Appendix 9 : Assessment of the Namibian Horse Mackerel Resource, Including Both Catch-at-Age and Catch-at-Length Information

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The data, parameterisation and parameter estimation used in this assessment are as described in Kirchner and Punt (Appendix 7). Age-length keys for the Namibian horse mackerel are available for 1996 and 2004 and for those years, the catch-at-age data are used as input (data as in Appendix 7). For the years where no age-length keys are available, catch-at-length data have been used to fit the model (data derived as in Appendix 10). The length-at-age is estimated by the Von Bertalanffy growth equation, with the following Von Bertalanffy parameter values: L_∞=57.19cm, K=0.11 and t_0=-1.65.

20-year projections have been carried out assuming a constant catch of 320 and 41 thousand tons for the midwater and pelagic fleets respectively.

Table 1: Estimates of management quantities for the assessment of the horse mackerel resource.

'-lnL:overall	-43.7						
'-lnL:CPUE	-25.8						
'-lnL:Survey	-1.2						
'-lnL:CAA	-68.1						
'-lnL:CAAsurv	1.5						
'-lnL:LAA	27.3						
'-lnL:LAAsurv	4.8						
Recruitment_Pen	17.8						
		Midwater	Pelagic	Bulgaria	Poland	Romania	USSR
K^{sp}	5077						
K^{ex}	2871	2753	701	1678	3810	3119	2746
B^{sp}_{2004}	923						
B^{ex}_{2004}	666	607	260	447	630	678	518
h	**0.600**						
M	**0.300**						
$MSYL^{sp}$	1655	1638	1603	1602	1702	1663	1651
$MSYL^{ex}$	1171	1098	318	720	1280	1242	987
MSY	334	365	180	305	431	352	418
B^{sp}_{2004}/K^{sp}	0.182						
B^{ex}_{2004}/K^{ex}	0.232	0.221	0.372	0.266	0.165	0.217	0.189
$B^{sp}_{2004}/MSYL^{sp}$	0.558	0.563	0.576	0.576	0.542	0.555	0.559
$B^{ex}_{2004}/MSYL^{ex}$	0.569	0.553	0.819	0.620	0.492	0.546	0.524
$MSYL^{sp}/K^{sp}$	0.326	0.323	0.316	0.315	0.335	0.328	0.325
$MSYL^{ex}/K^{ex}$	0.408	0.399	0.453	0.429	0.336	0.398	0.360
Age	Survey1	Midwater	Pelagic	Bulgaria	Poland	Romania	USSR
S(0)	0.25	0.00	0.07	0.00	0.00	0.00	0.00
S(1)	0.85	0.05	1.00	0.18	0.08	0.25	0.06
S(2)	1.00	0.84	0.25	1.00	0.32	0.91	0.22
S(3)	0.35	1.00	0.12	0.73	0.68	1.00	0.75
S(4)	0.12	0.76	0.05	0.28	1.00	0.75	1.00
S(5)	0.04	0.25	0.03	0.07	0.62	0.31	0.34
S(6)	0.01	0.25	0.01	0.07	0.62	0.31	0.34
S(7)	0.01	0.25	0.01	0.07	0.62	0.31	0.34
	Midwater	Bulgaria	Poland	Romania	USSR		
Commercial_q's	0.007	0.004	0.002	0.002	0.020		
Commercial_sigma's	0.200	0.451	0.796	0.626	0.336		
Survey_q's	**2.000**						

