Catch comparison of two mesh sizes in the bottom gillnet used in the Gambian sole fishery

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Photo Credit: Geoffrey Kibler Peace Corps Volunteer, USAID/BaNafaa project/WWF-WAMPO

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Introduction

The Fishery Co-Management Plan for the Gambian Sole Complex, the first such plan in the Gambia, was formally adopted in January 2012. The precautionary approach is part of the basic framework for the plan, especially important in fisheries with limited data. Most of the data for the management actions in the plan came from local knowledge and limited data collection by the USAID/BaNafaa project, the National Sole Co-management Committee (NASCOM) and the Gambian Department of Fisheries (DOFISH). The committee included a closed area from shore out to 1 nm annually from May to October to protect fish during spawning periods as a precautionary measure even though the first stock assessment did not find evidence of overfishing.

One of the research priorities identified in the plan included work on improving gillnet selectivity, especially for the bycatch species of catfish that is listed as vulnerable. A previous study conducted on hanging ratio determined some improvement to selection was possible, however the added work of attaching the net to the hanging lines, difficulty of enforcement and the loss of fish makes this feature unattractive as a management measure. Therefore, the committee opted to examine the increase of mesh size as a possible management option. This study is designed to test the change in catch between the standard net currently used (84 mm stretched mesh) in the fishery to a larger mesh size (92 mm stretched mesh). Note: Legal minimum mesh size is 80 mm stretched mesh although fishermen are already using larger mesh sizes.

Objective

To compare the catch composition (size and species) of two net mesh sizes in the bottom gillnets: 84 and 92 mm stretched mesh (42 and 46 bar length).

Description of Fishing Area

The fishing trials were conducted in a 5 nautical mile radius off the coast of Kartong on the Atlantic coast of The Gambia (13°05'26.01 "N and 16°45'15.76" (Figure 1)). This area is characterized by exposed coastal beaches composed of mostly sandy bottom with some rocky reef areas. The village of Kartong is located at the mouth of the Allehien river estuary (Figure 2).

Figure 1: The Gambia

Locally know to be a hotspot for the Sole fishery and other locally important fish species.

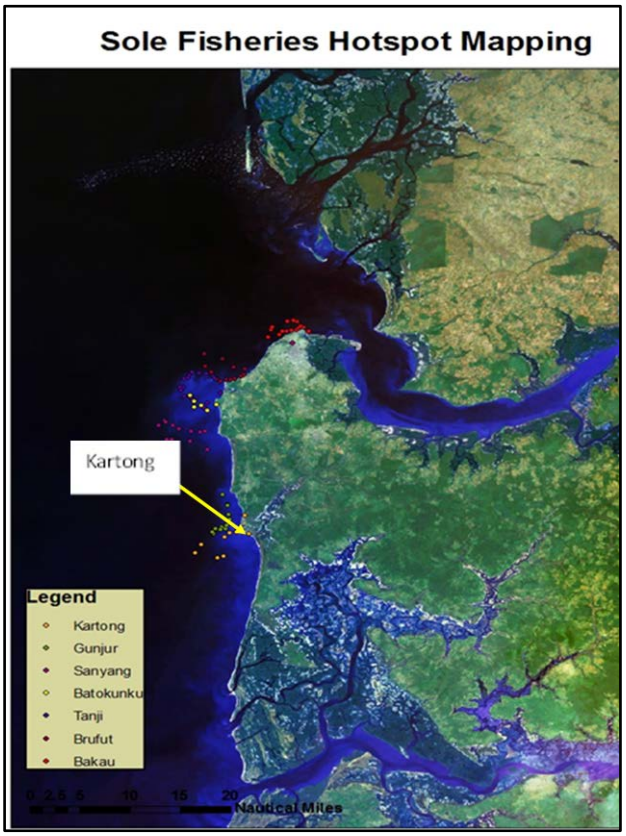


Figure 2: Sole fisheries hotspot mapping

Kartong is known as a sole hot spot by local fishermen. Fishing areas are indicated by yellow dots on the GIS figure. Fishing trials were conducted from May 25-June 22, 2013 resulting in 29 net hauls.

