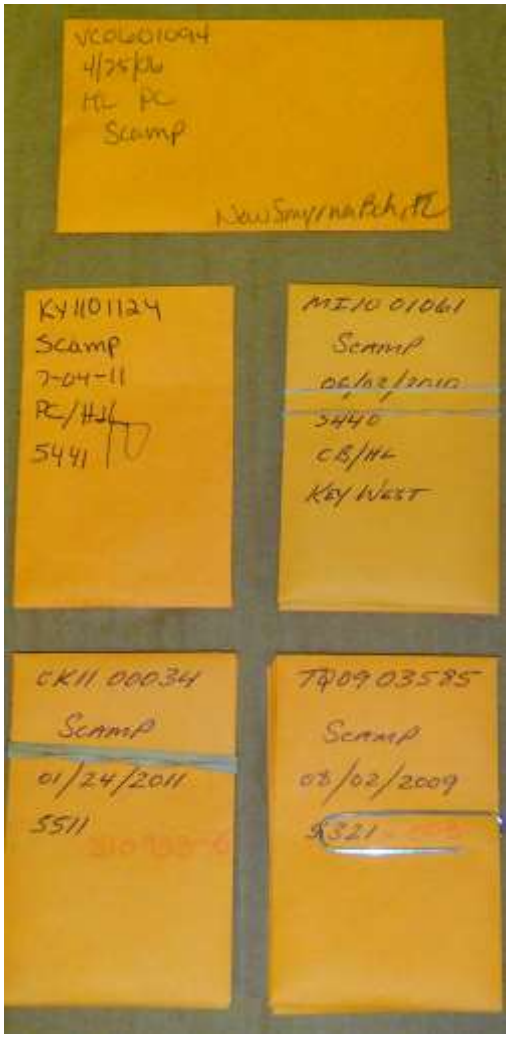
Research

- Validation
- Stock structure

Primary Sources of Samples and Data

Beaufort Lab	Panama City Lab
• Trip Interview Program • Observer Programs • NCDENR • SCDNR • Southeast Headboat Survey • FL FWC • CRP • MRFFS/MRIP Rec Survey (FL only)	
• MARFIN • NC Resource Grant	• GSMFC – RECFIN • Florida Marine Research Institute F-I surveys • SEFSC MS Lab F-I Survey • Panama City F-I Survey