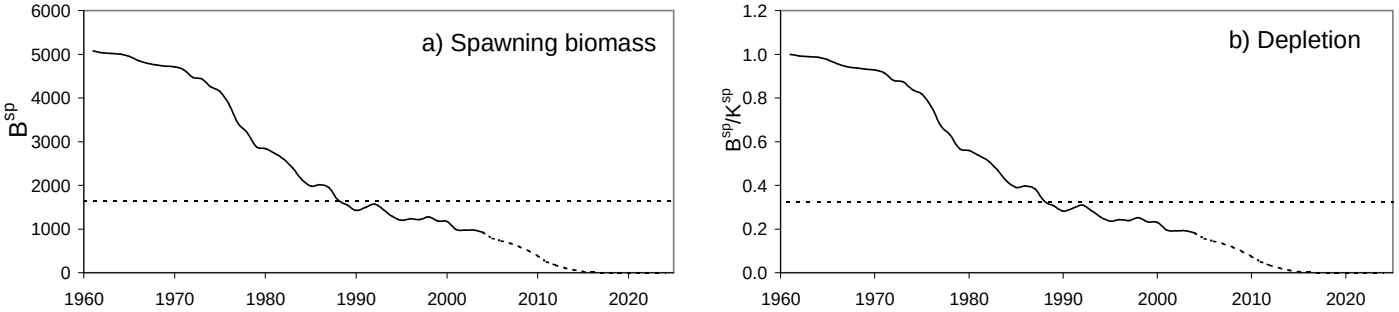

Fig. 1: Time-series of estimated spawning biomass for the Namibian horse mackerel resource. Projected spawning biomass under a constant catch strategy is also shown (dashed lined).

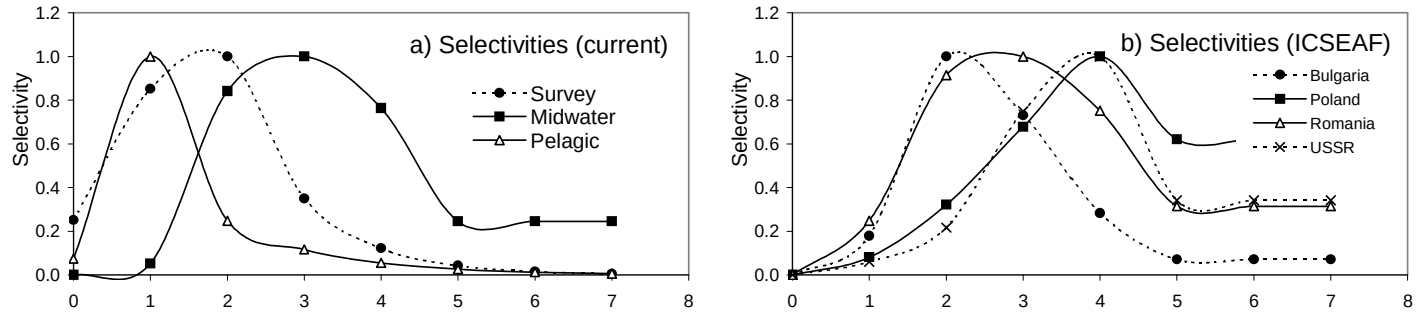

Fig. 2: Commercial and survey fishing selectivities estimated.

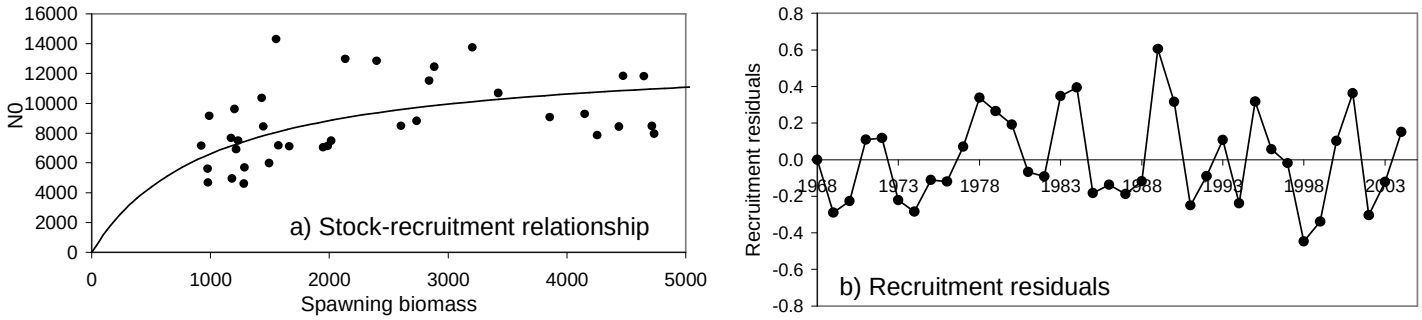

Fig. 3: a) Estimated stock-recruitment relationship and b) time-series of model estimated recruitment residuals.

