Length-weight relationships and condition factors of Red sole, Cynoglossus senegalensis and Black sole, Synaptura cadenati from The Gambia

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Acknowledgements

There is little doubt that involving all stakeholders as partners in developing management plans will assist in the progress towards improved management of the fishery resources. The industrial sector plays a very important role in data collection for fishery management purposes. The participation of processing plants in collecting basic biological information is critical, especially in data deficient situations. We wish to thank Atlantic Seafood Company for their participation in data collection about the sole resources. This information dramatically improved the data poor scenario and allowed very specific questions to be formulated and investigated.

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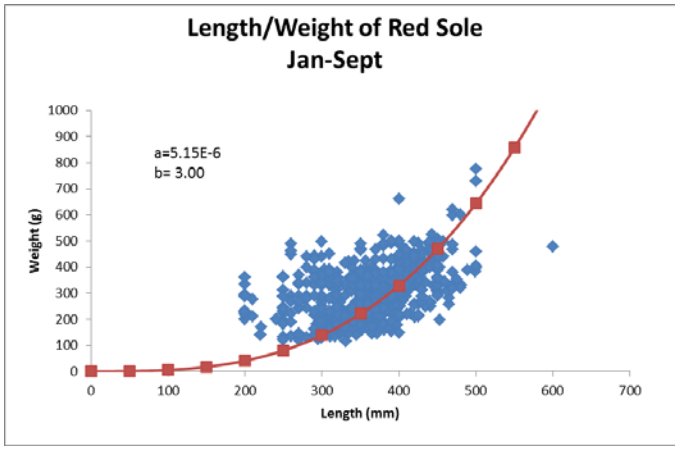
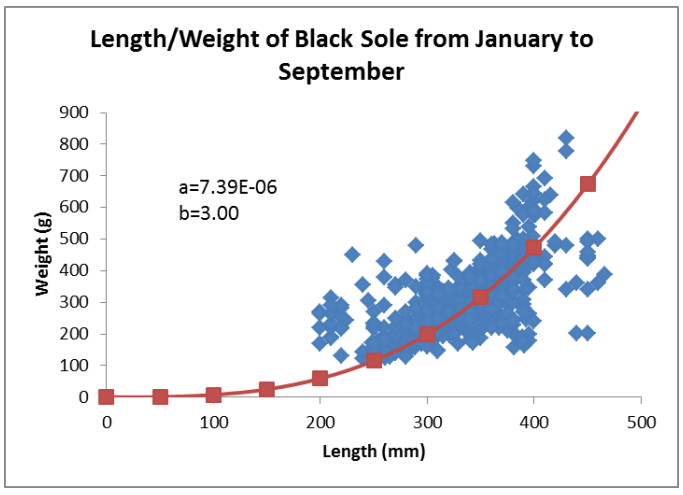
Introduction

The fishery for sole in the Gambia consists of two major species: black sole (*Synaptura cadenati*) and red sole (*Cynoglossus senegalensis*). The species have been aggregated in the first sole stock assessment as an attempt at estimating preliminary values of fishing mortality. However, as a suggested improvement, length/weight data have been collected for the individual species by the Atlantic Seafood Company from January 1, 2010 to September 2, 2010.

Combining data from the entire year produced length weight relationships with considerable variability (Figure 1: a and b). The length-weight relationship of fish is modeled $W=aL^b$, where W is the weight, L is the length, and a and b are constants that stay generally consistent for each species (Nielsen and Johnson 1983). A non-linear SOLVER process was used to estimate a and b minimizing the sum of squares.



a)



b)

Figure 1. Length-weight relationship for red (a) and black (b) sole

To further examine the variation, fish were examined by their body condition index (K) in each month. Measures of fish condition are thought to be reliable indicators of the energetic condition or energy reserves of fish. Abowei et al. (2009) found that for red sole in Nigeria, K values vary over the season because of spawning activities with the lowest K value found during the spawning season. We used Fulton's condition index (Figure 2) and it is calculated as $K= 100W/L^3$, where W is the weight of the fish in grams and L is the length of the fish in centimeters (Nielsen and Johnson 1983).

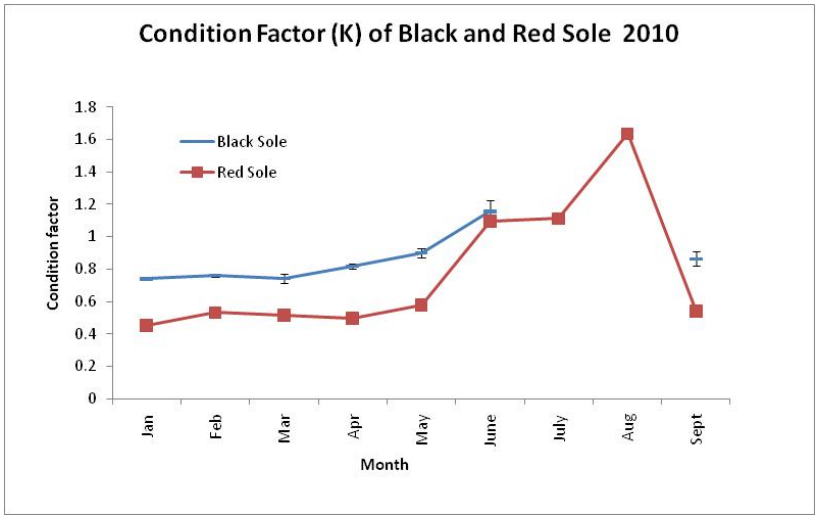


Table 1. Calculated Fulton's condition factor

Red Sole		Black Sole
Month	Avg K	Avg K
January	0.45	0.74
February	0.53	0.76
March	0.51	0.74
April	0.50	0.82
May	0.58	0.90
June	1.09	1.16
July	1.11	
August	1.63	
September	0.54	0.86

