Size selectivity by old and new trap mesh sizes in the US South Atlantic black sea bass trap fishery

P.J. Rudershausen, J.A. Buckel & J.E. Hightower
North Carolina State University Department of Applied Ecology

CMAST
The Center for Marine Sciences and Technology

Sea Grant
North Carolina
www.ncseagrant.org

Can optimal trap mesh size be predicted from body depth in a laterally compressed fish species?

Fisheries Research 179: 259-270 (2016)

Motivation

Traps: main commercial gear used to harvest BSB in US South Atlantic

Mesh size regs have not evolved with fish size regs

Motivation

Traps: main commercial gear used to harvest BSB in US South Atlantic

Mesh size regs have not evolved with fish size regs

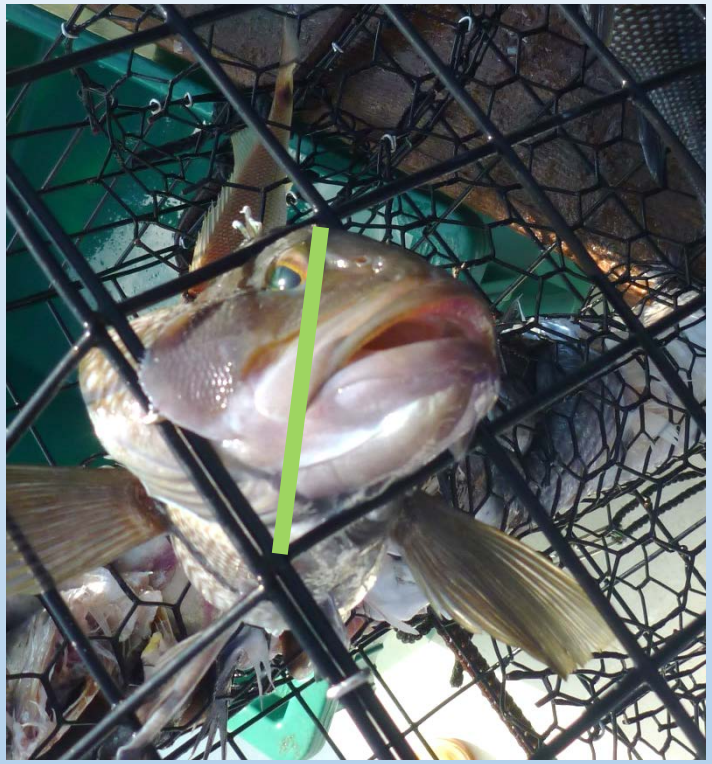
Goals

Determine whether larger trap mesh would better match fish size regs

Determine whether an optimal mesh size could be predicted from black sea bass morphometry

Background: Trap construction and culling devices

Using morphometry to predict length of BSB length where 50% of individuals are retained by a mesh size (L_{50})



Using morphometry to predict fish length at which 50% of individuals are retained by a mesh size

Body Depth = 0.942 + 0.272*Total Length

Rudershausen et al. NAJFM 2008

Using morphometry to predict fish length at which 50% of individuals are retained by a mesh size

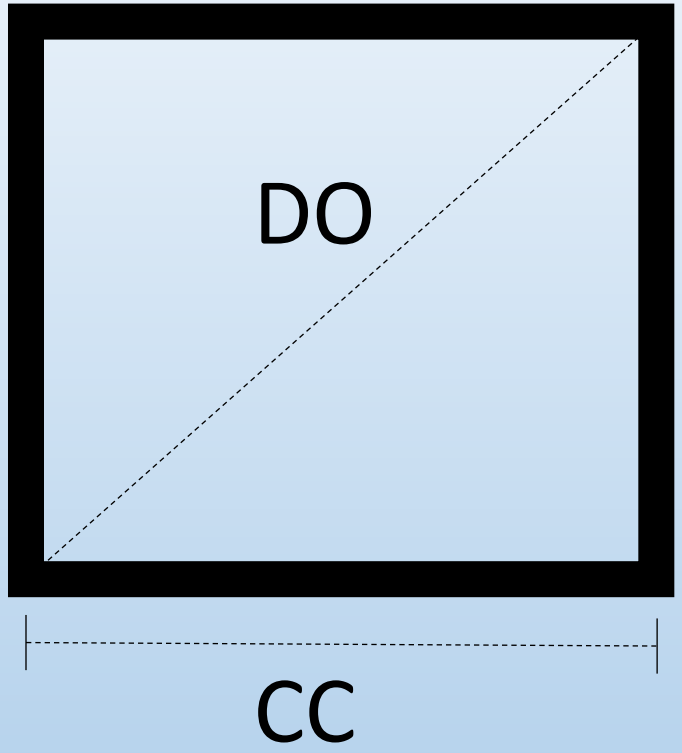
Body Depth = 0.942 + 0.272*Total Length

Rudershausen et al. NAJFM 2008

279 mm Total Length = 76.8 mm Body Depth

Using morphometry to predict fish length at which 50% of individuals are retained by a mesh size