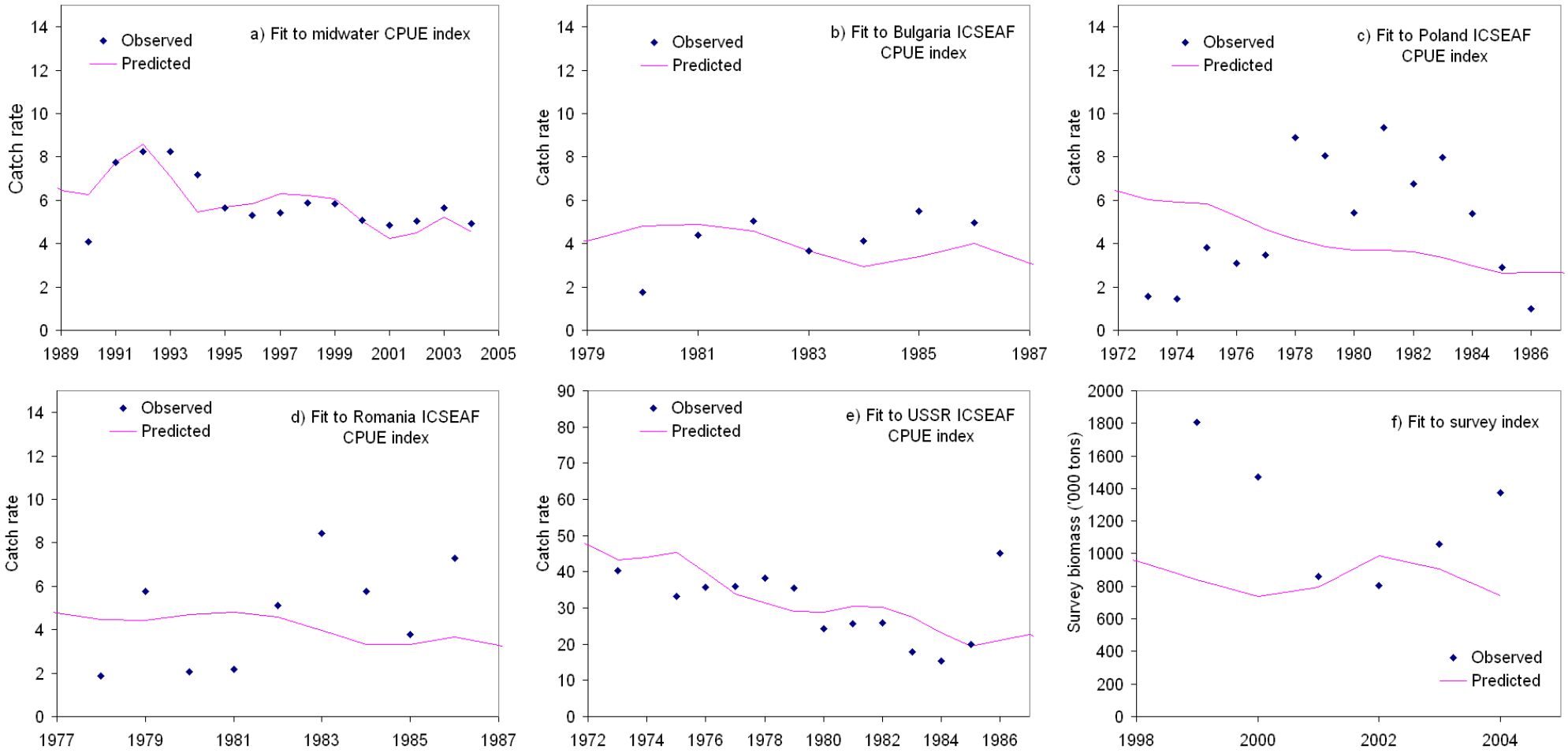

Fig. 4: Model fits to the CPUE and survey abundance indices for the Namibian horse mackerel resource.