Figure 2. Fulton's Condition factor for black and red sole

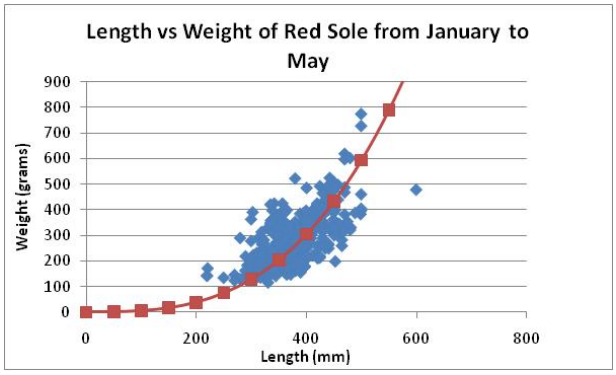
Both species showed changes in the condition factor over the season (Figure 5). Black sole is consistently higher than red sole starting at 0.8 and steadily rising. No data is available in July and August. Red sole started at 0.5 and showed a significant increase in the k from June to August, where the index rose from 1.1 to 1.6. Both fish then showed a decrease to the initial index by September: 0.54 for red sole and 0.86 for black sole.

This implies that the relationship between length and weight changes dramatically, must likely because of a spawning event. From fishermen's observations in southern Gambia, the sole fish appear in Gambian waters moving north in January moving to shallow waters and the females carry eggs that are not well developed. In June/July, the eggs are fully mature and are released in sandy areas known as pass. The movement back to deeper water occurs in August after spawning.

As a consequence of this possible biological parameter that would affect the L/W relationship, data was divided into two seasons: before spawning (January to May) and

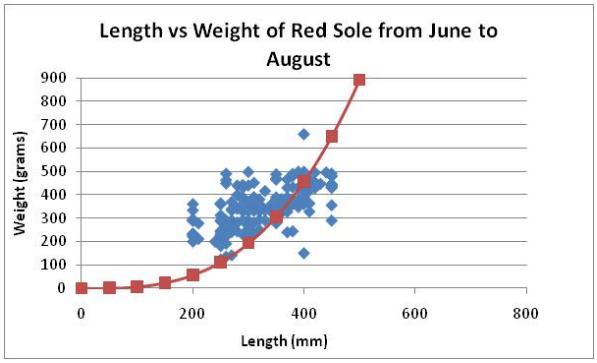
during spawning (June to August). For both species, data from the pre-breeding period appeared to have a closer fit to the predicted curve, whereas data from June through August showed much more scatter and didn't fit as well. This may be due to the fact that there is a transition period when some but not all fish are spawning. There is no ability to distinguish sexes and changing sex ratios may affect the relationship. Total number sampled is also smaller (Figure 3: a-d).

a)



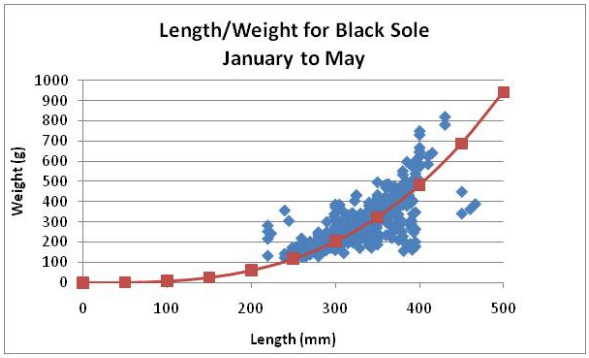
Red Sole: January to May
a = 4.75E-06
b= 3.00

b)



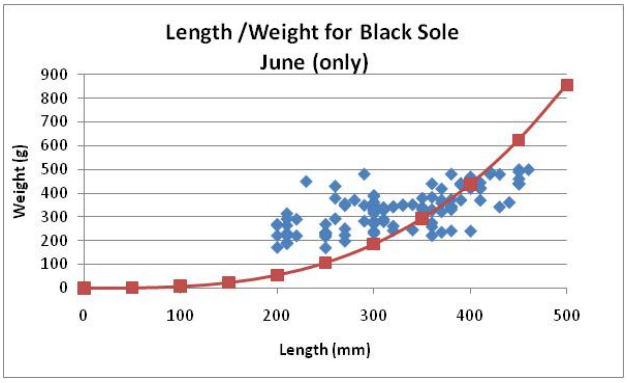
Red Sole: June-August
a=7.14E-06
b=3.00

c)



Black Sole: January to May:
a = 7.54E-06
b= 3.00

d)



Black Sole: June:
a = 6.85E-06
b= 3.00

Figure 3: (a) Red sole length-weight relationship (January-May); (b) Red sole length-weight relationship (June-August);(c) Black sole length-weight relationship (Junuary-May);(d) Black sole length-weight relationship June only.

Summary

As a first step towards improving the stock assessment for the Gambian red and black sole, more detailed information is needed. The length-weight relationship by species is an important segment of that data needed to interpret composition of landings information (in the absence of age/length data). Although we have been able to establish more detailed species specific curves, it is clear that these can be improved. Suggested future work includes matching species weight and gonad condition to verify spawning times and sex ratios of the catch and age at length information).

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