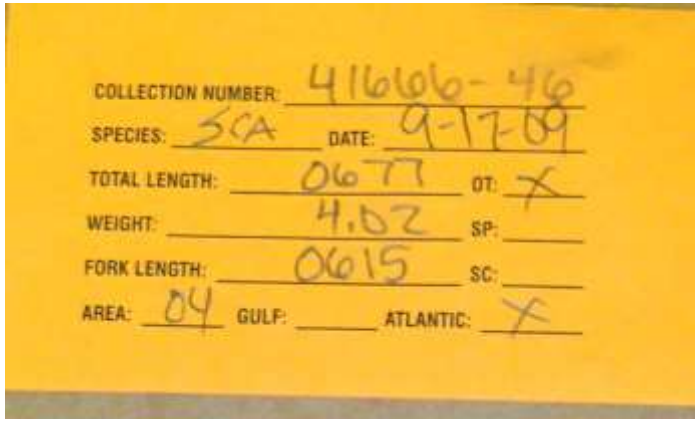
Receipt of Age Samples



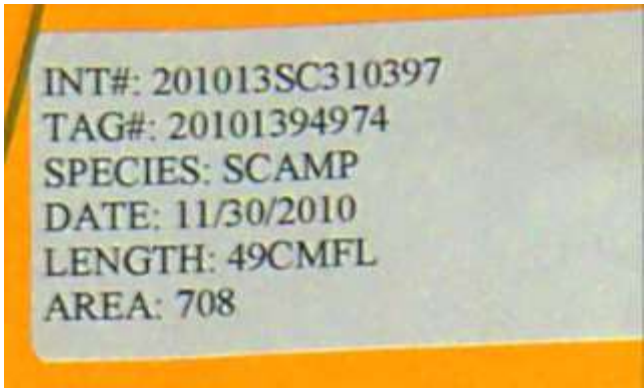
Florida FWC

TIP

NCDMF

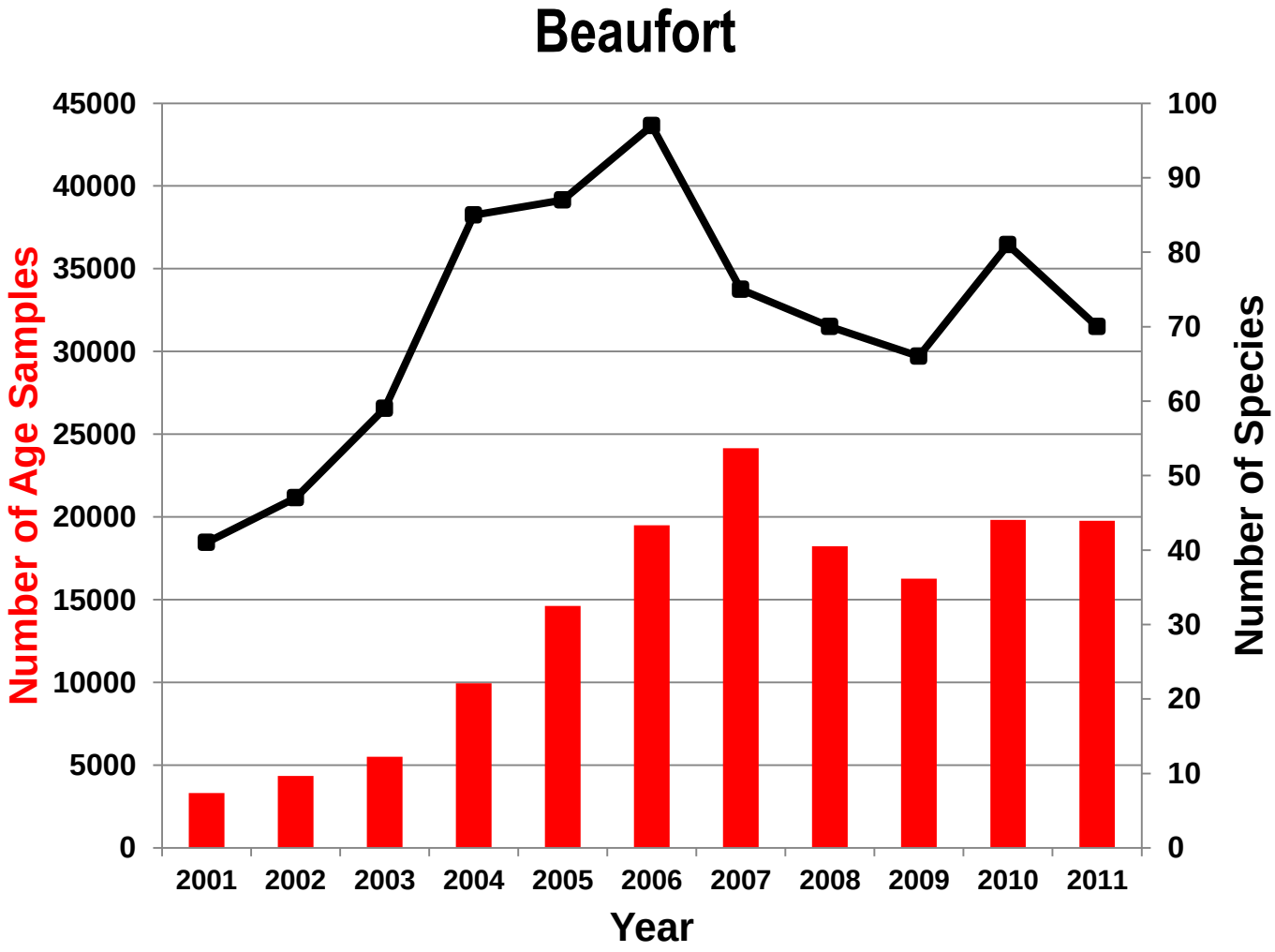


Headboat Survey



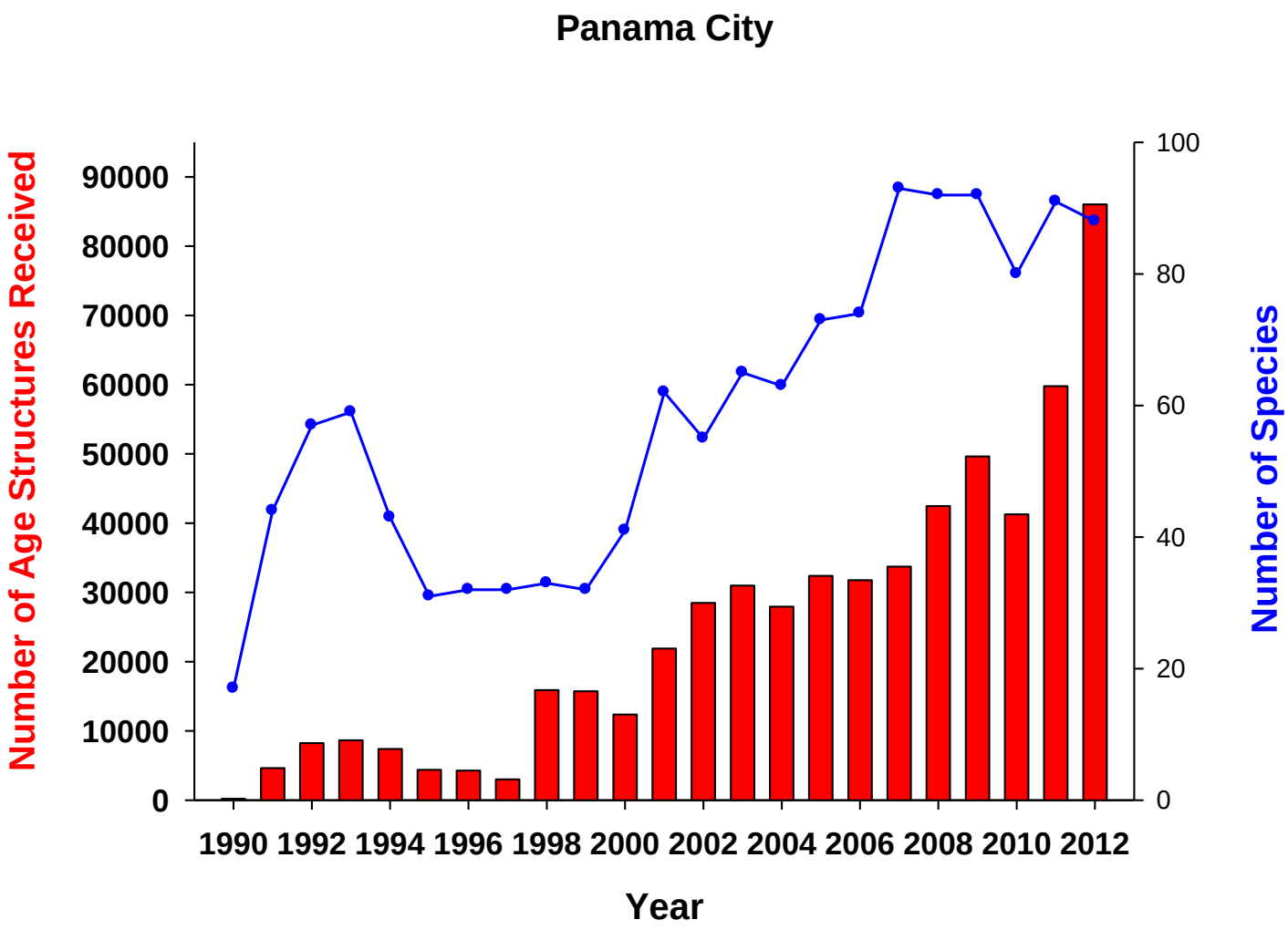
SCDNR using TIP Online

Ageing Structures Received and Archived



HB samples date from 1970's; commercial samples from 1990.

Ageing Structures Received and Archived



Summary for Beaufort and Panama City

Beaufort	Panama City
Receive ~20,000 fishery-dependent samples/year	Receive up to 85,000 samples/year; average 55,000
At current 2012 staffing, can process 15,000/year	At current staffing, can process up to 20,400/yr
State agencies instrumental in ageing for stock assessments	State agencies and universities instrumental in ageing for stock assessments
Focus on 11 species	Focus on 10 species
Sub-sample as needed to meet SEDAR schedule and not due to large sample sizes	Sub-sampling based on number of samples per significant strata/species (typically due to large sample sizes)

Receipt of Age Samples – *Strengths/Successes*

- Proofing of data by TIP port agents has reduced errors
- Bio-Sample Database (BSD)
  - no longer enter and proof TIP data from hard-copy field sheets
- Receiving electronic data from sources other than TIP; imported to Access database (FWRI, HB, Observer)
- All Biological Data (ages, otolith weights, reproductive stages) edited and proofed