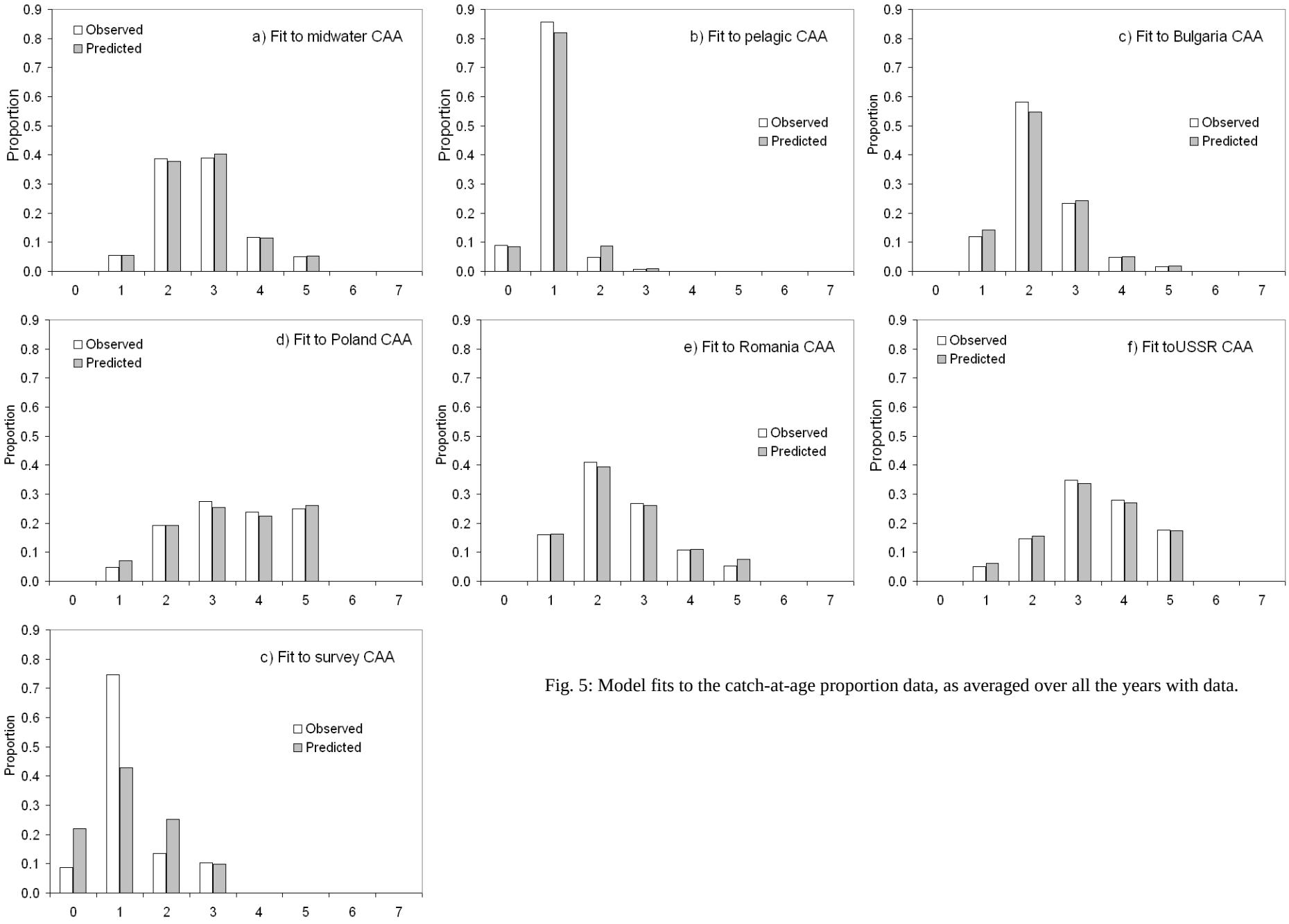

Fig. 5: Model fits to the catch-at-age proportion data, as averaged over all the years with data.

