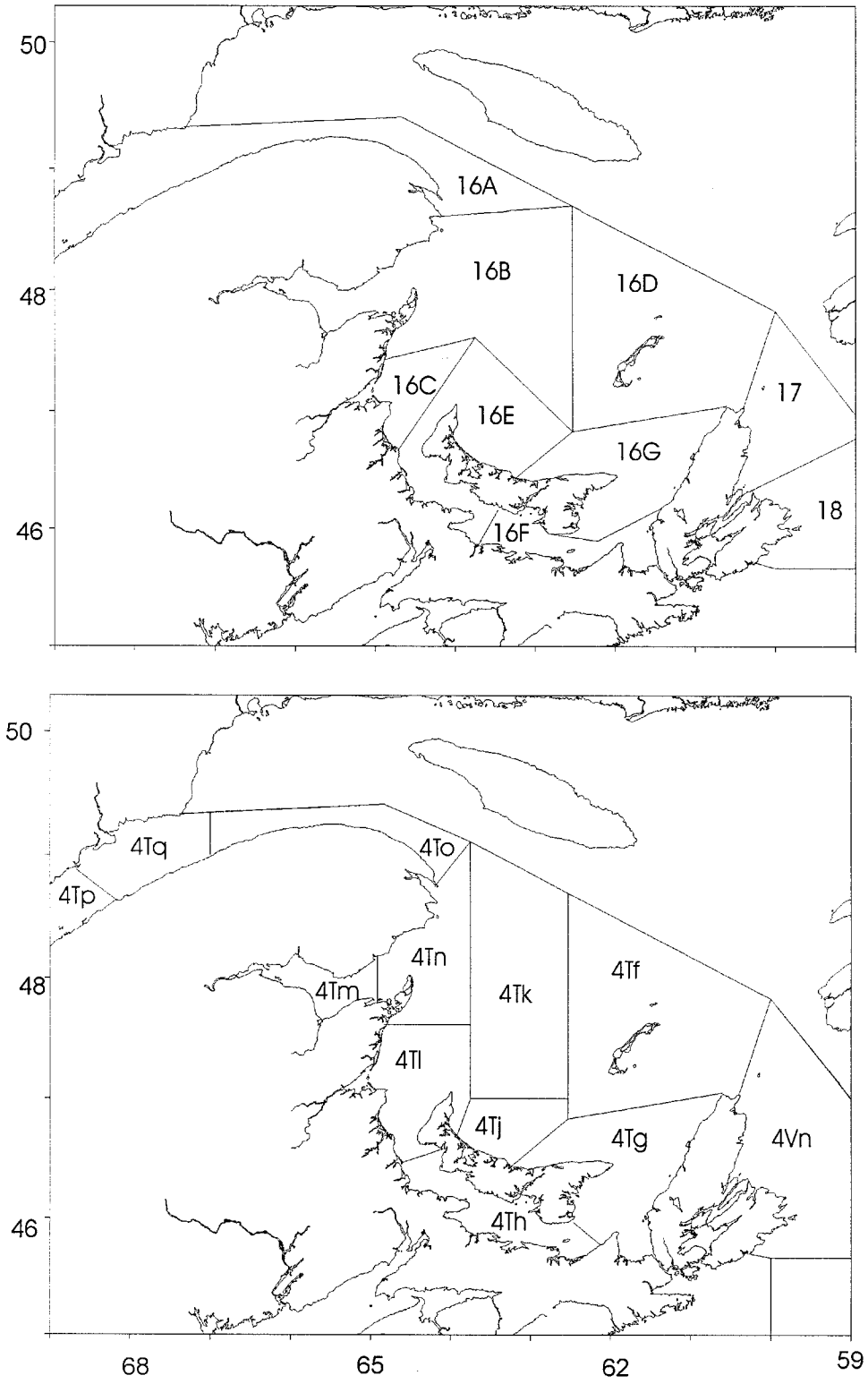


Fig. 1. Herring 4T managment zones (upper) and Canadian Statistical unit areas(lower) in Northwest Atlantic Fisheries Organization (NAFO) 4T.

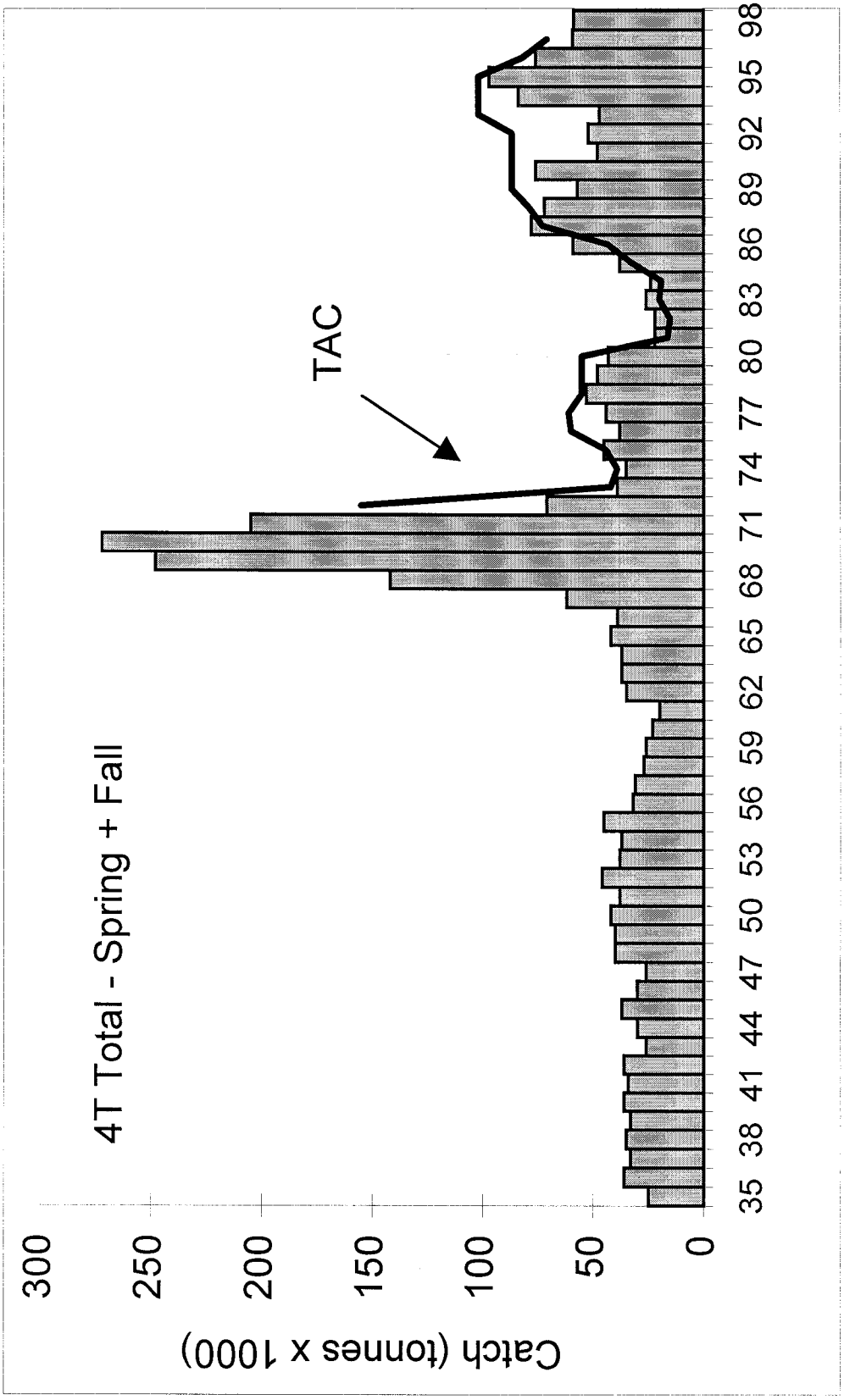
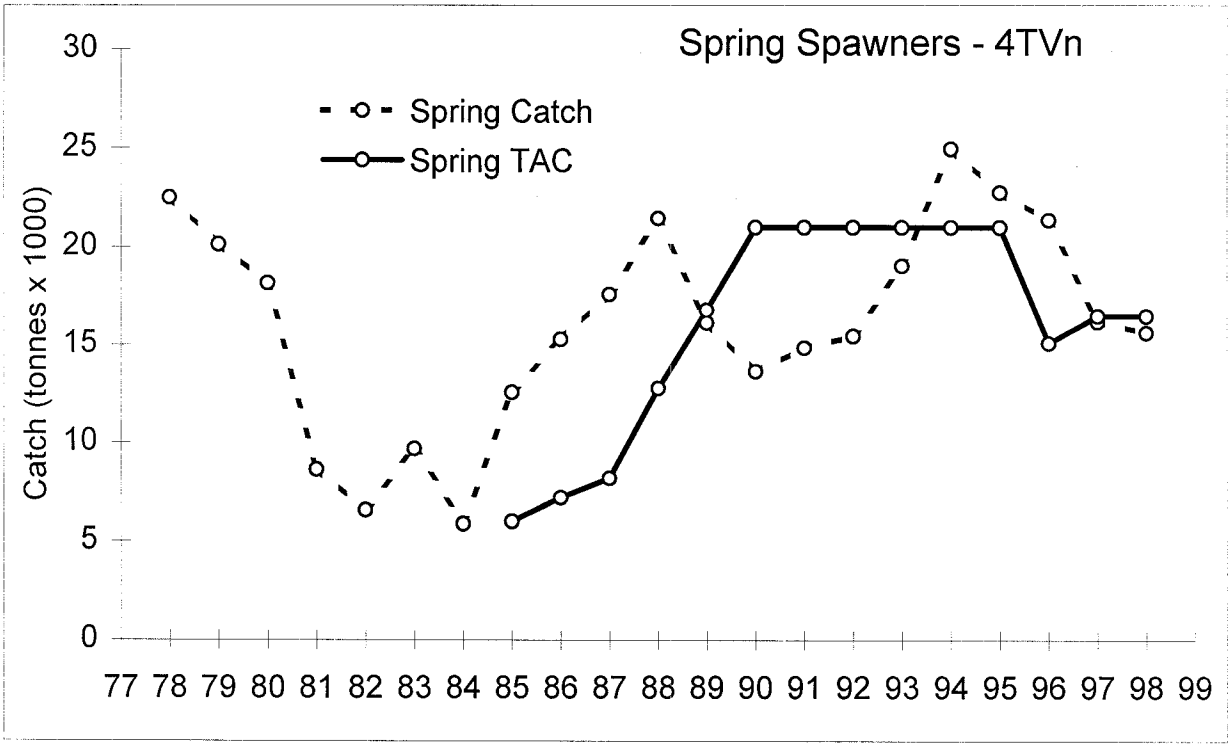


Fig. 2. Combined spring and fall 4T herring landings compared to the overall spring and fall 4T TAC since 1935



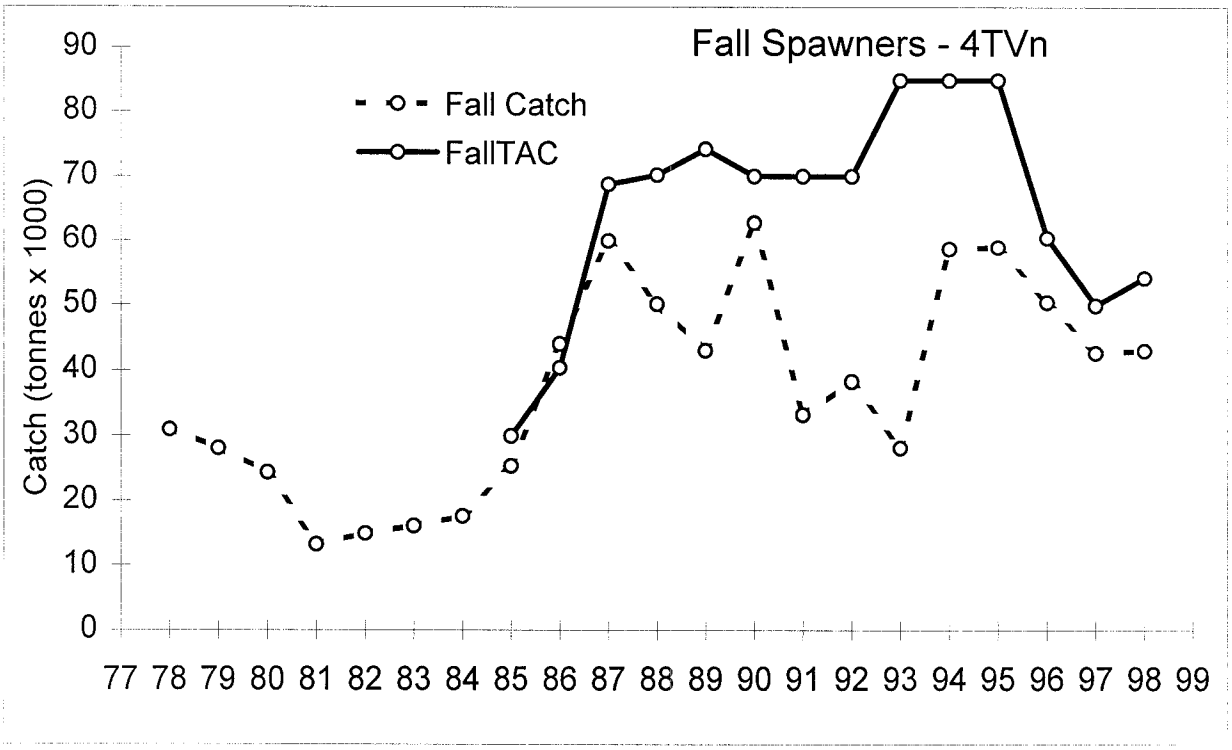
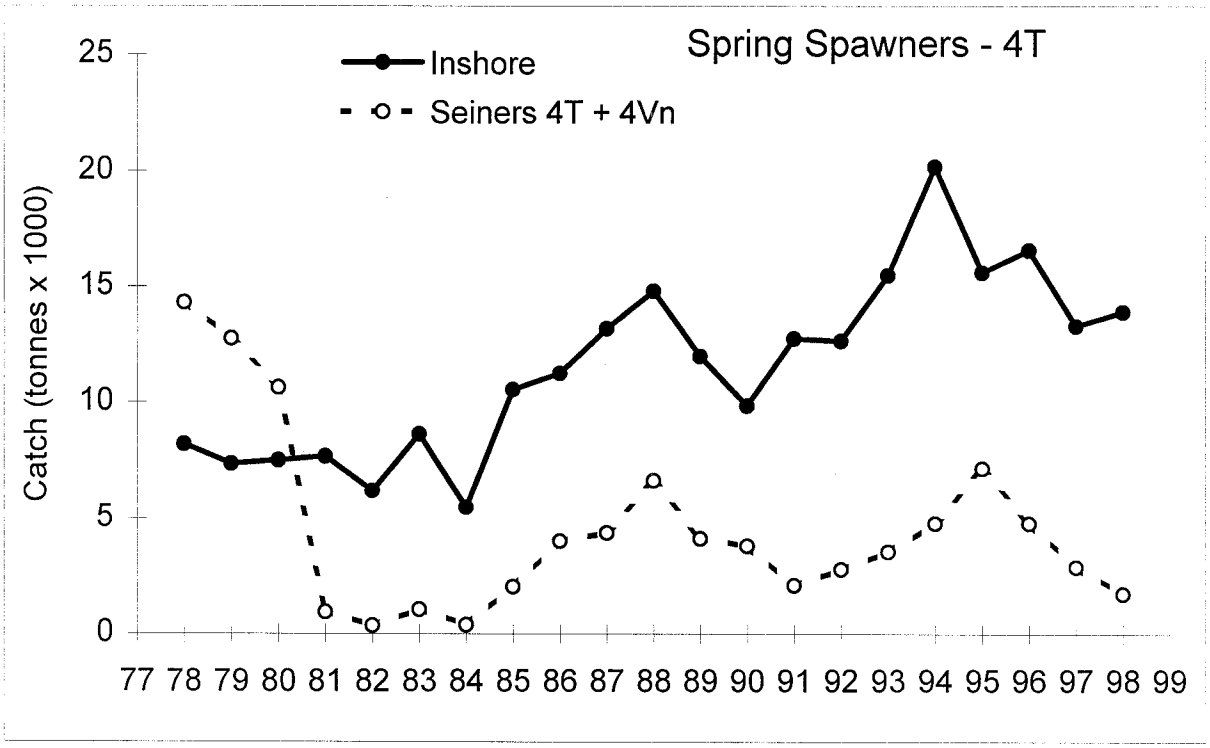


Fig. 3. Comparison of spring and fall spawners landings and TACs from 1978 to 1998 for 4T herring.



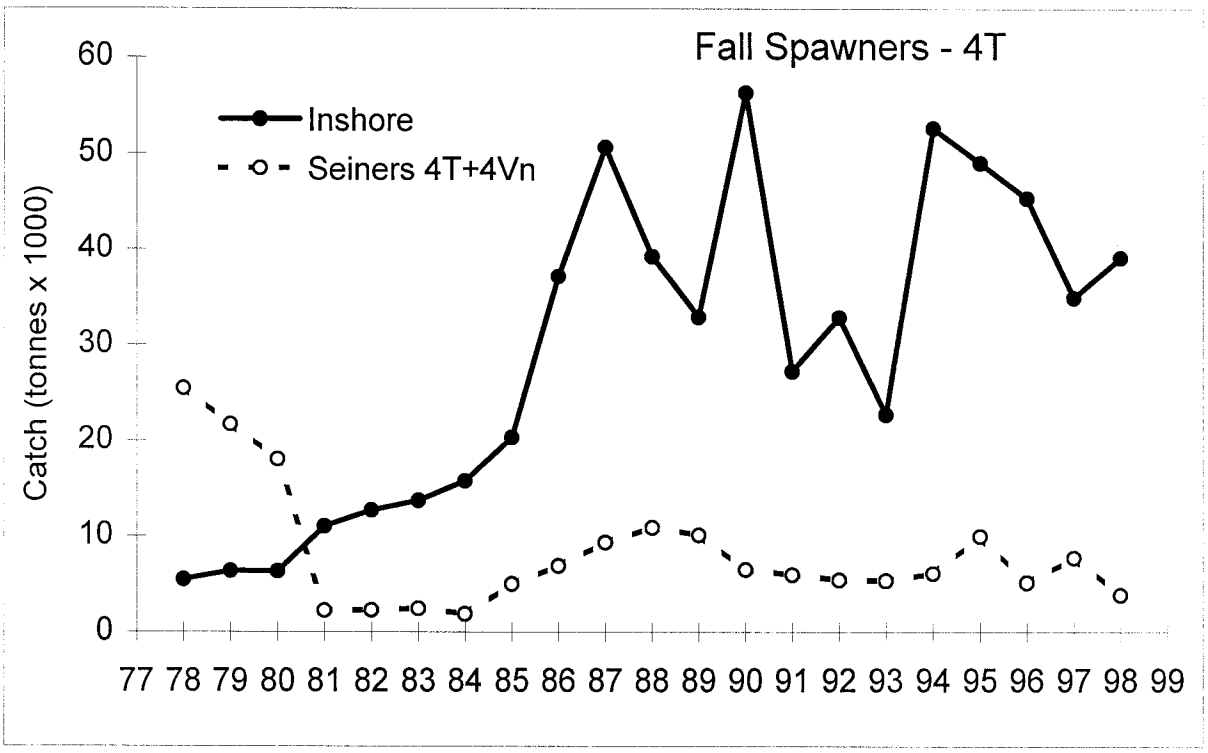


Fig. 4. Comparison of spring and fall 4T herring spawning groups by gear type.

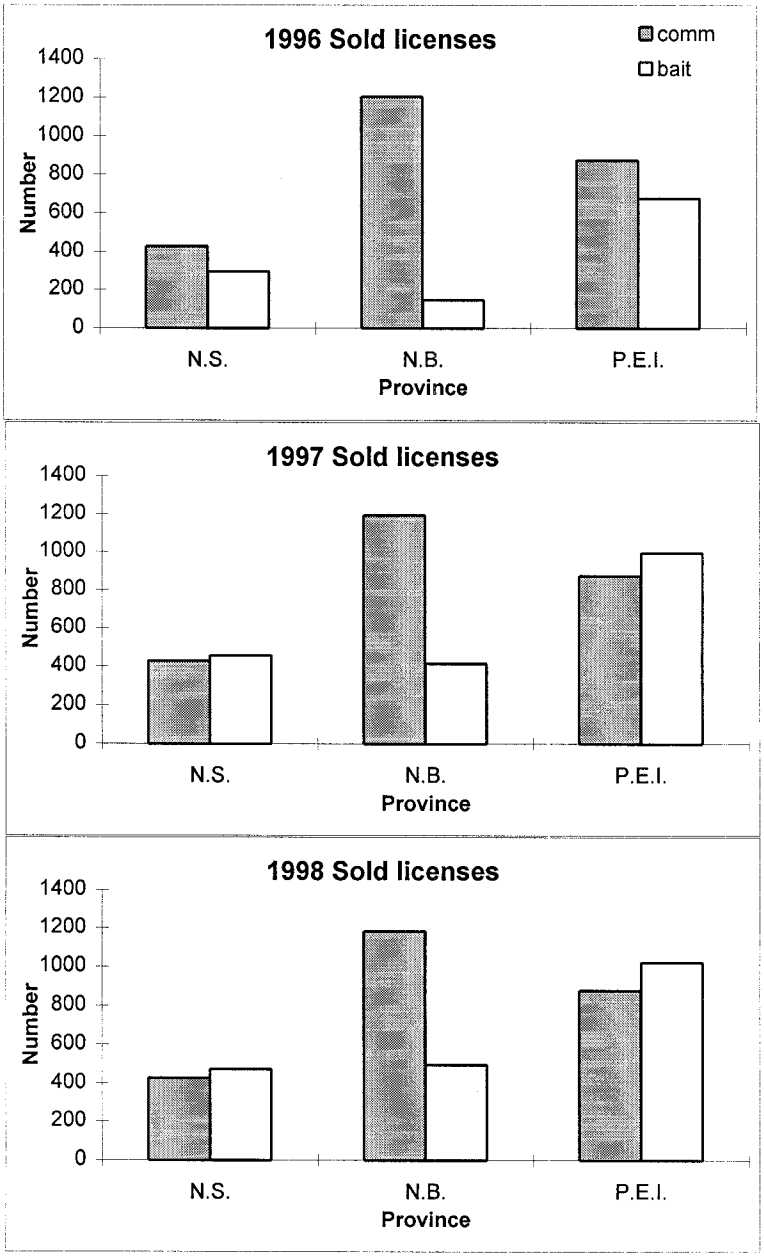


Fig. 5. Number of bait and commercial licenses sold by Maritime province in the 4T herring fishery.

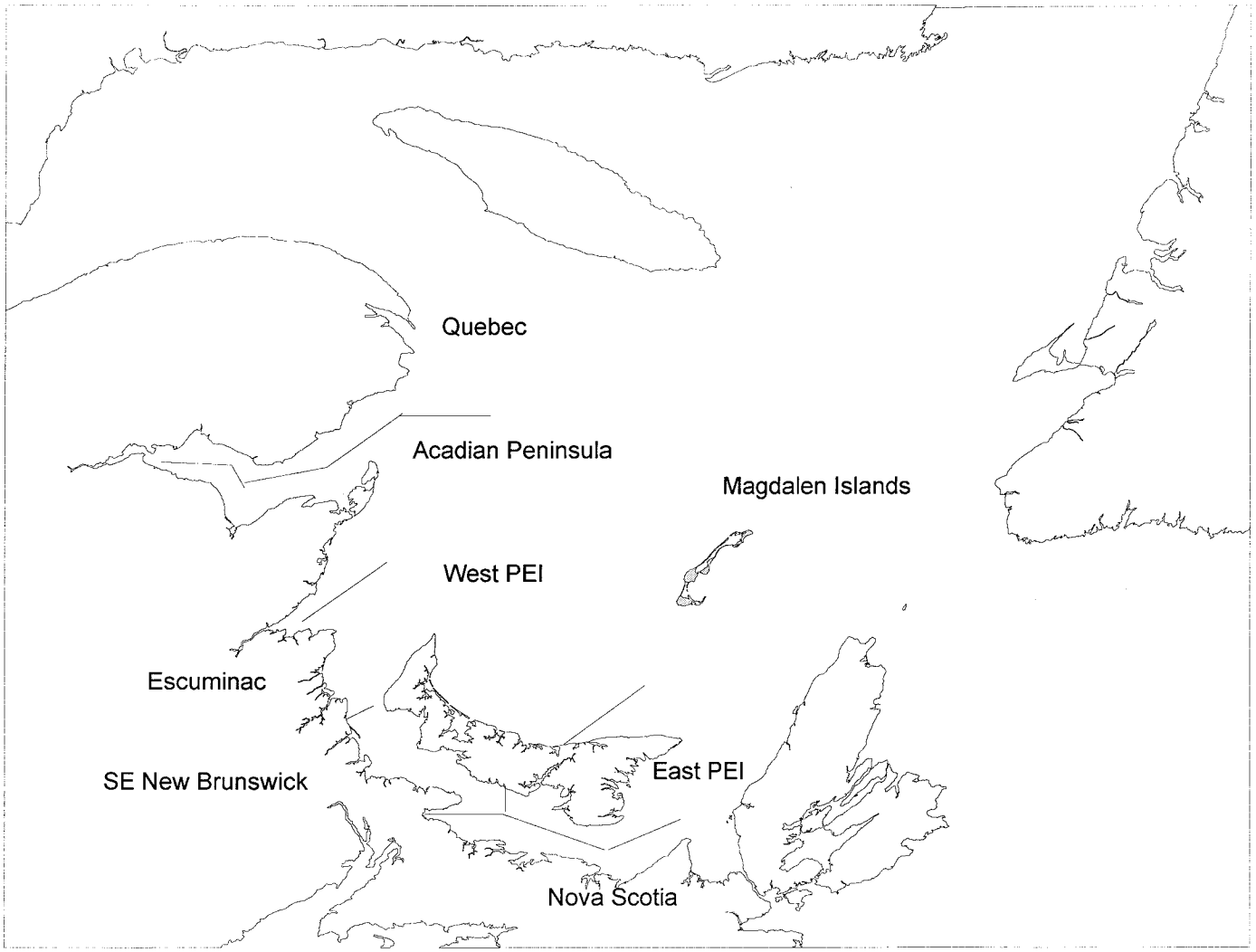


Fig. 6. Geographic ares in the southern Gulf of St. Lawrence used in the herring gillnet fishery telephone survey.

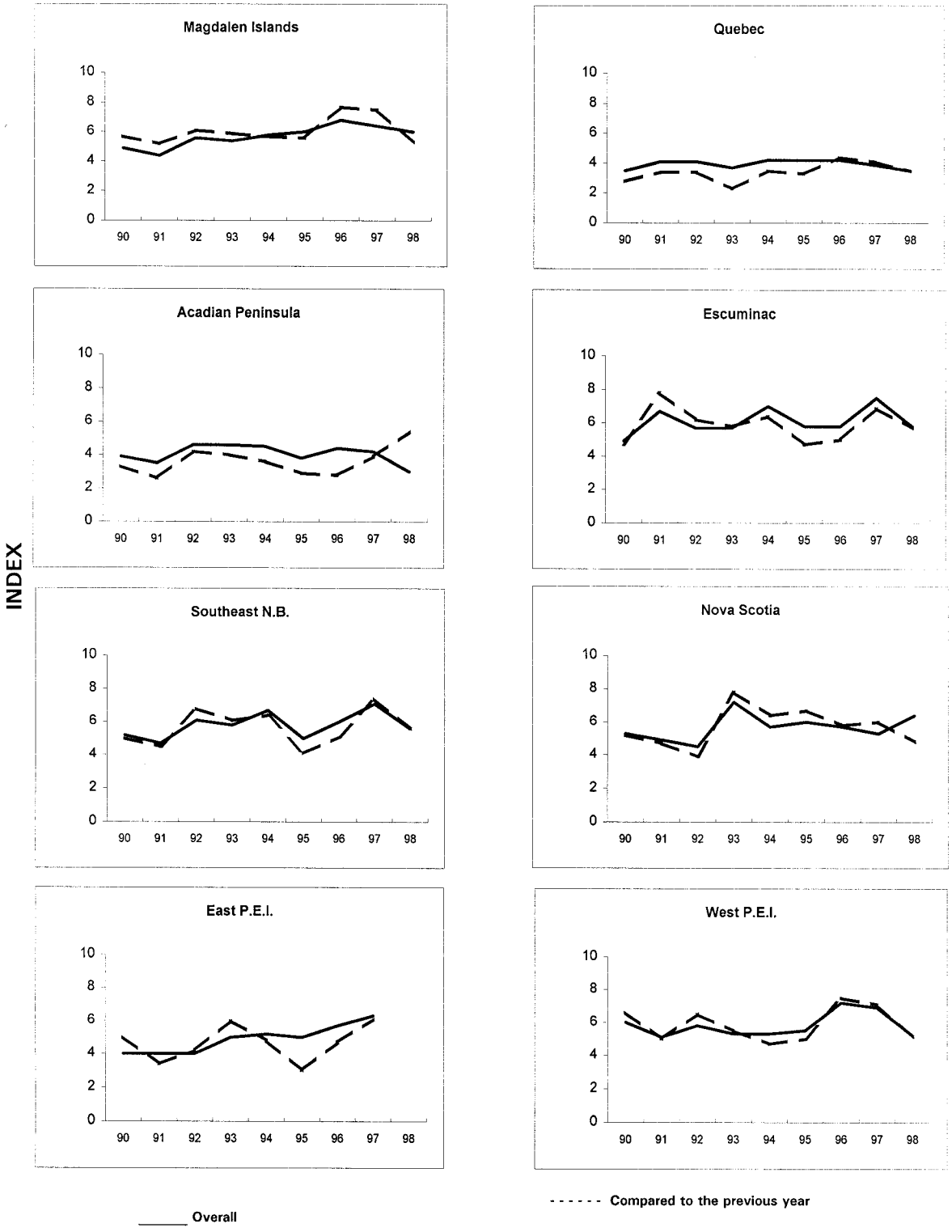


Fig. 7. Spring indices of abundance by area from phone survey.

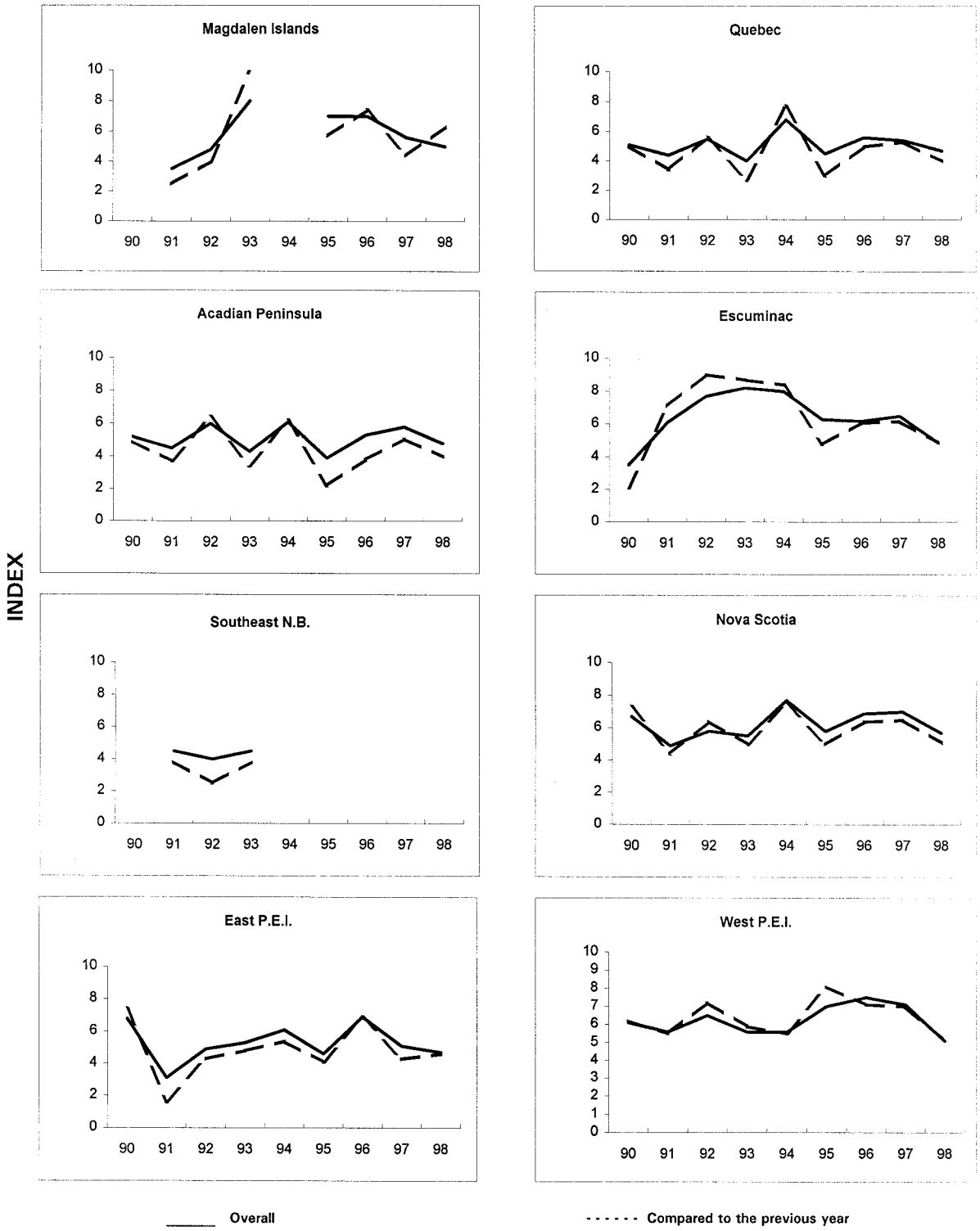


Fig. 8. Fall indices of abundance by area from phone survey

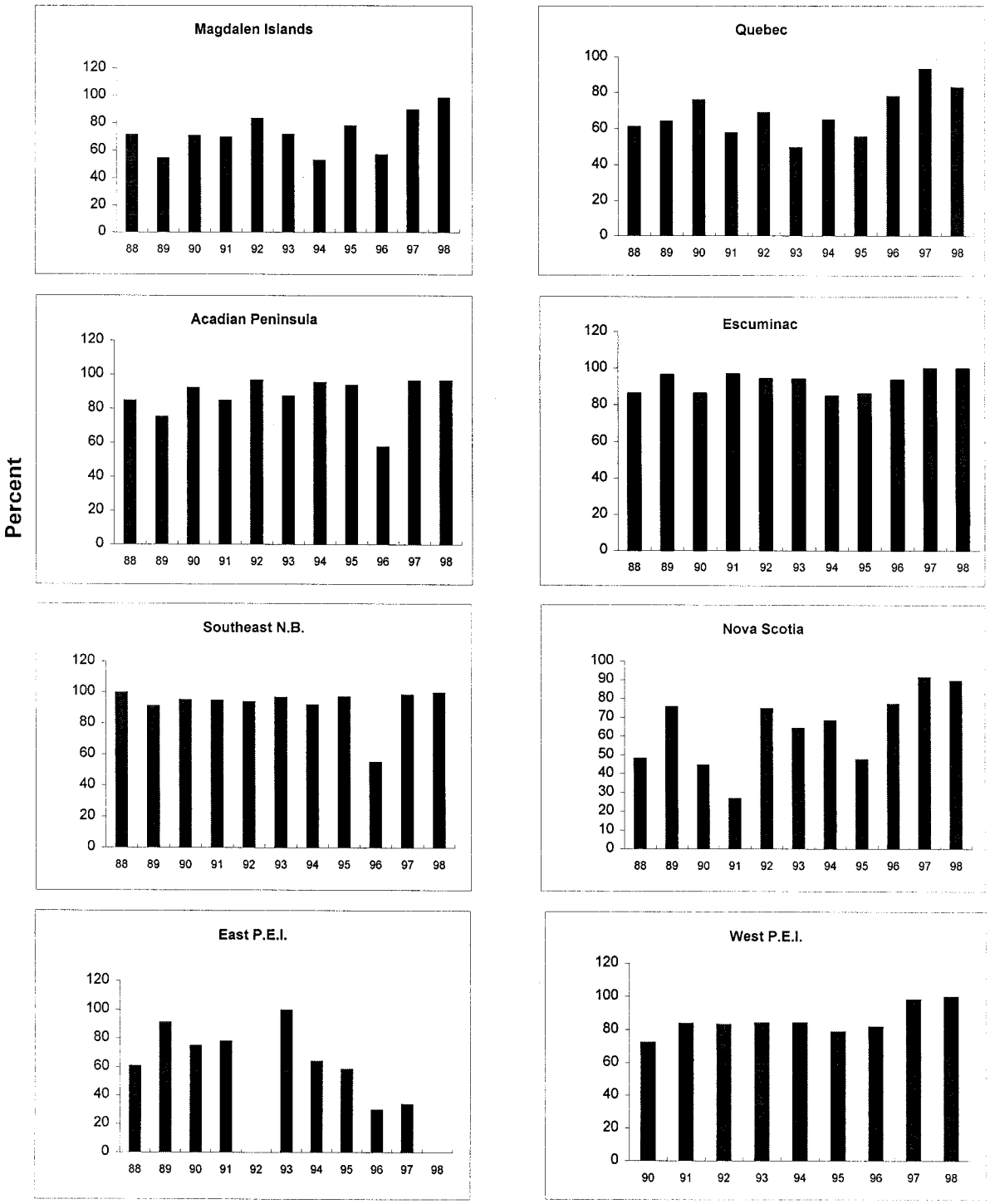


Fig. 9. Percent of nets fished that are between 2 1/4" and 2 1/2" mesh in the 4T spring fishery.