Receipt of Age Samples

Improvements Needed – Effects to Data Quality

Issue	Potential Improvement
Incoming electronic data in various formats (e.g., Oracle, Access, Excel, SAS, Dbase)	Move to one Oracle database -- the TIP Online/Bio-Sample Database (BSD)
Sample inventory in 2 places (i.e., BSD-Oracle and BFT-Access/PC-Access DB constraints)	Move all sample inventory to centralized database system (i.e., BSD)
Different variable codes and formats (e.g., Interview #, Specimen ID, State, Gear, Species, Area fished, etc.) in MRFSS, Headboat, commercial, states	Standardize all codes to NMFS TIP format (already used by TIP, ACCSP and all but one State)
Varying levels of trip information details in data (e.g., challenge to link sample to trip)	Standardize trip level information entered into database
Errors/edits in data(aging) received	Data proofing as a standard (TIP samplers example), establish standardization of fields(interpretations), validations
No in-house data manager	Full-time data manager
Timeliness of samples and data shipped to lab	Better coordination with samplers and outside agencies

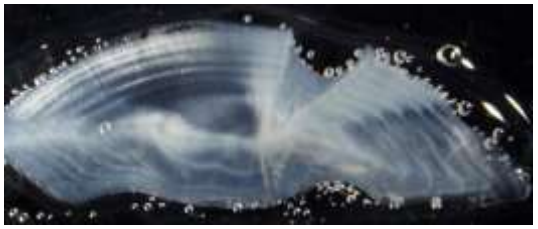
Age Sample Processing

Improvements Needed - Effects on Timeliness

Issue	Potential Improvements
• Typically only process samples according to SEDAR schedule; archive other samples	• Process potential SEDAR species samples in real time rather than archive
• Abrupt changes in SEDAR schedule	• Set schedule 2-3 years in advance • Adhere to schedule
• Beaufort - Required to sub-sample collection to meet SEDAR schedule despite insufficient sample sizes for assessment	• Increase staff to process all needed samples • Set and keep SEDAR schedule far in advance
• Panama City - Sub-sampling is done due to large sample sizes per target species	• A more focused statistically valid sampling strategy which establishes number of samples per significant strata balancing recreational and commercial sectors (in development)

Age Readings - *Strengths/Successes*

Strengths	Effect
QA/QC readings – Panama City	↑ Precision
Completed age validation studies	↑ Precision/Accuracy
South Atlantic Age workshops	↑ Precision/Accuracy
GSMFC Annual Otolith Processors Meeting	↑ Precision/Accuracy
Established reference collections for exchanges with other labs or training	↑ Precision/Accuracy



Age Readings – Improvements Needed

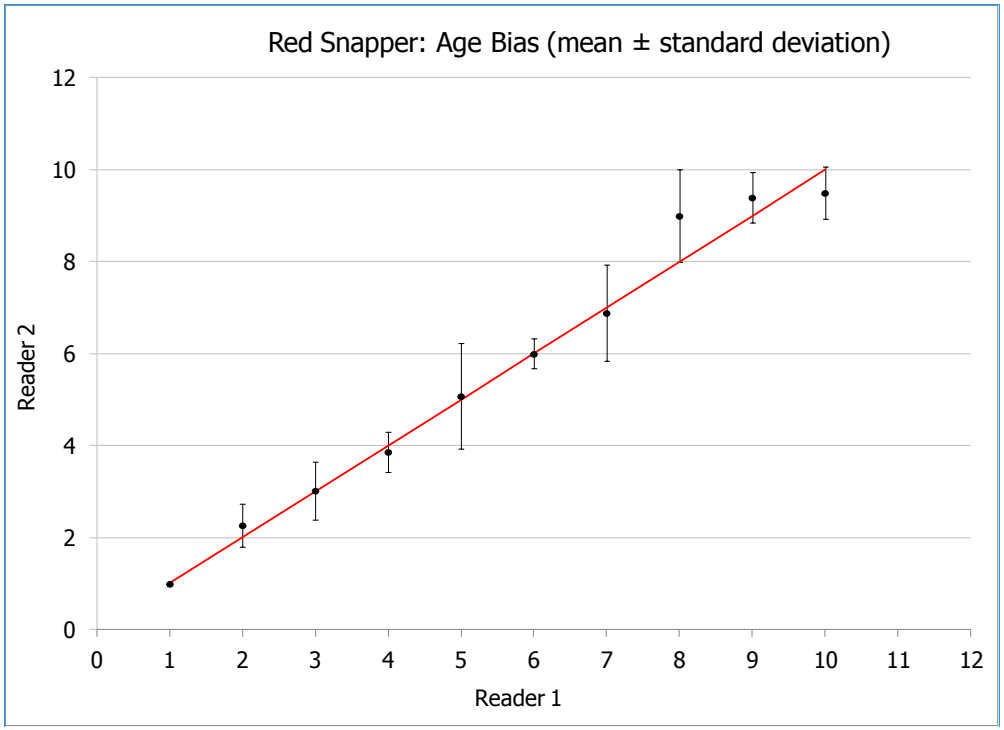
Effects on Precision, Accuracy, and Timeliness