279 mm Total Length = 76.8 mm Body Depth

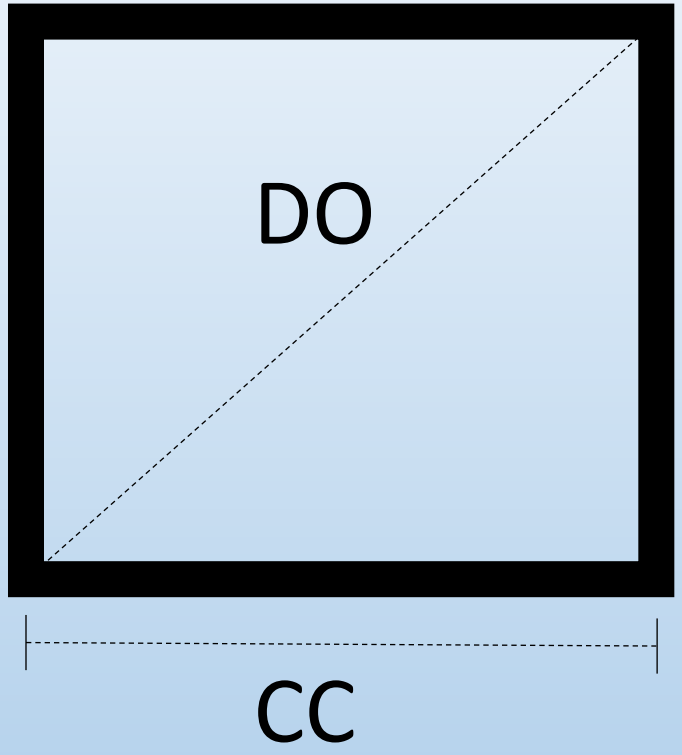


$DO = (2(CC \times 0.925)^2)^{0.5}$

Actual diagonal opening of two inch mesh: 66.5 mm

Using morphometry to predict fish length at which 50% of individuals are retained by a mesh size

279 mm Total Length = 76.8 mm Body Depth



$$DO = (2(CC \times 0.925)^2)^{0.5}$$

Actual diagonal opening of two inch mesh: 66.5 mm

Using morphometry to predict fish length at which 50% of individuals are retained by a mesh size

Square mesh size (mm)	Actual diagonal opening (mm)	Predicted 50th percentile retention: total length (mm)
50.8 (2 inch)	66.5	241
57.2 (2.25 inch)	74.8	272
63.5 (2.5 inch)	83.1	302

Trap types and field sampling

Five square mesh trap types:

1. Uniform 1.5” (37.5 mm) mesh (control)
2. 1.5” (37.5 mm) mesh w/ 2” (50.8 mm) mesh back panel
3. Uniform 2” (50.8 mm) mesh
4. Uniform 2.25” (57.2 mm) mesh
5. Uniform 2.5” (63.5 mm) mesh

Fished offshore NC in 2013

Fished all trap types simultaneously in the same area

Analysis

Fit a negative binomial model to observed catch data

Control trap type: retention probability assumed to be 1 for all length bins.

Modeled retention probability of experimental traps as a 2 parameter logistic selection function, fitted to catch data divided into 10 mm length bins

$$r(l) = \frac{\exp(a+bl)}{1+\exp(a+bl)}$$

Calculated l_{50} (50^{th} percentile length of retention, a.k.a. size where 50% of bass are retained): $\frac{-a}{b}$