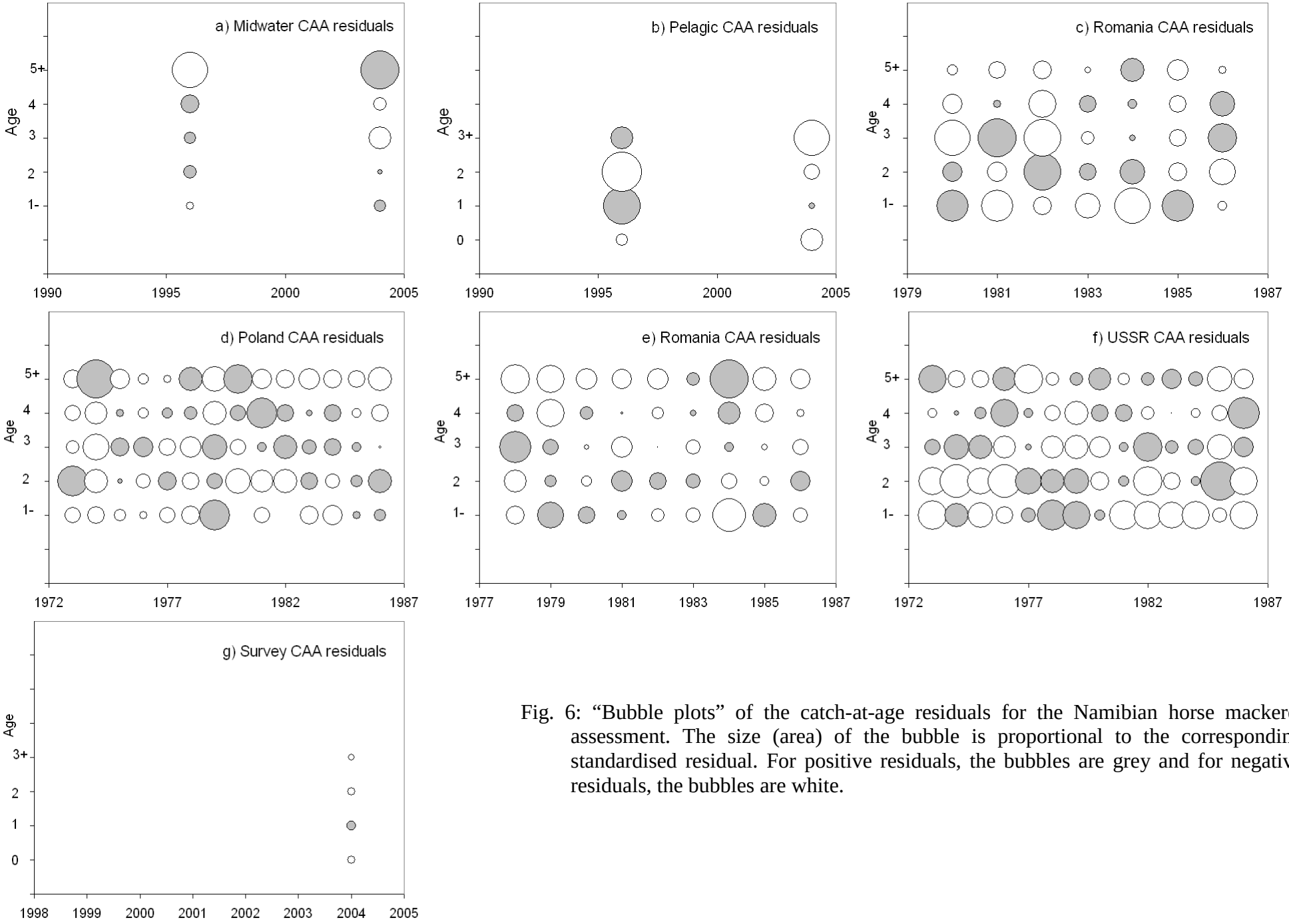

Fig. 6: "Bubble plots" of the catch-at-age residuals for the Namibian horse mackerel assessment. The size (area) of the bubble is proportional to the corresponding standardised residual. For positive residuals, the bubbles are grey and for negative residuals, the bubbles are white.

