On steepness

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Abstract. The base case value for h, the Beverton-Holt steepness parameter is 0.49, which falls outside the range of values used in assessments of species of fish with similar life histories. It also fall in the lower part of the MCB probability densities. Some questions are raised about uncertainties are associated with the derivation of h from the model data.

Introduction. A problem common to forward projection assessment models is that there are two parameters that in most cases are not well determined for the stock by observational or experimental data. These are M Natural Mortality and in the case of a Beverton-Holt formulation h the steepness parameter.

In the case of SEDAR 25 for the South Atlantic black sea bass natural mortality was estimated by a quasi-meta-analysis of estimates for various species modified to introduce a size (age) specific vector. The spawner-recruit relation was established based on modeled data[1]. The assessment models the South Atlantic black sea bass stock without considering the biological peculiarities of this protogynous species and how they may affect the assumptions of the Beaufort Assessment Model

Our main concern n with this process is that the modeling is carried back in time to 1978. The sample data, however, is divided into two time periods and an unknown number of areas. The two time periods are from roughly from 1978 to 1990 and 1990 to present. The early period has to rely on length frequency sample, whereas actual age composition samples become available for the later period[2]. As a result the estimates of age 0 recruits are uncertain and more uncertain for the early period. This variable uncertainty is likely not considered in modeling the B-H curve.

Comparisons. The meta-analysis approach is frequently invoked for choosing a value of h for an assessment. Table 1.is a compilation of demersal species assessed by SEDAR. Black sea bass is the only species where h is lower than 0.5.

Table 1. Steepness values used in SEDAR assessments for snapper-grouper the S. Atlantic

Reference	Species	h
SEDAR 2	Vermillion Snapper (*Rhomboplites aurorubens)*	0.9 .7-,95

[1] In this there would seem to be considerable circularity as both the spawning biomass (the eggs produced) and the recruits of age-0 fish are products of the model.

[2] The data picture is further complicated for BSB in that for the headboat fish, the principal source of landings data prior to 1990, the reporting underwent several changes. See SEDAR 25- DW -14 for details.

SEDAR 2	Black Sea bass (*Centropristis striata*)	0.4- 0.8 (0.62)
SEDAR 3	Yellowtail Snapper (*Ocyurus chrysurus)*	0.8
SEDAR 4	Snowy grouper (*Epinephelus niveatus*)	0.7
SEDAR 10	Gag Grouper (*Mycteroperca microlepis*)	0.95
SEDAR 15A	Mutton Snapper (*Lutjanus analis)*	0.75
SEDAR 19	Black Grouper (*Mycteroperca bonaci*)	0.84
SEDAR 19	Red Grouper *(Epinephelus morio)*	0.97 unconstrained
SEDAR 24	Red Snapper (*Lutjanus campechanus)*	0.85
SEDAR 25	Black Sea Bass (*Centropristis striata*)	0.49

A similar table was prepared for SEDAR 19[3]. That paper also includes a summary statement that seems sensible.

"Rose et al. (2001) conducted a similar meta-analysis of the Myers et al. (1999) data. In that analysis, species were categorized into one of three general life-history strategies: periodic, opportunistic, or equilibrium spawners. Of the three, reef fishes of the southeastern U.S. would likely be best characterized by the periodic strategy. Rose et al. (2001) found that periodic spawners had a mean steepness of 0.70, with a median near 0.75. Those values are quite similar to the mean (0.72) and median (0.77) steepness values in this analysis.
For choosing between the beta and normal distributions of steepness, one consideration might be the mode of each distribution, because using a prior distribution pushes the posterior estimate toward the mode of the prior. (The strength of that "push" depends on the shape of the distribution.) The mode of the beta distribution was 0.82, and the mode of the normal distribution was 0.72 (the mean). Although the beta distribution appeared to fit the data better than did the normal distribution, the mode of 0.82 might be considered high for some reef fishes, particularly those that are relatively long-lived and slow to mature."

Conclusions The question is raised as to whether black sea bass are expected to fall outside the range for similar species. Given their high natural mortality and early maturity one might expect this not to be the case.

Finally, for this note we draw attention to the MCB Probability Density distribution SEDAR 25, Section III, Fig. 3.32 which suggests that 0.49 from the base run is low.

[3] Steepness of spawner-recruit relationships in reef fishes of the southeastern U.S.: A prior distribution for possible use in stock assessment SEDAR19-DW-06, June, 2009

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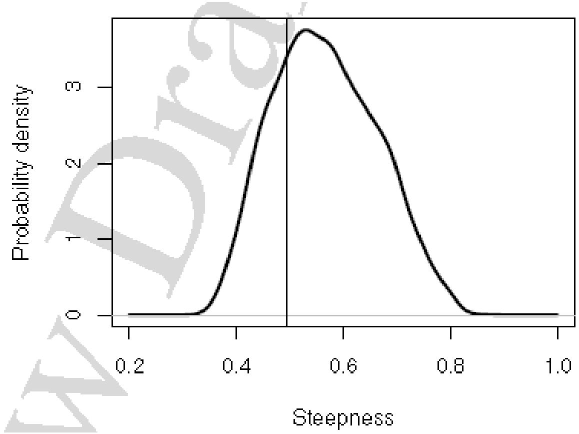

From SEDAR19-DW-06

Table 1. Estimates of steepness (h) from marine demersal species (excluding Scorpaeniformes) reported in Myers et al. (1999). N represents the number of stocks used to estimate the distribution of steepness for a given species, and h20, h50, and h80 represent the 20th, 50th, and 80th percentiles from that distribution.

Common name	Scientific name	N	h20	h50	h80
Gadiforms					
Gadidae		**49**	**0.67**	**0.79**	**0.87**
Blue whiting	*Micromesistius poutassou*	2		0.71	
Atlantic cod	*Gadus morhua*	21	0.76	0.84	0.9
Haddock	*Melanogrammus aeglefinus*	9	0.64	0.74	0.82
Hake	*Merluccius hubbsi*	1		0.82	
Pacific hake	*Merluccius productus*	1		0.32	
Pollock (saithe)	*Pollachius virens*	5	0.78	0.81	0.84
Silver hake	*Merluccius bilinearis*	3	0.31	0.39	0.47
Walleye Pollock	*Theragra chalcogramma*	2	0.53	0.55	0.58
Whiting	*Merlangius merlangus*	5	0.64	0.81	0.91
Lophiformes					
Lophidae		**1**		**0.64**	
Black angler fish	*Lophius budegassa*	1		0.63	

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Perciformes					
Sparidae		**3**		**0.95**	
New Zealand snapper	*Pagrus auratus*	2		0.94	
Scup	*Stenotomus chrysops*	1		0.95	
Pleuronectiformes					
Pleuronectidae		**14**	**0.71**	**0.8**	**0.87**
European flounder	*Platichthys flesus*	1		0.57	
Greenland halibut	*Reinhardtius hippoglossoides*	3	0.59	0.79	0.91
Plaice	*Pleuronectes platessa*	8	0.83	0.86	0.88
Yellowtail flounder	*Pleuronectes ferrugineus*	2	0.69	0.75	0.81
Soleidae		**7**	**0.72**	**0.84**	**0.91**
Sole	*Solea vulgaris*	7	0.72	0.84	0.91

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