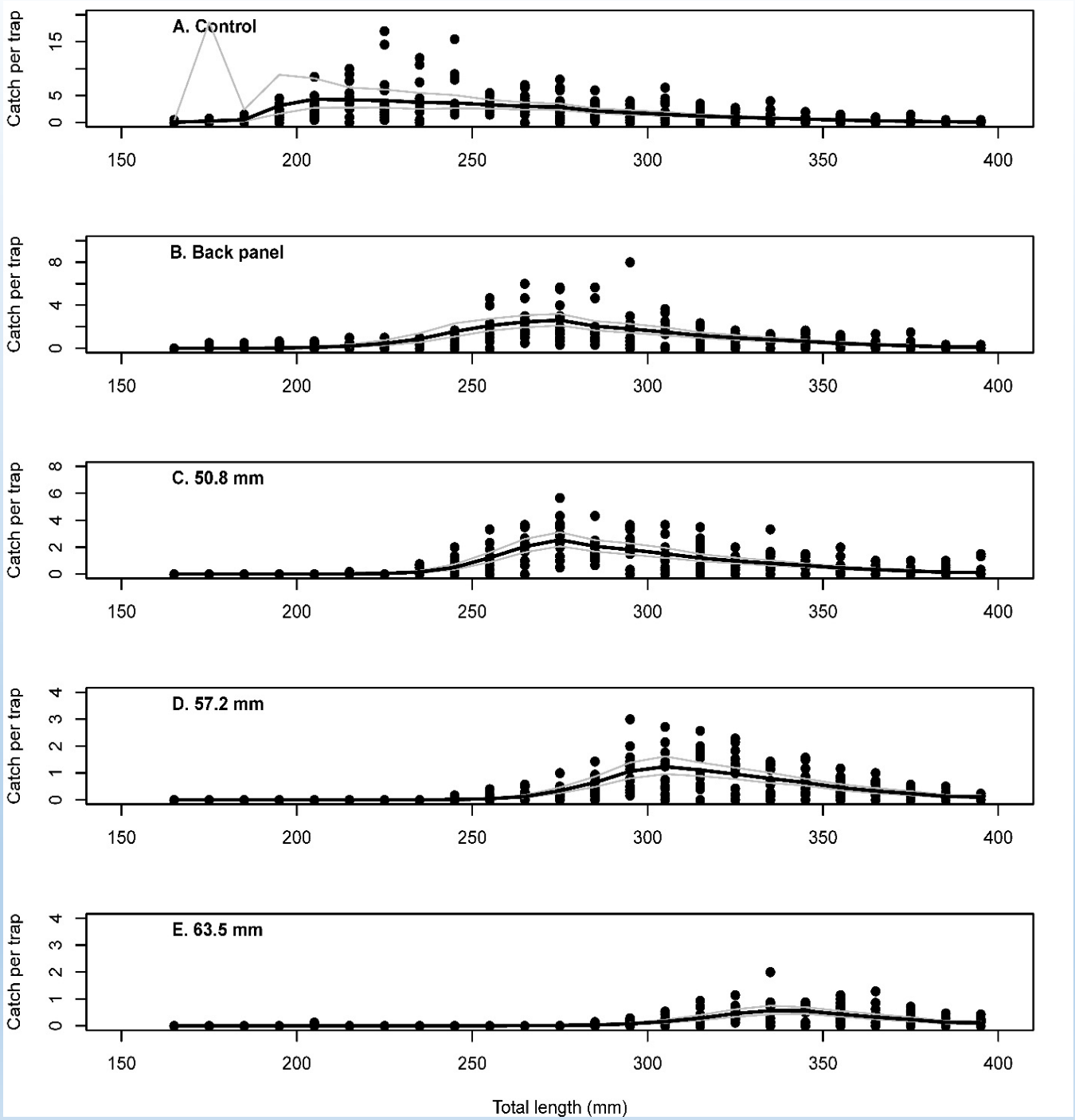
Calculated l_{10} (10^{th} percentile length of retention, a.k.a. size at initial retention): $\frac{(logit(0.1)-a)}{b}$