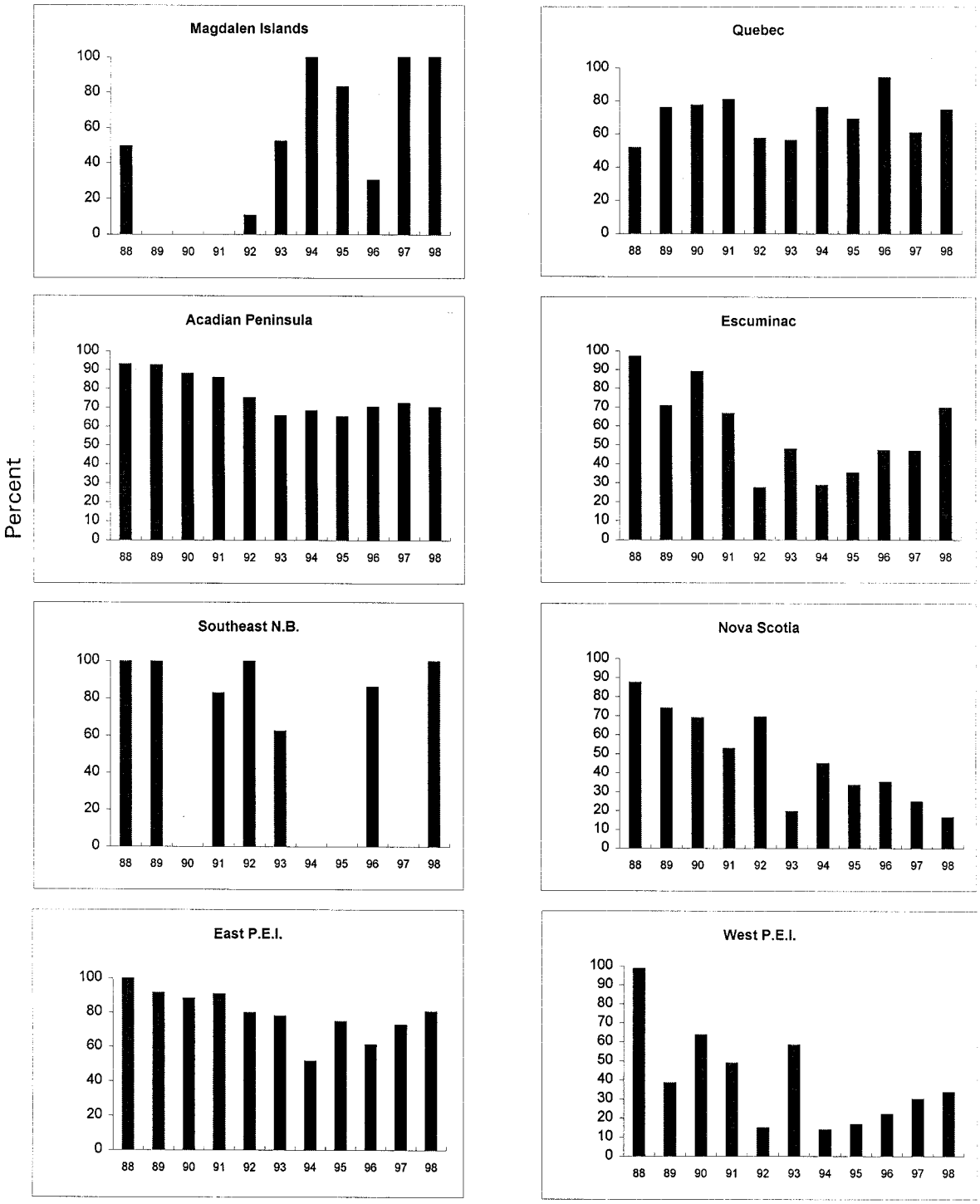


Fig. 10. Percent of nets fished that are 2 5/8" mesh in the 4T fall fishery.

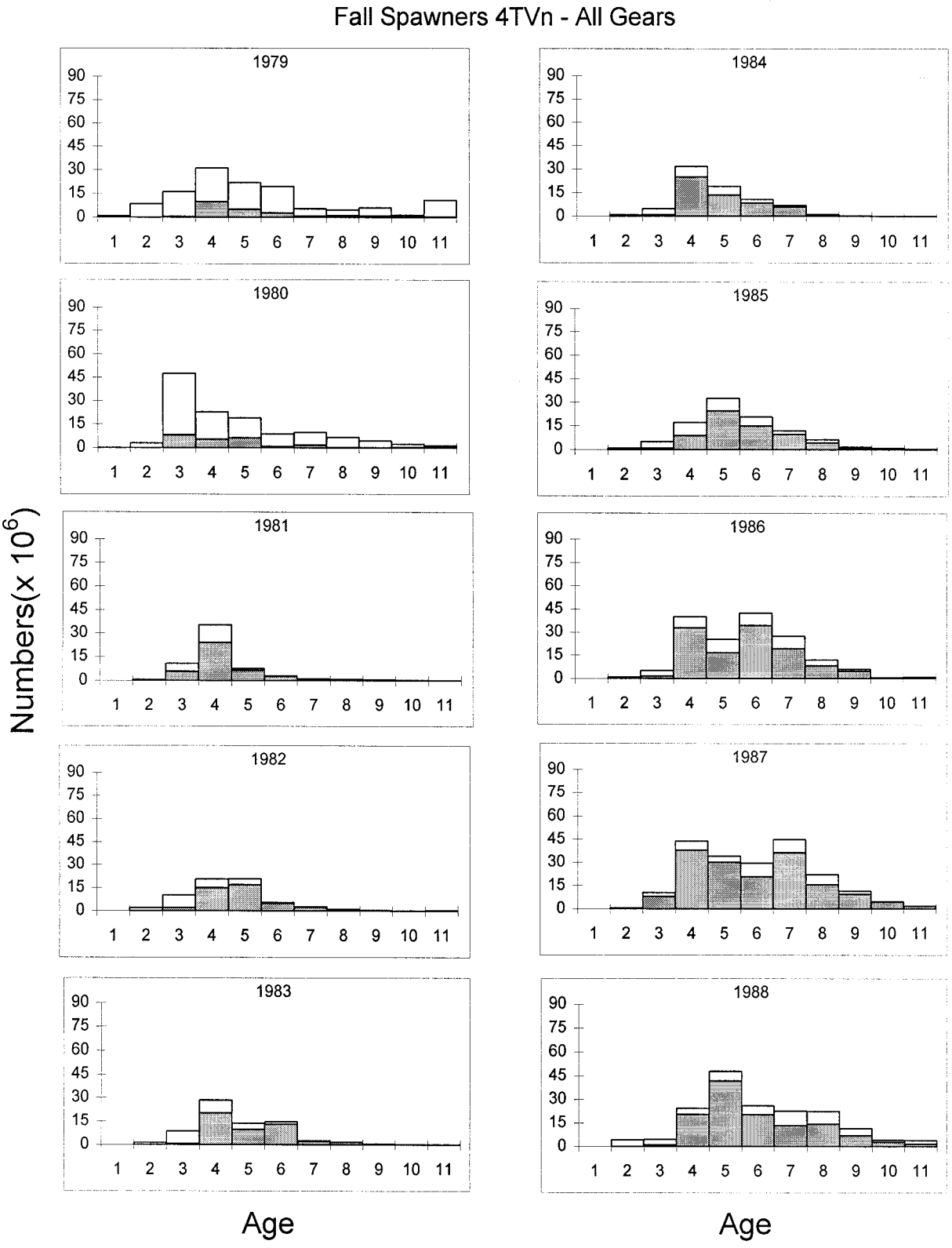


Fig. 11. Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

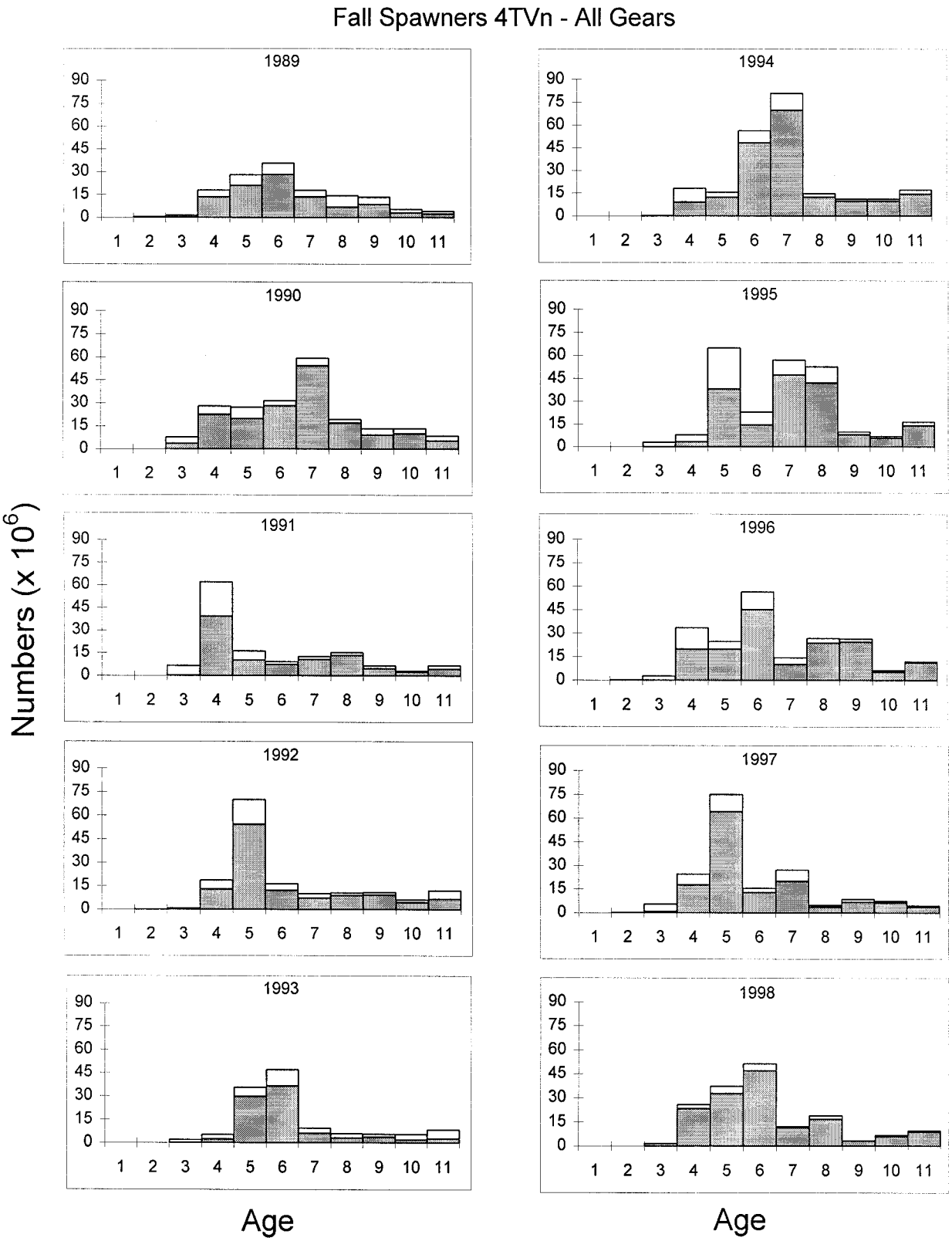


Fig. 11. (continued) Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

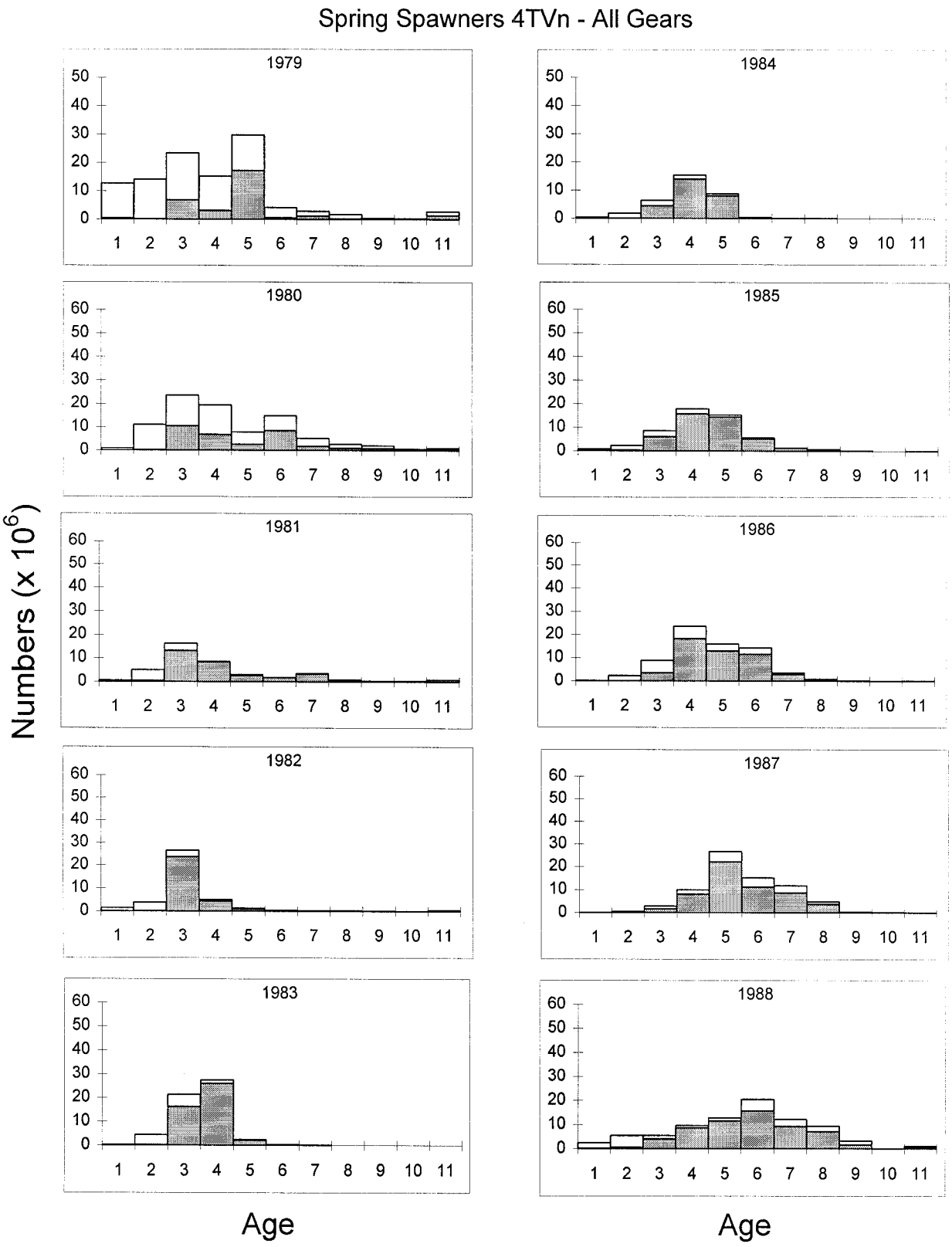


Fig. 12. Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

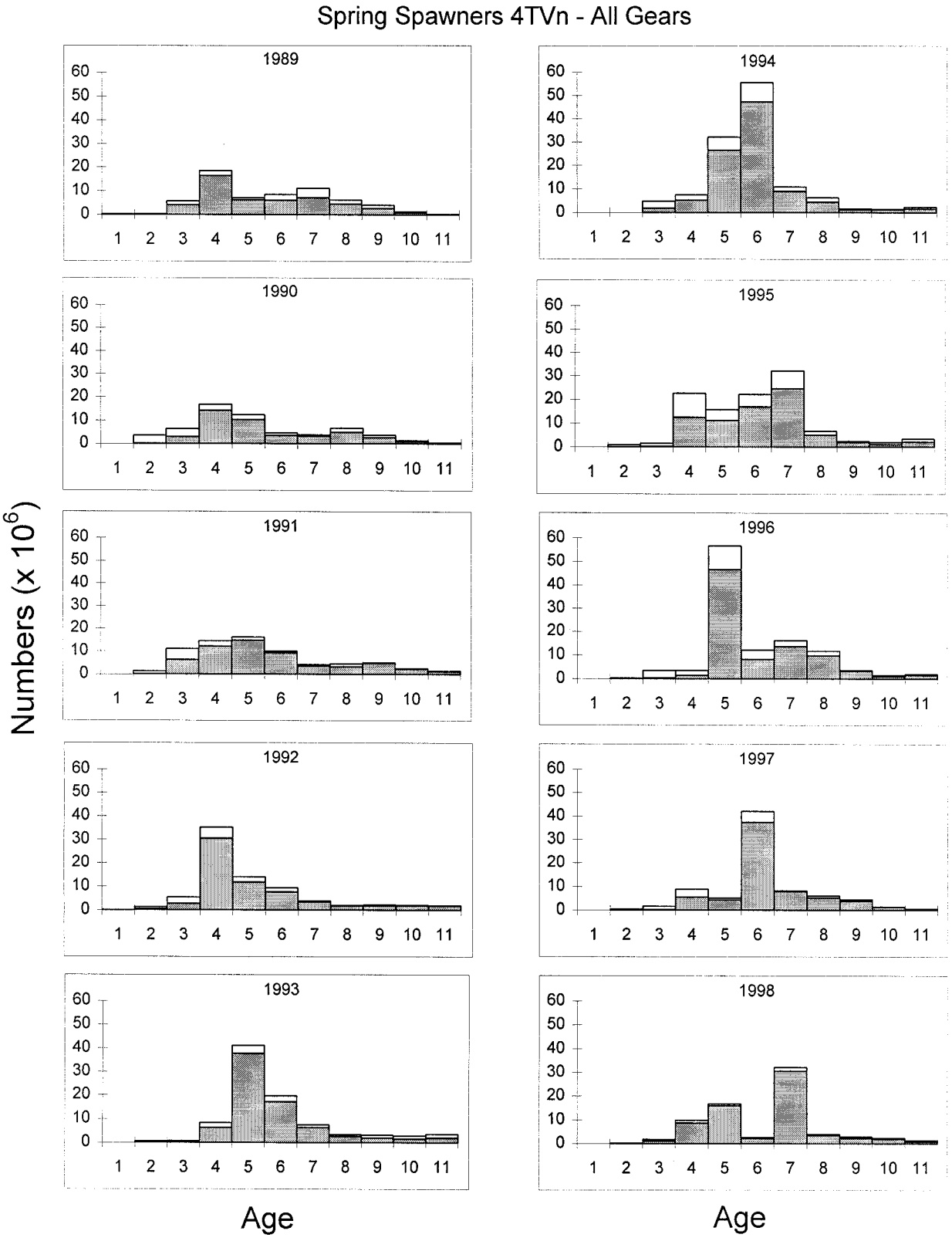


Fig. 12. (continued) Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

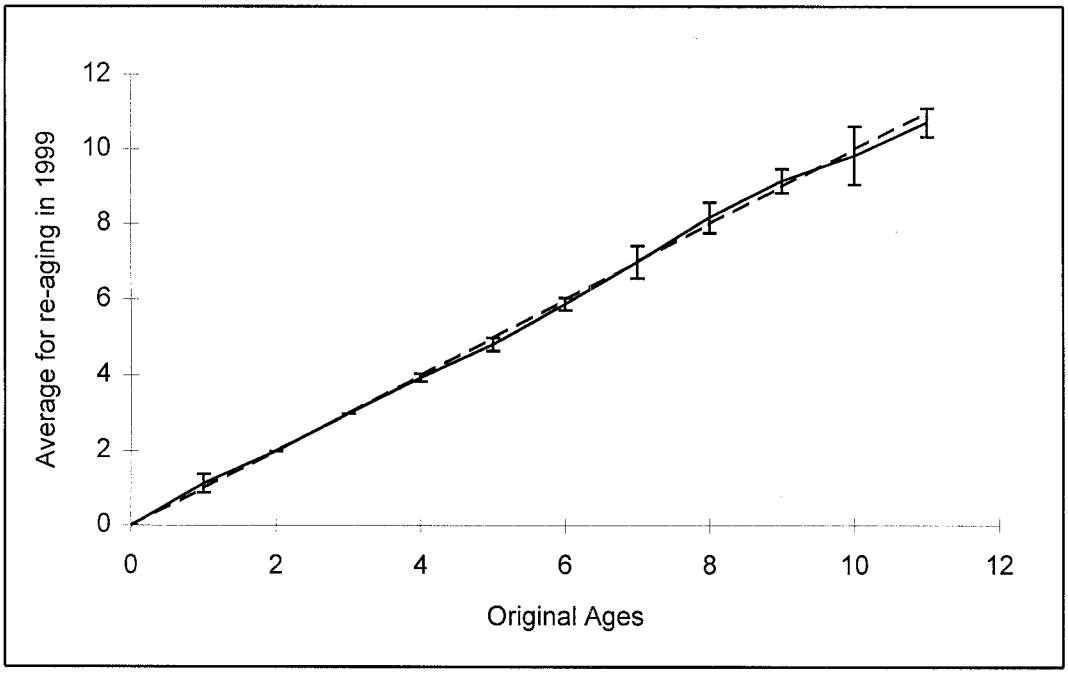


Fig. 13. Age bias plot.

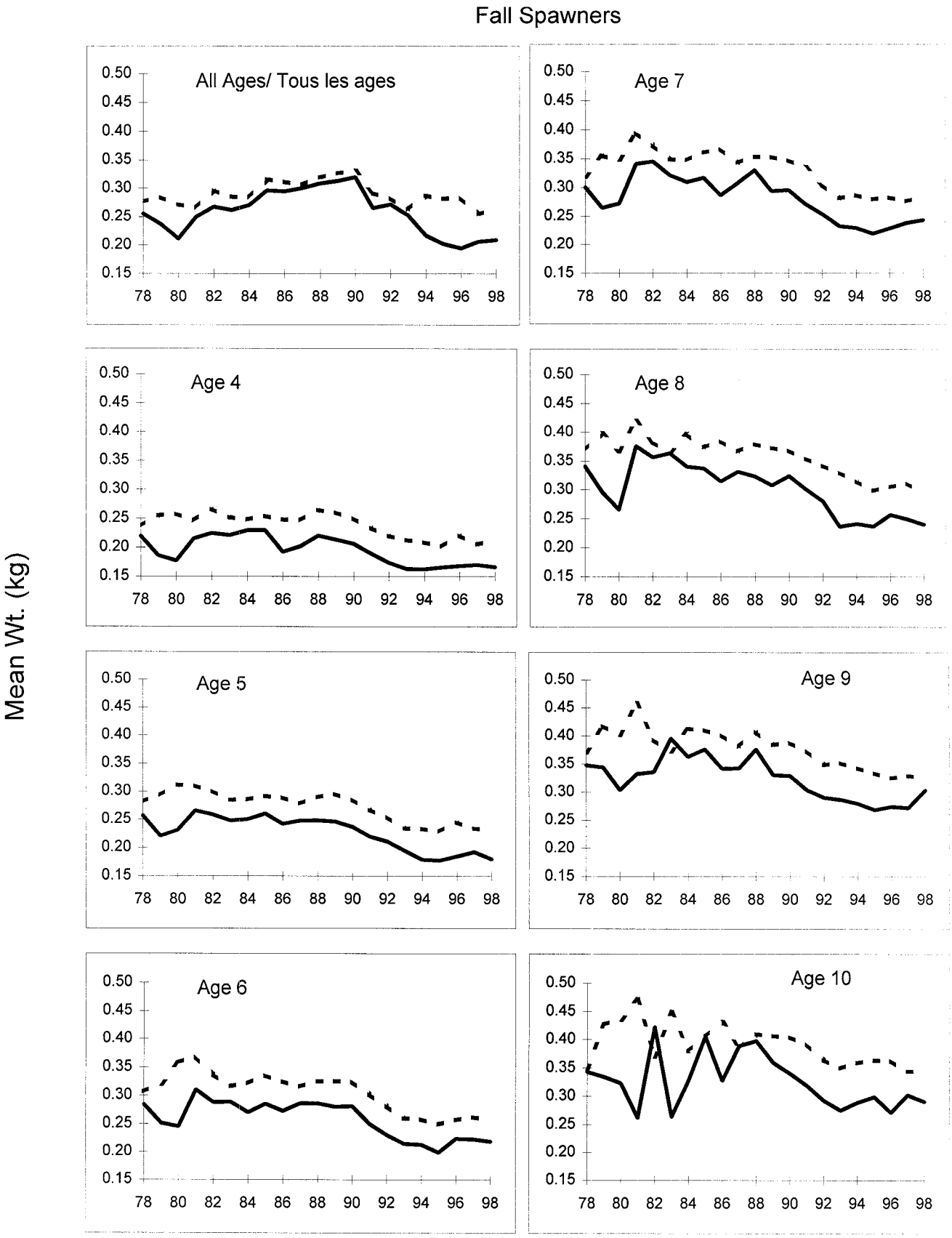


Fig. 14. Fall Spawners mean weight-at-age for all gears and for fixed and mobile gears, ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kilograms.

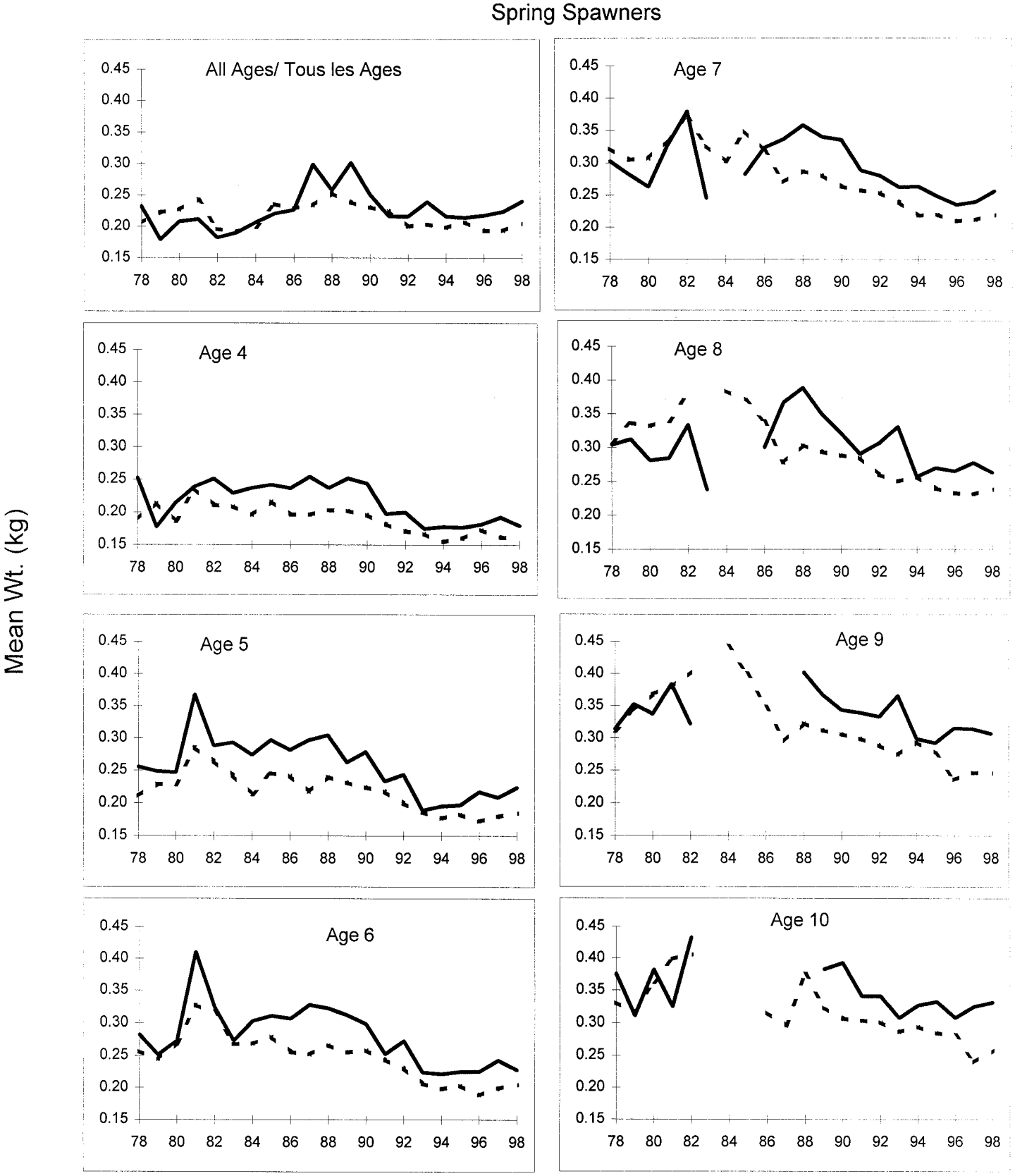


Fig. 15. Spring Spawners mean weight-at-age for all gears and for fixed and mobile gears,ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kg.

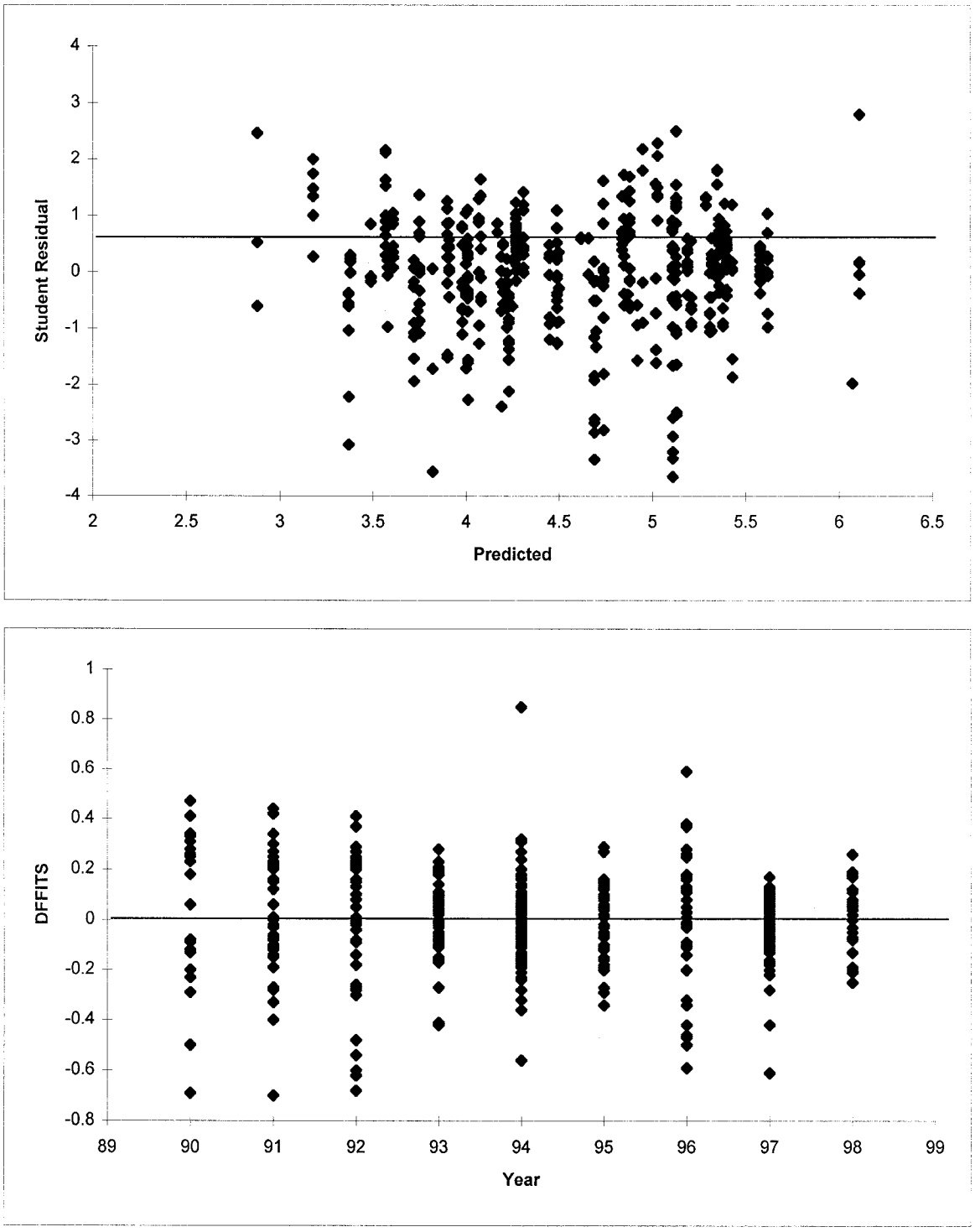


Fig. 16. Residuals and DFFITS plots from multiplicative analysis of Escuminac and southeast New Brunswick catch rates.

Spring Spawner - Escuminac:SENB

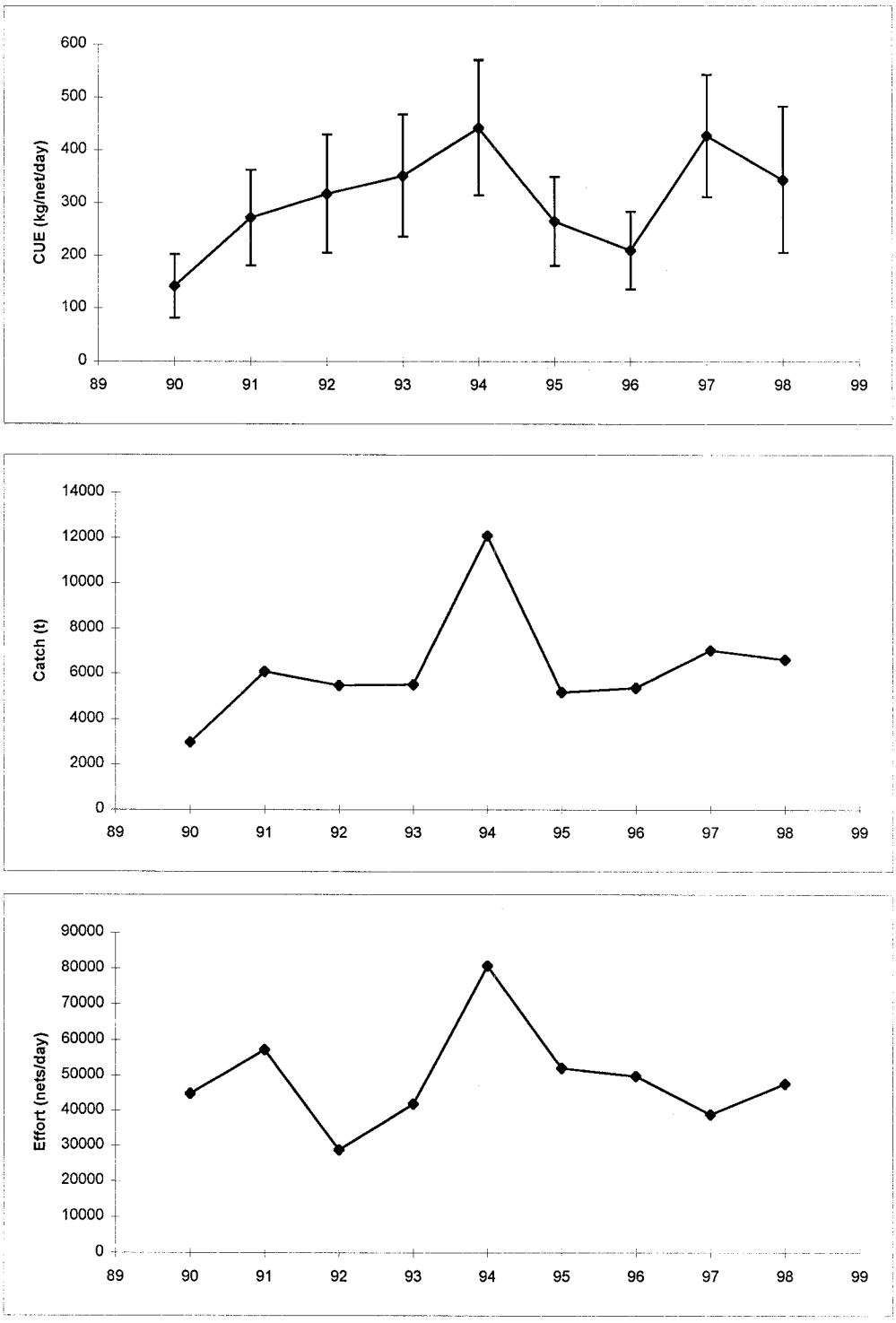


Fig. 17. Catch rates, catch, and effort from Escuminac and southeast New Brunswick catch rate analysis.