Materials and Methods

A planked dug-out (motorized) canoe (11m) propelled by 25HP (Yamaha) was used for the study (Figure 3). Four crew were involved in the study (2 local fishers and 2 from the USAID/Ba Nafaa team.

Figure 3: Photo of plank dugout canoes, Kartong Fisherman and the Kartong Landing Sites

Two monofilament nets were prepared for the study and fished side by side. The first net was constructed with 84 mm mesh while the second was 92 mm. Both nets were 720 m in length. The Gambians designate mesh size by bar length (which is ½ stretched mesh size). No hanging ratio was used in either gillnet.

Data on species, length, weight, gear type and mesh size were recorded. Both nets were hauled every 24hrs. Different fishing grounds were used during the study and the GPS coordinates were recorded. An electronic scale was used for weighing and a measuring board with 1 mm increments was used for measuring length. A handheld Garmin GPS was used for the recording of coordinates. Fish were identified using the fish guide to the identification of saltwater Senegalese and Gambian fish (Bellemans et al, 1988) and the Gambian fish guide (Gabis et al, 2012).

Results

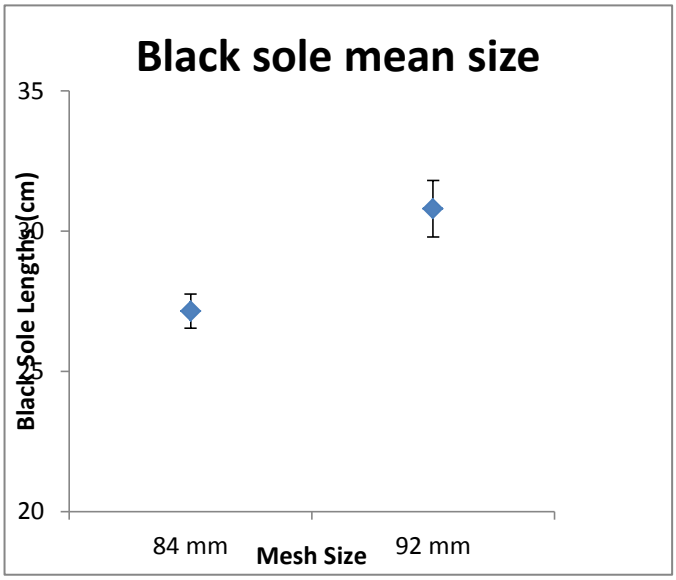
There were 29 net hauls completed. Weights were not obtained as the electronic scale failed partway through the project. 41 species were captured. Table 1 shows the number of fish captured per net mesh size.

Species	84 mm	92 mm	Common name
Arius spp	802	737	Catfish
Taeniura grabata	1	6	Round sting ray
Gainde gauge	26	19	Gainde gauge/Milk shark
Lutjanus agennes	4	6	Yahk/red snapper
Caranx crysos	13	3	Fetta/Blue runner
Pentanemus quinquarius	36	19	Ngorr sikem/Royal threadfin
Dentex angolensis	311	295	Camera camera Butterfish
Brachydeuterus auritus	141	173	Hurr hurr/bigeye grunt
Pomadasys jubelini	60	125	Sompat/Sompat grunt
Pseudotolithus elongates	75	64	Jotto/Bobo croaker
Cynoglossus senegalensis	23	19	Red sole
Synaptura cadenati	50	34	Black sole
Pseudotolithus senegalensis	78	69	Fotta/Cassava croaker
Galeoides decadactylus	45	38	Chekem/Lesser African threadfin
Chloroscombrus chrysurus	81	34	Lanya lanya/Atlantic bumper
Pseudotolithus brachygnathus	16	19	Nguka/Law croaker
Polydactylus quadrifilus	3	1	Kujali/Giant Africa threadfish
Epinephelus aeneus	5	0	Choff/ White grouper
Acanthurus monroviae	4	19	Doctour gauge/Doctor fish
Plectorhynchus mediterraneous	3	23	Wasampierre/Rubberlip grunt
Sparus aurata	0	1	Warrange/Gilthead seabream
Alectis alexandrines	0	7	Yawal/Pompano
Pseudotolithus typus	18	9	Tonone/ladyfish
Sphyrna spp	18	15	Hammerhead shark
Drepane Africana	16	63	Tapendar/African sicklefish
Ephippion guttifer	10	13	Konkareh/Puffer
Sardinella maderensis	259	340	Yoboye Tass/Madeiran sardinella
Palinurus mauritanicus	1	1	Soum/Pink spiny lobster