Compared mean estimated mass of legal bass among 4 exp. trap types

Compared mean number of sub-legal bass among 4 exp. trap types

Results

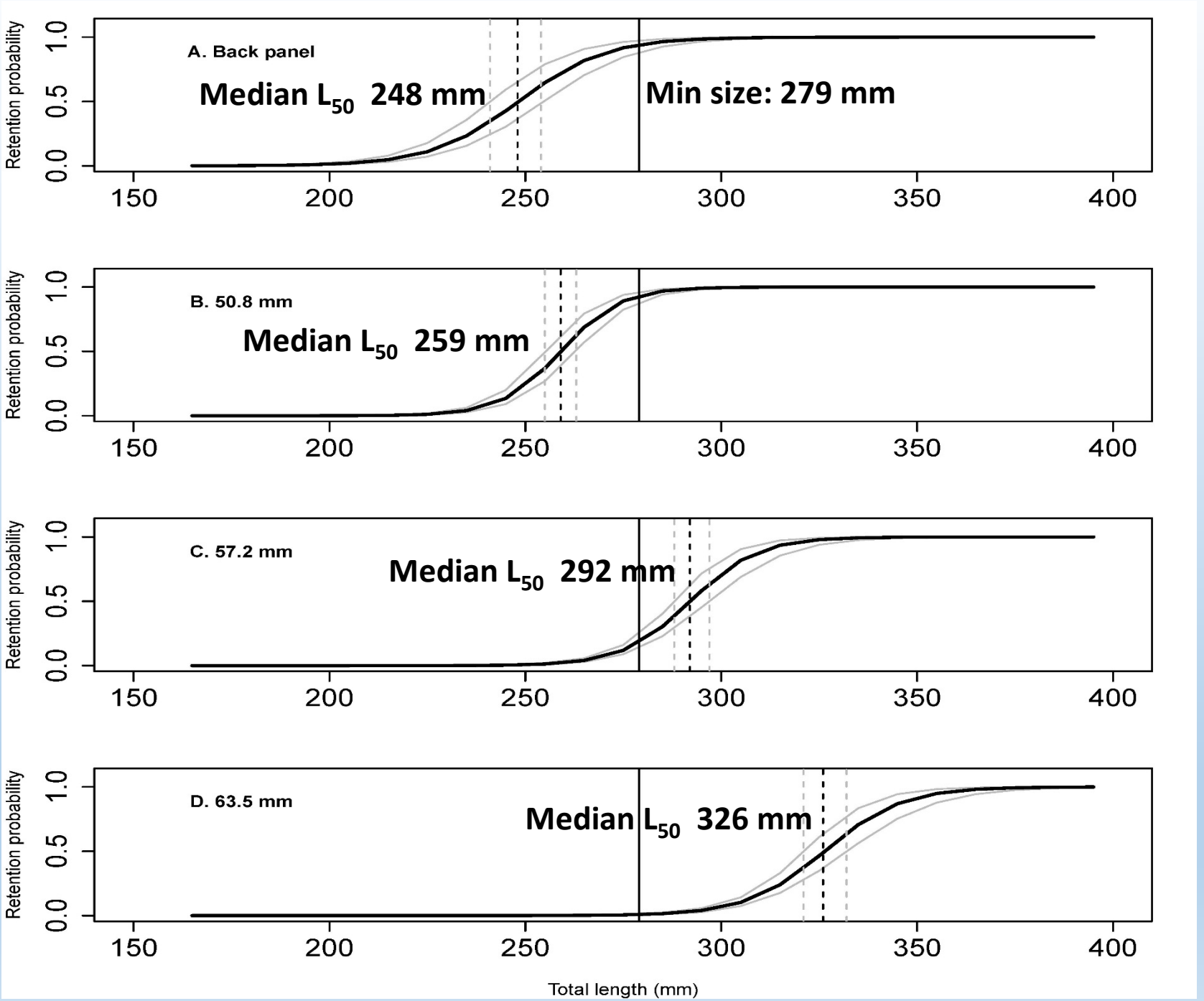
Modeling catch rates



Results

Retention probability of each experimental trap type:
2 parameter logistic model

$$r(l) = \frac{\exp(a+bl)}{1+\exp(a+bl)}$$