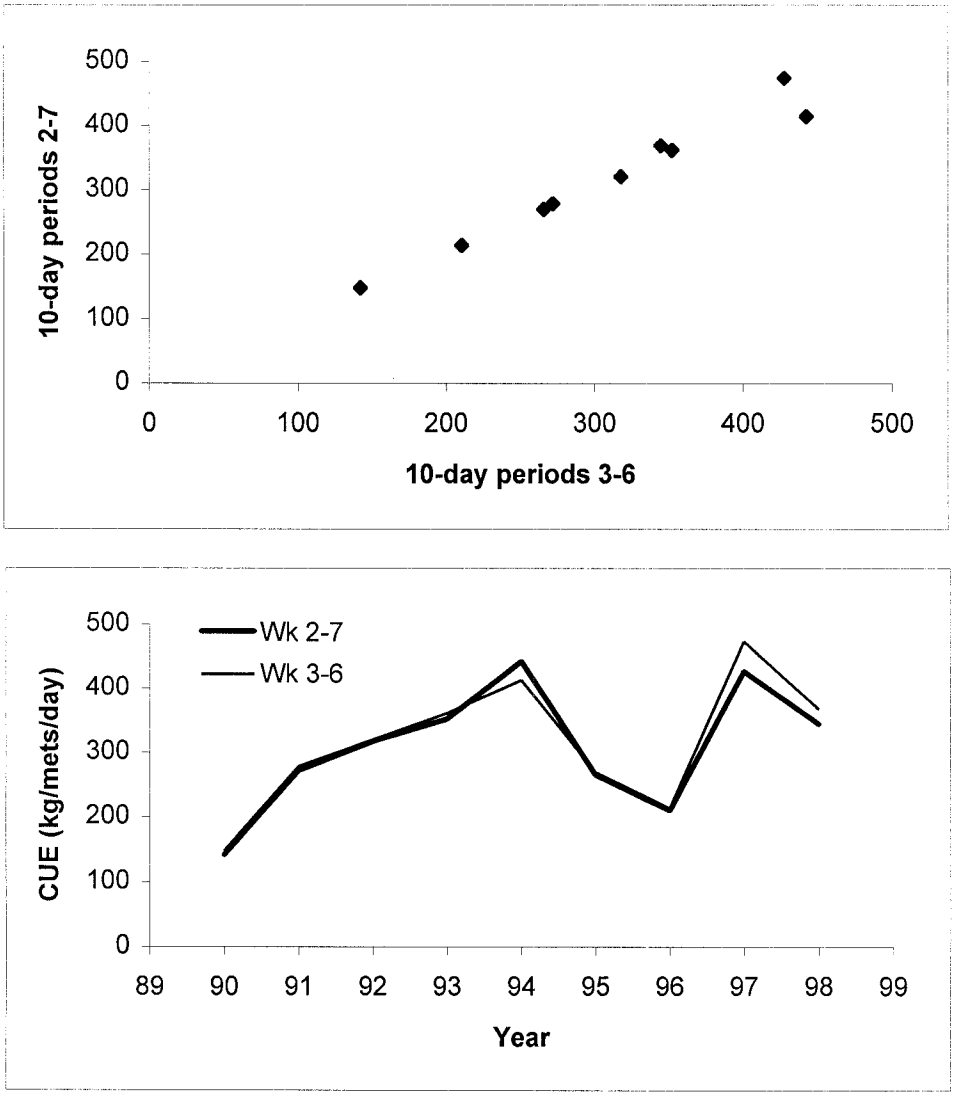


Fig. 18. Comparison of catch rates estimated using 10-day periods 2-7 and 10-day periods 3-6 from spring inshore herring fishery.

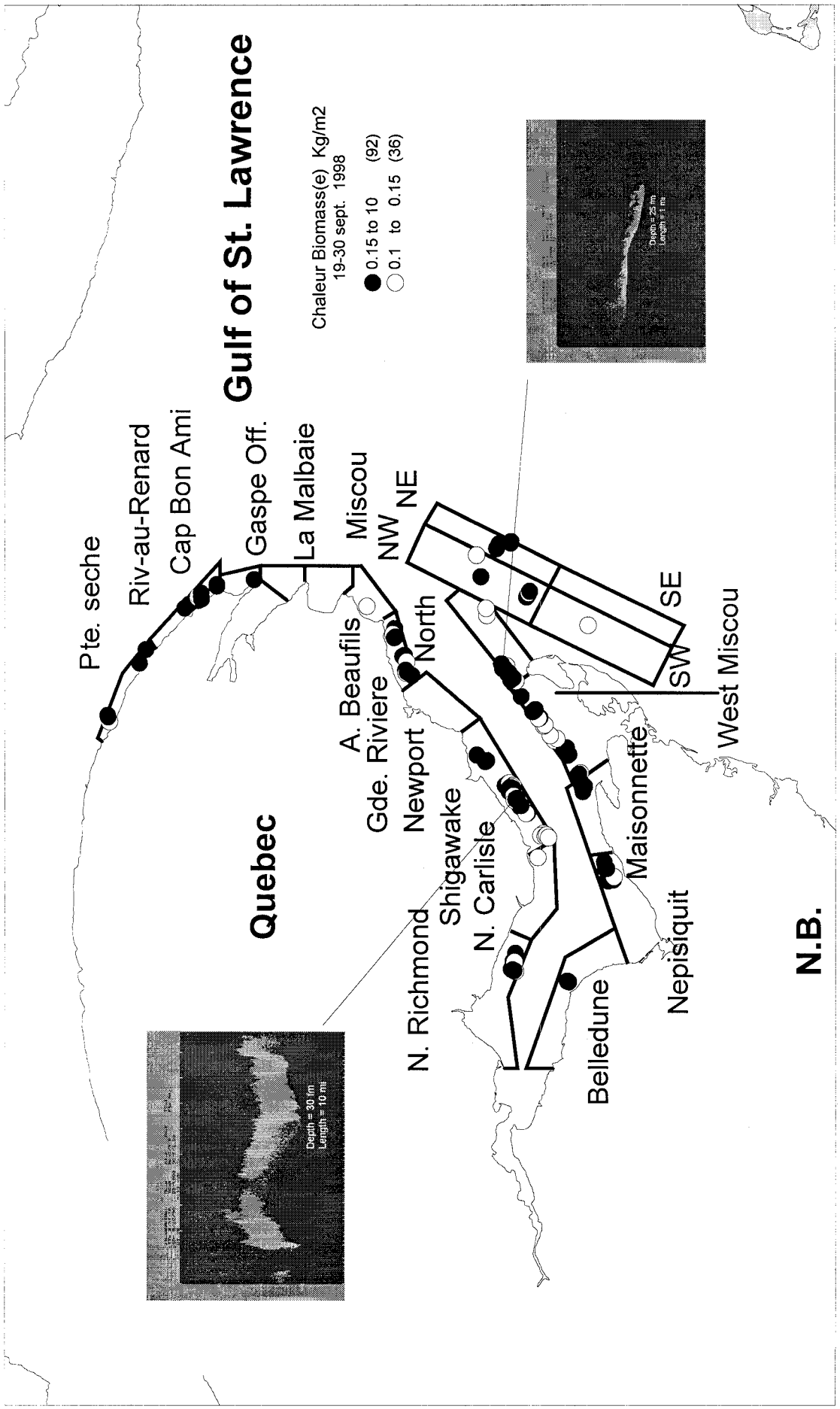


Fig. 19. Chaleur-Miscou area strata with relative biomass ranges detected between Sept. 19 and Sept. 30, 1998.

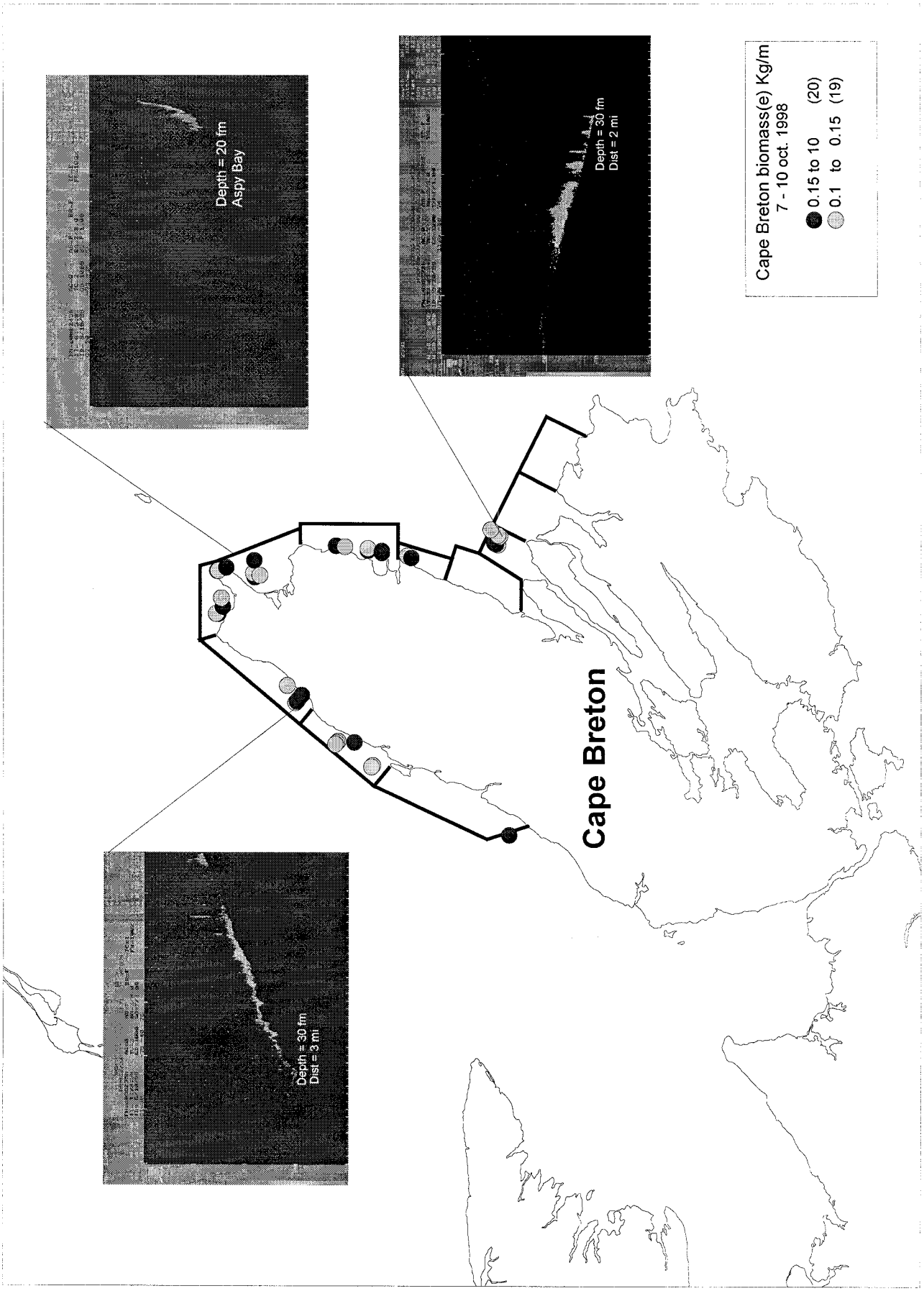


Fig. 20. Cape Breton area strata with relative biomass ranges detected between Oct. 7 and Oct 10, 1998.

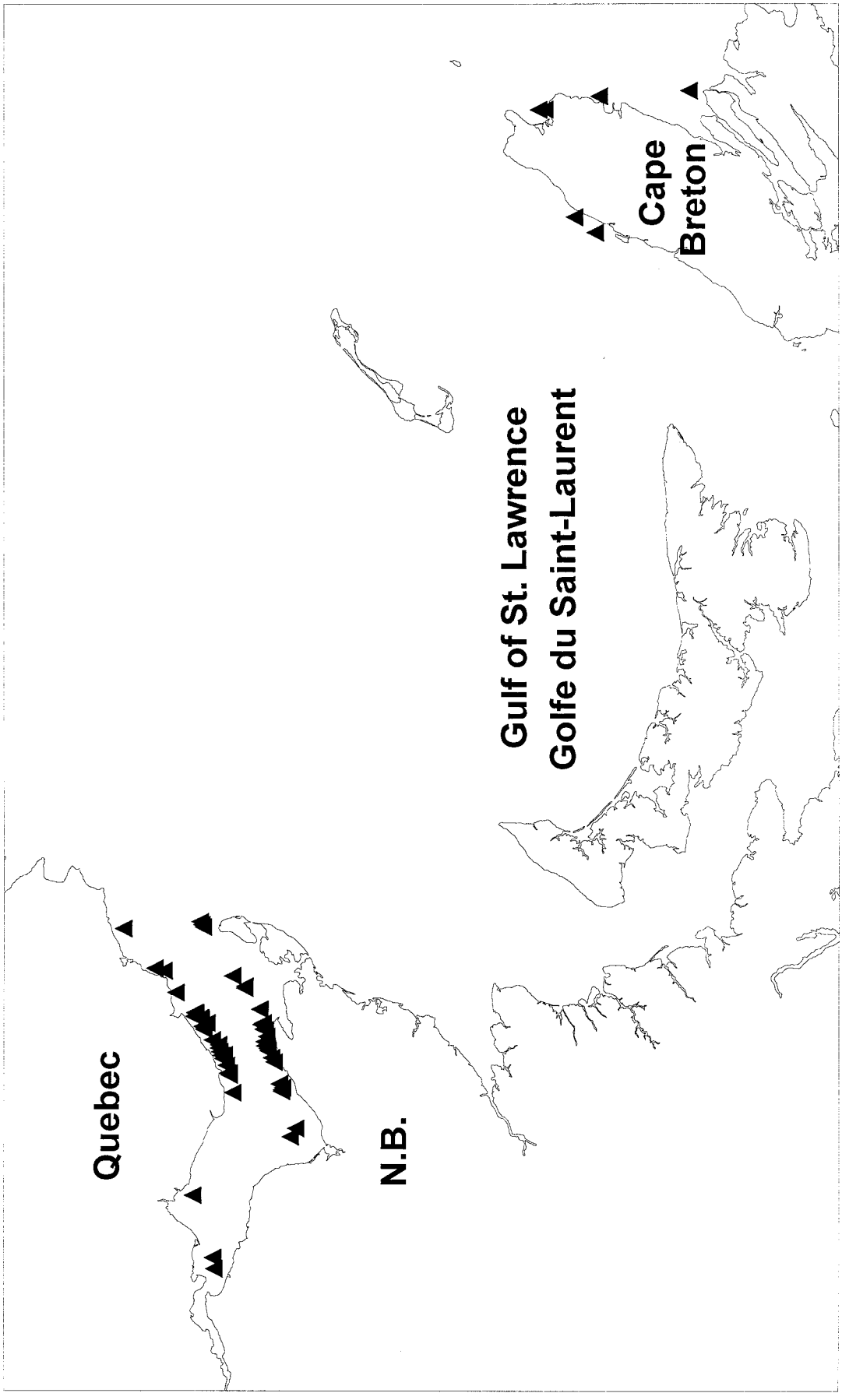
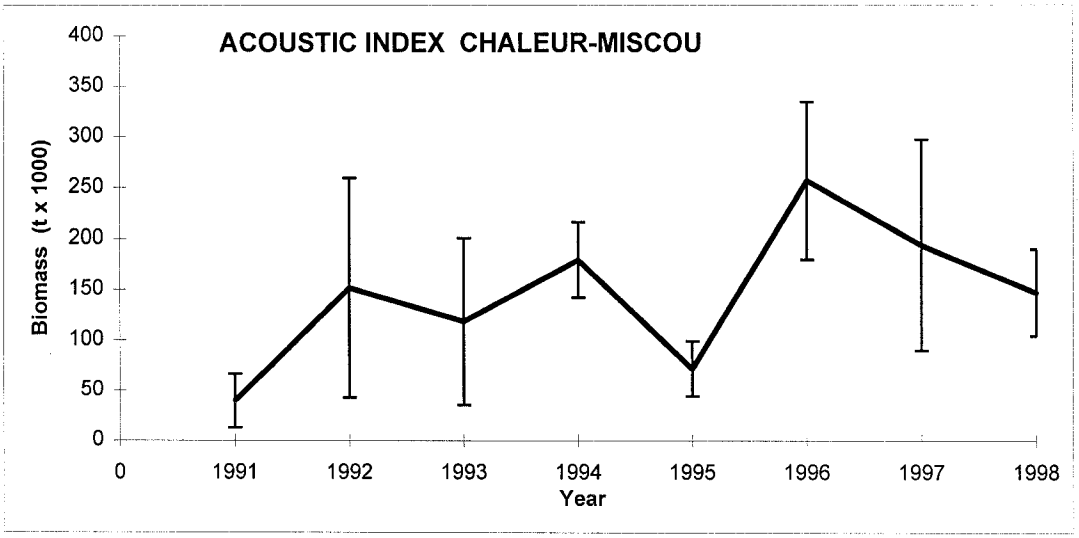
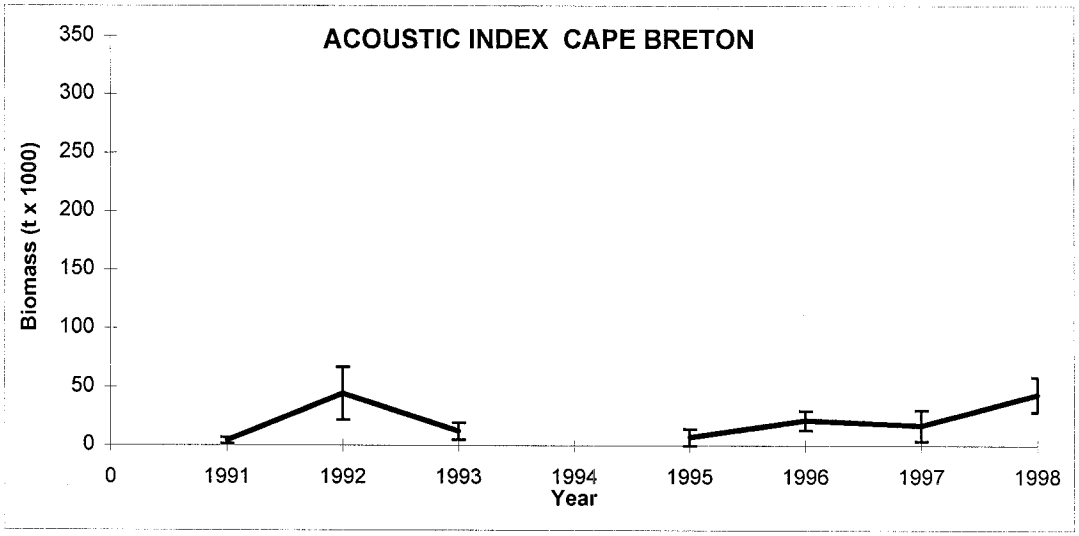


Fig. 21 Acoustic survey set locations, Sept. 19 to Oct. 10, 1998.





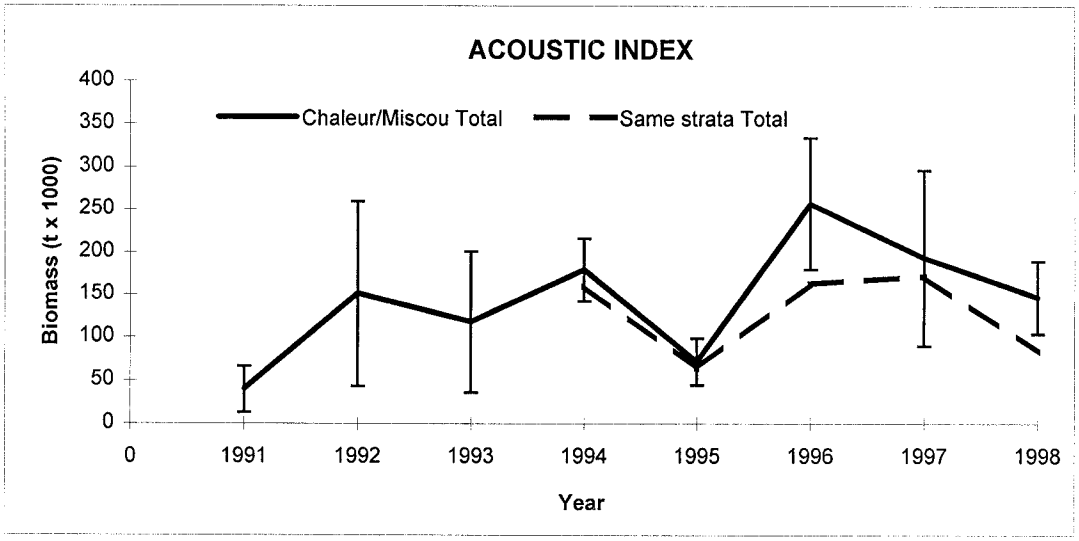


Fig. 22. Biomass index, combined spring and fall spawners, from acoustic survey of all strata from Chaleur-Miscou (top), all strata from Cape Breton (middle), and all Chaleur - Miscou strata compared to strata consistently surveyed in each year (bottom).

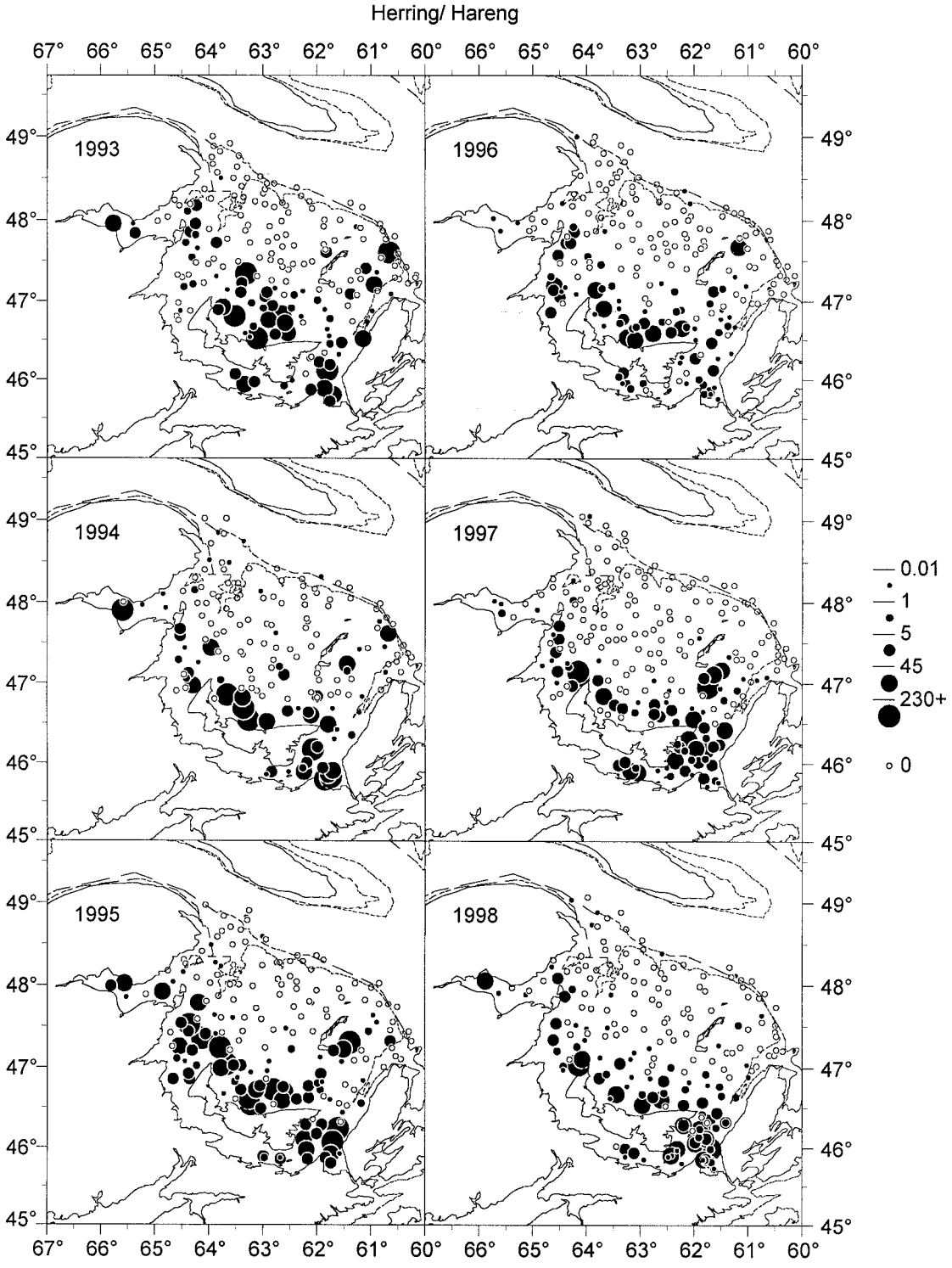
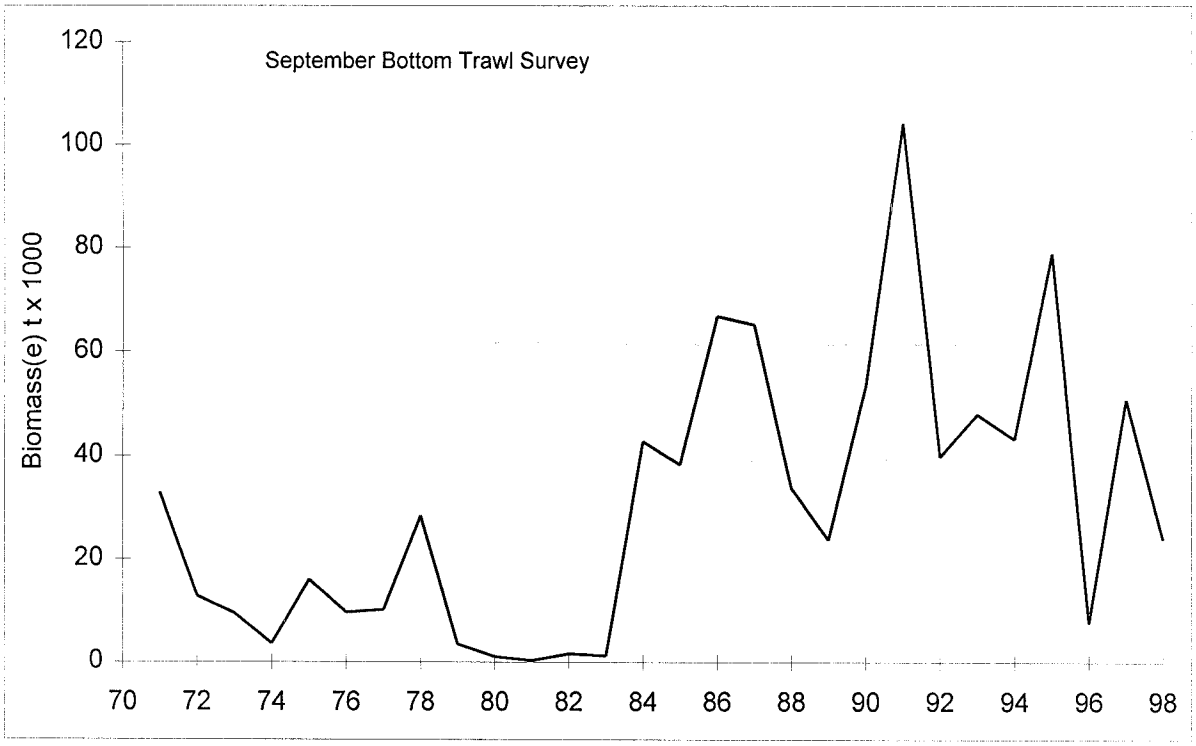


Fig. 23. Herring catches (kg/tow) in the southern Gulf of St. Lawrence September bottom trawl survey.



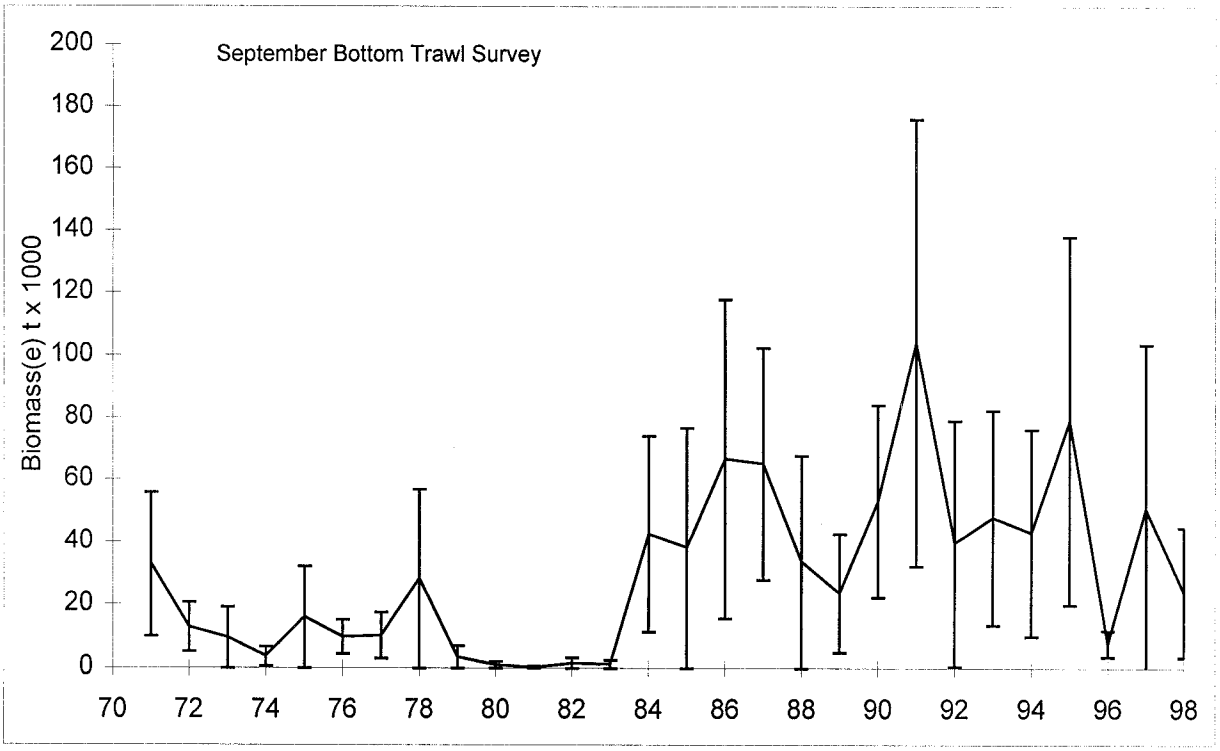


Fig. 24. Biomass trends (top) with confidence limits (+/- 2 S.E.) (bottom) for spring and fall spawning herring biomass estimates from September bottom trawl survey.

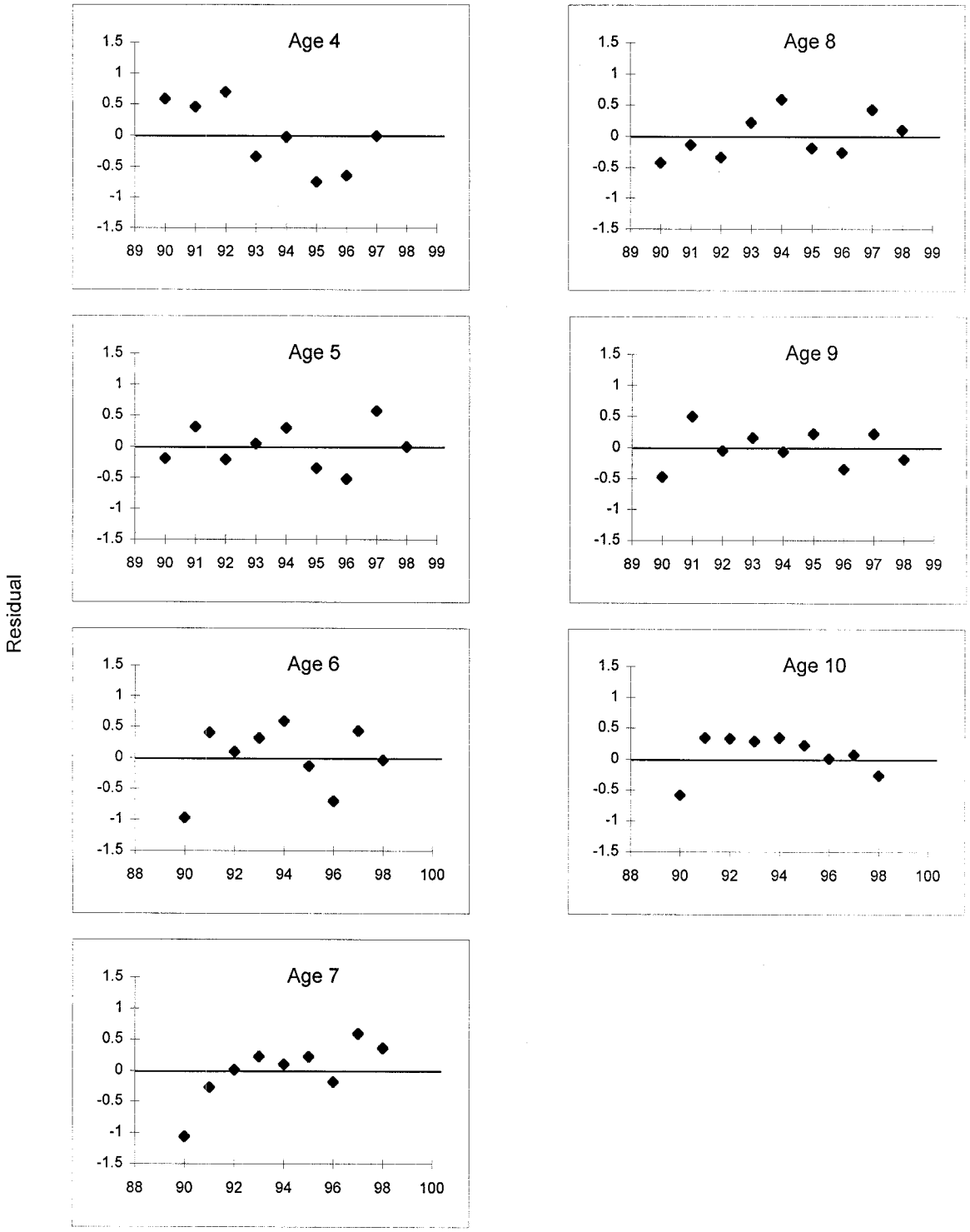


Fig. 25. Residuals by age from ADPAT-VPA using F-OLD formulation.

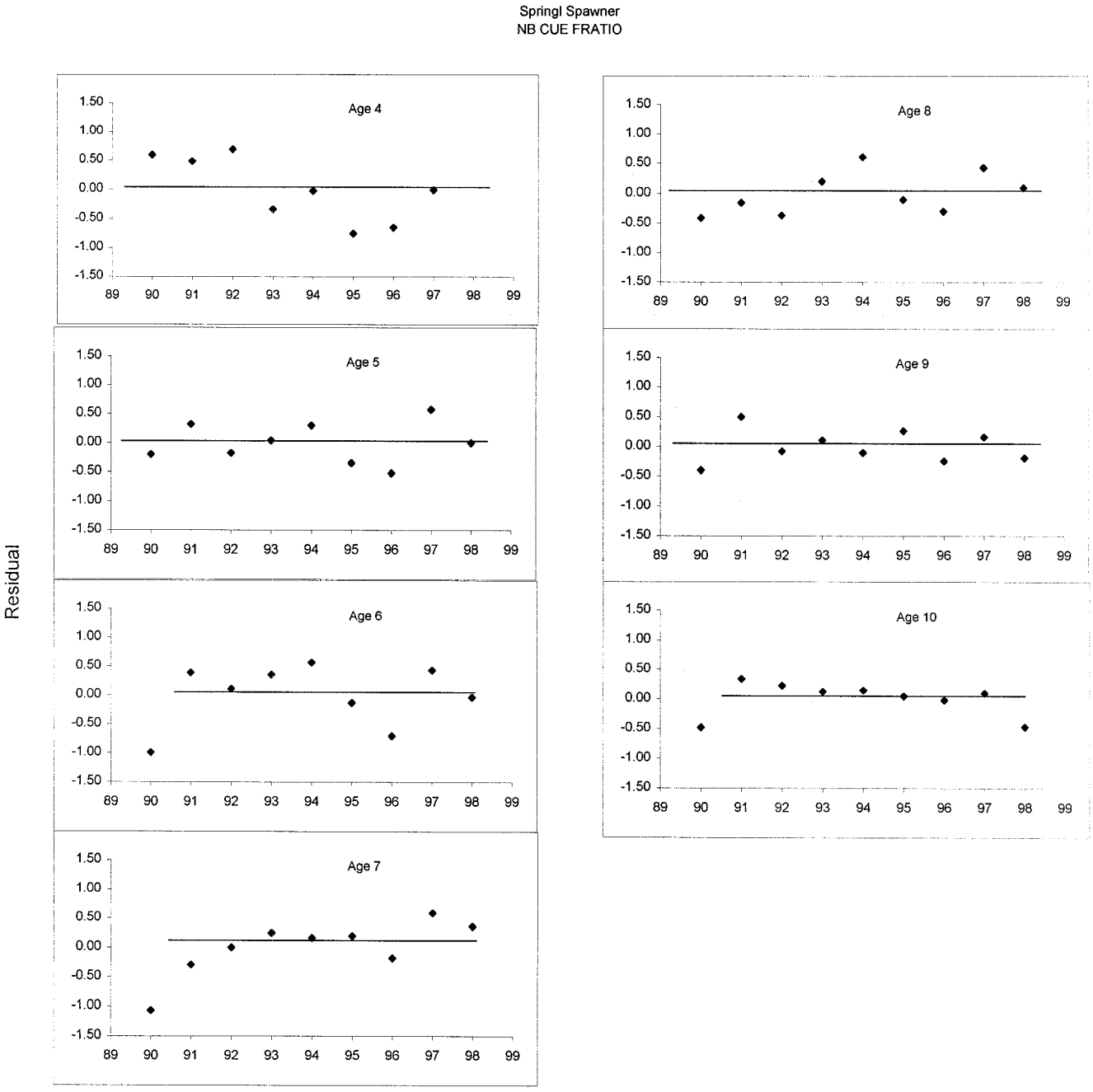


Fig. 26. Residuals by age from ADAPT-VPA using FRATIO formulation.