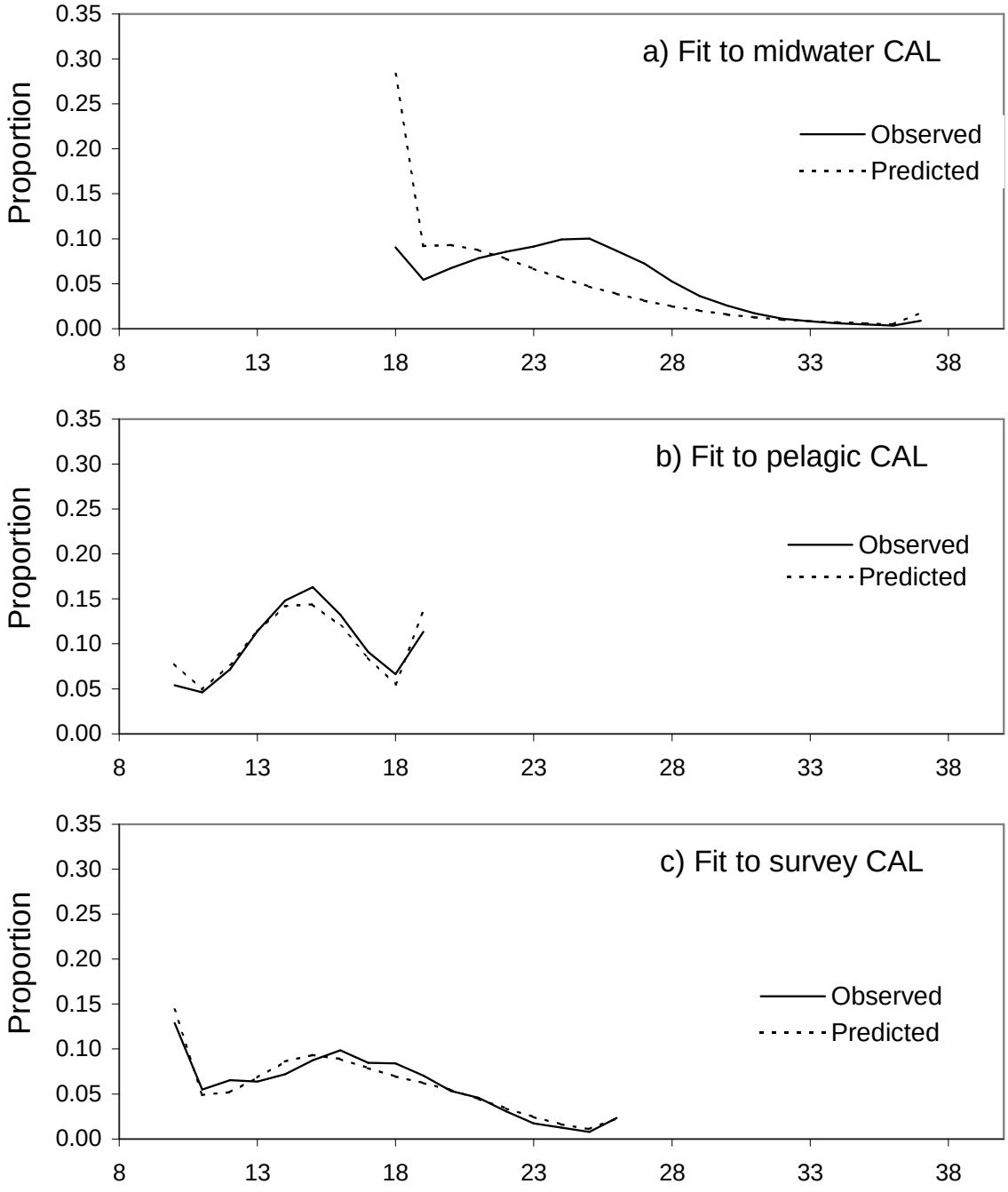

Fig. 7: Model fits to catch-at-length proportion data, as averaged over all the years with data . The "spikes" at the two ends of the plots reflect minus- and plus-groups.