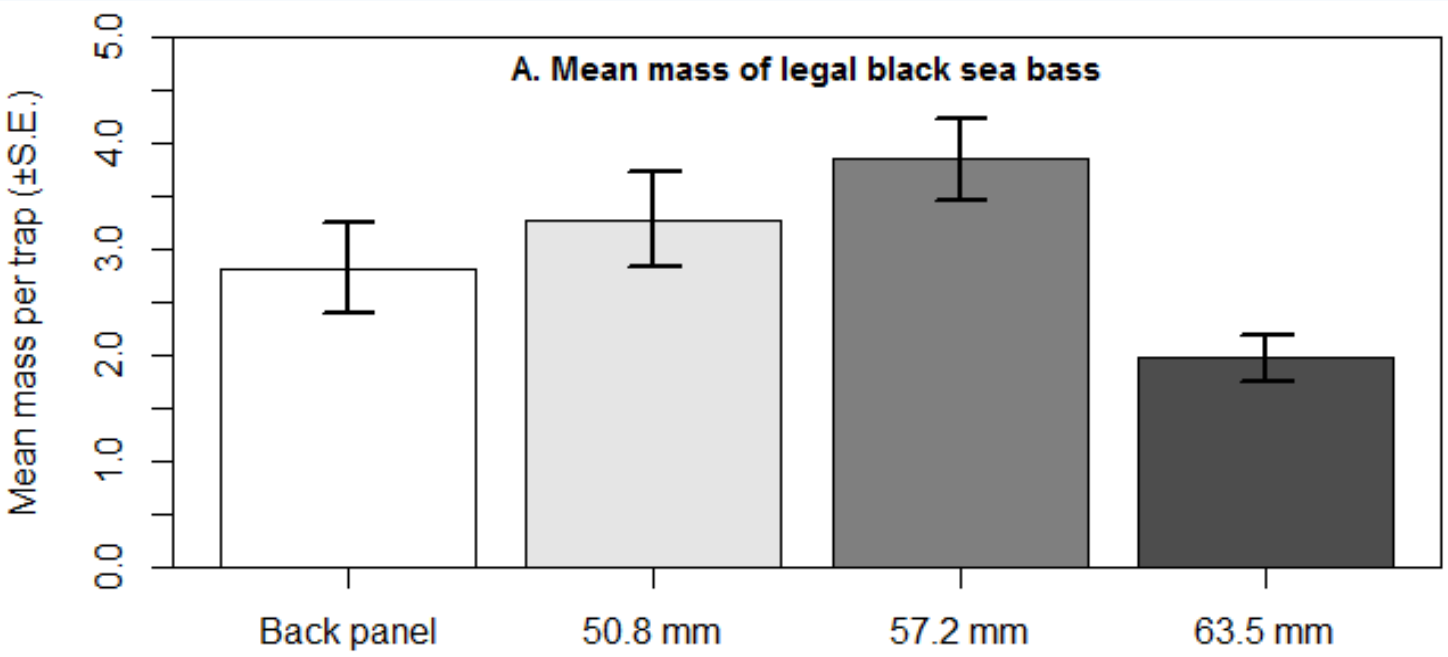


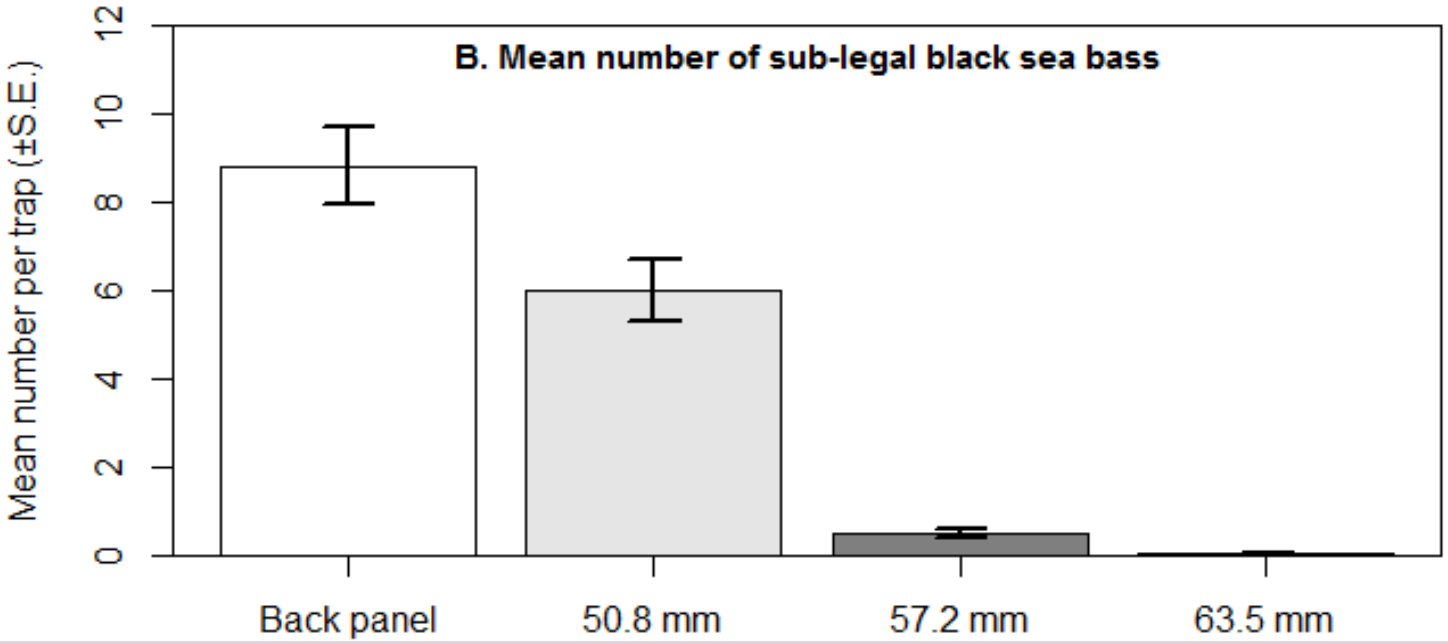
Results

Comparing catch rates

Mass of legal bass: Non-significant difference between back panel trap and each of the other trap types

#’s of sub-legal bass: Significant decrease between back panel and each new mesh size