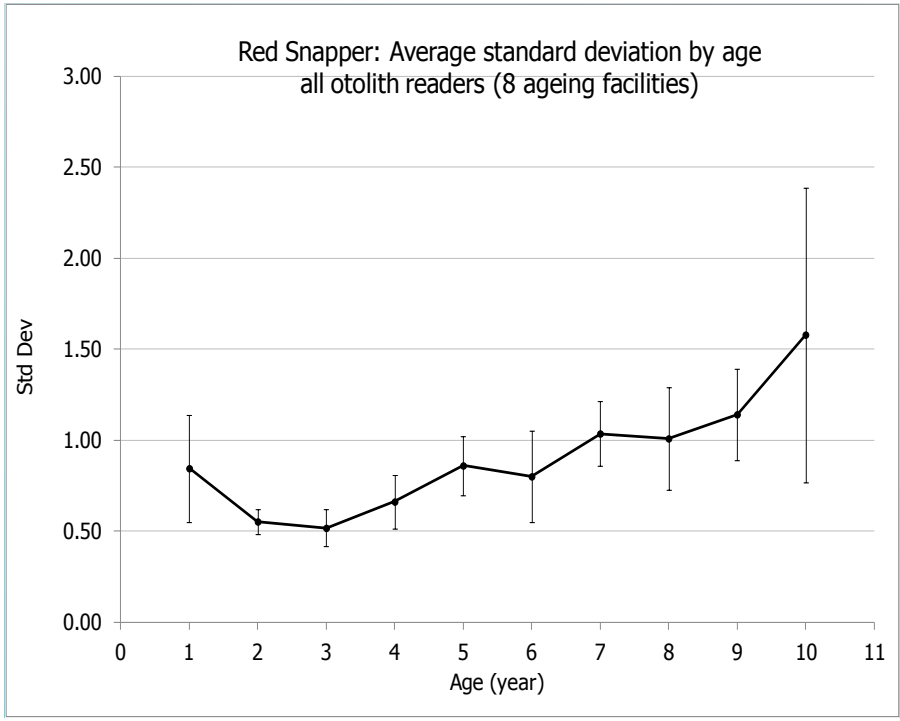
Issue	Effect	Potential Improvements
One reader - Beaufort	↓ Precision	Increase staff to allow time for secondary readings
Limited age validation studies	↓ Precision/Accuracy	Funding for age validation research
More timely age workshops	↓ Precision/Accuracy	Schedule workshops far enough in advance of SEDAR schedule to address any issues that arise
Lack of control over other fish aging programs – high turnover and high APE's	↓ Precision/Accuracy	Establish species-specific aging centers

Ageing Error – Panama City

- Coordinate methodologies of interpreting growth increments either in thin sectioned otoliths and/or surface of whole otoliths.
- Provide estimate of bias when multiple readers (agencies) interpret ages.
- These biases are applied to assessment models to incorporate the uncertainty in traditional age estimates.

- What Ages does the reference set encompass and how does that affect the standard variation in an assessment ?
- GULF Readers (for all years over time):
  - Panama City Laboratory: 9 personnel
  - Other Agencies:
    - 7 (each of the 5 Gulf States, Mote, LSU)
    - Each agency typically has 2 personnel each





Ageing Error – Beaufort

Error and bias addressed through exchange of calibration sets
Calibration sets encompass full age and geographic range of each species
Readability influenced by location of catch
Age-error matrices provide to analysts for model input

Accessibility of Data

Center Stock Assessment Scientists

Age data in 2 databases – BSD and in-house lab db

- Only TIP data are in BSD currently
- SA commercial data from one state agency and all recreational data only available in Beaufort db
- Life-history data from other laboratories only available through SEDAR Data Workshops or GSMFC

External Researchers (limited requests)

- Only in limited, summarized format via SEDAR and workshop reports

Overall Successes

Collaboration with other agencies

- Increased # of representative samples processed
- Closer cooperation
- Build network of ageing laboratories
- Increased precision of age between laboratories
- Shared Reference sets