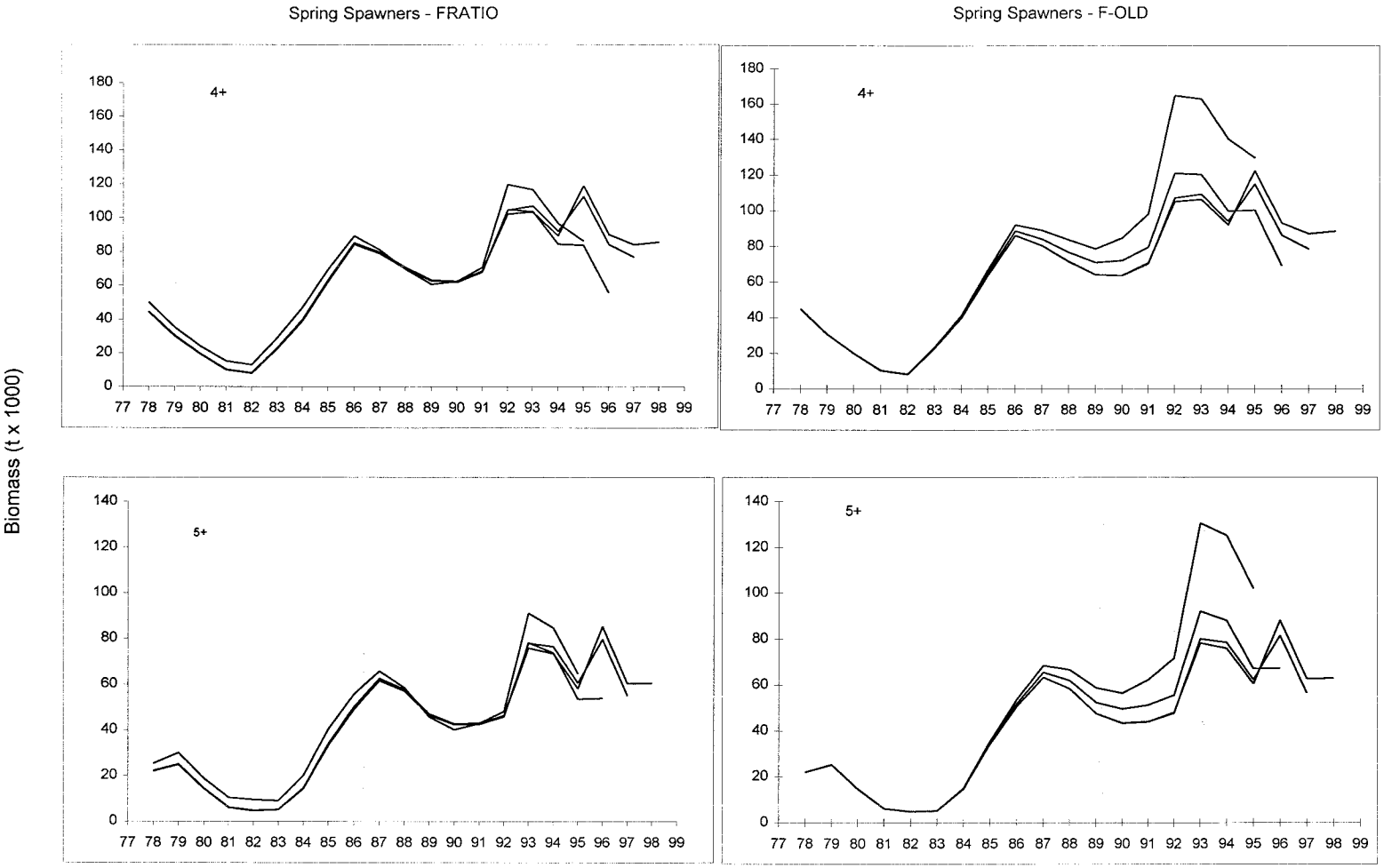


Fig. 27. Comparison of retrospective analysis for 4+ and 5+ biomass estimates using FRATIO and F-OLD ADAPT-VPA models.

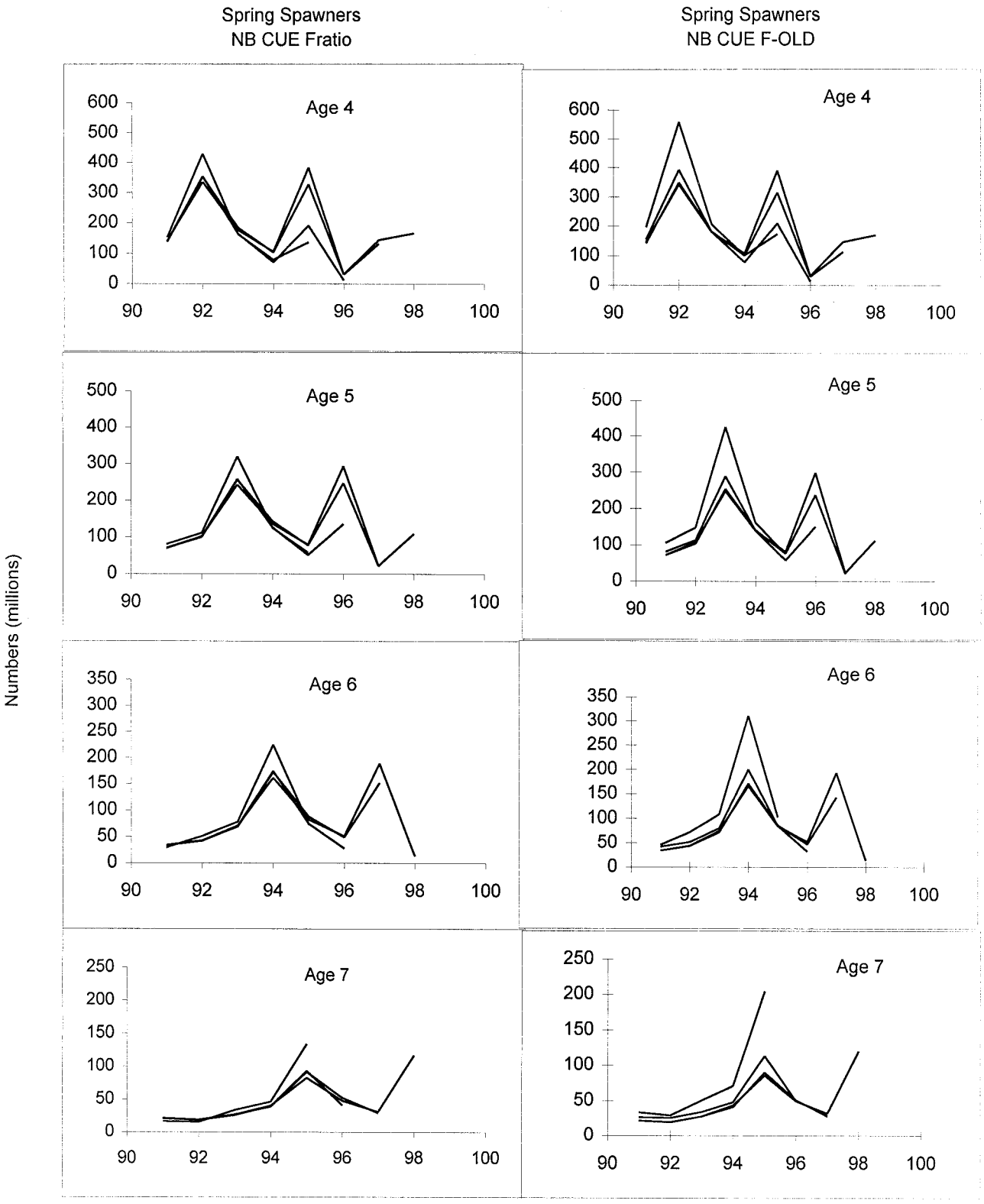


Fig. 28. Retrospective analysis by age for FRATIO and F-OLD spring spawner ADAPT-VPA models.

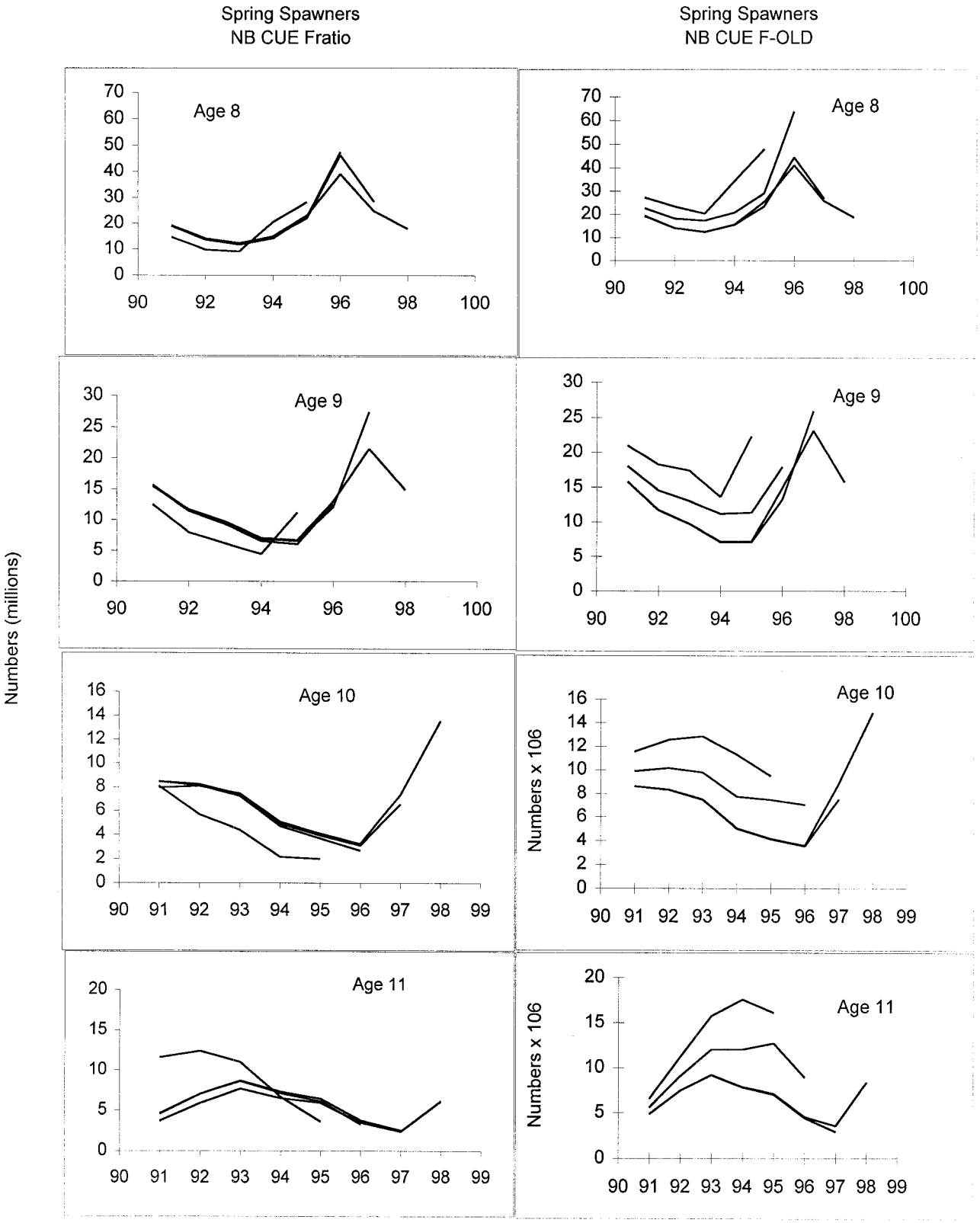
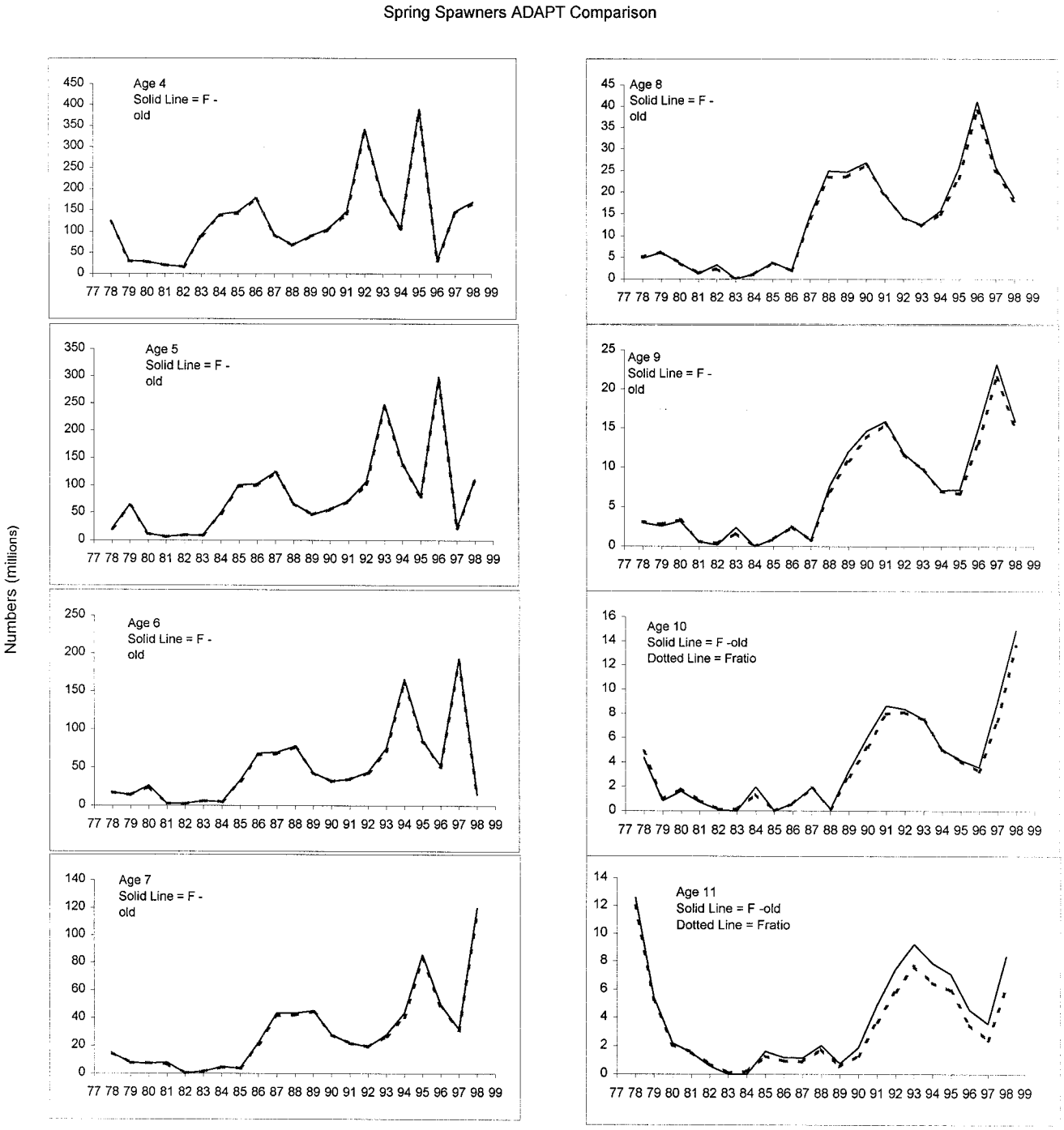

Spring Spawners
NB CUE Fratio
Spring Spawners
NB CUE F-OLD
Age 8
Age 9
Age 10
Age 11
Numbers (millions)
Numbers x 106

Fig. 28. Cont.



Fig;. 29. Comparison of population numbers estimated by FRATIO and F-OLD ADAPT-VPA models for spring spawners.

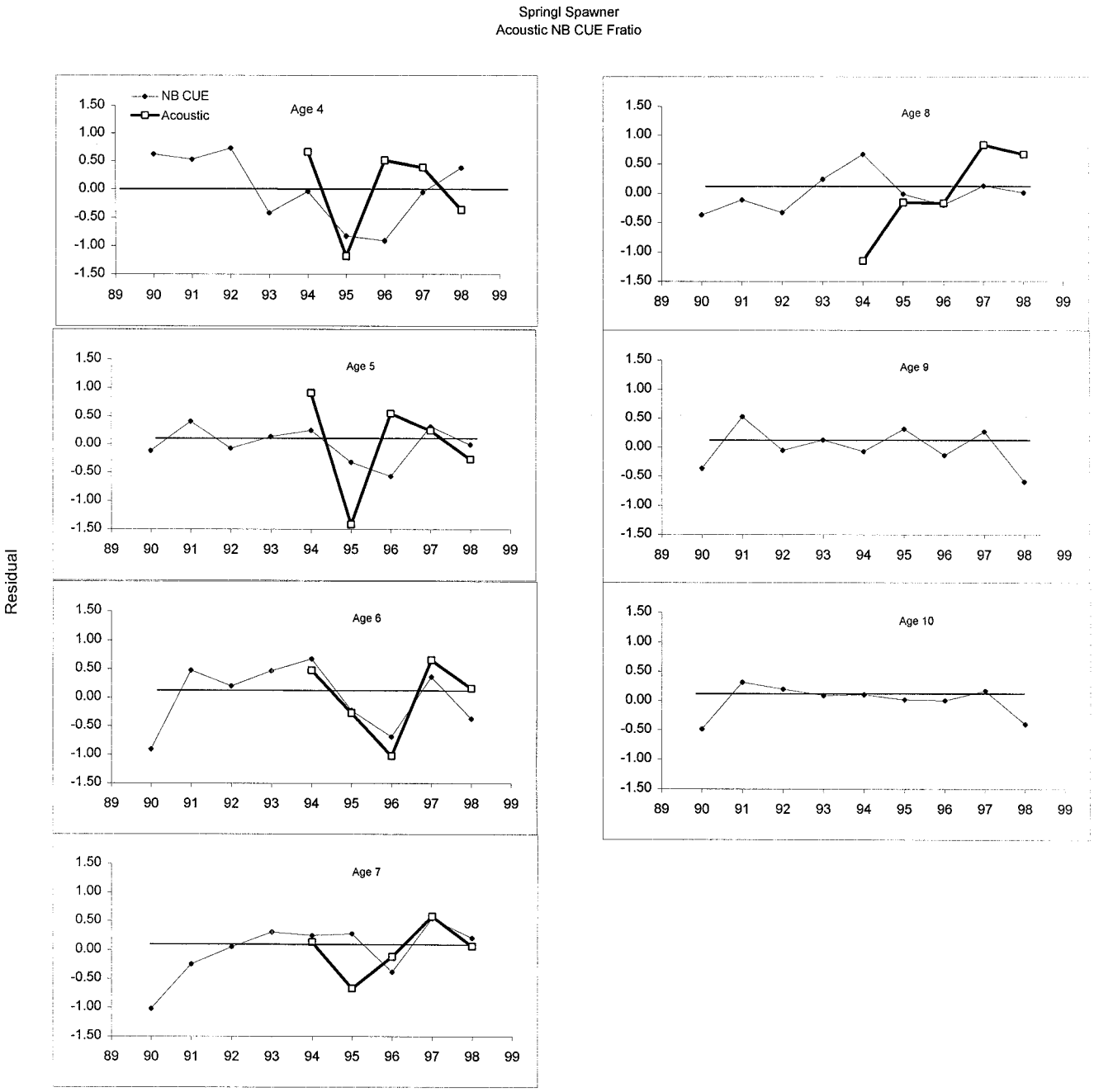


Fig. 30. Residuals by age for spring spawner ADAPT-VPA using acoustic and catch rate indices.

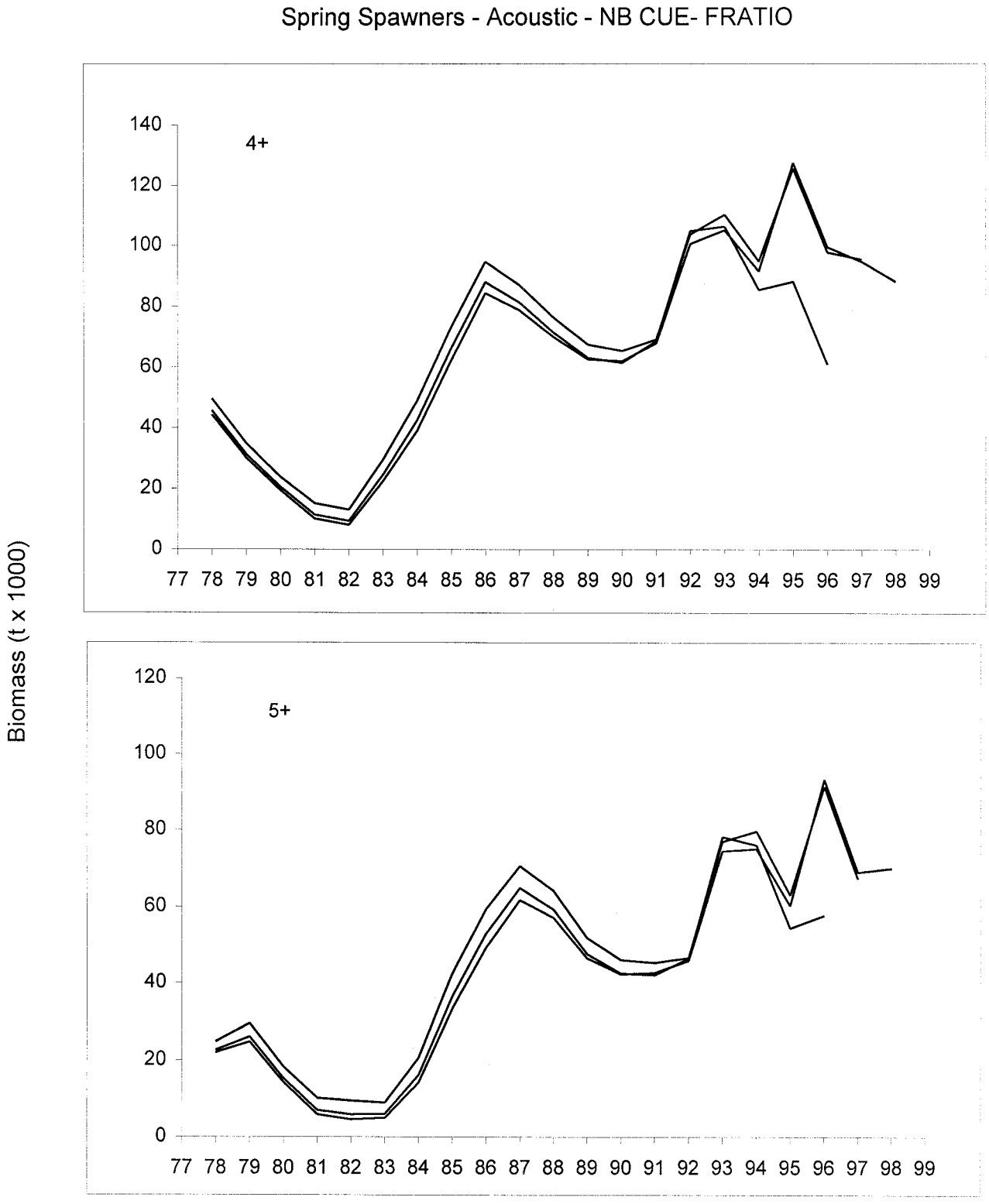


Fig. 31. Retrospective analysis of spring spawner ADAPT-VPA biomass estimates using acoustic and catch rate indices.

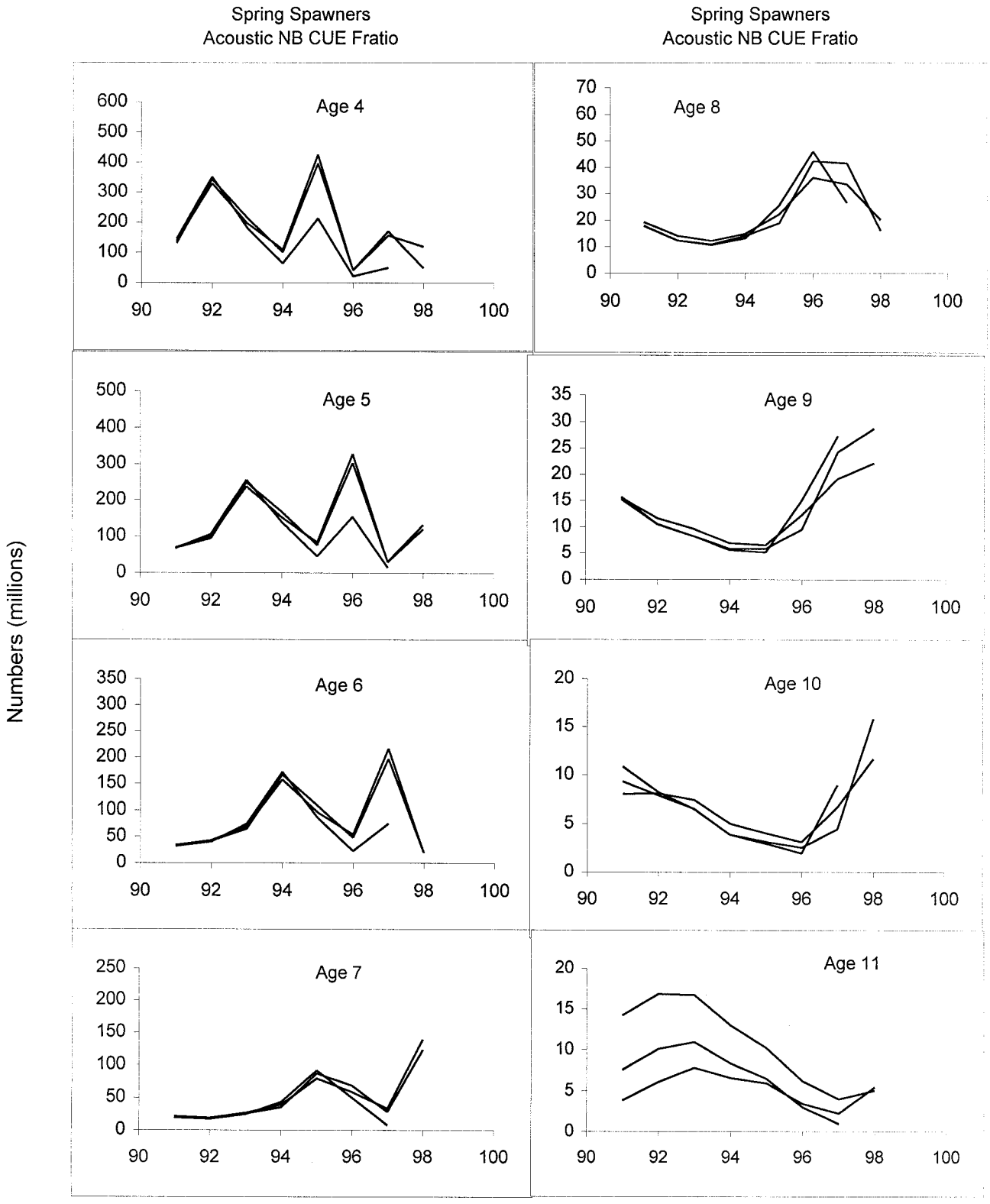


Fig. 32. Retrospective by age for spring spawner ADAPT-VPA using acoustic and catch rate indices.

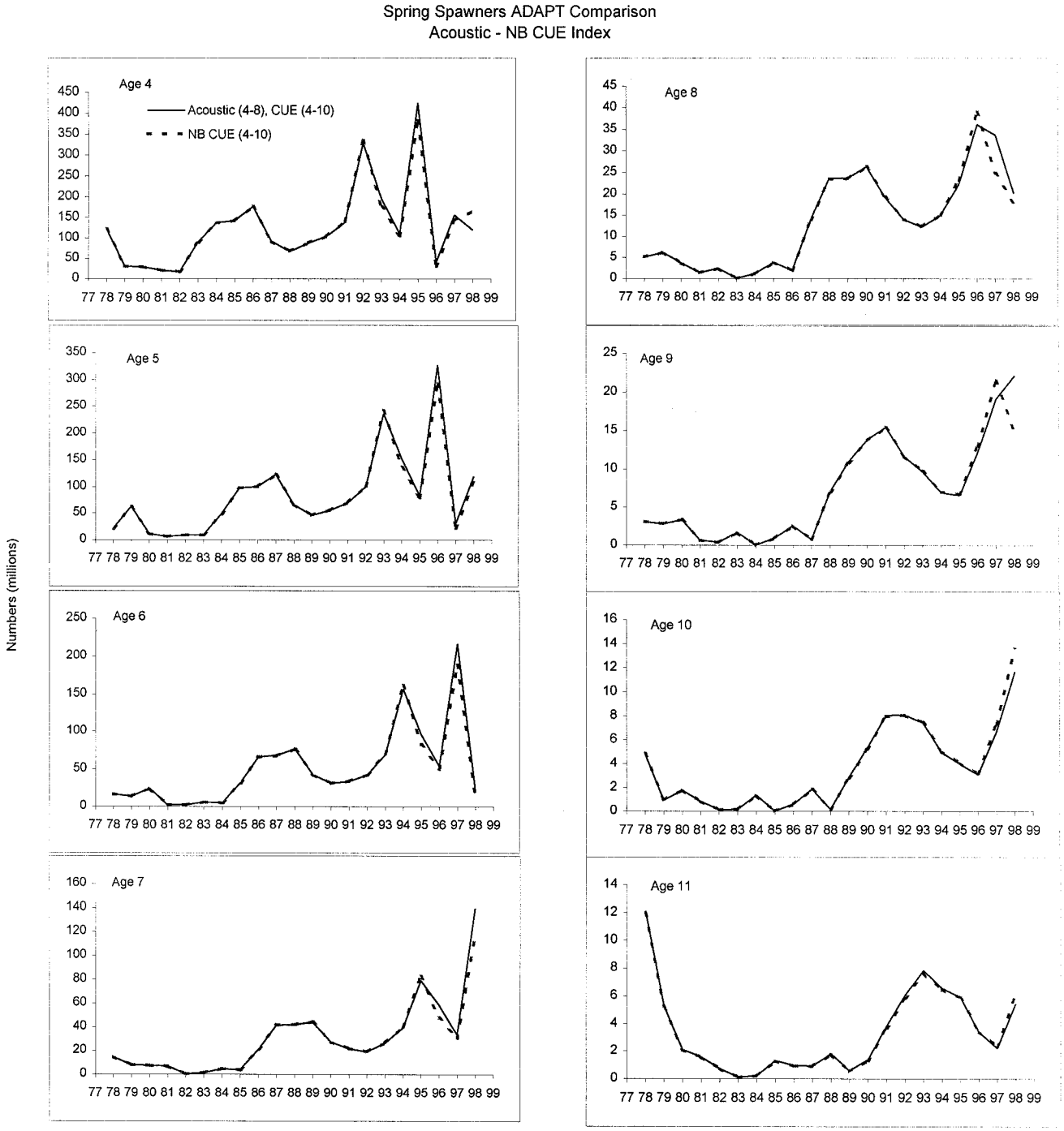
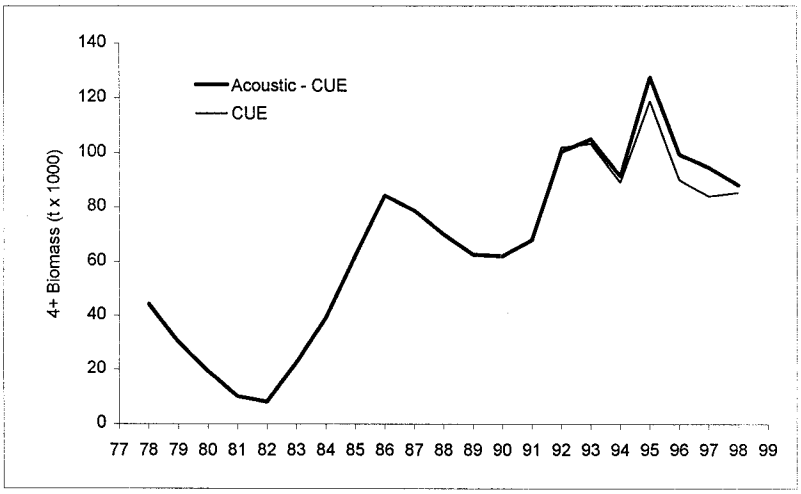
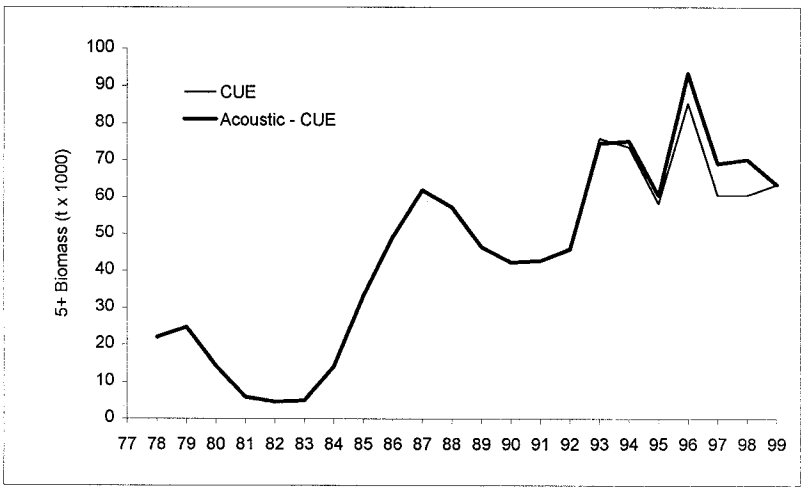


Fig. 33. Comparison of population estimates by number for spring spawner ADAPT-VPA using acoustic and catch rate indices together and catch rate indices alone.

Spring Spawners
Projection Comparisons





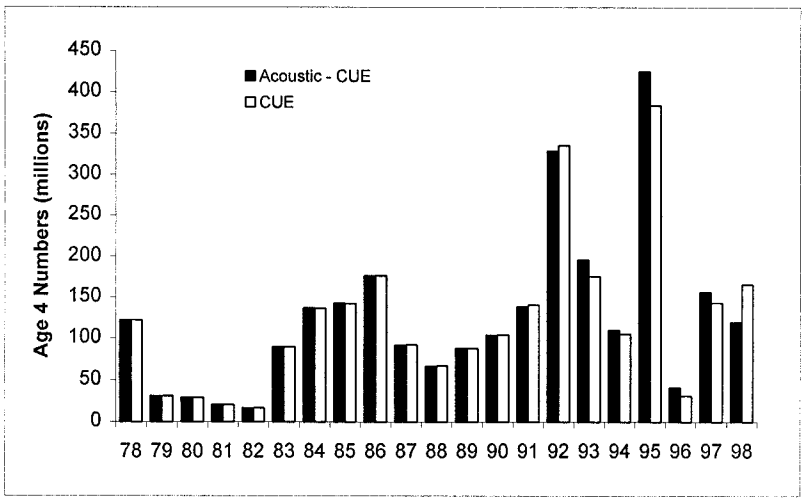


Fig. 34. Comparison of spring spawner ADAPT-VPA biomass and recruitment (age 4) estimates for FRATIO model using catch rates alone and catch rates combined with acoustic survey as calibration index.