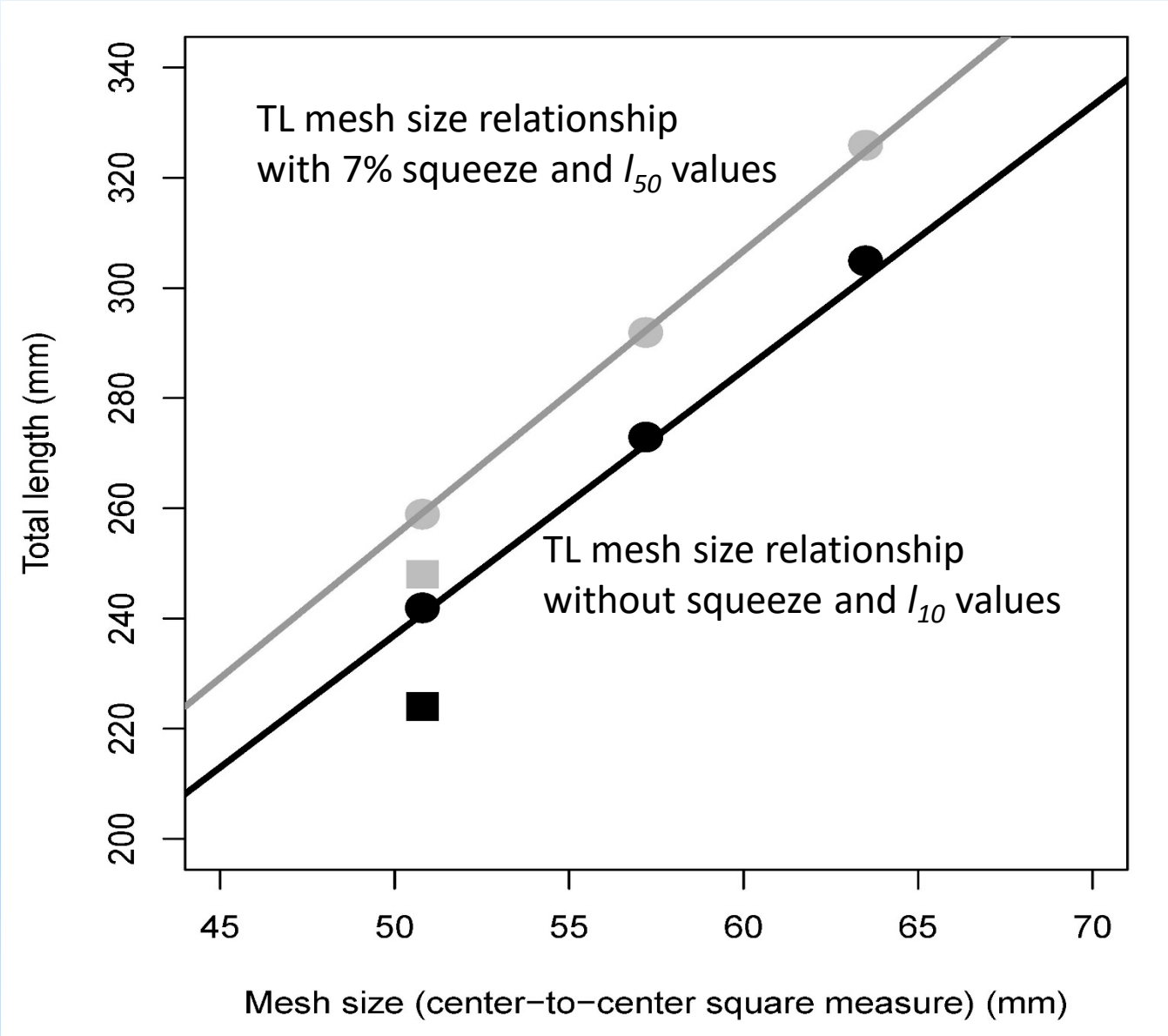


Results

Numerical percentages of legal & sub-legal black sea bass in experimental traps

Fish category	Back panel	50.8 mm (2”)	57.2 mm (2 ¼”)	63.5 mm (2 ½”)
Legal	51.9	65.5	94.5	99.8
Sub-legal	48.1	34.5	5.5	0.2
Total %	100	100	100	100