Modernization of processing equipment

Biological Sampling Database

Overall Limitations/Weaknesses

Dependence on extramural funds to accomplished work

- **Funding uncertain**
- **High turnover rate and time lost to training new personnel**
- **Solution: long-term ongoing need filled with FTEs**

Need for age validation studies (for major species and species of concern)

Hold age workshops further in advance to allow time to address unresolved issues

Resolving data quality issues is extremely time consuming

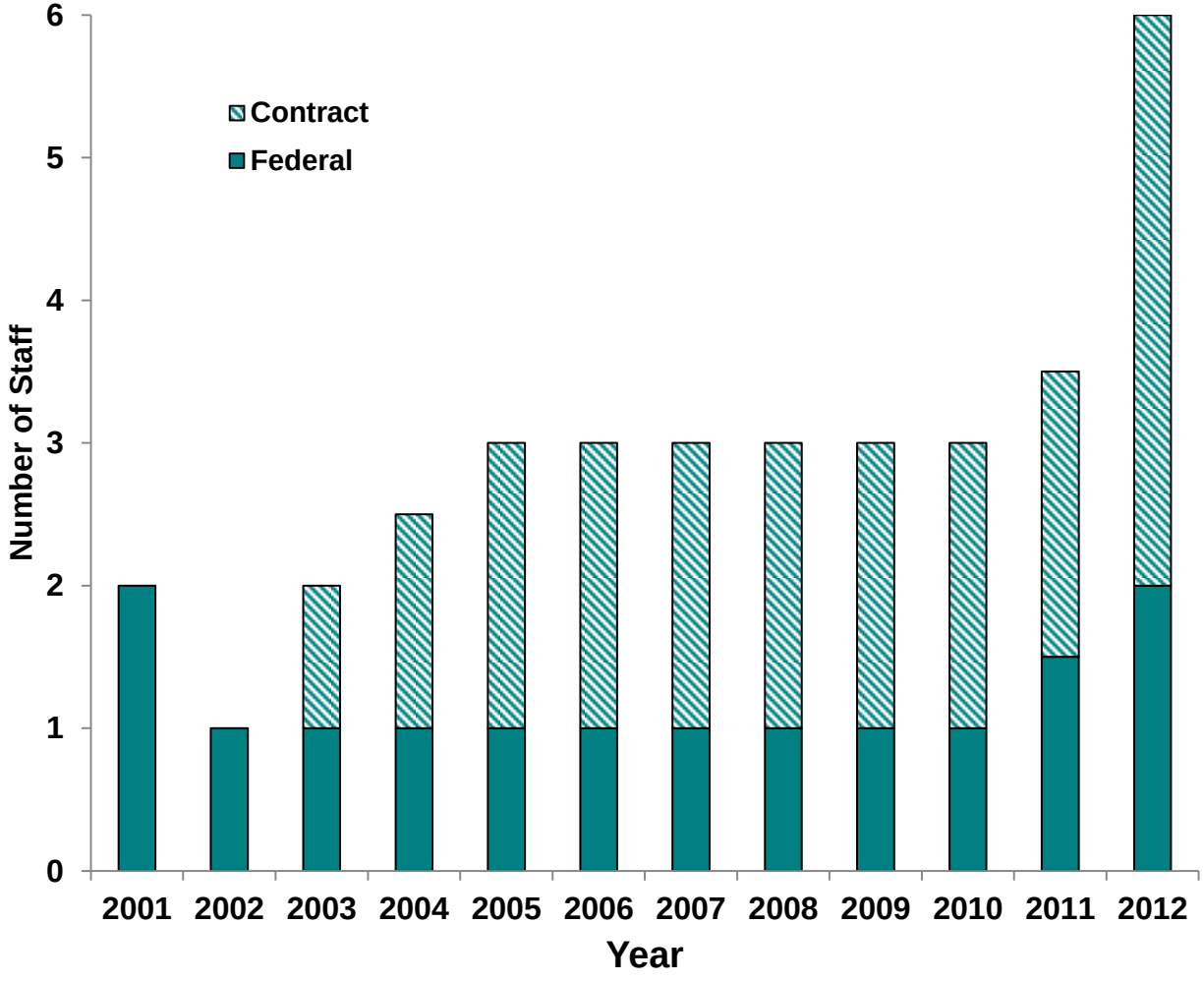
Overall Limitations/Weaknesses

Staffing - Panama City in 2013

Samples	FTEs	Contractors
Otoliths	3	3 fulltime 4 part time (archiving)
Gonads	1.5	1 fulltime 1 part time