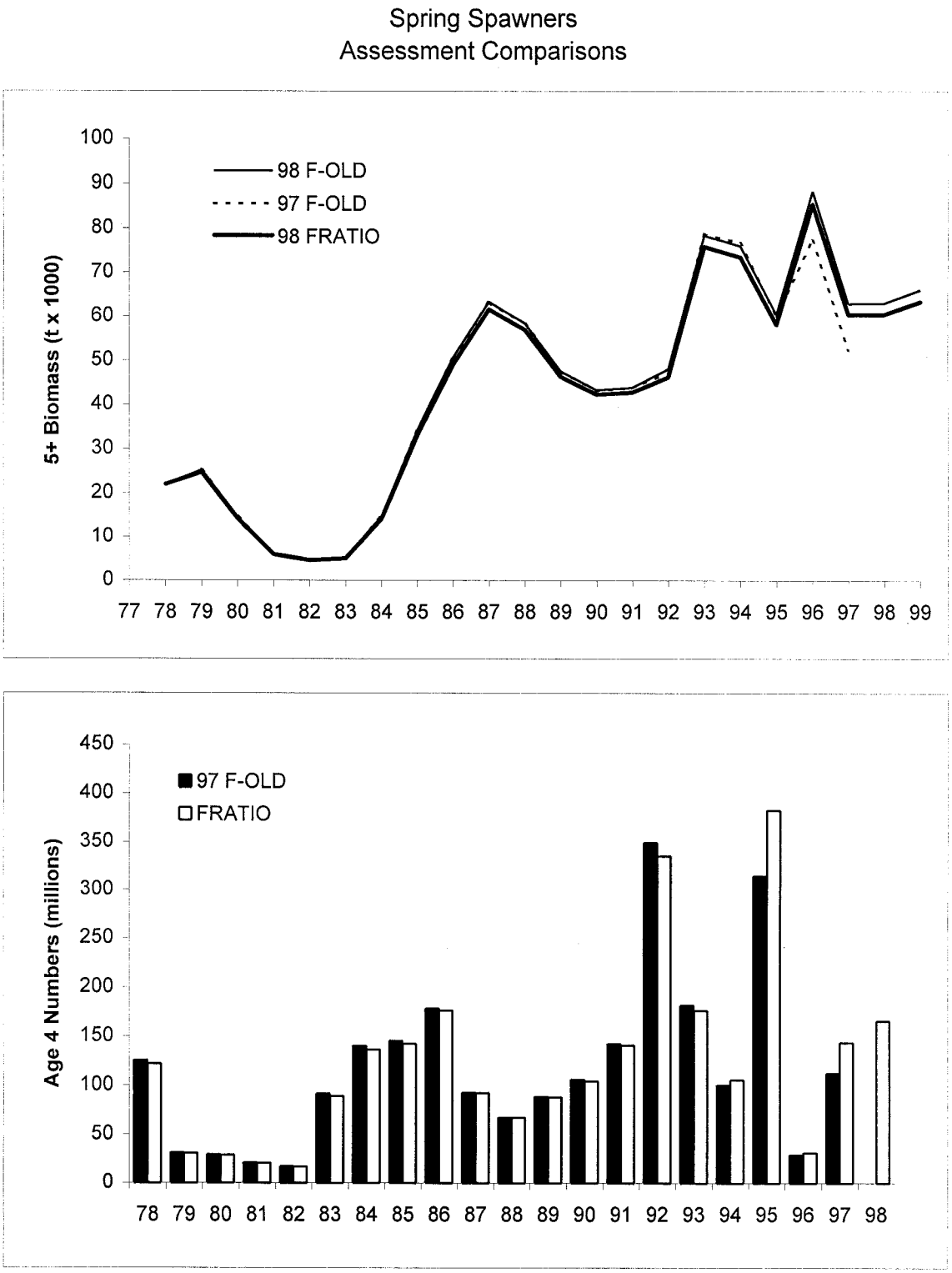


Fig. 35. Comparison of spring spawner population estimates in assessment of 1997 fishery (last year's assessment) using F-OLD and 1998 assessment (this year) using FRATIO and catch rate as the calibration index.

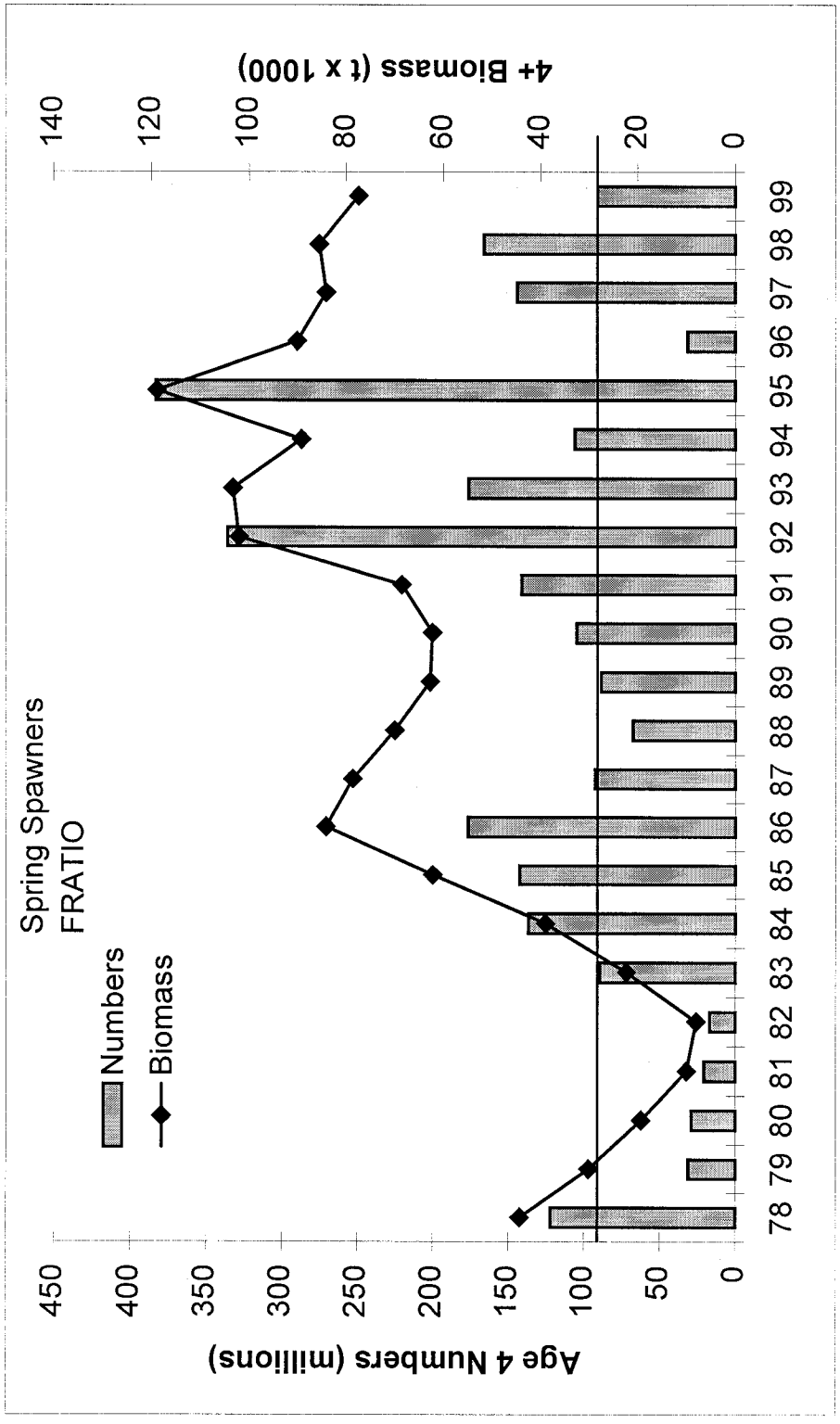


Fig. 36. Recruitment (numbers at age 4), age 4+ biomass, and average recruitment (horizontal line) for spring spawners estimated by ADAPT-VPA FRATIO model.

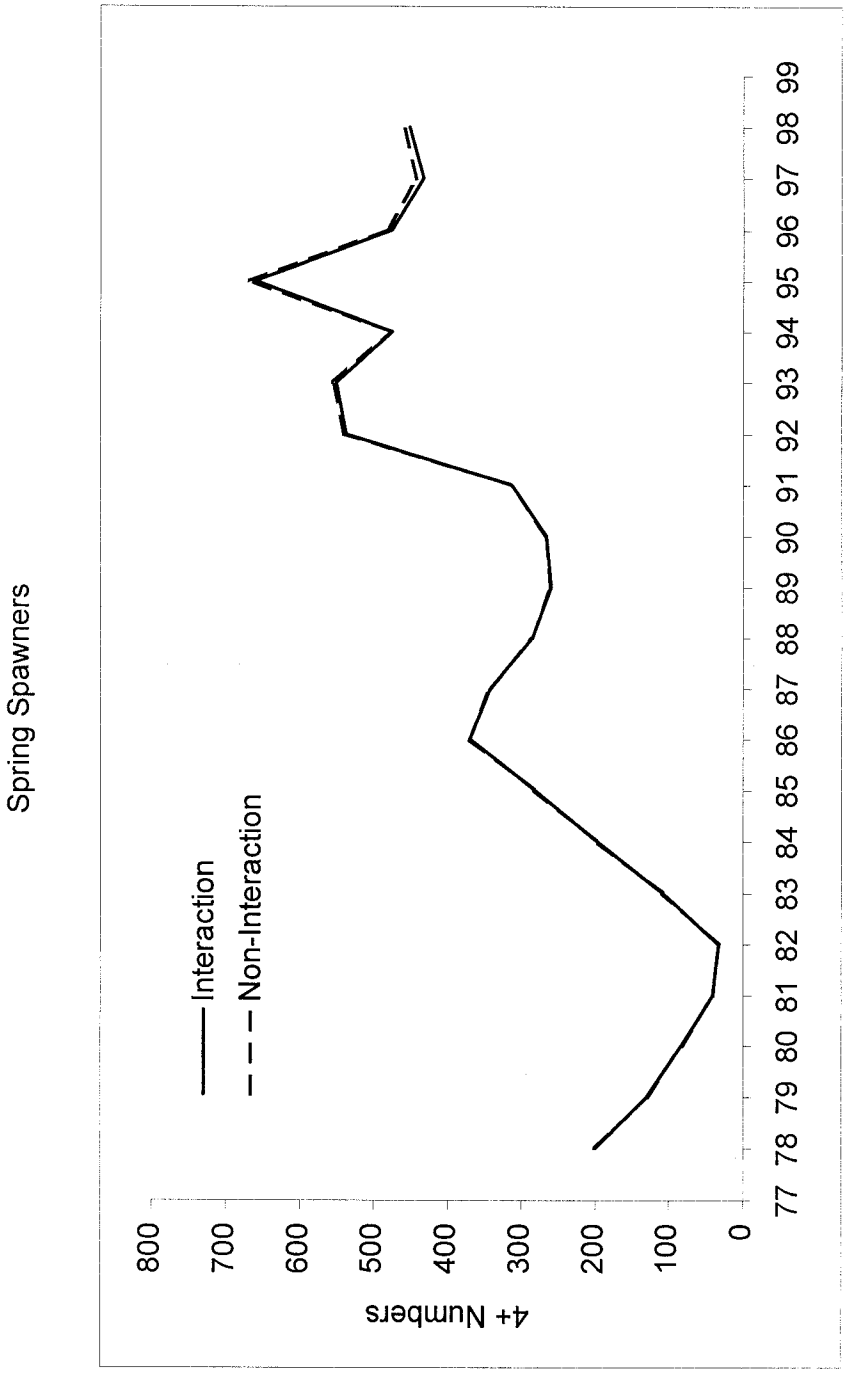


Fig. 37. Comparison of 4+ numbers estimated for spring spawners using catch rates estimated by interaction and non-interaction model to calibrate ADAPT-VPA FRATIO model.

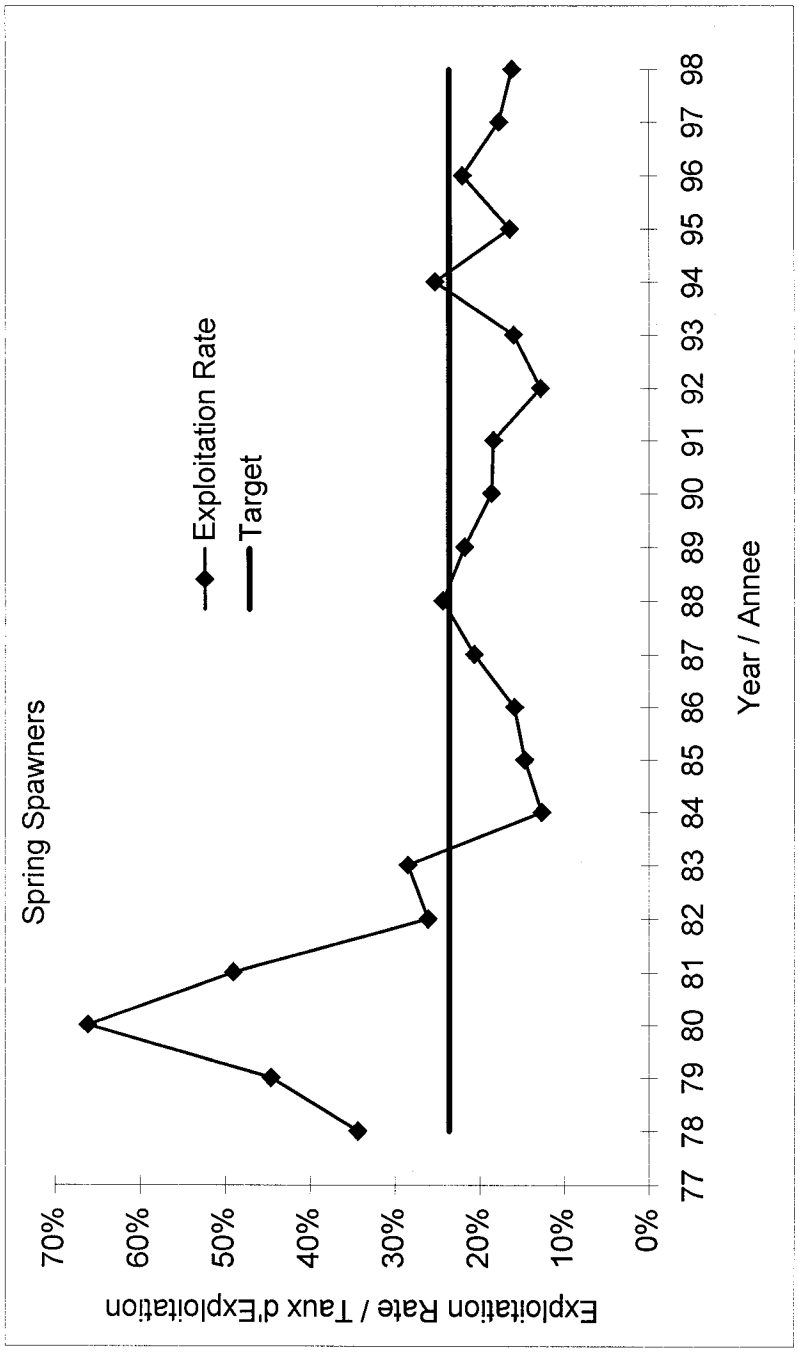
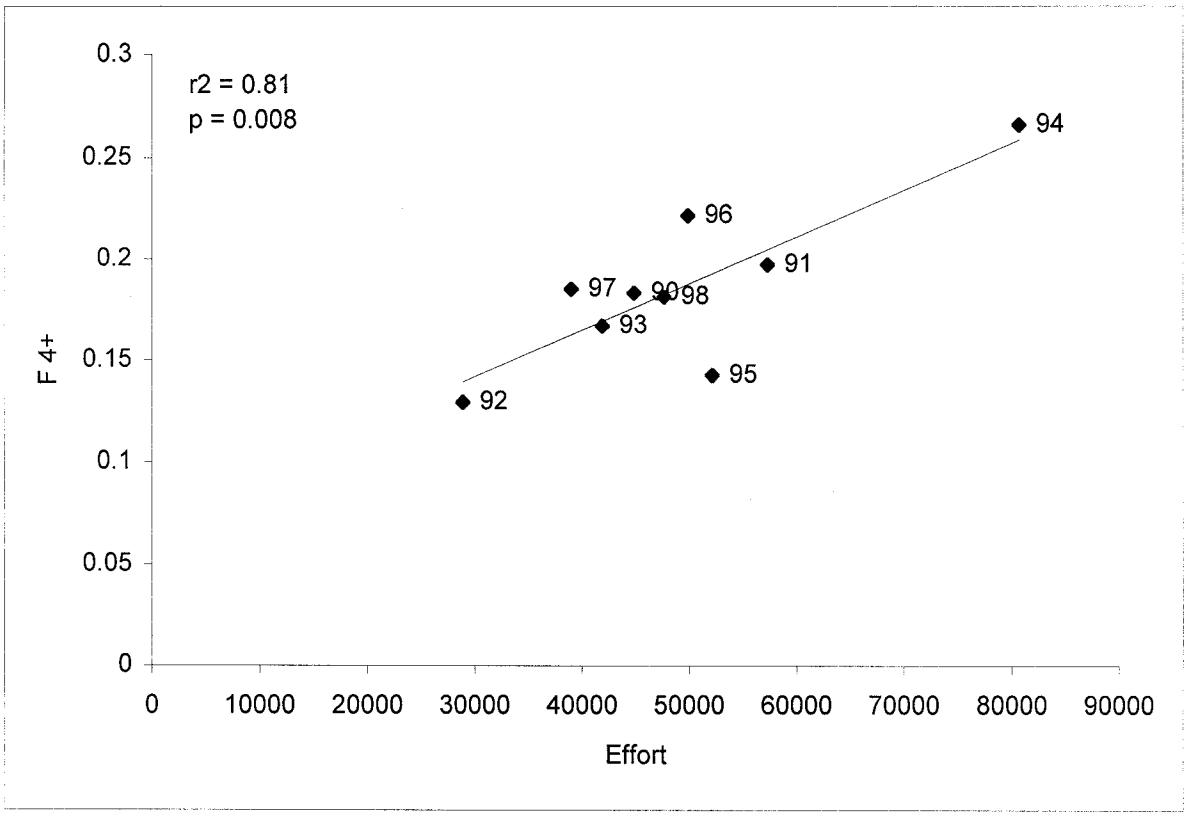


Fig. 38. Estimated fishing mortalities for 4+ spring spawners from ADAPT-VPA FRATIO model
Fig. 38. Estimated fishing mortalities for 4+ spring spawners from ADAPT-VPA FRATIO model using catch rates for calibration compared to target exploitation rate of 24%.



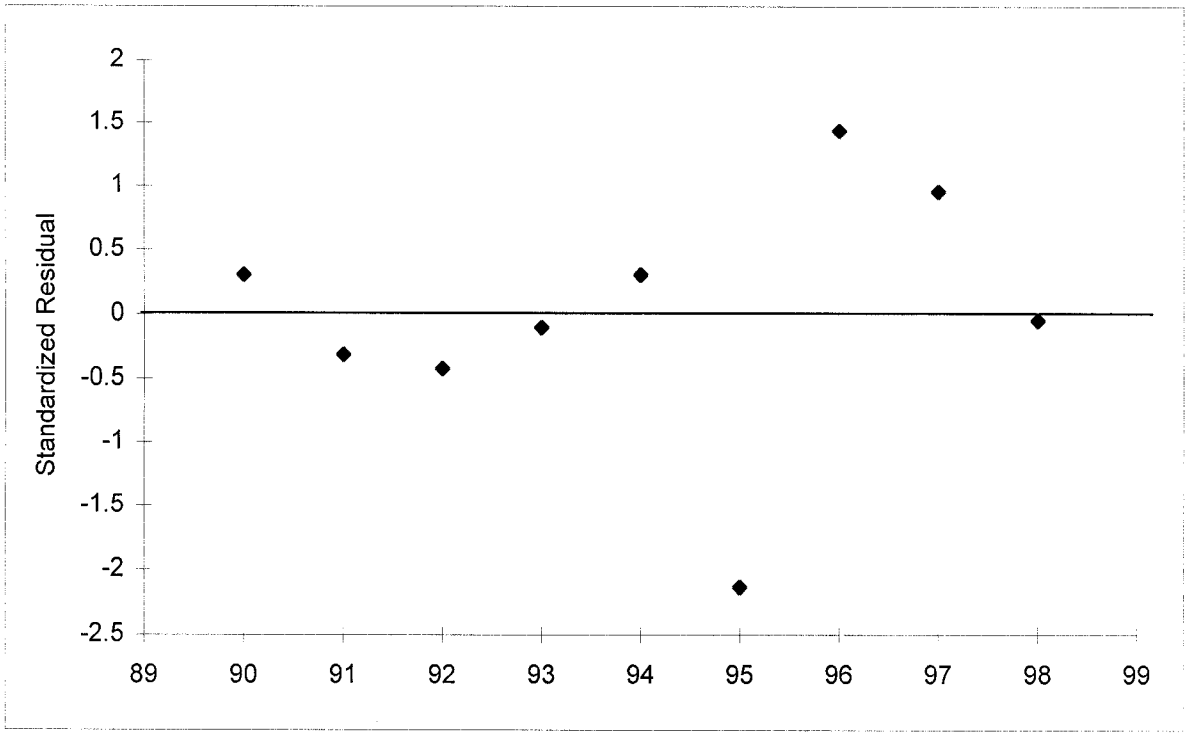


Fig. 39. Relationship between fishing mortality and effort for spring spawners from ADAPT-VPA FRATIO model using catch rates for calibration.

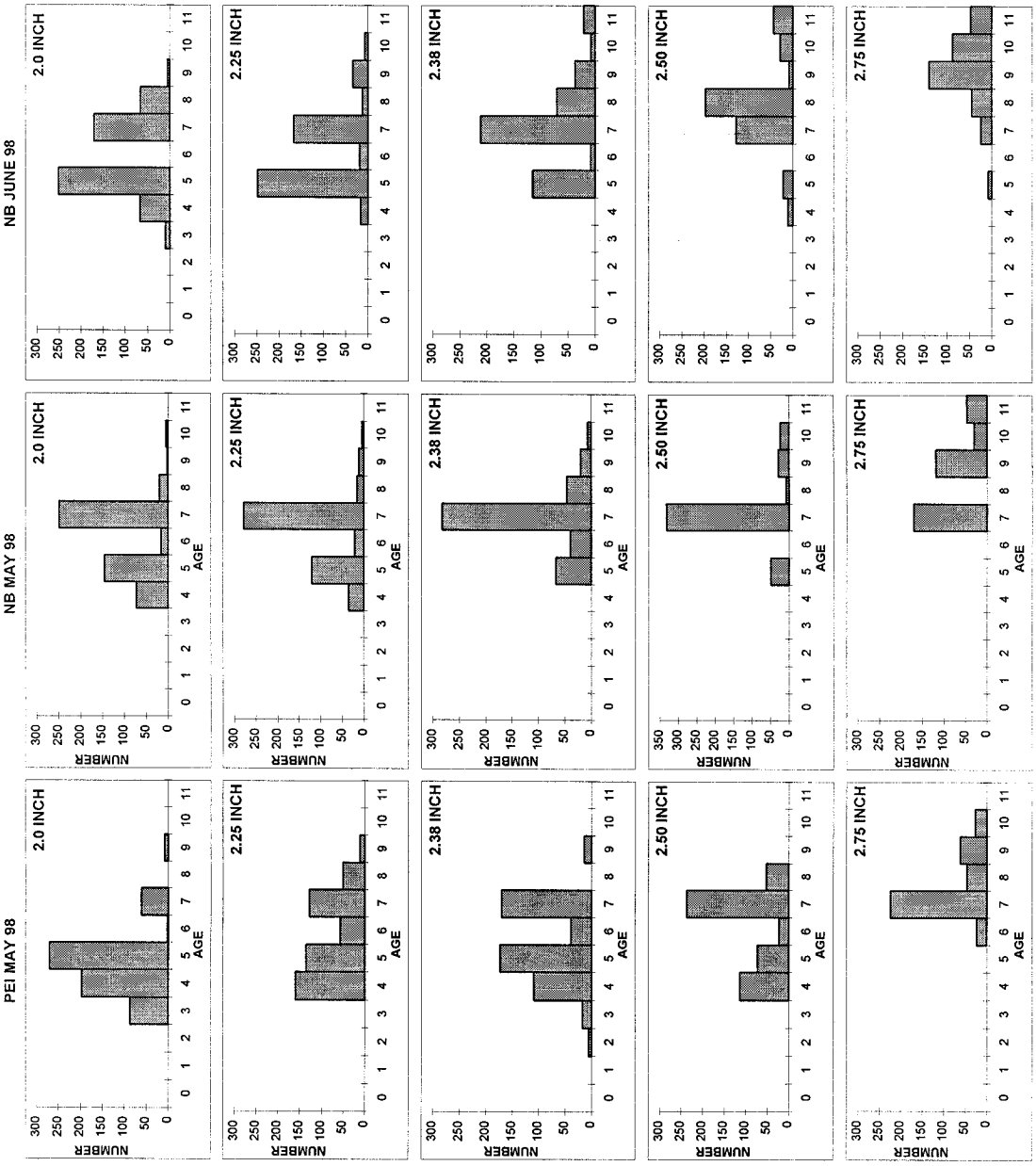


Fig. 40. Comparison of age structure in experimental nets for indicated mesh size fished in southeast N. B. and west P.E.I. in spring of 1998. Landings used = 100t

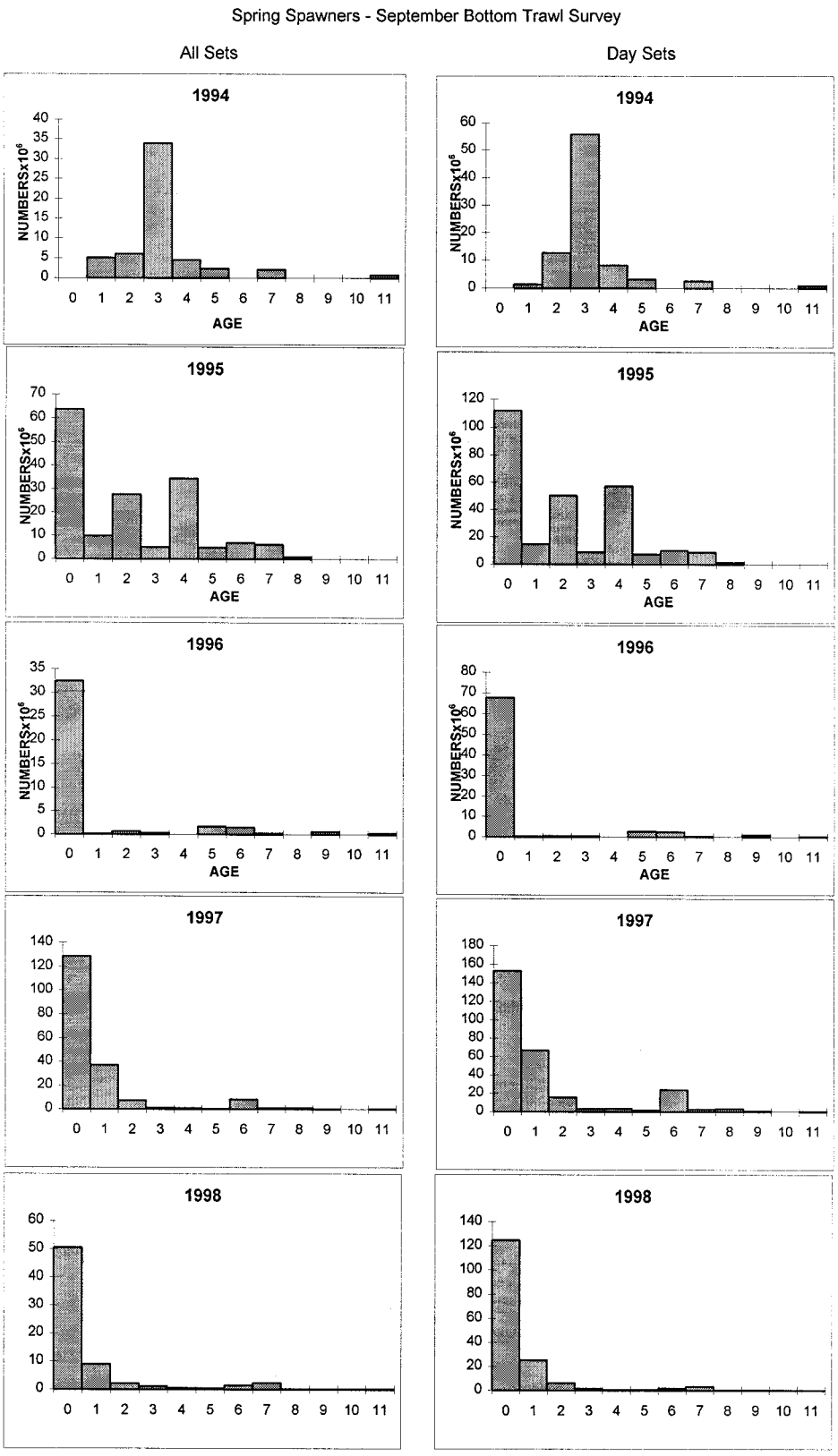


Fig. 41. Spring spawner numbers-at-age from September bottom trawl survey.

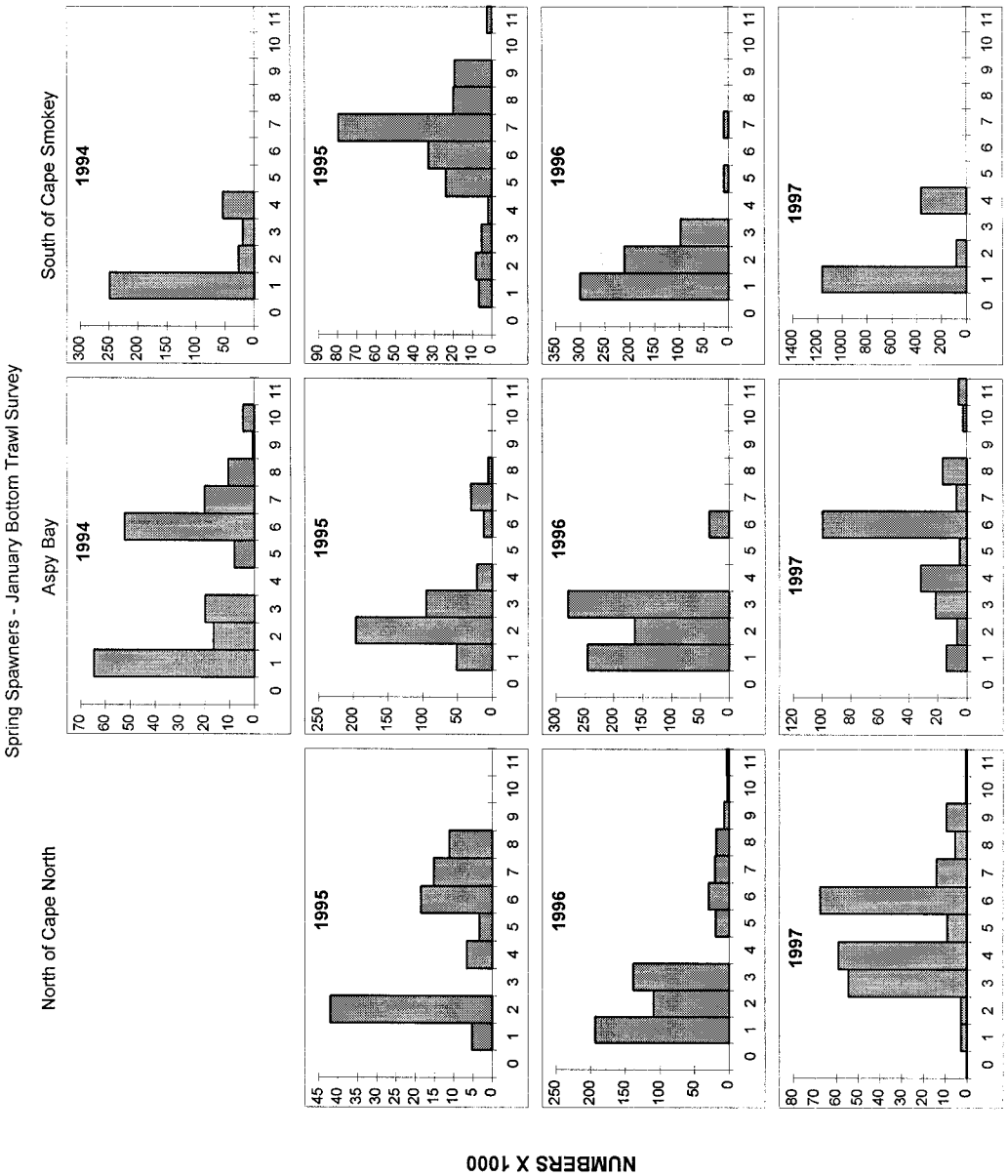


Fig. 42. Numbers-at-age from January bottom trawl survey for spring spawners.

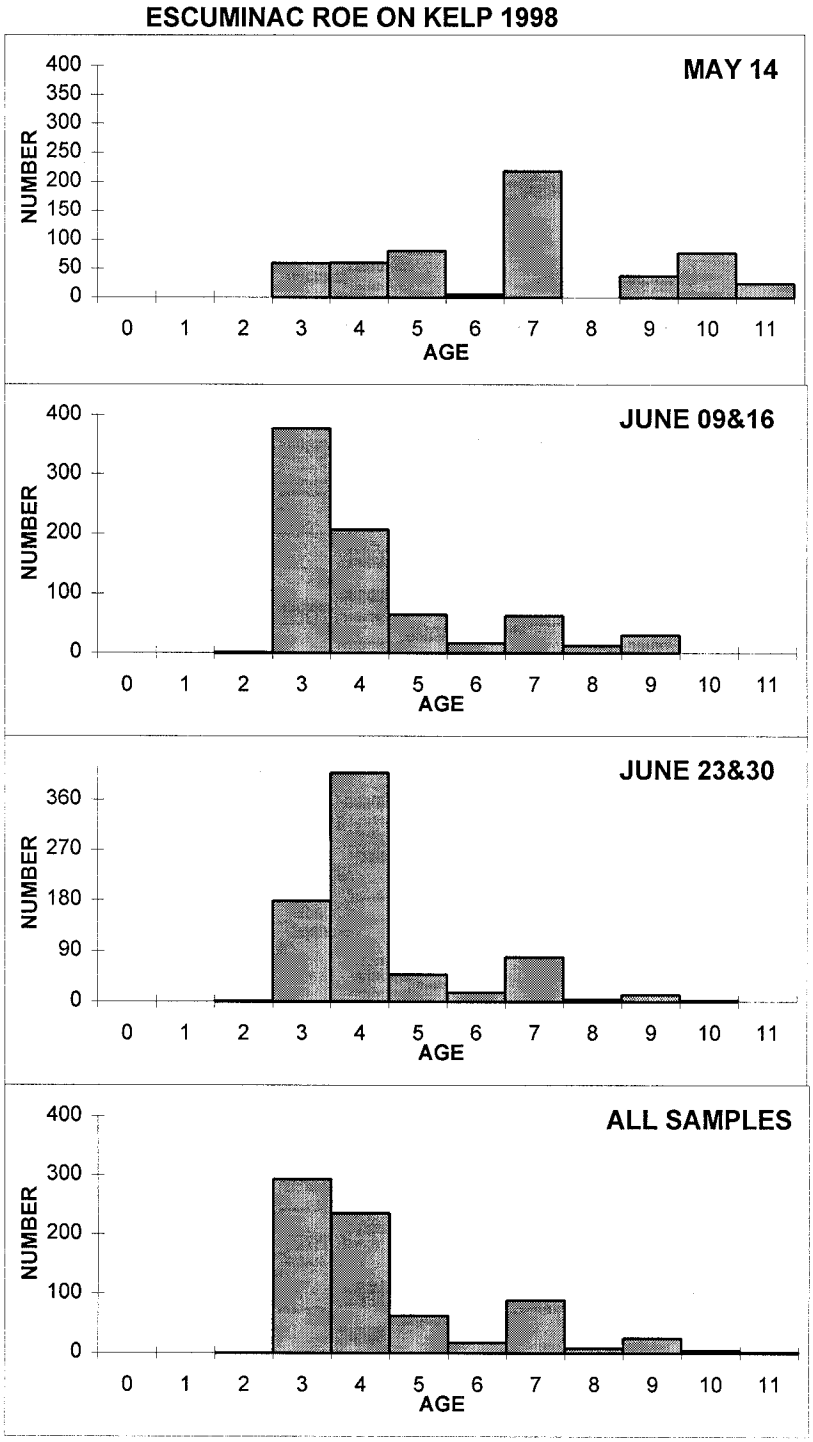


Fig. 43. Comparison of age structure in spring 1998 Escumunac roe on kelp trap nets. Landings used = 100t

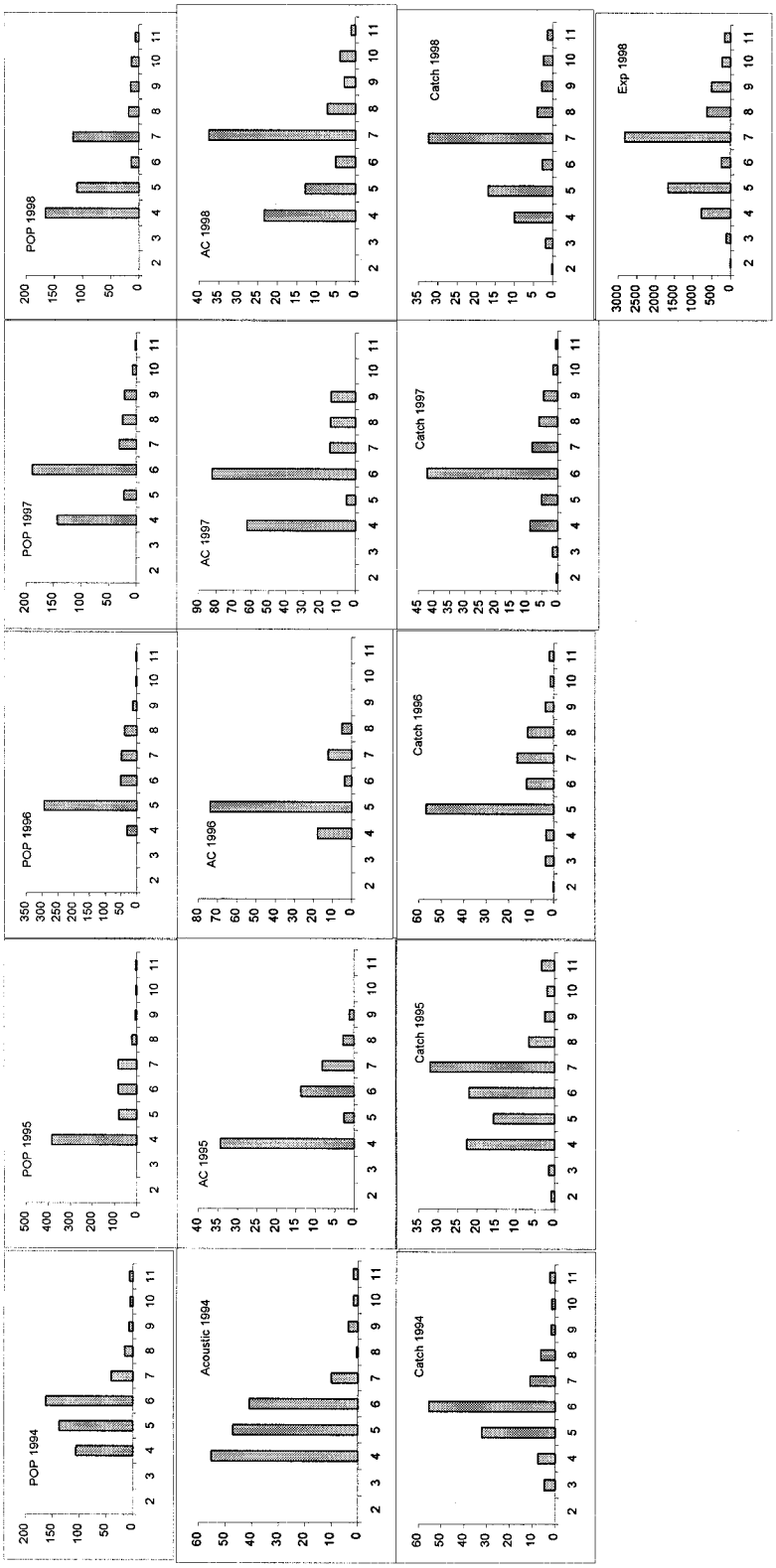


Fig. 44. Spring spawner numbers-at-age from ADAPT-VPA FRATIO CUE compared to numbers in acoustic survey, catch, and experimental nets.