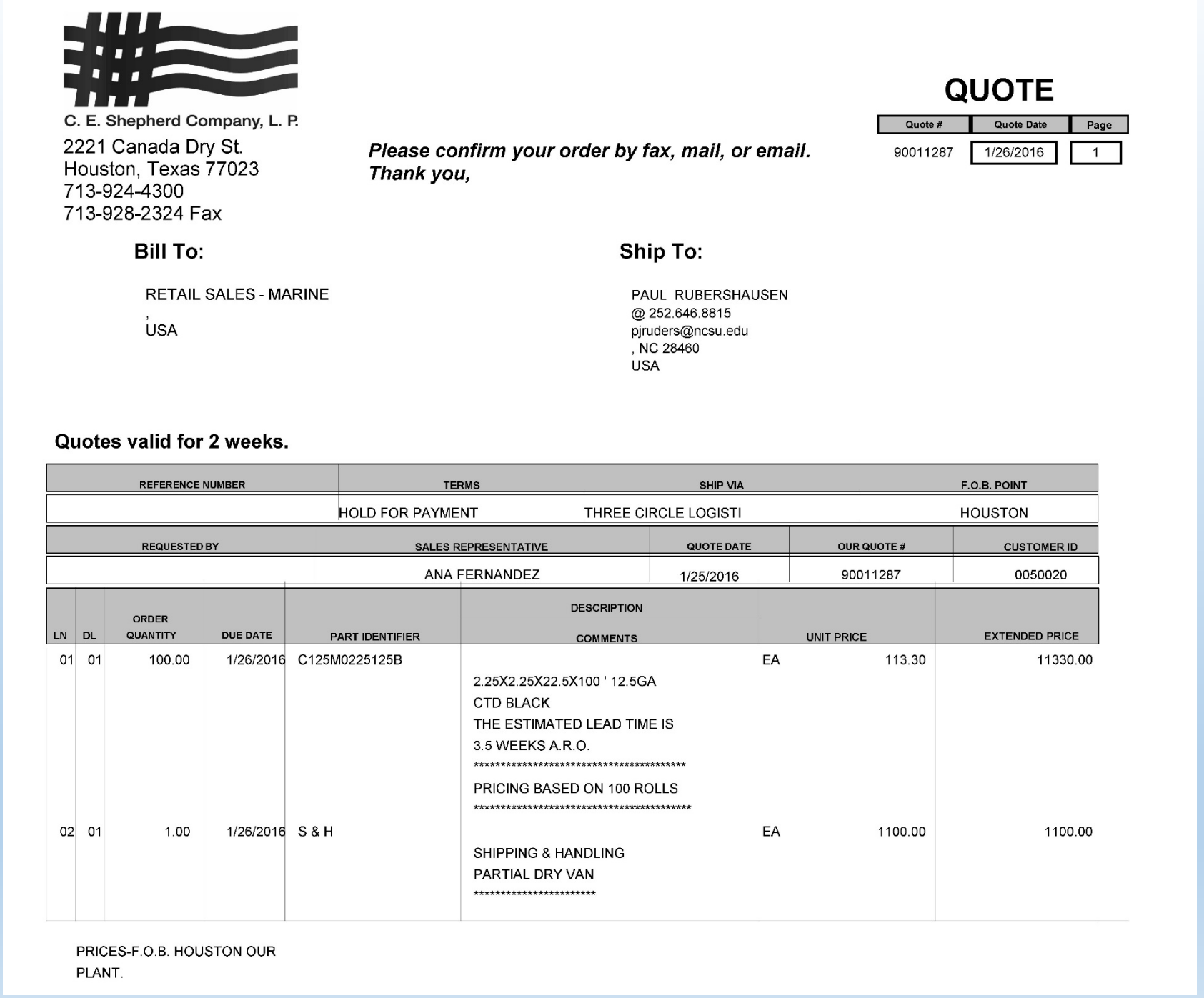
Discussion: Was an l_{50} successfully predicted for experimental traps? No
Can fish morphometry predict optimal trap mesh sizes? Yes



Discussion: Estimated annual reduction of sub-legal catch if switch from back panel to 57.2 mm traps: US South Atlantic

Back panel		57.2 mm (2 ¼")		Annual % reduction of sub-legal discards	References for discard/ discard mort
# Discarded	#Discarded dead	#Discarded	#Discarded dead		
208,000	35,400	11,000	1,900	95%	Rudershausen et al. CJFAS 2014, SAFMC effort data

Discussion: Availability of new mesh



C. E. Shepherd Company, L. P.
2221 Canada Dry St.
Houston, Texas 77023
713-924-4300
713-928-2324 Fax

Please confirm your order by fax, mail, or email.
Thank you,

QUOTE

Quote #	Quote Date	Page
90011287	1/26/2016	1

Bill To:

RETAIL SALES - MARINE
,
USA

Ship To:

PAUL RUBERSHAUSEN
@ 252.646.8815
pjruders@ncsu.edu
, NC 28460
USA

Quotes valid for 2 weeks.