Overall Limitations/Weaknesses

Staffing - Beaufort

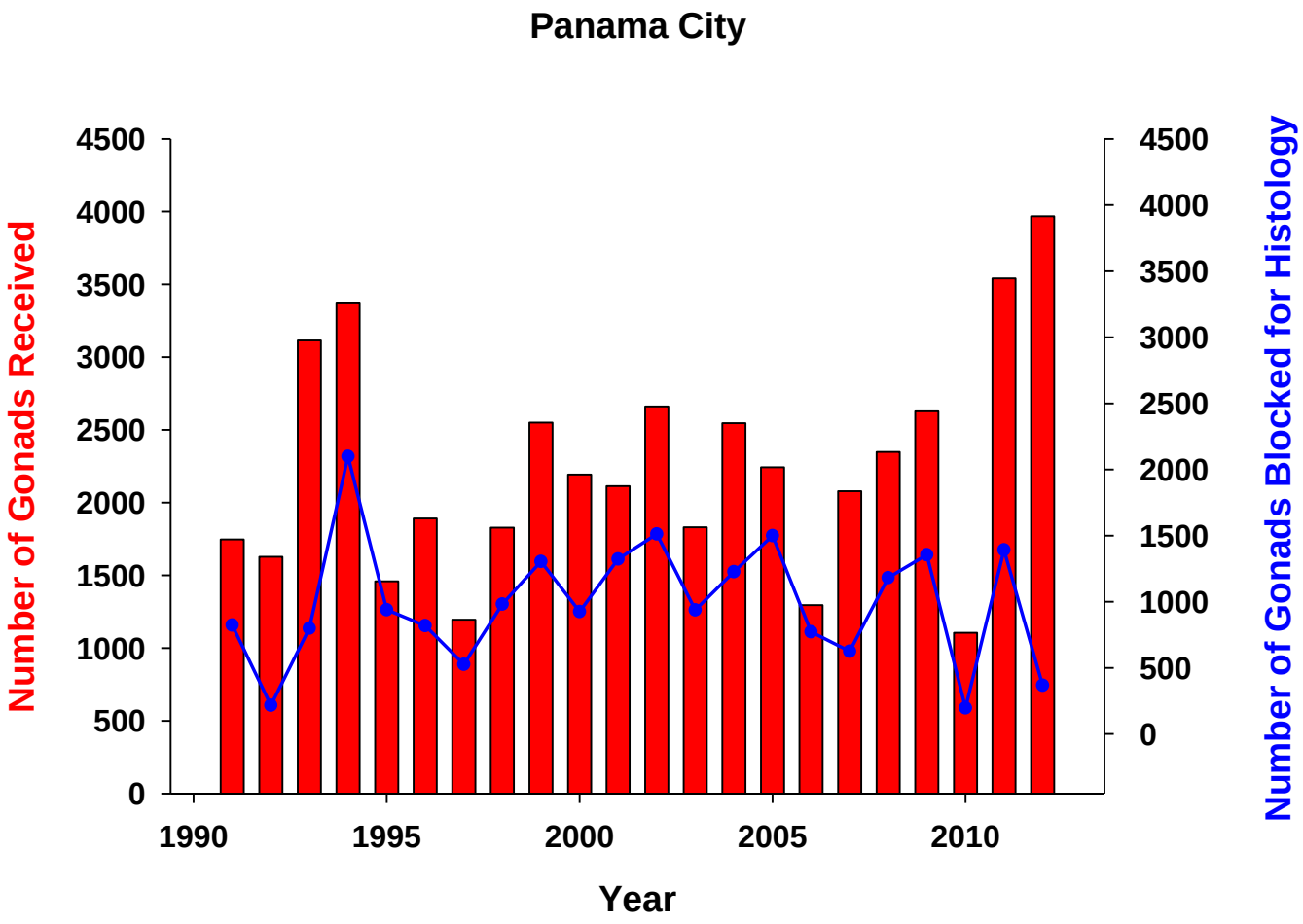


Prioritized Needs for Ageing

Need	Effect
Beaufort - More Staffing (currently 2 FTE's, 4 contractors - 3 funded for one yr)	↑ Processing Production ↑ Need to sub-sample
Panama City and Beaufort Permanent Staffing	↓ Turnover ↑ Efficiency/Precision
Age Validation Studies	↑ Accuracy ↑ Precision
Species-specific Age Workshops held further in advance of SEDAR	↑ Accuracy ↑ Precision

Reproduction

Gonads Received along with # of Gonads Blocked for Histological Analysis.
This analysis is used for histological sex and gonad development stage determinations



Reproduction
Challenges for reproductive work

South Atlantic

- Relies entirely on SCDNR for reproductive studies.
- Need better sampling of gonad tissues to represent the fishery and entire area.