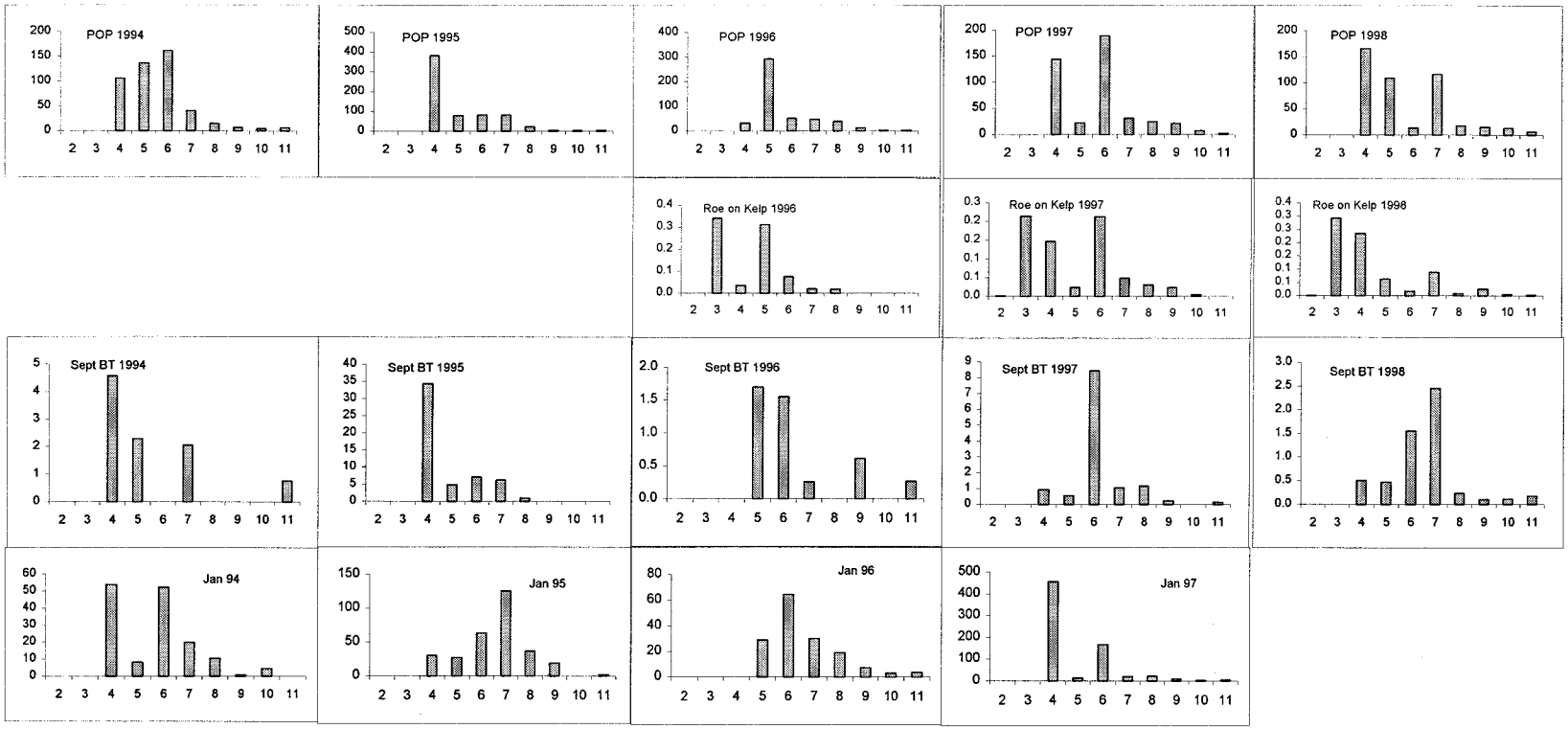


Fig. 45. Spring spawner numbers-at-age from ADAPT-VPA FRATIO CUE compared to Escuminac roe-on-kelp, September and January bottom trawl surveys.

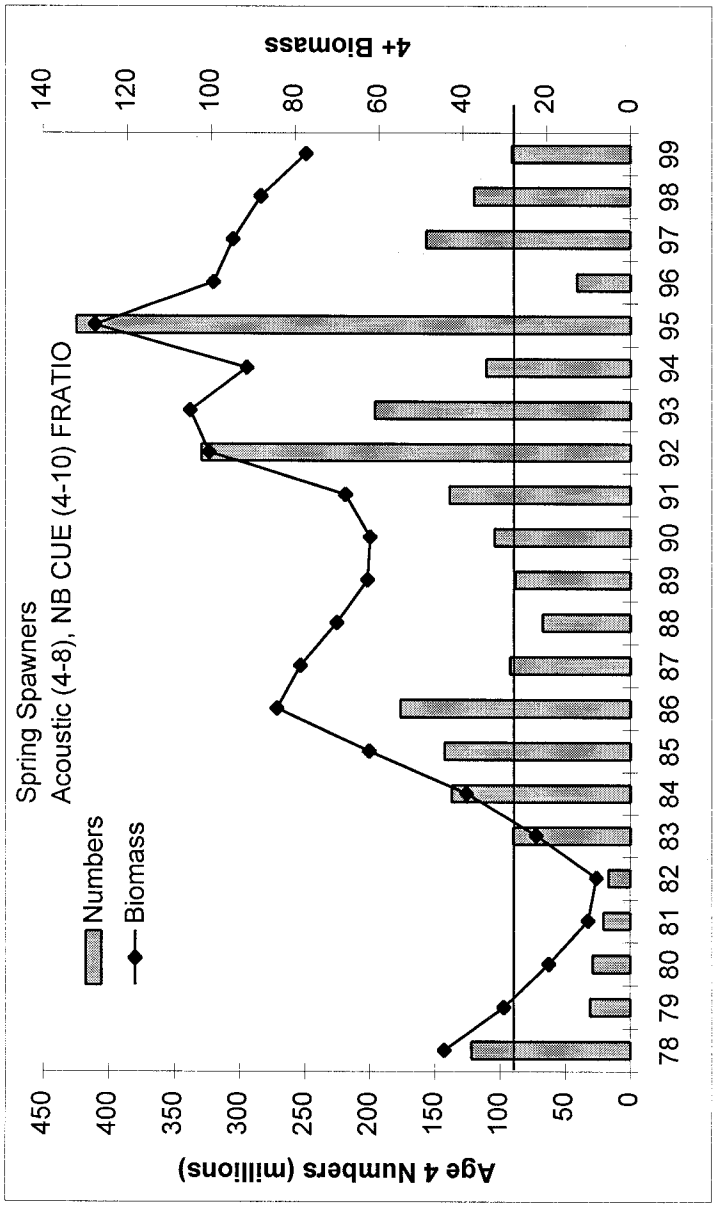


Fig. 46. Age 4 numbers, 4+ biomass, and average recruitment (horizontal line) as estimated by ADAPT-VPA using acoustic and catch rate indices for calibration.

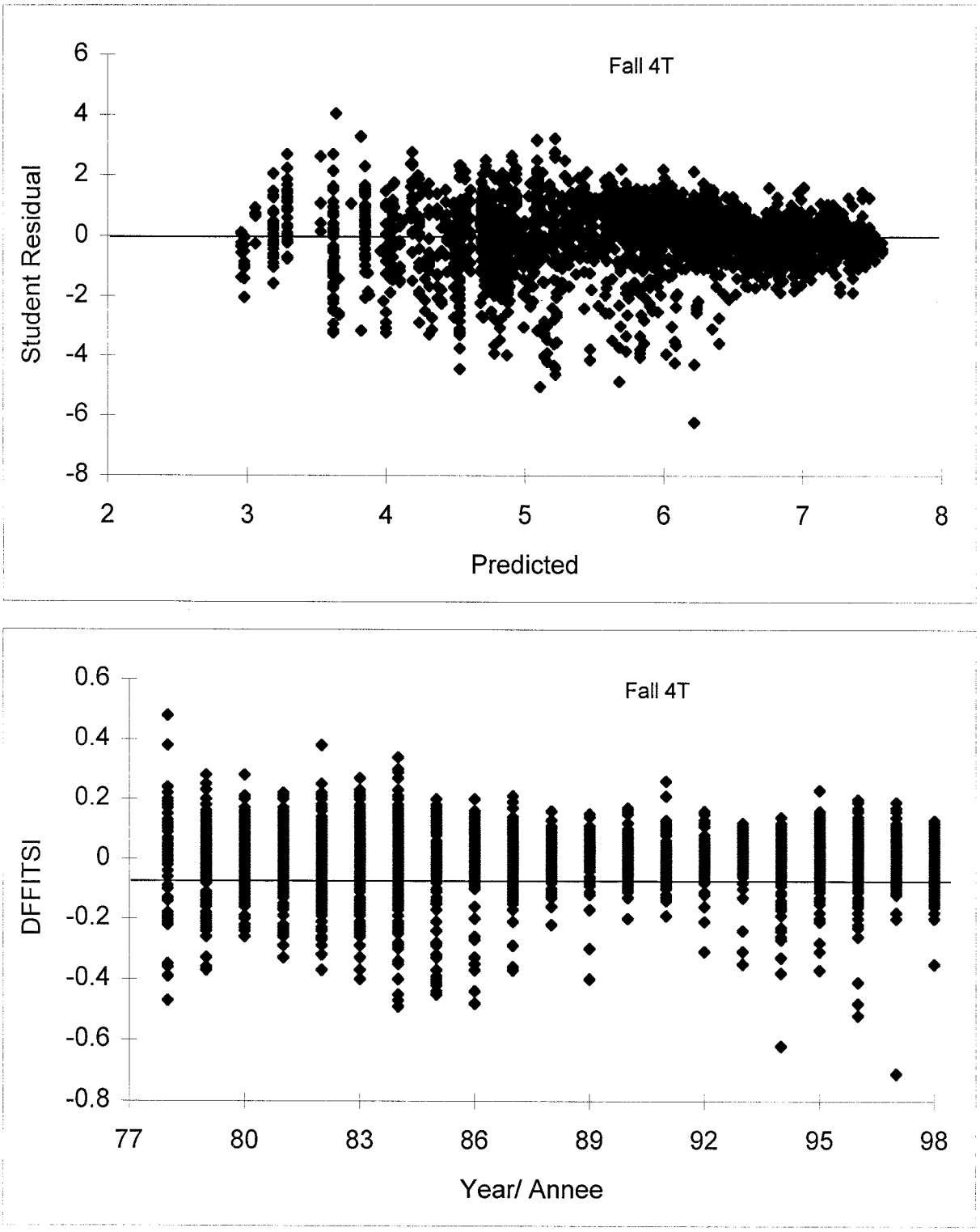


Fig. 47. Diagnostics for 4T fall spawners from multiplicative catch rate analysis.

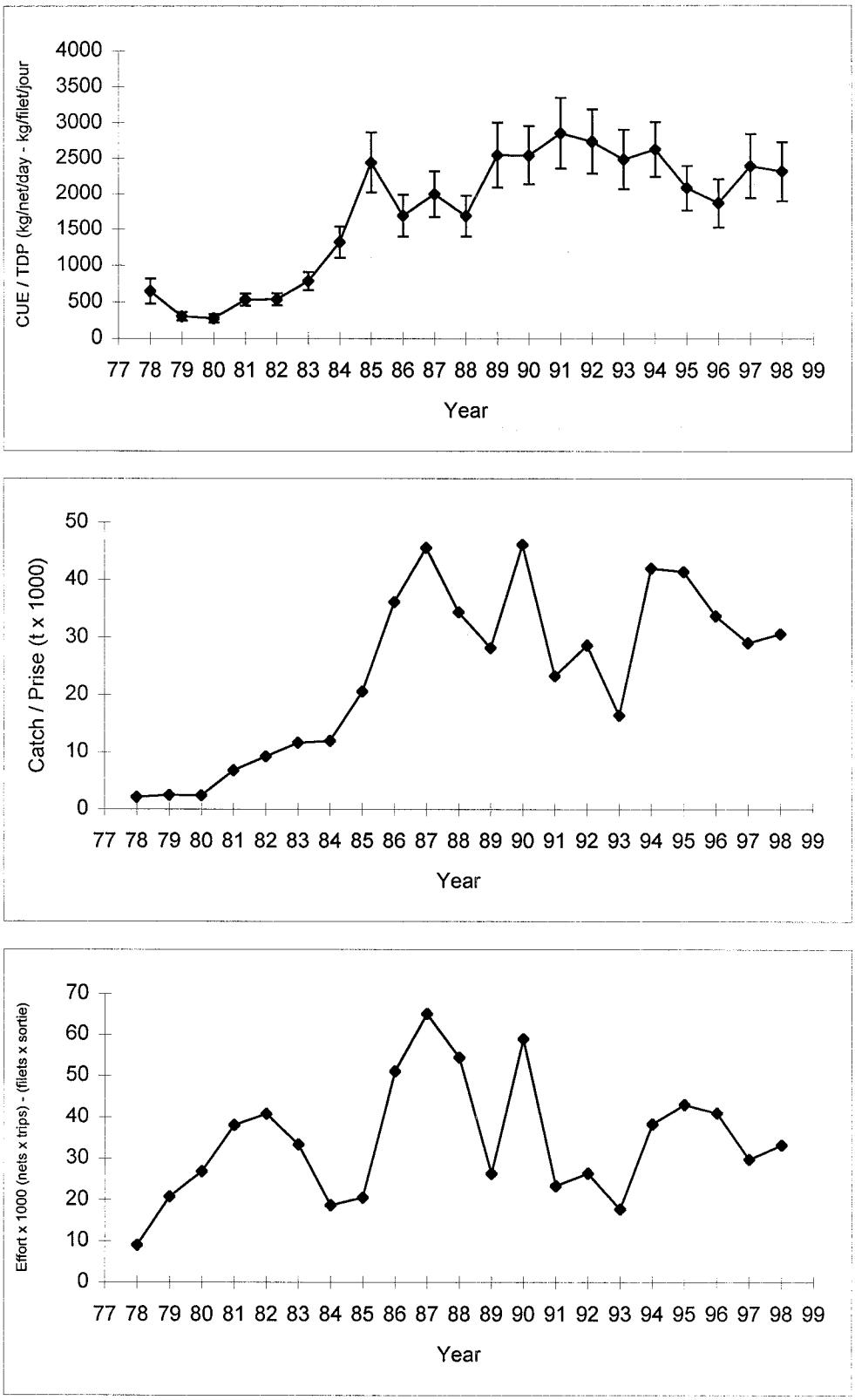


Fig. 48. Fall spawner catch rates (top), catch (middle), and effort (bottom).

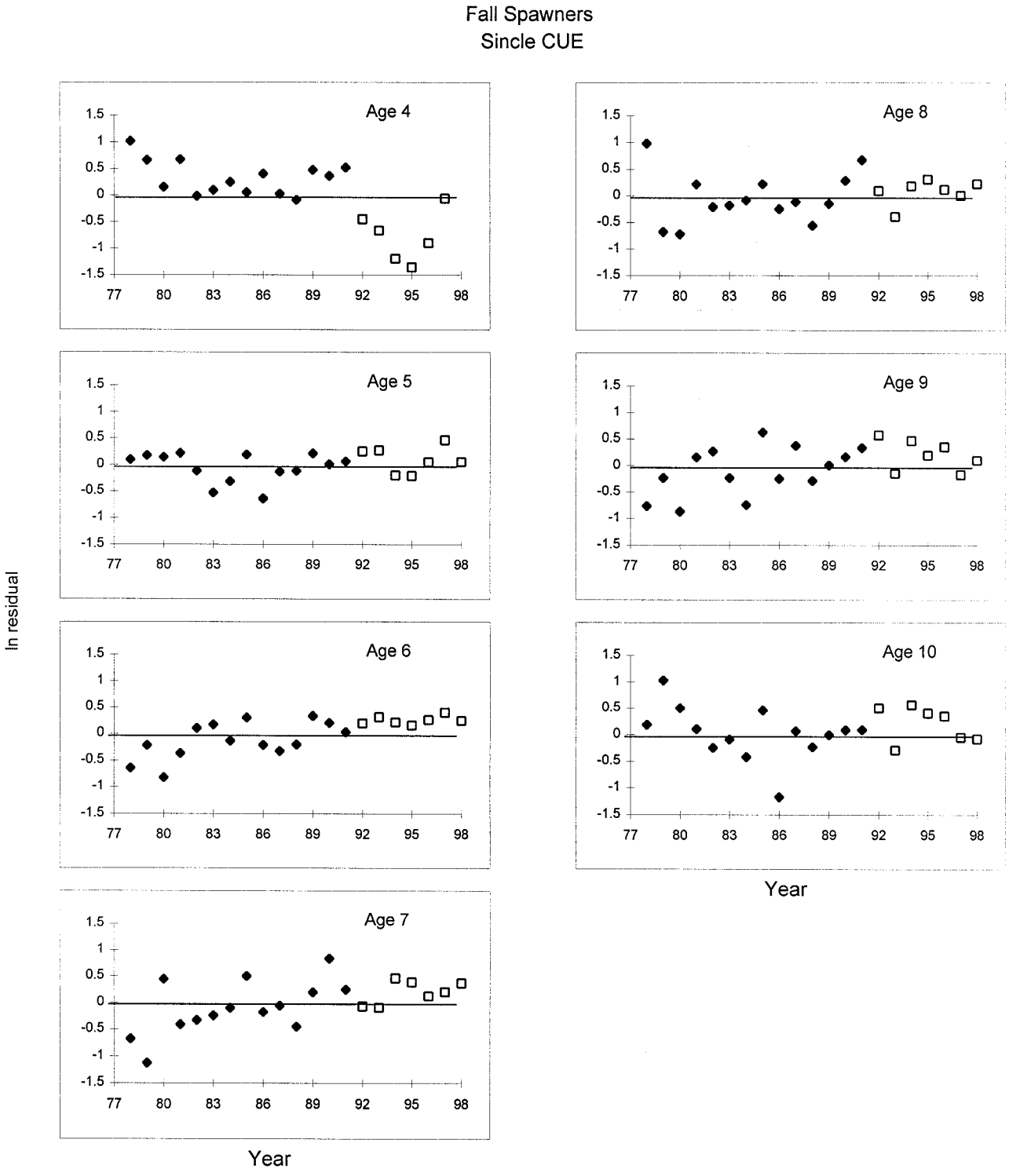


Fig. 49. Fall spawner residuals from ADAPT-VPA using single CUE to calibrate model. Open squares represent years with larger mesh sizes.

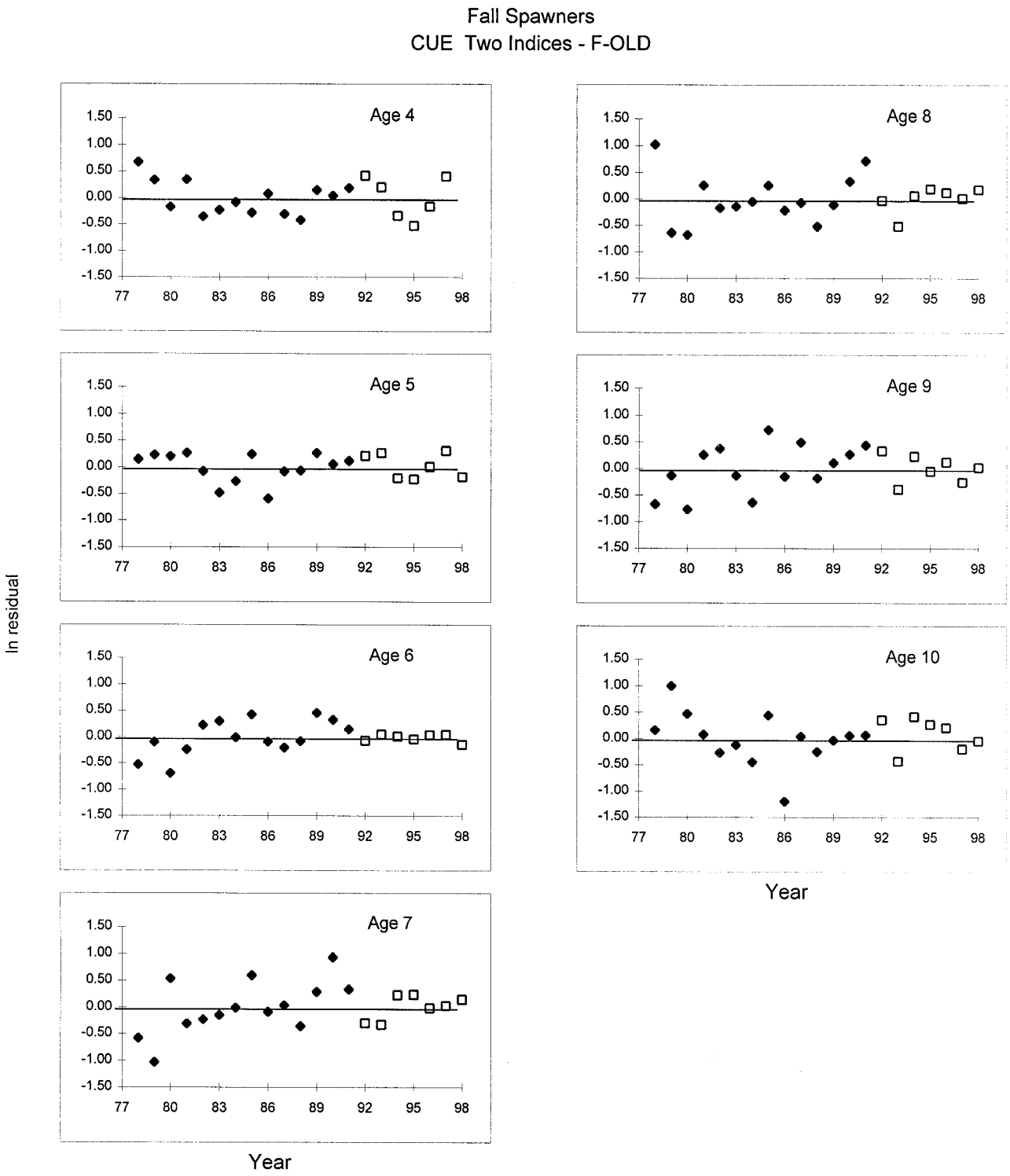


Fig. 50. Residuals from ADAPT-VPA using split CUE and F-OLD for fall spawners. Open squares represent years with larger mesh sizes.

Fall Spawner
Select CUE FRATIO

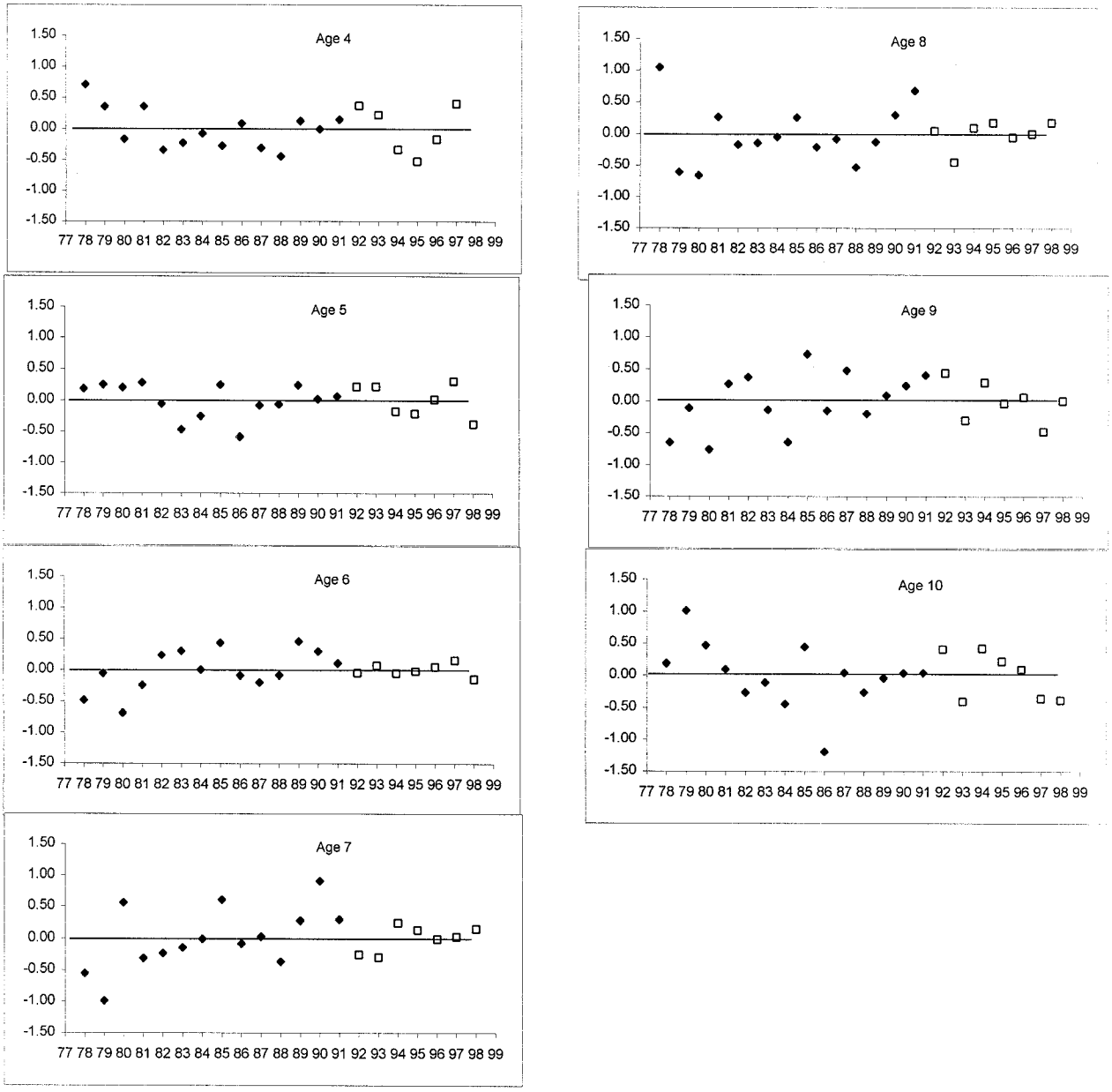


Fig. 51. Residuals from fall spawner ADAPT-VPA using split CUE and FRATIO.

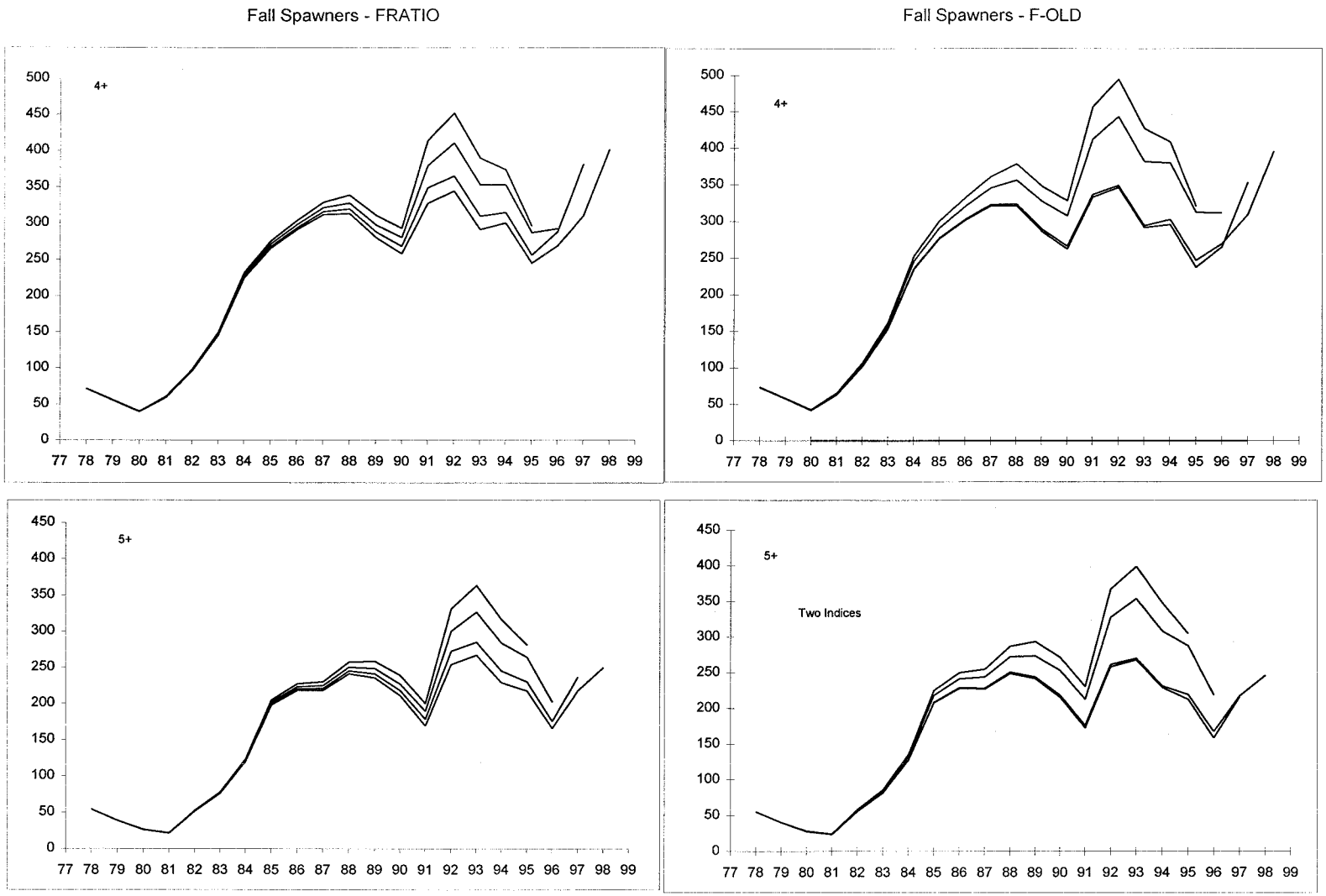


Fig. 52. Fall spawner retrospecitve analysis of ADAPT-VPA split CUE F-OLD and FRATIO models.

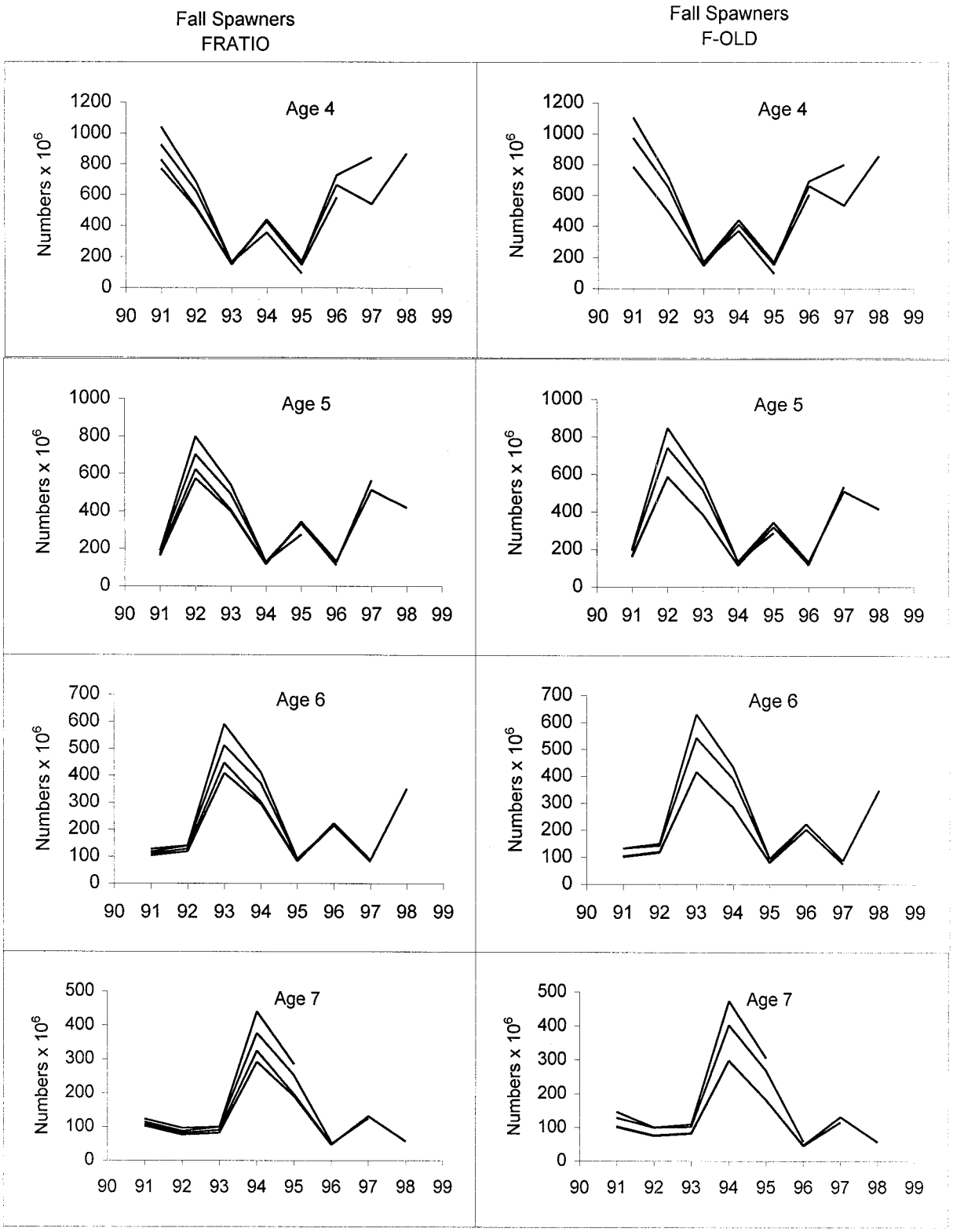


Fig. 53. Retrospective analysis by age for fall spawner ADAPT-VPA F-OLD and FRATIO models using split CUE indices.