Species	84 mm	92 mm	Common name
Arius spp	802	737	Catfish
Taeniura grabata	1	6	Round sting ray
Ethmalosa fimbriata	45	36	Bonga/shad
Mugil curema	4	0	Tambajang/guiss/Curema mullet
Sardinella aurita	8	4	Yabauye morro/Round sardine
Pomadasys incisus	1	0	Daha/bastard grunt
cuttlefish	1	0	cuttlefish
Scomberomorus tritor	0	2	Njuna/Spanish mackerel
Simput	0	1	Simput
Elaops lacerta	2	0	Lak/west African ladyfish
Umbeina canariensis	5	1	Nyaw neh/Canary drum
Decapterus rhonchus	1	0	Jai/False scad
Not identified	0	2	Torpedo Ray
Caranx hippos	0	1	Saka/Crevelle jack
Total	2166	2200	

Table 1: List of species and total number of individuals captured by mesh size**.**

The mean size of fish caught in each mesh size was examined for sole species and catfish. However, several other species were caught in large enough quantities to allow for analysis including butterfish, sardinella, Sompat grunt, jotto, Cassava croaker, lesser African threadfin and Bigeye grunt.



	84mm	92mm
Avg. Size	**27.14**	**30.79**
SE	**0.61**	**1.01**
T-test statistic	**3.27**	
P	**0.001**	

Table 2: Black sole mean size and standard error (SE).
T-test results indicate significant difference

Figure 4: Black Sole mean size with standard error.

Figure 4 and Table 2 shows the average Black sole caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 27.14 mm and the 92mm caught an average fish size of 30.79 mm. Figure 5 illustrates the shift to larger fish with the bigger mesh size.

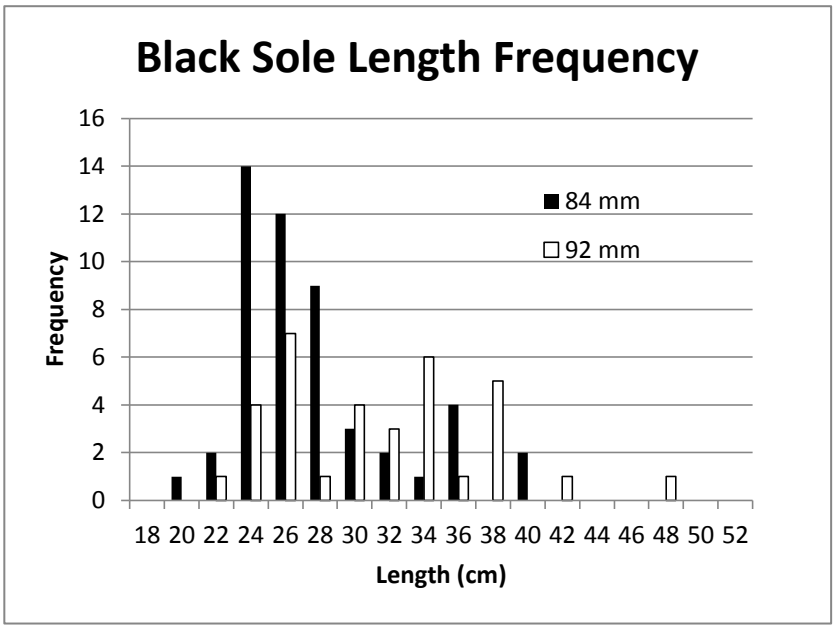
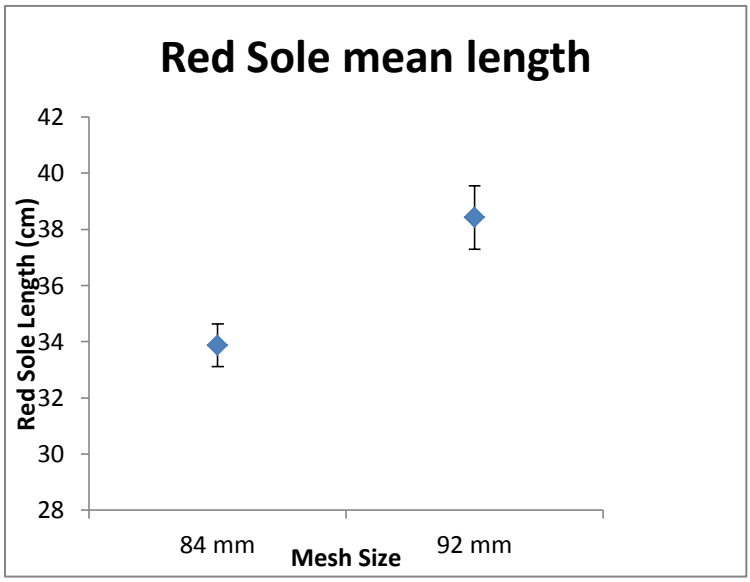