Gulf of Mexico

- Fecundity estimation: difficulties with indeterminate spawners common to our SE subtropical region.
- Reproductive workups require spatial/temporal coverage. Look to onboard scientific observer programs, rather than dockside sampling, or scientific surveys. Nonetheless, spatial/temporal sampling requirements = expensive
- When costs are balanced against other assessment priorities, routine requests for fecundity information should be carefully considered
- Better understand condition and energy allocation to reproduction
- Developing optical scanning methods to digitally count and identify oocyte stages

Gonad Processing

Strengths

- Processing Standards
- Histology second readings / discoveries
- Counts….developing imaging software

Weaknesses

- Consistent sampling strategy for data collections across data sources
- Logistics of handling samples in the field (formalin)

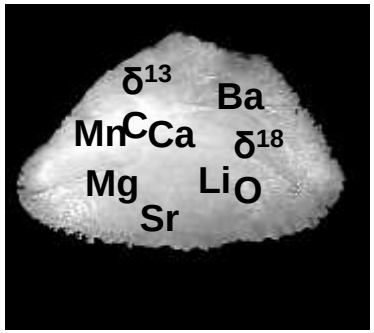
Research

Beaufort	Panama City
• Age validation age studies • Workshops/training	
• Genetics – SA BSB	• Otolith micro-chemistry • Oocyte imaging analysis

Research

Future Endeavors – Otolith Chemistry

SEFSC -Panama City Laboratory

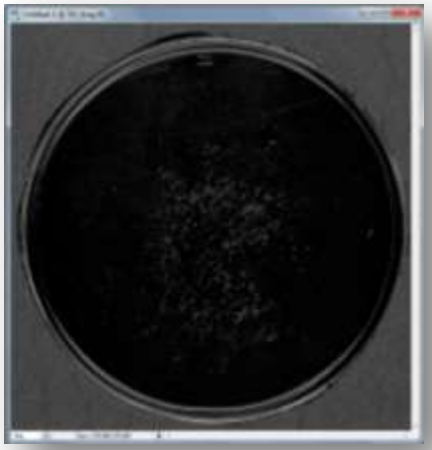


- Stable isotope and microchemical analysis allows a determination of whether distinct geochemical signatures can be detected hardparts of marine species.
- Determining nursery sources to adult populations enables an understanding of whether recruitment within a particular region or management unit is self-sustaining or supported from other areas.
- Otolith chemistry enables estimates of spatial mixing rates by providing a measure of movements between nursery and adult feeding and breeding grounds.

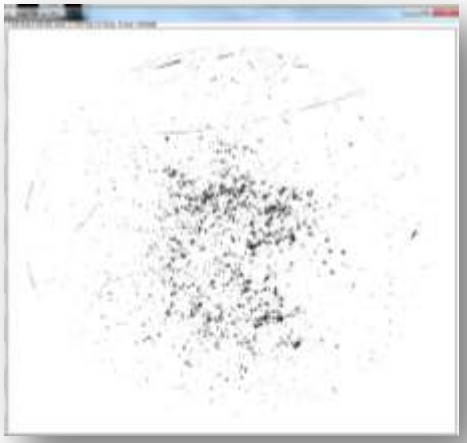
Future Endeavors – Reproduction

Example of automated image analysis – new approach

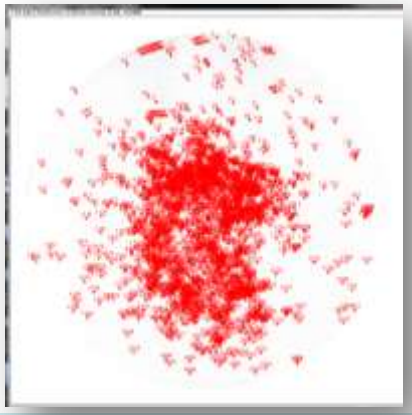
A) Reflective scanned image (Epson V750) of whole mount formalin fixed gray triggerfish (*Balistes capriscus*) oocytes



B) The same image that has gone through the thresholding or binary process (making color values black or white),



C) All measurements of each detected dark value,



D) Zoomed in view of oocytes detected with measurements