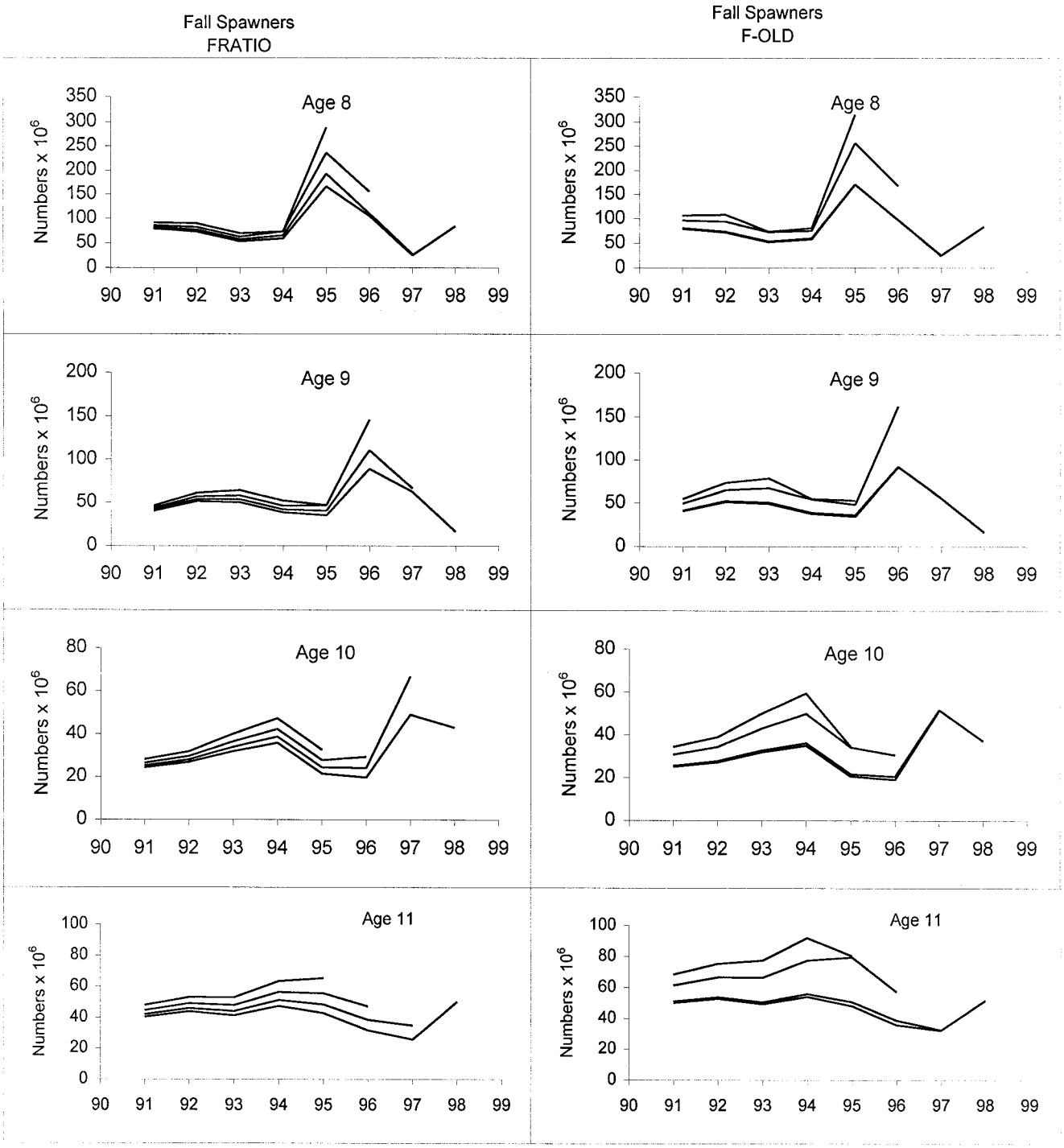

Fall Spawners
FRATIO
Fall Spawners
F-OLD
Age 8
Age 9
Age 10
Age 11
Numbers x 10^6
90 91 92 93 94 95 96 97 98 99

Fig. 53. Cont.

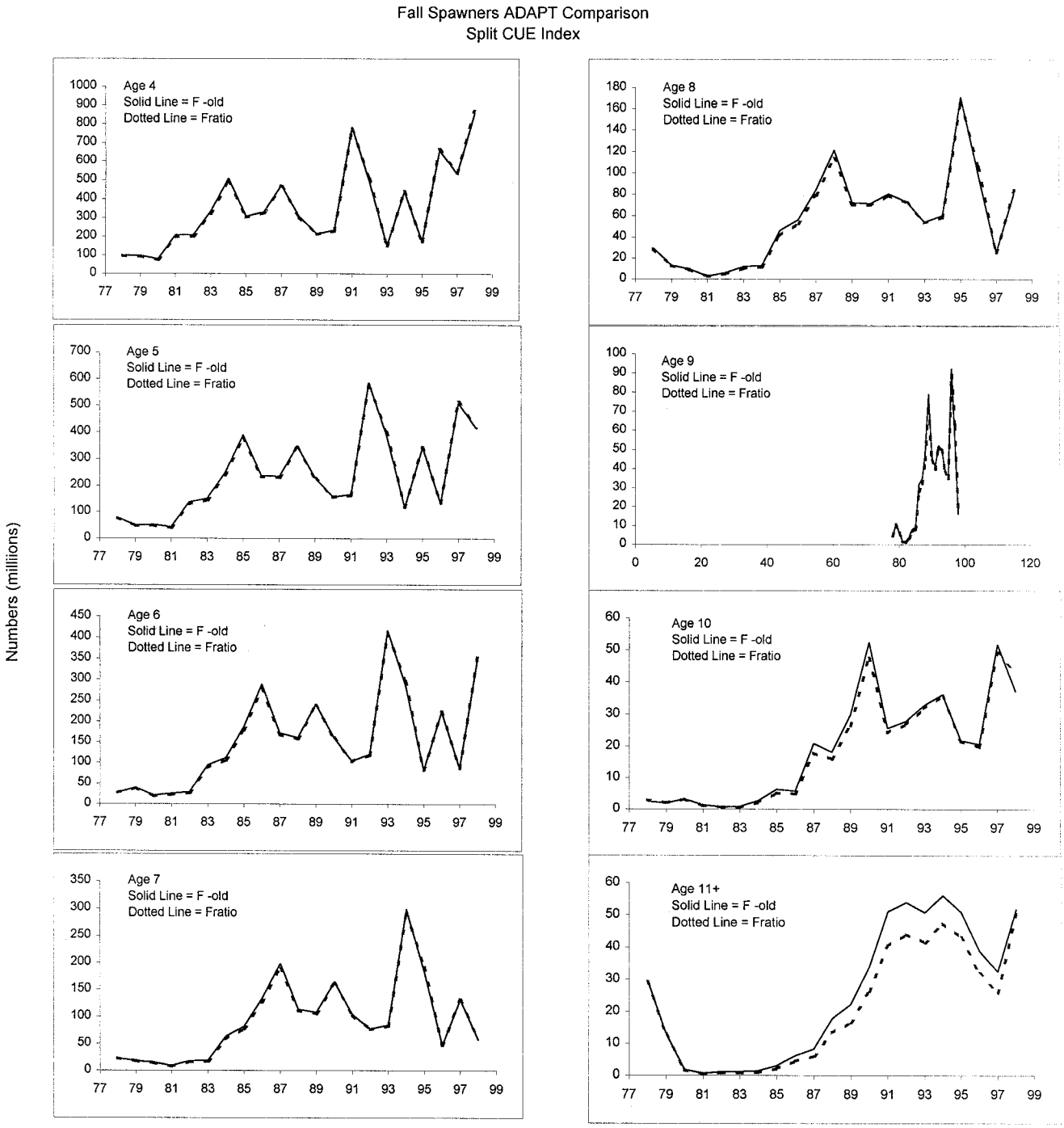


Fig. 54. Numbers-at-age estimates for fall spawners from ADAPT-VPA F-OLD and FRATIO split CUE models.

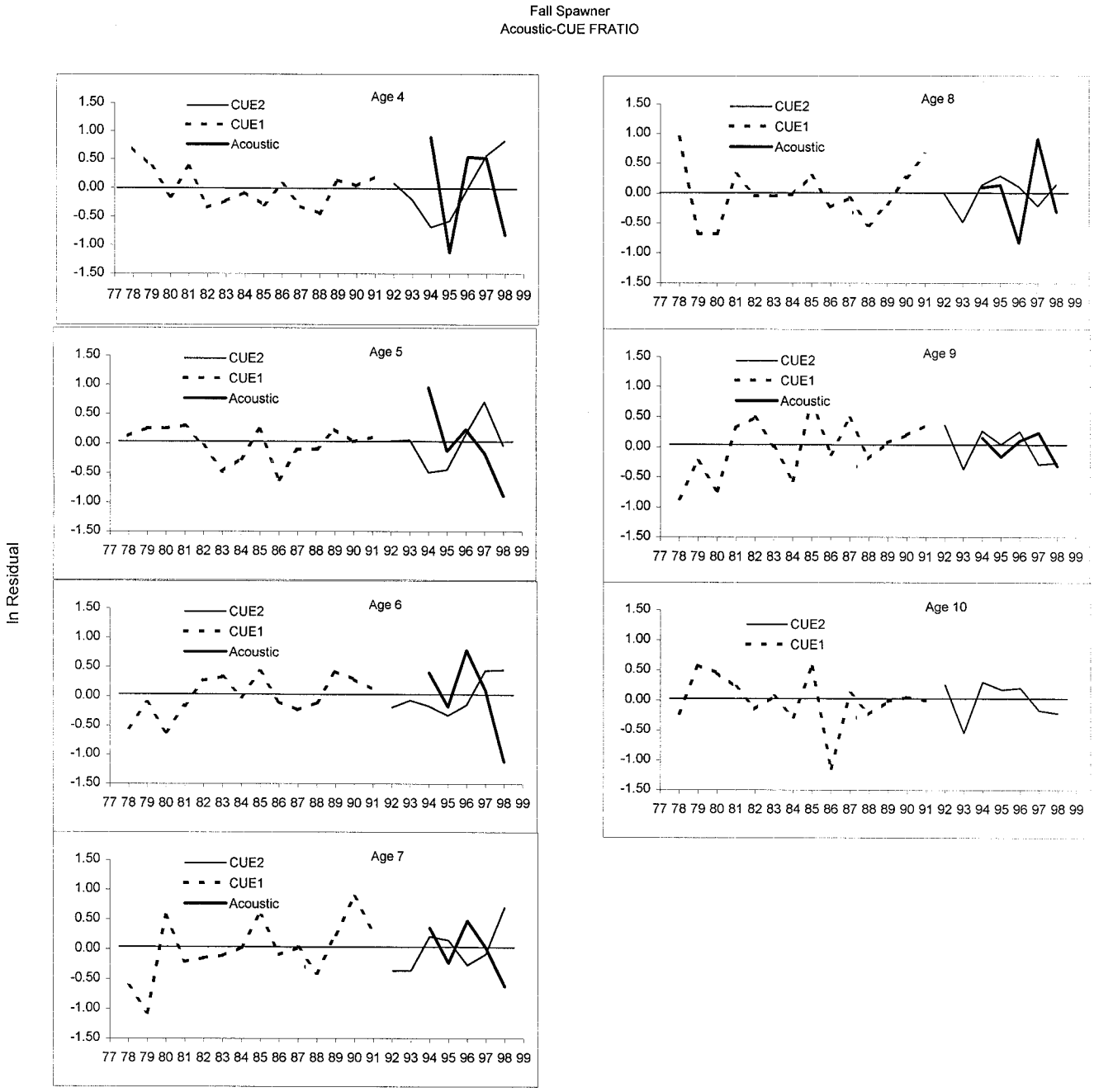


Fig. 55. Fall spawner ADAPT-VPA FRATIO residuals using split CUE and acoustic index.

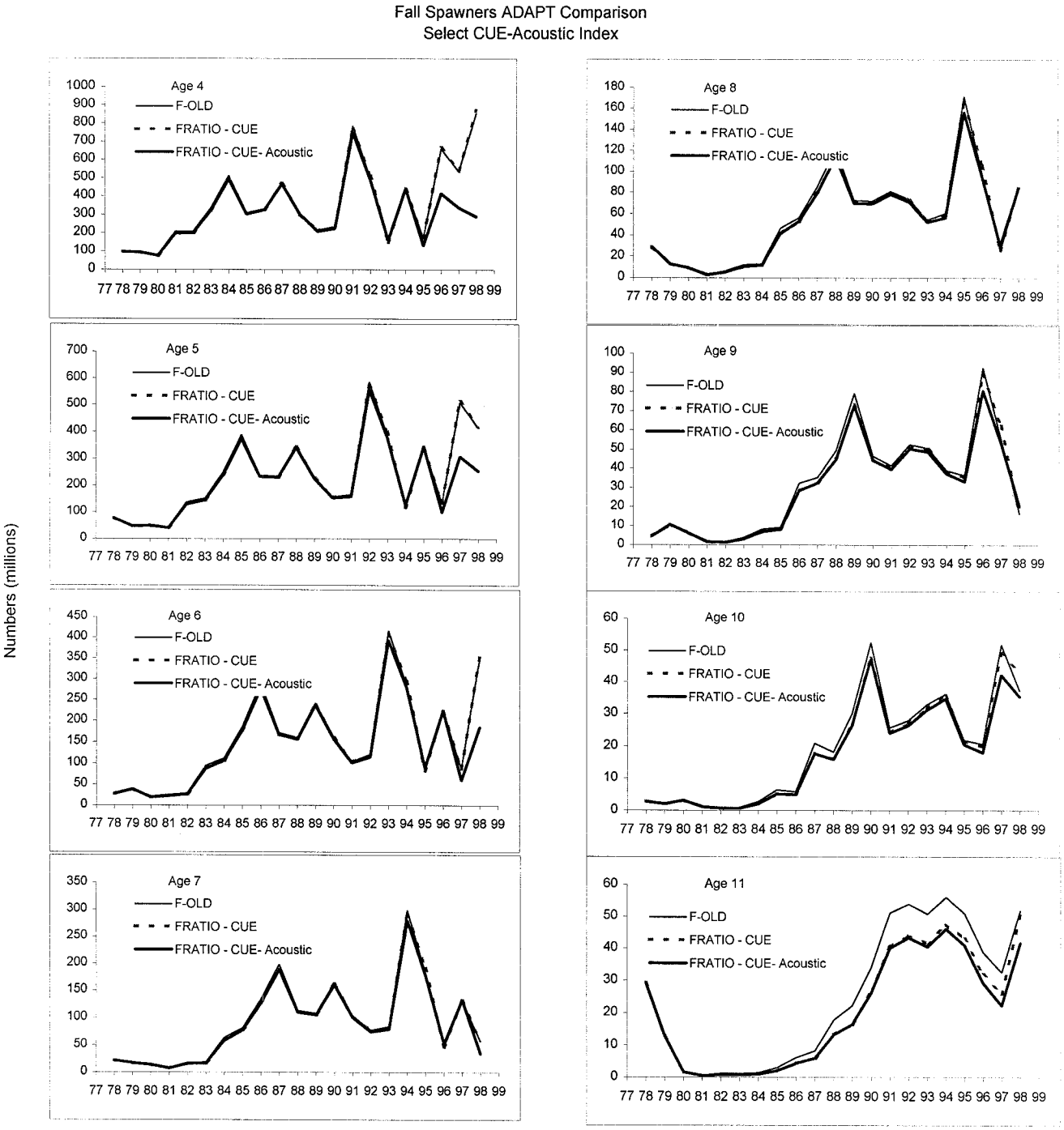


Fig. 56. Fall spawner numbers-at-age from ADAPT-VPA FRATIO using acoustic and split CUE indices, compared to ADAPT-VPA FRATIO and F-OLD split CUE models.

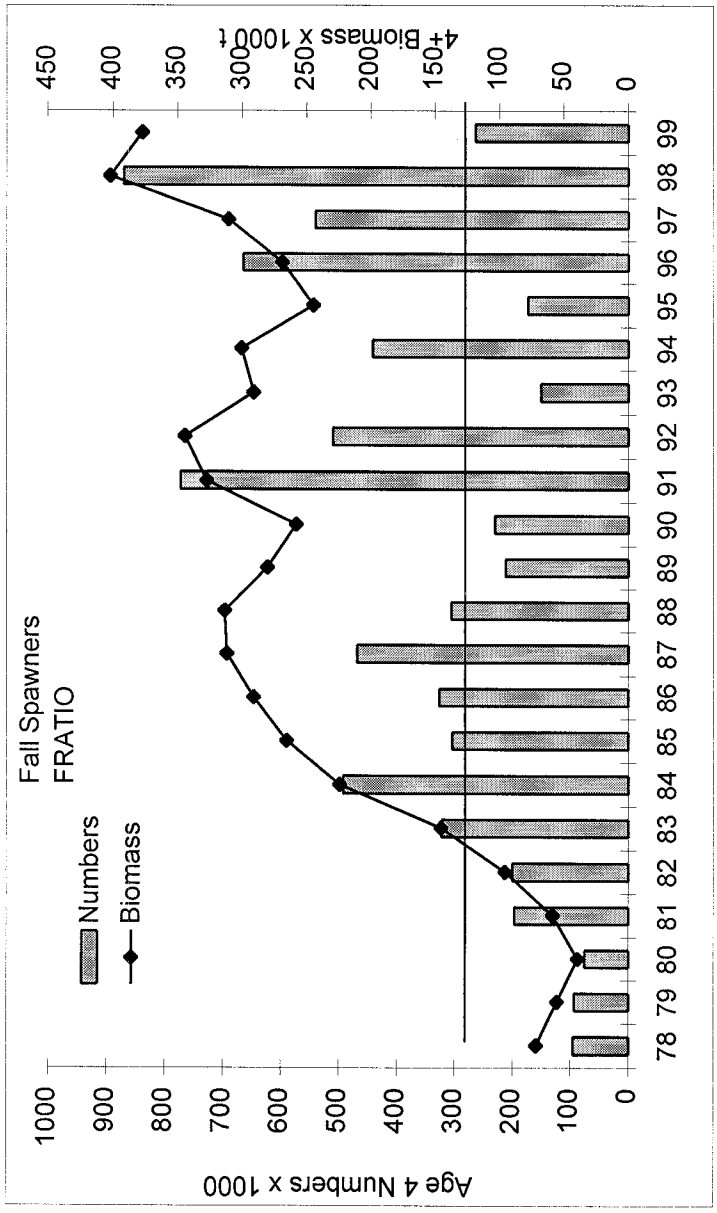


Fig. 57. Age 4 numbers-at-age, 4+ biomass, and average recruitment of age 4 (horizontal line) for fall spawners estimated from ADAPT-VPA FRATIO split CUE model.

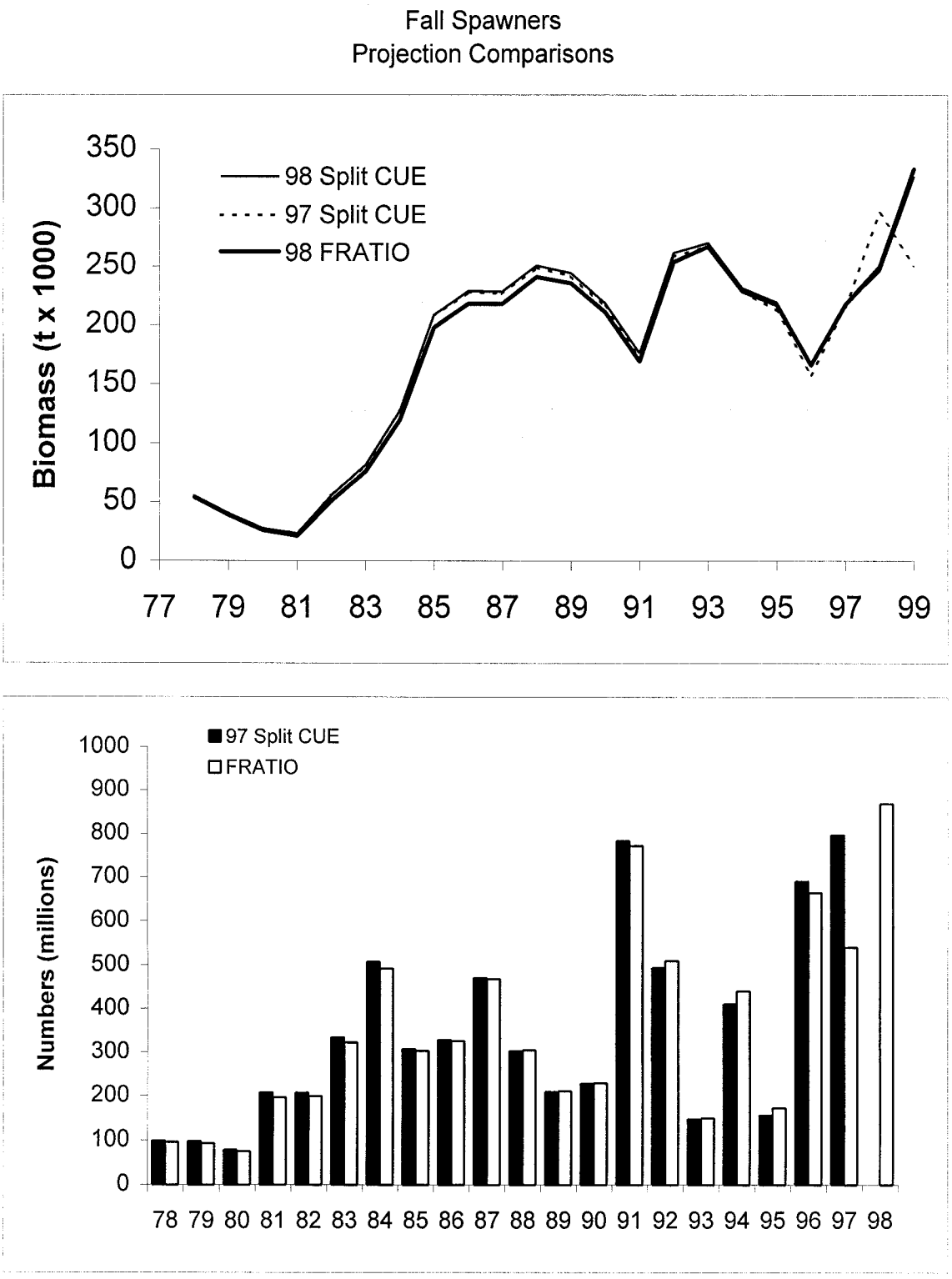


Fig. 58. Fall spawner 5+ biomass and age 4 numbers from ADAPT-VPA FRATIO for 1998 assessment compared to last year's 1997 assessment using F-OLD model.

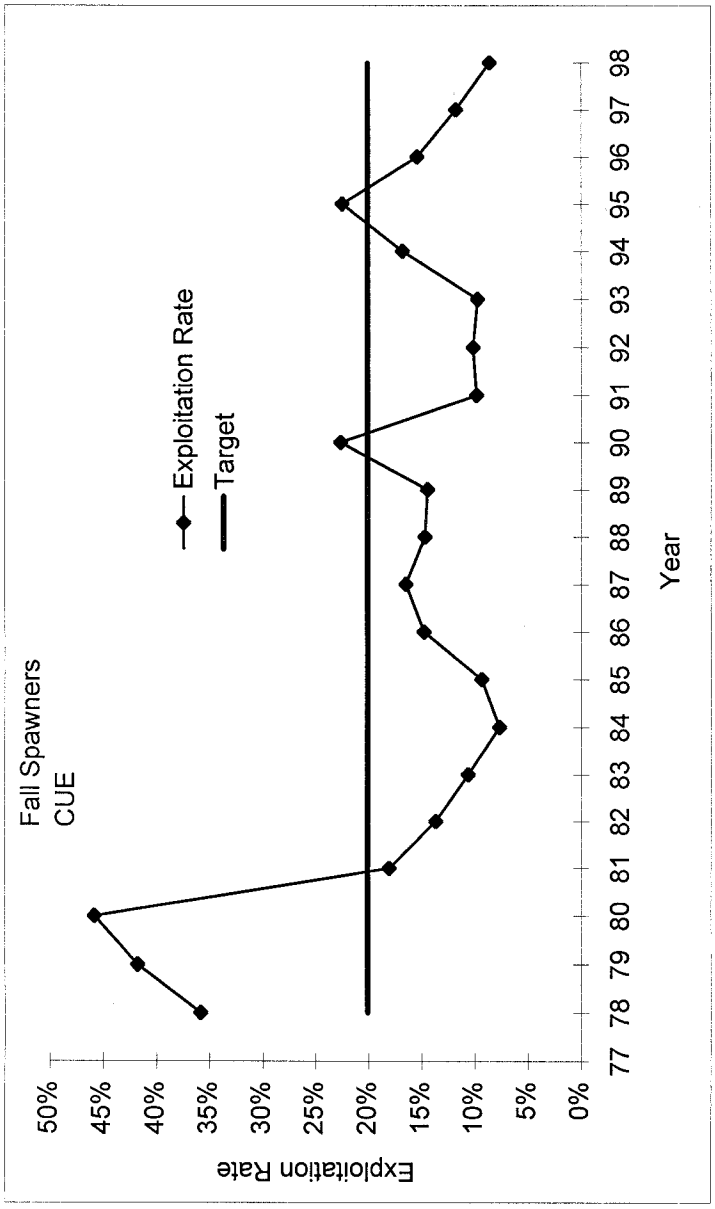
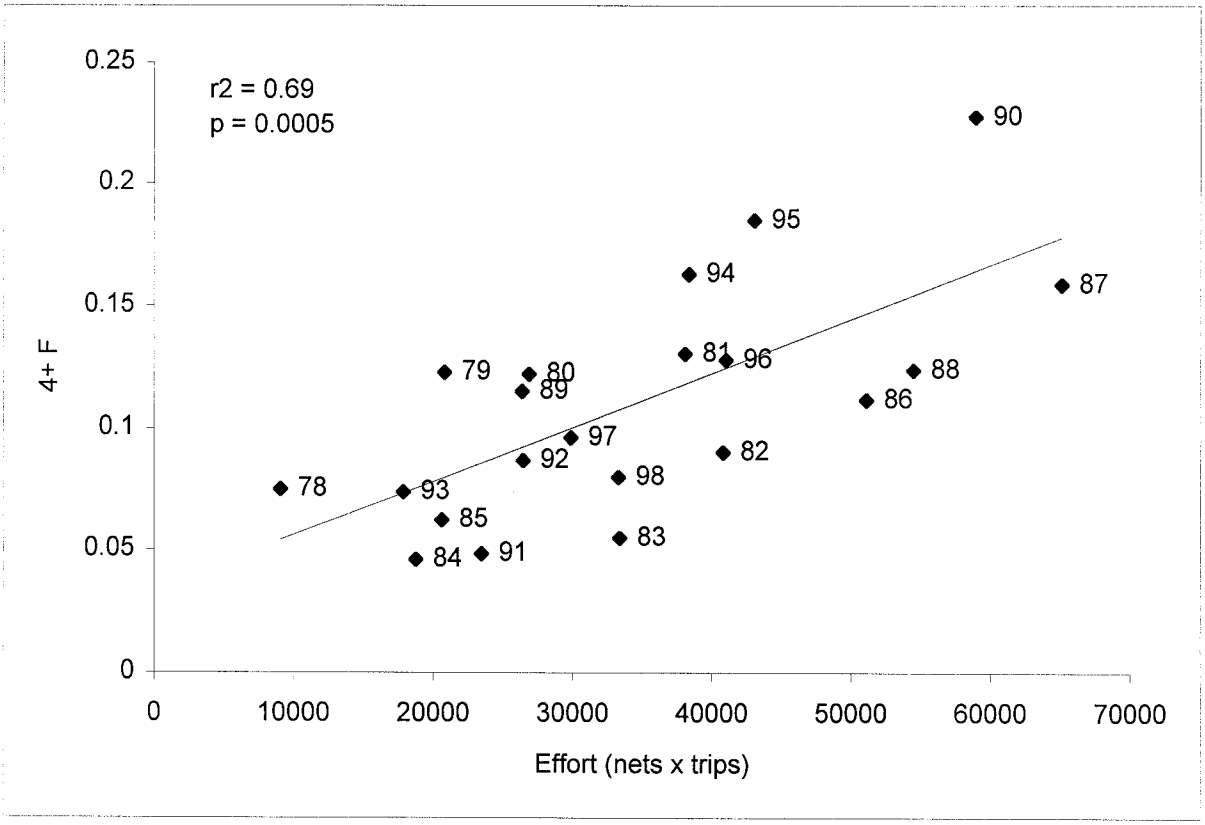


Fig. 59. Estimated fall spawner fishing mortality using ADAPT-VPA FRATIO split CUE compared to 4+ target fishing mortality.



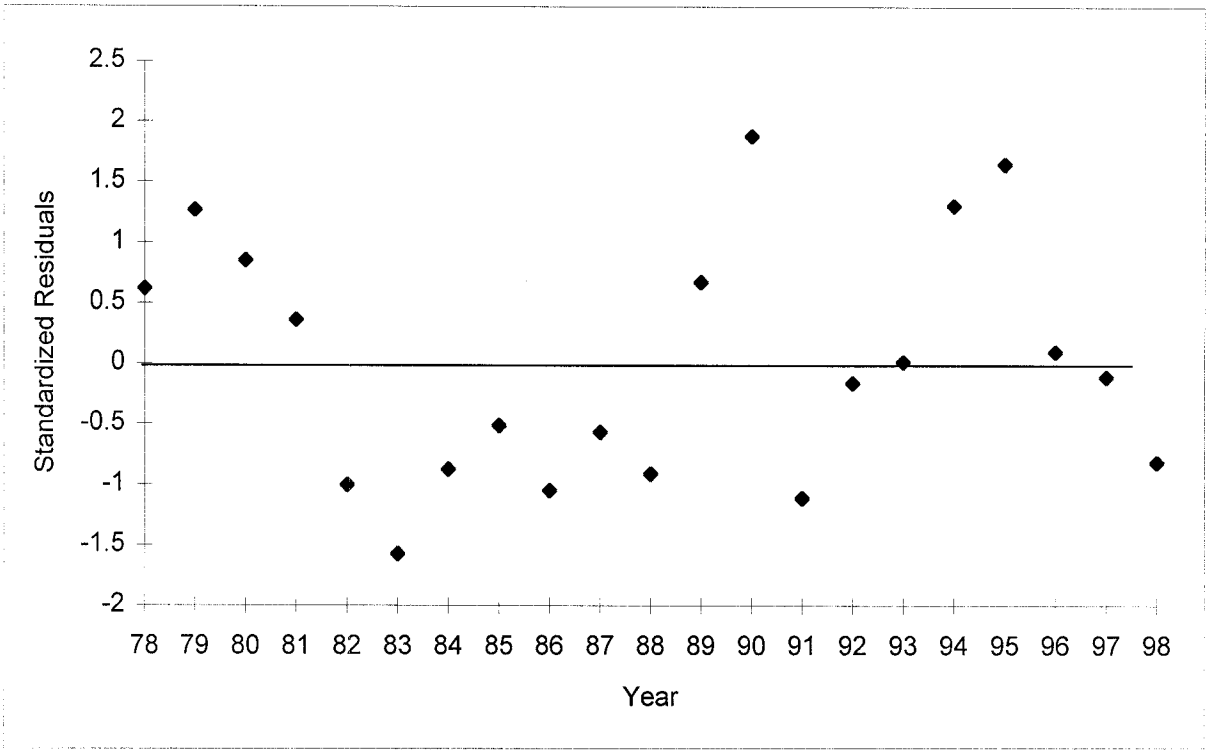


Fig. 60. Relationship between fishing mortality and effort for fall spawners estimated using ADAPT-VPA and split CUE.

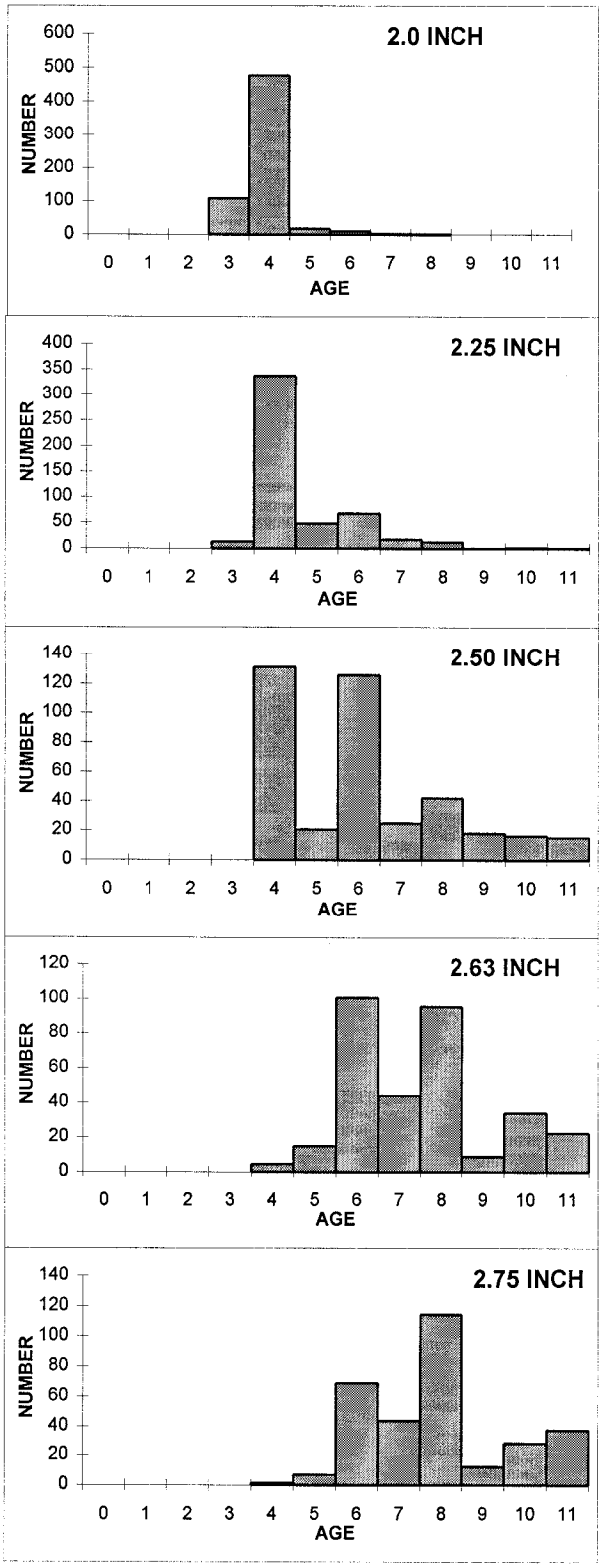


Fig. 61. Comparison of age structure in experimental nets for indicated mesh size fished in Pictou, N.S. in fall of 1998.

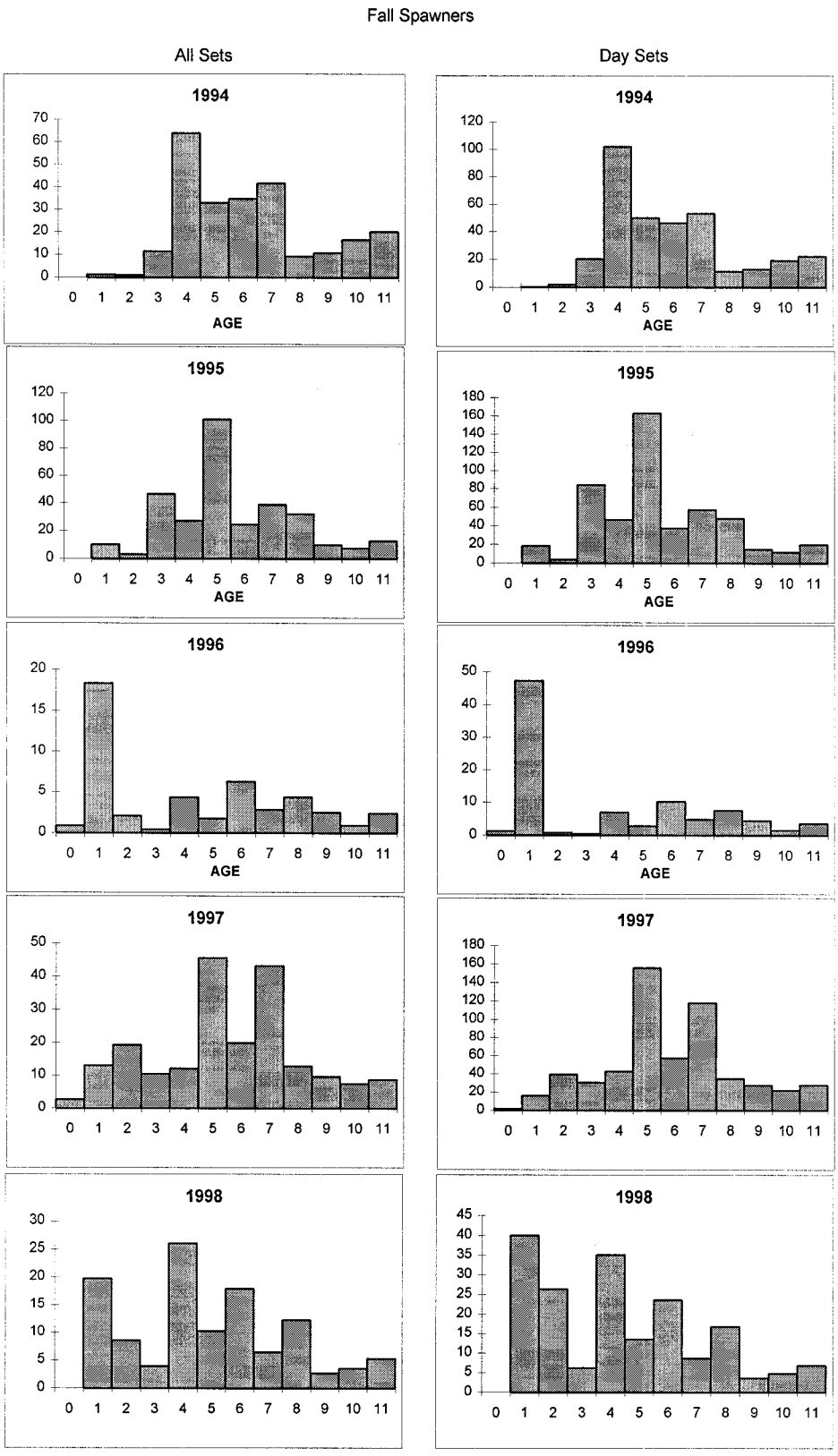


Fig. 62. Fall spawners numbers-at-age estimated from September bottom trawl survey.