Figure 5: Length frequency of black sole from the two mesh sizes.



	84mm	92mm
Avg. Size	**33.87**	**38.42**
SE	**0.76**	**1.12**
T-statistic	**3.45**	
P	**0.001**	

Table 3: Red sole mean size and standard error (SE).

T-test results indicate significant difference.

Figure 6: Mean size of red sole captured by mesh size (with standard error).

Figure 6 and Table 3 shows the average Red sole caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 33.87 mm and the 92 caught an average fish size of 38.42 mm. Figure 7 illustrates the shift in range of sizes caught in the larger mesh size.

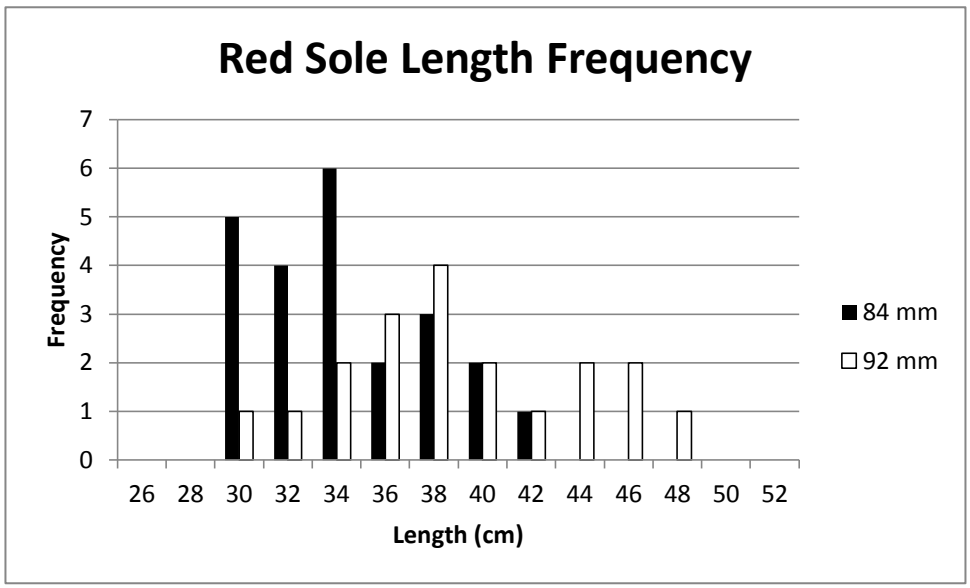
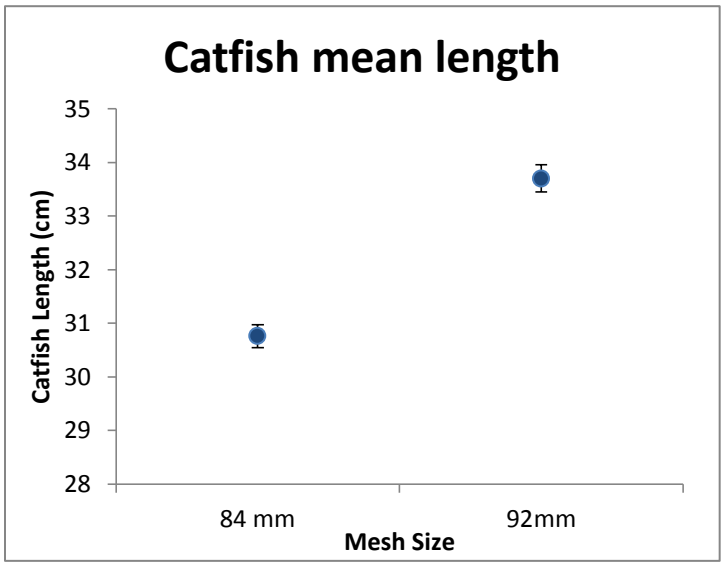