REFERENCE NUMBER	TERMS	SHIP VIA	F.O.B. POINT
	HOLD FOR PAYMENT	THREE CIRCLE LOGISTI	HOUSTON

REQUESTED BY	SALES REPRESENTATIVE	QUOTE DATE	OUR QUOTE #	CUSTOMER ID
	ANA FERNANDEZ	1/25/2016	90011287	0050020

LN	DL	ORDER QUANTITY	DUE DATE	PART IDENTIFIER	DESCRIPTION / COMMENTS		UNIT PRICE	EXTENDED PRICE
01	01	100.00	1/26/2016	C125M0225125B	2.25X2.25X22.5X100 ' 12.5GA CTD BLACK THE ESTIMATED LEAD TIME IS 3.5 WEEKS A.R.O. ********** PRICING BASED ON 100 ROLLS **********	EA	113.30	11330.00
02	01	1.00	1/26/2016	S & H	SHIPPING & HANDLING PARTIAL DRY VAN **********	EA	1100.00	1100.00

PRICES-F.O.B. HOUSTON OUR PLANT.

Conclusions

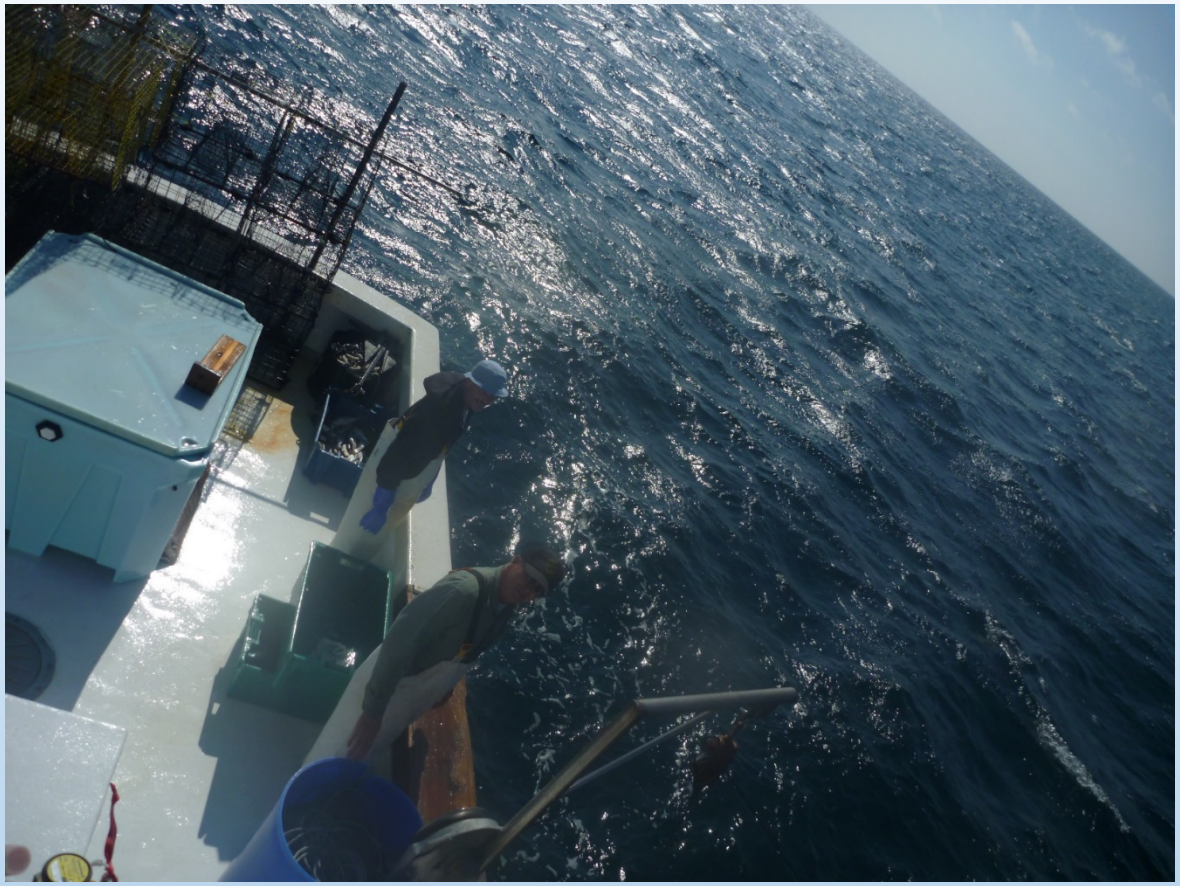
Uniform 57.2 mm (2 ¼”) mesh traps balance wire availability and optimal selectivity for the 279 mm TL limit.

Mixed mesh traps (e.g. back panel) do not optimize selectivity.

Future predictions of optimal mesh size should be based on bass squeezing.

Acknowledgments

Tom Burgess (Sneads Ferry NC) (cooperator)
North Carolina Sea Grant FRG Program (funding)
CE Shepherd Co., Houston TX (wire)
Chip Collier, SAFMC (effort data)



Bass trap testing, F/V Barbara Lynne, Onslow Bay, NC