been adjusted because of minimum length limits (McGarvey and Fowler, 2002) and selectivity (Troynikov, 1999; Taylor et al., 2005; Troynikov and Koopman, 2009), growth curve parameter estimates are generally unadjusted for maximum length limits or dome-shaped selectivity and few studies have tested proposed methods with simulated data. Gwinn et al. (2010) explored the bias in the methods that account for dome-shaped selectivity including fixing L_∞. However, when good data are unavailable to provide an estimate of L_∞, fixing it is inappropriate. Alternately, one could use the variance observed in fully selected age classes to assume a variance at non-fully selected ages to provide information about the approximate scale of the L_∞ value. Two stock assessments with the potential for biased growth because of dome-shaped selectivity and lack of fishery-independent age data are assessments for Gulf menhaden *Brevoortia patronus* and Atlantic menhaden *B. tyrannus*.

Both Gulf menhaden and Atlantic menhaden are ubiquitous filter-feeding clupeid species (Ahrenholz, 1991). Gulf menhaden occur in the northern Gulf of Mexico from Florida to Mexico, and Atlantic menhaden are found along the U.S. Atlantic coast from Florida to Maine and into Canada. Both species are schooling, forage fish that are harvested by large, industrial purse-seine fisheries. Gulf menhaden move towards the centre of the species range, off the coast of Louisiana, as they age (Ahrenholz, 1981). Atlantic menhaden migrate north in spring from the spawning grounds off North Carolina through summer and stratify by size and age with older and larger individuals migrating the farthest north (Nicholson, 1971, 1978; Ahrenholz, 1991). Both species exhibit spatial heterogeneity in size and age, and as such, spatial heterogeneity in age occurs on the fishing grounds, which may be responsible for overall dome-shaped selectivity in the fishery (Sampson and Scott, 2011).

The commercial purse-seine fishery is the largest fishery by volume in the Gulf of Mexico and the second largest (along with Atlantic menhaden) in the United States (NOAA, 2012). Currently, there are four processing plants on the Gulf coast, and one plant on the Atlantic coast. Biological samples are collected from vessels at dockside at each of the plants. The 10-fish samples are obtained from the top of a vessel's fish hold (Smith, 1991). Fork length and weight are measured for each specimen sampled, and a scale sample is taken for later age estimation. All scales are sent to the National Marine Fisheries Service (NMFS) Beaufort Laboratory for processing. Scales are used for age estimation because menhaden are short-lived, menhaden otoliths are small and fragile, and the effort needed to process enough otoliths for such a large fishery

Table 1
Run specifications, parameter estimates, and likelihood for runs completed to adjust the growth curve for Gulf menhaden with a minimum adjustment, maximum adjustment, and a minimum and maximum adjustment simultaneously. NA means that the minimum or maximum was not applied. A – indicates a run that did not converge.

Minimum	Maximum	L_∞	k	t_0	CV	Likelihood
100	NA	242.92	0.36	−1.25	0.06	653.09
105	NA	242.97	0.36	−1.26	0.06	650.13
110	NA	243.14	0.36	−1.27	0.06	646.41
115	NA	243.63	0.35	−1.30	0.06	641.37
120	NA	242.97	0.36	−1.28	0.06	636.36
125	NA	240.55	0.38	−1.17	0.06	630.00
130	NA	240.61	0.38	−1.20	0.05	621.63
135	NA	241.23	0.37	−1.26	0.05	612.59
140	NA	242.21	0.36	−1.34	0.05	601.87
145	NA	243.45	0.35	−1.45	0.05	586.78
150	NA	244.53	0.34	−1.53	0.05	568.67
NA	200	–	–	–	–	–
NA	205	–	–	–	–	–
NA	210	–	–	–	–	–
NA	215	–	–	–	–	–
NA	220	314.59	0.20	−1.73	0.07	547.74
NA	225	283.50	0.25	−1.57	0.07	591.00
NA	230	265.94	0.29	−1.44	0.07	624.25
NA	235	253.86	0.32	−1.32	0.07	644.36
NA	240	246.31	0.35	−1.22	0.07	653.93
NA	245	243.17	0.37	−1.17	0.06	660.39
NA	250	242.67	0.37	−1.17	0.06	665.79
100	200	–	–	–	–	–
105	205	–	–	–	–	–
110	210	–	–	–	–	–
115	215	–	–	–	–	–
120	220	–	–	–	–	–
125	225	266.75	0.27	−1.63	0.06	556.14
130	230	257.25	0.30	−1.58	0.06	580.07
135	235	248.18	0.33	−1.45	0.05	590.28
140	240	243.24	0.35	−1.37	0.05	588.23
145	245	242.95	0.35	−1.44	0.05	579.04
150	250	245.21	0.33	−1.56	0.05	566.28
150	200	–	–	–	–	–
145	205	–	–	–	–	–
140	210	–	–	–	–	–
135	215	–	–	–	–	–
130	220	282.69	0.23	−1.86	0.06	506.33
125	225	266.75	0.27	−1.63	0.06	556.14
120	230	264.44	0.27	−1.68	0.06	593.97
115	235	254.70	0.31	−1.52	0.06	618.29
110	240	246.95	0.34	−1.34	0.06	632.47
105	245	244.29	0.35	−1.28	0.06	642.35
100	250	244.30	0.35	−1.28	0.06	650.60

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