Figure 7: Length frequency of red sole caught with the two mesh size

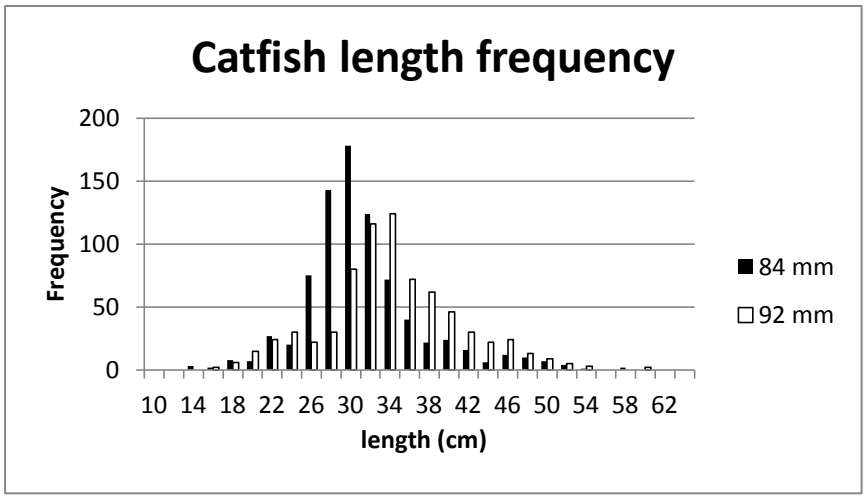


	84mm	92mm
Avg. Size	**30.76**	**33.70**
SE	**0.21**	**0.25**
T-test statistic	**8.9**	
P	**0.0001**	

Table 4: Mean catfish size captured by mesh size. There was a significant difference.

Figure 8: Catfish mean size with standard error bars

Figure 8 and Table 4 shows the average Catfish caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 30.76 mm and the 92 caught an average fish size of 33.70. Figure 9 illustrates the shift in range of size of fish captured



	84mm	92mm
Avg. Length	**25.28**	**31.95**
SE	**0.64**	**0.55**
T-statistic	**7.29**	
P	**0.0001**	

Table 5: Sompat grunt mean size with standard error. T-test results indicate significant difference.

Figure 9: Length frequency of catfish captured in the two mesh sizes.

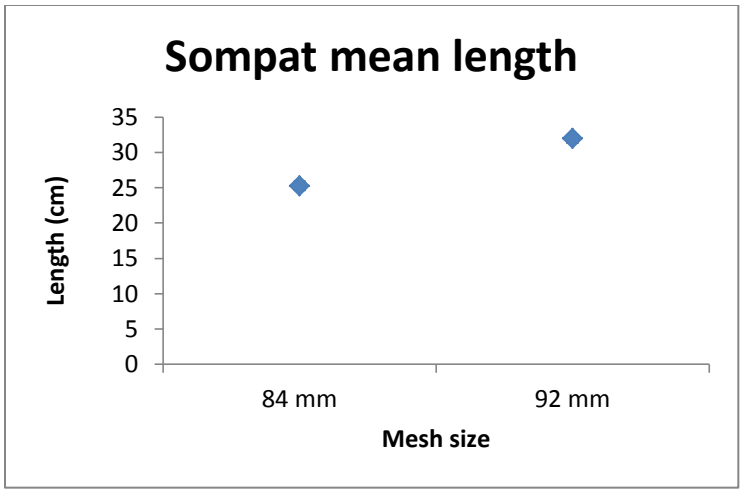


Figure 10: Sompat grunt mean size with standard error bars.

Figure 10 and Table 5 shows the average Sompat grunt caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 25.28 mm and the 92 caught an average fish size of 31.95 mm.

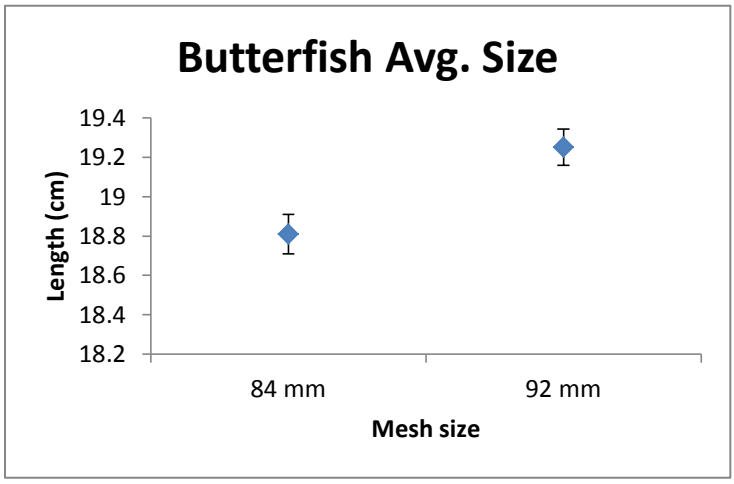
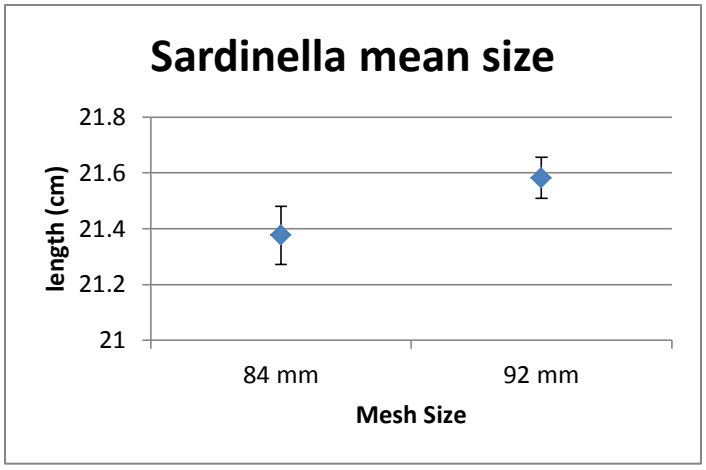


Figure 11: Butterfish mean size with standard error bars.

	84mm	92mm
Avg. Size	**18.81**	**19.25**
SE	**0.099**	**0.093**
T-statistic	**3.22**	
P	**0.001**	

Table 6: Butterfish mean size and standard error. T-test results indicate significant difference.

Figures 11 and Table 6 shows the average Butterfish caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 18.81mm and the 92 caught an average fish size of 19.25 mm.

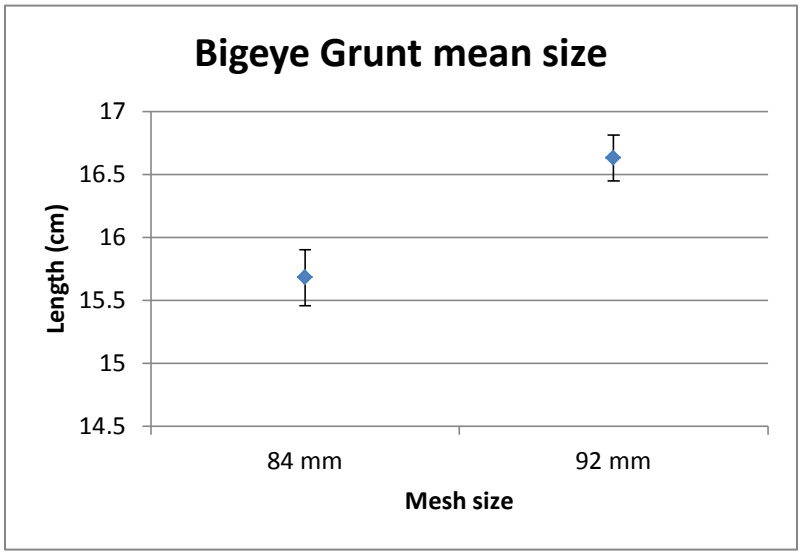


	84mm	92mm
Avg. Size	**21.28**	**21.58**
SE	**0.010**	**0.073**
T-statistic	**1.65**	
P	**0.09**	

Table 7: Average sardinella size for each mesh size. There was no significant difference found.

Figure 12: Sardinella mean size with standard error bars.

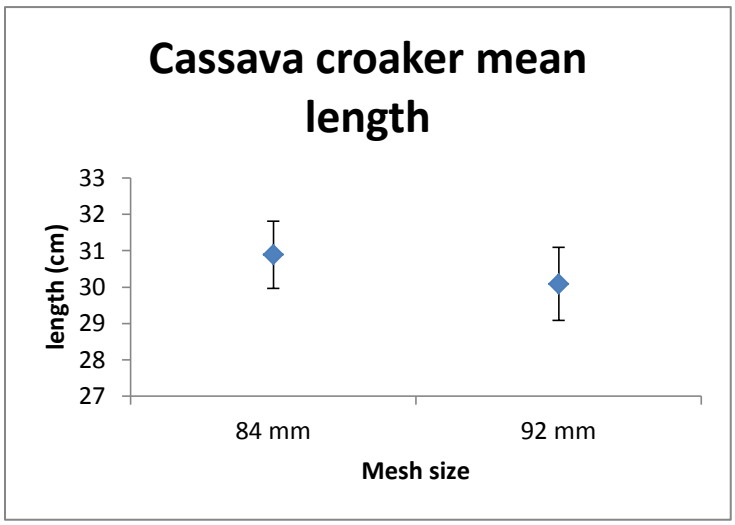
Figure 12 and Table 7 shows the average Sardinella caught in the 84mm and 92mm mesh nets. The 84mm net caught an average fish size of 21.28 mm and the 92 caught an average fish size of 21.58 mm.



	84mm	92mm
Avg. Size	**15.68**	**16.30**
SE	**0.22**	**0.18**
T-statistic	**3.59**	
P	**0.0003**	

Table 8: Bigeye mean size and standard error. T-test results indicate significant differences between mesh sizes.

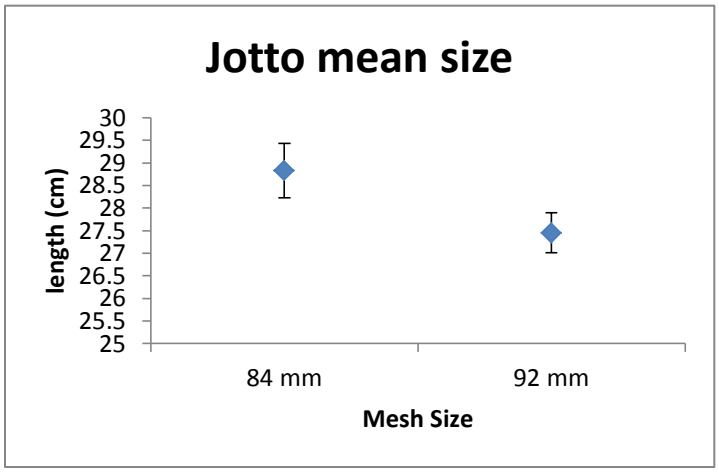
Figure 13: Bigeye grunt mean size with standard error bars.



	84mm	92mm
Avg. Size	**30.9**	**30.08**
SE	**0.93**	**1.00**
T-statistic	**0.58**	
P	**0.55**	

Table 9: Mean size of Cassava croaker for each mesh size. There was no significant difference

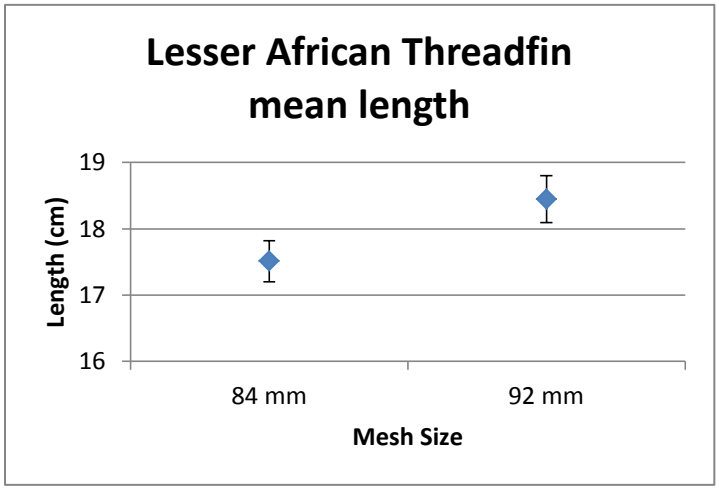
Figure 14: Mean size plus standard error for Cassava croaker.



	84mm	92mm
Avg. Size	**28.83**	**27.45**
SE	**0.60**	**0.44**
t-statistic	**1.86**	
P	**0.06**	

Table 10: Jotta mean size. There was not a significant difference.

Figure 15: Mean sizes for Jotto African threadfin with standard error bars.



	84mm	92mm
Avg. Size	**17.5**	**18.4**
SE	**0.31**	**0.36**
T-statistic	**1.99**	
P	**0.04**	

Table 11: Mean sizes and standard errors for Lesser African threadfin. This is significantly different between mesh sizes.

Figure 16: Mean sizes for Lesser African threadfin with standard error bars.

Figures 13, 14, 15 and 16 and Tables 8, 9, 10 and 11 summarize the mean sizes and statistics for Bigeye grunt, Cassava croaker, Lesser African threadfin and Bobo croaker. Only the bigeye grunt and Lesser African threadfin show a significant larger size with the bigger mesh.

Discussion

The overall results of the catch comparison of the 84 mm and 92mm bottom gillnet used in the study indicate that significantly larger sole, catfish, Sompat grunt, Bigeye grunt, Lesser African threadfin and butterfish are caught with the larger 92 mm stretch mesh net than in the 84 mm net. Both nets caught most of the same species and the total number captured was not considerably different between the two nets. The increased mesh size has the potential to be a meaningful management tool for the sole and catfish fisheries while also improving the status of grunt and butterfish. The species that did not show a change were sardinella, Cassava croaker and Bobo croaker. Others were not caught in sufficient numbers to compare statistically. Actual selectivity curves were not determined for the gillnets in this study (Holst et al., 1994).

Current mandated minimum mesh and fish size have been arbitrarily determined. New (although not complete) information on sole maturity can now be matched with mean size of fish captured using different mesh sizes. With better biological information, it will greatly improve harvesting rules and fishery sustainability. Preliminary data indicate that 50% maturity of Arius spp occurs between 20-25 cm lengths. Increasing mesh size to 84 or 90 mm will shift the mean size of fish captured to between 31-34 cm, well above the 50% maturity size.

Although the current mandated minimum mesh size is 80 mm, fisherman use both the 84 mm and 92 mm stretch mesh, so conversions can be rapid and easy. The information learned from this study was presented to NASCOM and action was taken to increase the mesh size to 92 mm. It is extremely important that the artisanal fisherman community understand that the use of a larger mesh net will further ensure the future sustainability of their livelihood by allowing the smaller juvenile fish to mature and reproduce.

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