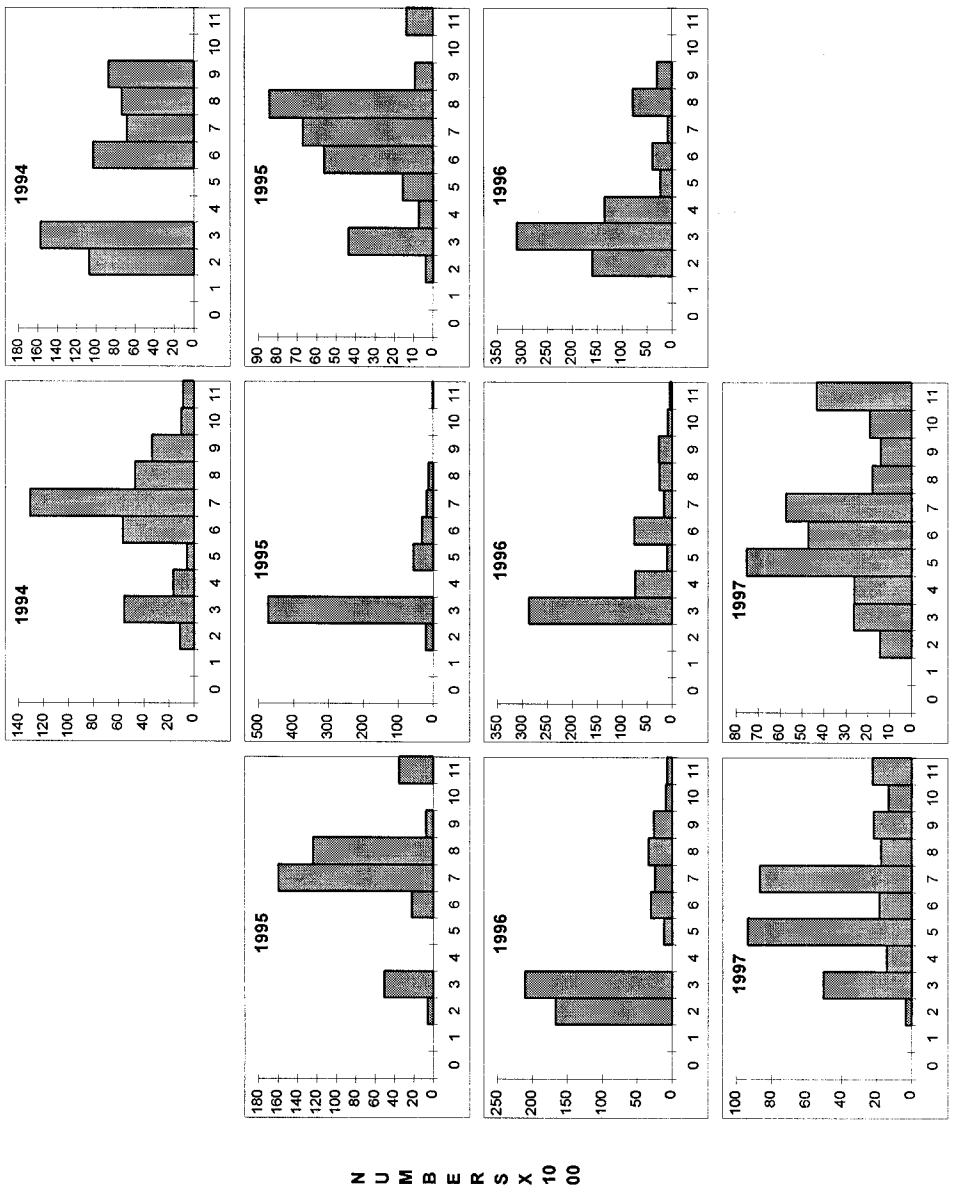


Fig. 63. Fall spawner numbers-at-age from January bottom trawl surveys in 4Vn.

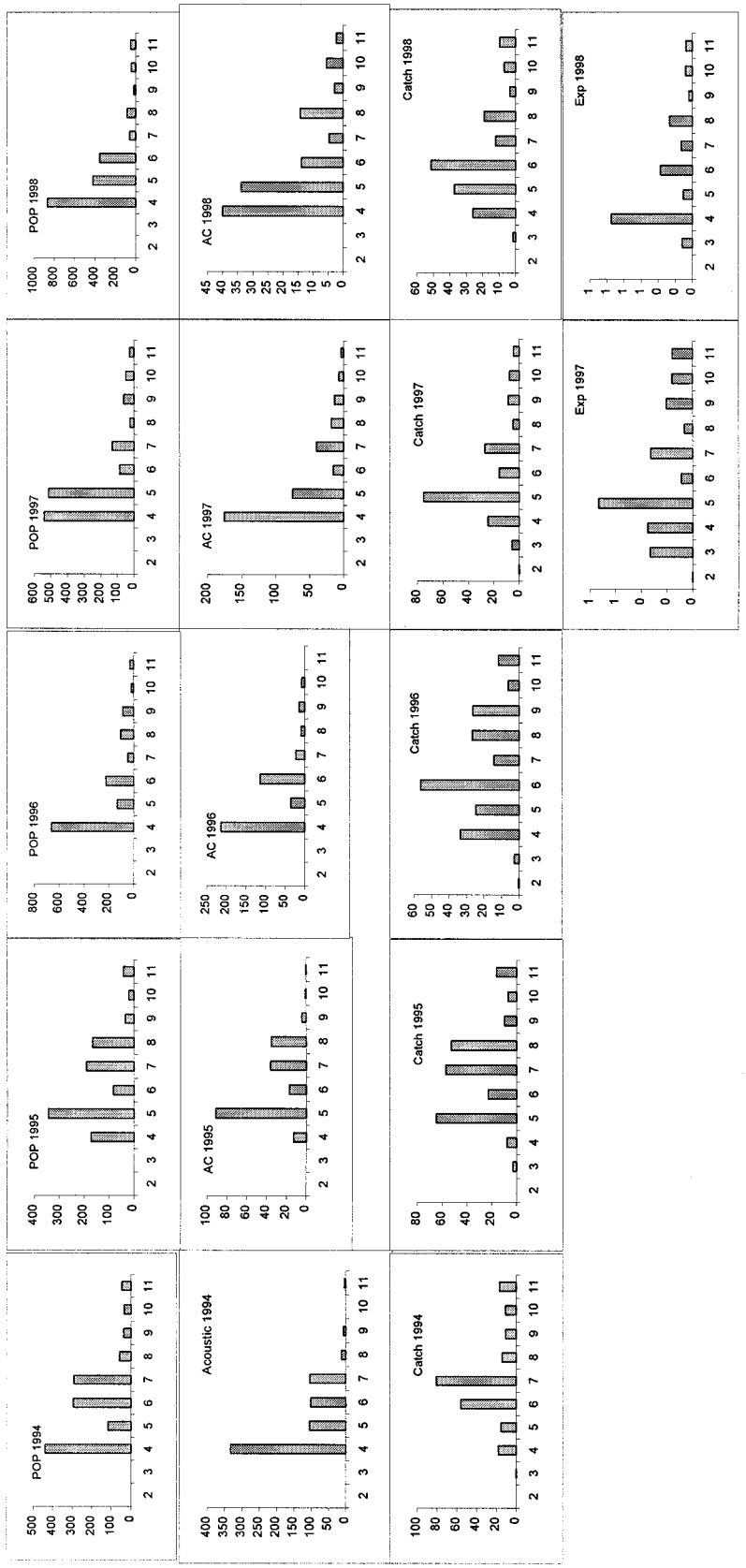


Fig. 64. Fall spawners numbers-at-age estimated from ADAPT-VPA. Acoustic survey, commercial catch, and Gulf Nova Scotia experimental nets.

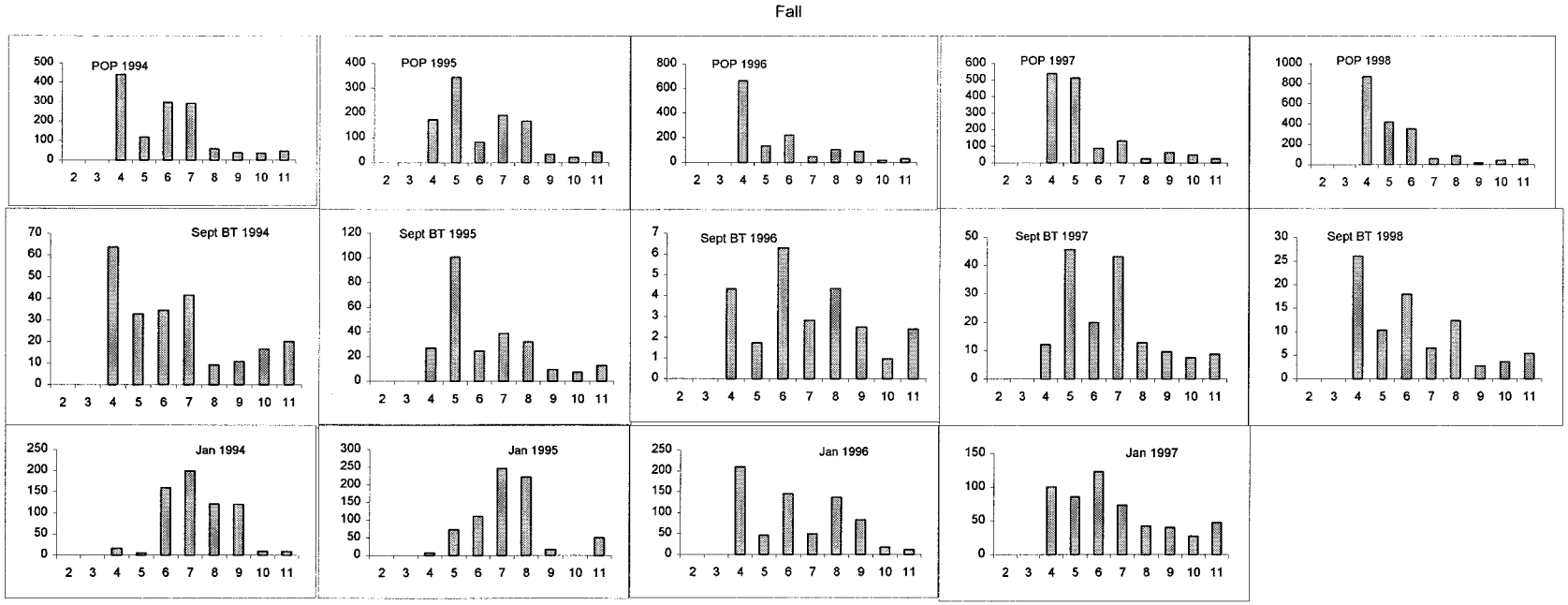
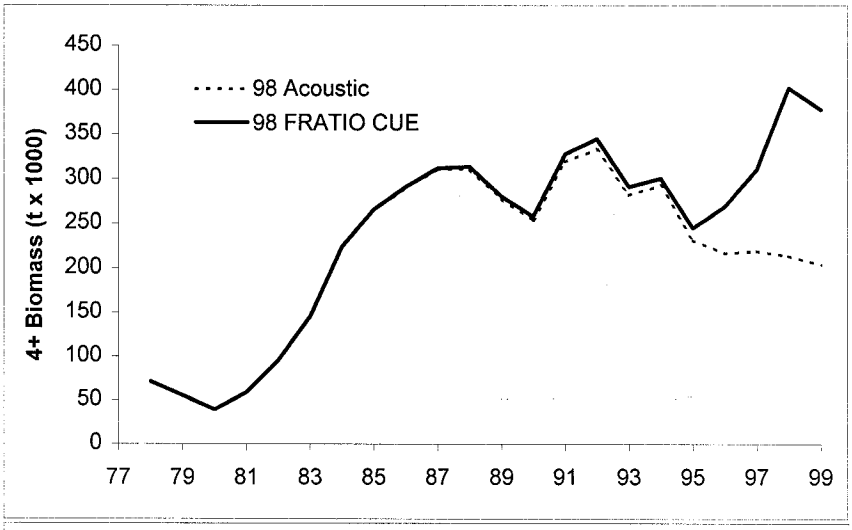
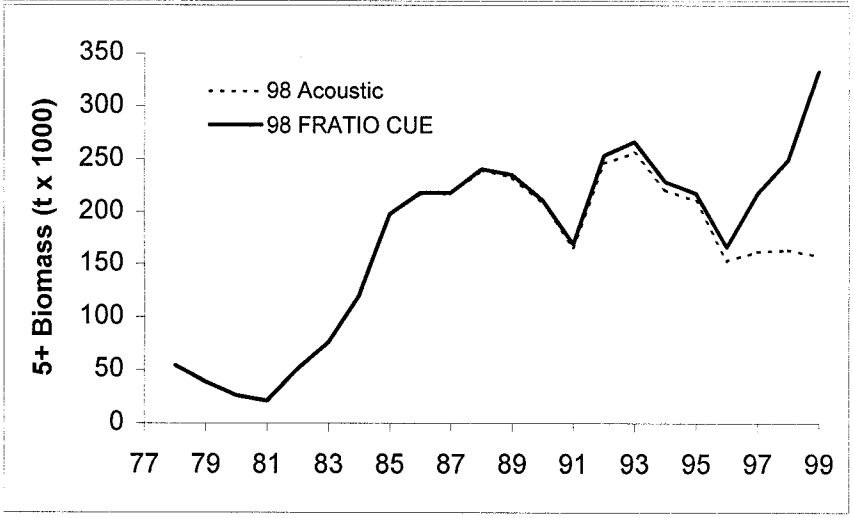


Fig. 65. Fall spawner numbers-at-age estimated from ADAPT-VPA, September, and January bottom trawl surveys.

Fall Spawners
Projection Comparisons





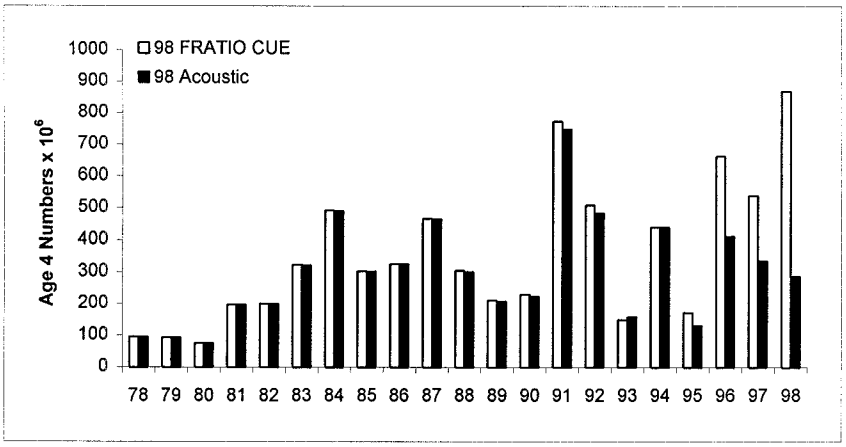
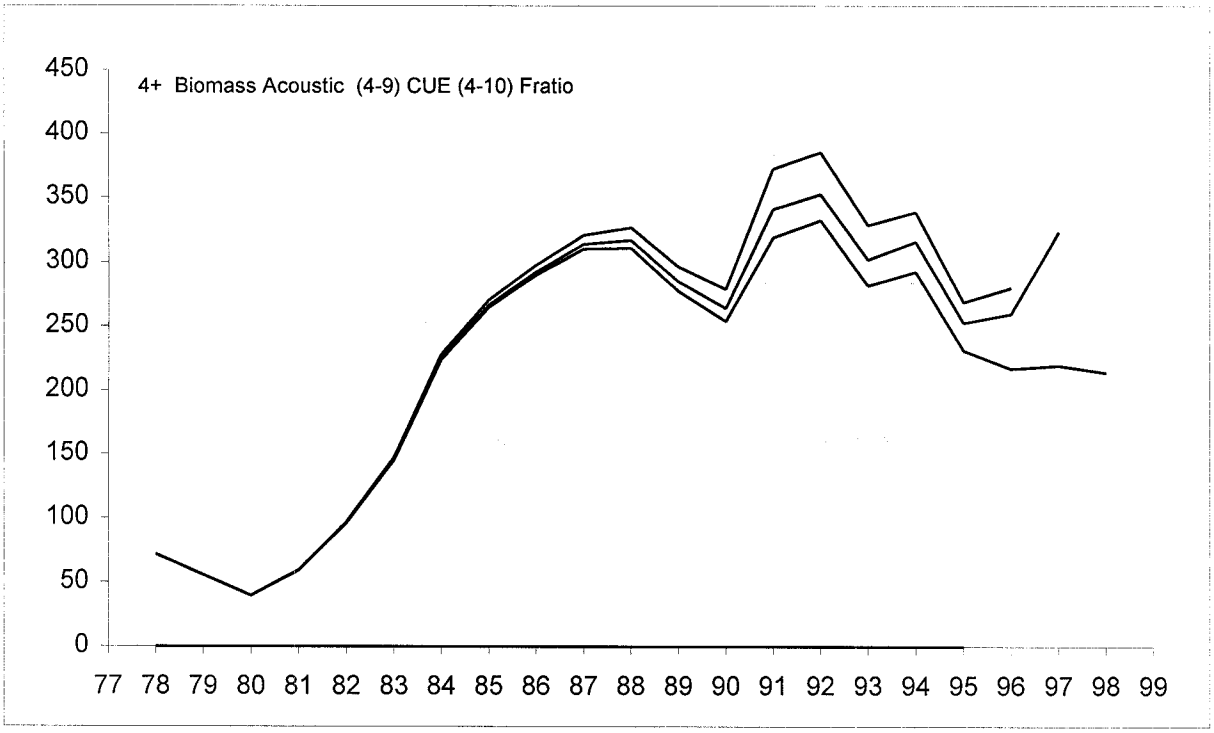


Fig. 66. Fall spawner biomass and age 4 numbers using ADAPT-VPA FRATIO model with split CUE and split CUE combined with acoustic index.

Fall Spawners - Acoustic 4-9, CUE 4-10 FRATIO



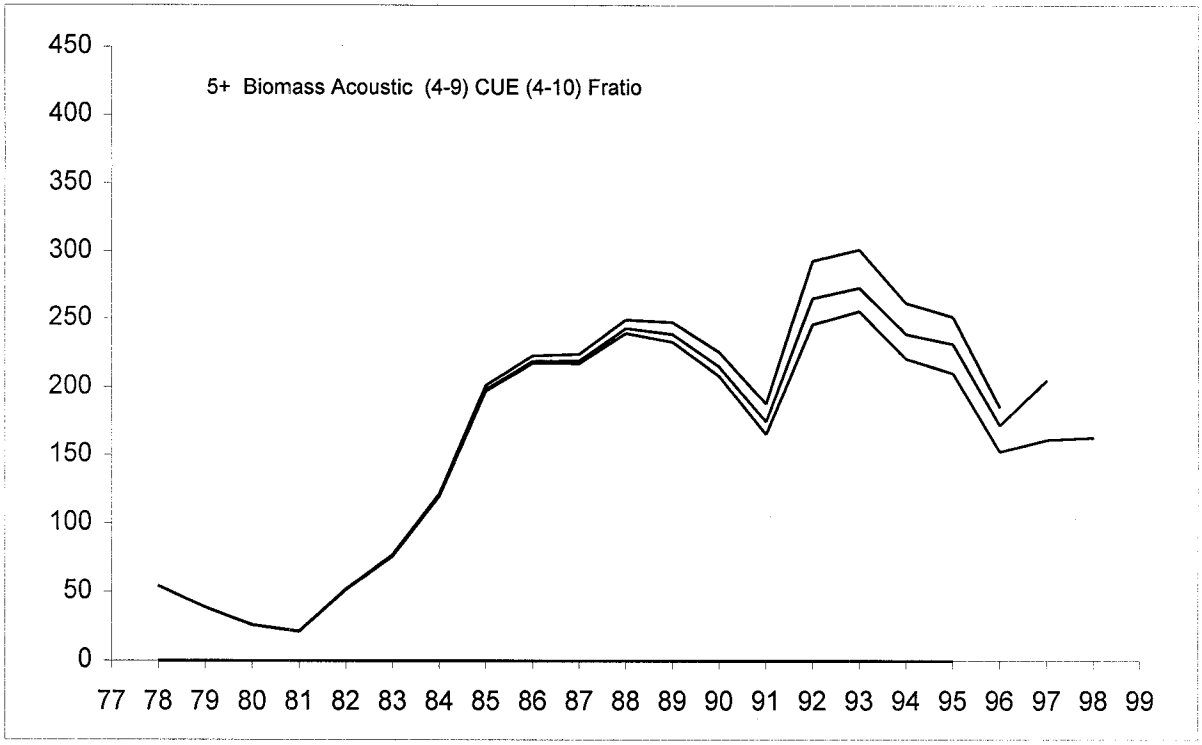


Fig. 67. Fall spawner retrospective analysis of ADAPT-VPA FRATIO model combining acoustic and split CUE indices.

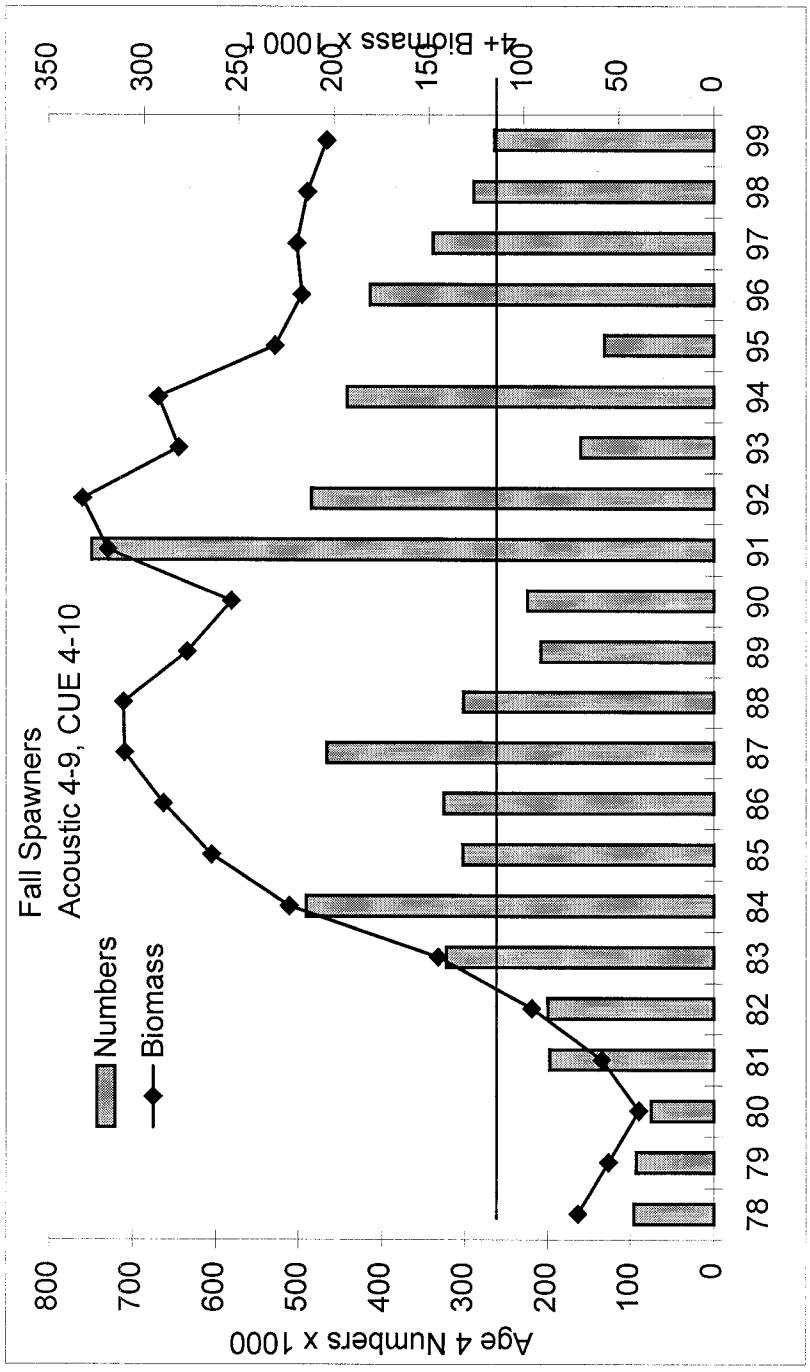


Fig. 69. Fall spawner age 4 numbers, 4+ biomass, and average numbers of age 4 (horizontal line) for ADAPT-VPA FRATIO model using acoustic index.

Appendix 1a. Herring biomass and density estimated from the acoustic survey in the southern Gulf of St. Lawernce. See Tables 37, 38 for areas included in estimates for each year. Night hours are defined as 1900 to 0700.

Year and Dates	Area	Number of Transects	Mean Density (kg/m^2)	Estimated Biomass (t/area)	CV	Proportion surveyed at night
1998	CHALEUR-MISCOU	151	0.0346	146831	0.15	1
Sept. 19 to	PEI	0	--	--	--	--
10-Oct	CAPE BRETON INSHORE	52	0.0305	43933	0.17	1
	1998 TOTAL	203	0.0335	190764	0.12	1
1997	CHALEUR-MISCOU	156	0.0285	193656	0.27	1
Sept. 21 to	PEI-MAGDELEN ISLANDS	64	0.0109	70373	0.09	1
11-Oct	CAPE BRETON INSHORE	42	0.0158	17463	0.38	1
	1997 TOTAL	262	0.0196	281492	0.19	1
1996	CHALEUR-MISCOU INSHORE	142	0.0494	241992	0.16	1
Sept 24-	CHALEUR-MISCOU OFFSHORE	36	0.0052	15090	0.28	1
16-Oct	PEI-PICTOU-GEORGES	55	0.0128	62846	0.19	1
	CAPE BRETON INSHORE	28	0.0260	21869	0.19	1
	1996 TOTAL	261	0.0252	341797	0.12	1
1995	CHALEUR-MISCOU INSHORE	98	0.0181	62229	0.22	1
Sept 23-	CHALEUR-MISCOU OFFSHORE	18	0.0058	9156	0.2	1
8-Oct	MILNE - GEORGES	21	0.0083	10564	--	1
	CAPE BRETON INSHORE	35	0.0066	7295	0.5	1
	1995 TOTAL	172	0.0121	89244	0.16	1
@ 1994	CHALEUR-MISCOU INSHORE	106	0.0415	162585	0.11	1
Oct 16-28	CHALEUR-MISCOU OFFSHORE	27	0.0063	16838	0.34	1
	CAPE BRETON INSHORE	0	--	--	--	--
	1994 TOTAL	133	0.0272	179423	0.1	1
1993	CHALEUR-MISCOU INSHORE	163	0.0202	114052	0.35	0.93
Oct 2-20	CHALEUR-MISCOU OFFSHORE	45	0.001	4284	0.41	0
	CAPE BRETON INSHORE	91	0.0039	7945	0.23	0.68
	CAPE BRETON OFFSHORE	39	0.0019	4567	0.41	0.09
	1993 TOTAL	338	--	130848	0.31	0.85
1992	CHALEUR-MISCOU INSHORE	216	0.0207	48258	0.1	0.65
Oct 1-22	CHALEUR-MISCOU OFFSHORE	102	0.0078	96582	0.52	0.75
	CAPE BRETON INSHORE	78	0.0227	44762	0.25	0.85
	CAPE BRETON OFFSHORE	22	0.0008	83	0.69	0
	1992 TOTAL	418	--	189685	0.29	0.75
1991	CHALEUR-MISCOU INSHORE	158	0.0054	16724	0.46	0.87
Oct 10-24	CHALEUR-MISCOU OFFSHORE	50	0.0015	23214	0.55	0.65
	CAPE BRETON INSHORE	49	0.0026	4418	0.32	0.98
	1991 TOTAL	257	--	44356	0.33	0.75

Appendix 1b. Acoustic survey stratum and area herring biomass densities and estimates.

Area and Stratum	Average TS (dB/kg)	Stratum Area (km^2)	Weighted Mean Sa (dB/m^2)	Biomass Density (kg/m^2)	Biomass index per Stratum Total (tons)	SE (tons)	SE % of Total
CHALEUR-MISCOU							
PTE_SECHE	-35.4	65.9	-45.0	0.1107	7298	4881	67
RIV_RENARD	-35.4	124.6	-42.2	0.2108	26275	16717	64
CAP_BON_AMI	-35.4	54.9	-53.5	0.0157	859	622	72
GASPE_OFF	-35.4	75.0	-61.0	0.0028	208	106	51
LA_MALBAIE	-35.8	95.6	-65.1	0.0012	113	71	63
ANSE_BEAUFILS	-35.8	96.0	-54.5	0.0136	1307	1099	84
GDE_RIVIERE	-35.8	86.9	-45.4	0.1097	9533	2165	23
NEWPORT	-34.6	187.0	-62.2	0.0018	329	287	87
SHIGAWAKE	-34.7	323.3	-46.1	0.0735	23749	6397	27
NEW_CARLISLE	-34.3	167.0	-54.4	0.0098	1629	632	39
NEW_RICHMOND	-32.4	253.6	-50.2	0.0164	4152	1555	37
BELLEDUNE	-32.4	348.0	-53.7	0.0074	2579	751	29
NEPISIGUIT	-35.3	278.0	-49.4	0.0388	10780	4190	39
MAISONNETTE	-35.4	137.5	-50.2	0.0332	4564	599	13
WEST_MISCOU	-35	177.0	-45.2	0.0959	16966	3034	18
NORTH_MISCOU	-34.7	208.9	-47.7	0.0501	10456	5690	54
MISCOU_NW	-34.7	524.0	-51.1	0.0228	11960	4004	33
MISCOU_NE	-34.7	262.0	-50.8	0.0245	6413	3723	58
MISCOU_SE	-34.7	262.0	-51.1	0.0229	5993	3415	57
MISCOU_SW	-34.7	524.0	-59.6	0.0032	1668	802	48
TOTAL		**4251.3**			**146831**		
MEAN				**0.0346**		**21346**	
					C.V.	**0.15**	
CAPE BRETON							
MARGAREE	-35.3	164.0	-55.2	0.0104	1699	808	48
WHITE_CAPES	-35.3	107.0	-47.7	0.0577	6173	1503	24
PLEASANT_BAY	-35.3	140.7	-47.4	0.0620	8717	6011	69
BAY_ST.LAWRENCE	-35.3	63.5	-46.4	0.0771	4893	2148	44
ASPY_BAY	-35.3	168.3	-49.3	0.0392	6600	1683	26
NEILS_HARBOUR	-35.3	171.3	-48.8	0.0442	7575	2168	29
WRECK_COVE	-35.3	59.9	-50.4	0.0304	1818	690	38
ST_ANNS_BAY	-34.6	159.0	-62.4	0.0016	260	216	83
HADDOCK_BANK	-34.6	94.9	-48.3	0.0425	4034	1427	35
SYDNEY	-34.6	168.6	-54.2	0.0109	1838	1160	63
NEW_WATERFORD	-34.6	141.3	-60.9	0.0023	326	144	44
TOTAL		**1438.5**			**43933**		
MEAN				**0.0305**		**7424**	
					C.V.	**0.17**	

Appendix 1c. Acoustic survey Chaleur-Misccou transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
PTE_SECHE	6	1.31	-35.4	-69.35	0.0004	
19-Sep	7	3.36	-35.4	-42.13	0.2125	
	8	3.08	-35.4	-86.67	0.0000	
	9	2.54	-35.4	-48.39	0.0502	
	10	1.73	-35.4	-1009.36	0.0000	
	11	1.45	-35.4	-38.88	0.4485	
RIV_RENARD	12	2.71	-35.4	-94.83	0.0000	
19-Sep	13	2.19	-35.4	-1010.39	0.0000	
	14	2.49	-35.4	-54.35	0.0127	
	15	2.59	-35.4	-34.88	1.1269	
	16	3.34	-35.4	-40.25	0.3277	
	18	3.58	-35.4	-44.07	0.1360	
	19	4.07	-35.4	-43.30	0.1622	
	21	5.34	-35.4	-47.21	0.0659	
CAP_BON_AMI	22	2.79	-35.4	-48.40	0.0501	
20-Sep	24	5.60	-35.4	-58.82	0.0046	
	25	3.80	-35.4	-52.10	0.0214	
	26	3.56	-35.4	-1012.50	0.0000	
GASPE_OFF	27	5.52	-35.4	-63.25	0.0016	
20-Sep	28	6.98	-35.4	-62.64	0.0019	
	29	8.70	-35.4	-1016.38	0.0000	
	31	9.54	-35.4	-57.21	0.0066	
LA_MALBAIE	32	3.52	-35.81	-61.27	0.0028	
20-Sep	34	10.42	-35.81	-62.29	0.0022	
	35	8.50	-35.81	-1016.29	0.0000	
	36	5.93	-35.81	-1014.72	0.0000	
ANSE_BEAUFILS	37	2.56	-35.81	-1011.06	0.0000	
20-Sep	38	7.46	-35.81	-1015.72	0.0000	
	40	5.92	-35.81	-49.09	0.0471	
	41	6.63	-35.81	-59.47	0.0043	
GRANDE_RIVIERE	42	5.06	-35.81	-47.32	0.0707	
21-Sep	43	5.54	-35.81	-47.65	0.0655	
	44	5.43	-35.81	-46.59	0.0835	
	45	4.88	-35.81	-41.69	0.2581	48
	46	4.42	-35.81	-48.58	0.0529	
	47	3.63	-35.81	-43.42	0.1736	
	48	3.64	-35.81	-45.05	0.1192	12
	49	4.43	-35.81	-47.08	0.0747	13
NEWPORT	50	7.49	-34.61	-54.87	0.0094	
21-Sep	51	9.15	-34.61	-1016.61	0.0000	
	52	8.44	-34.61	-63.74	0.0012	
	53	7.89	-34.61	-1015.96	0.0000	
	54	7.61	-34.61	-73.38	0.0001	
	55	5.90	-34.61	-1014.70	0.0000	
SHIGAWAKE	56	7.93	-34.72	-1015.98	0.0000	8
22-Sep	57	8.50	-34.72	-64.88	0.0010	9
	58	8.88	-34.72	-49.35	0.0345	11
	59	9.95	-34.72	-47.63	0.0512	14
SHIGAWAKE	60	7.57	-34.72	-43.70	0.1266	15
22-Sep	61	7.18	-34.72	-44.79	0.0985	18
	62	7.69	-34.72	-42.47	0.1678	19
	63	6.89	-34.72	-48.88	0.0384	20
	64	6.87	-34.72	-44.90	0.0961	25
	65	4.95	-34.72	-39.57	0.3278	21
	66	6.20	-34.72	-47.65	0.0510	22
	67	4.46	-34.72	-48.49	0.0420	24
	68	5.95	-34.72	-47.46	0.0532	46
	69	6.80	-34.72	-47.07	0.0583	47
	70	6.78	-34.72	-46.39	0.0681	49
	71	6.25	-34.72	-48.14	0.0455	

Appendix 1c (cont.)

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
NEW_CARLISLE	72	8.87	-34.3	-84.33	0.0000	
23-Sep	73	6.31	-34.3	-52.85	0.0140	10
	75	5.83	-34.3	-55.34	0.0079	16
	76	5.88	-34.3	-61.10	0.0021	
	77	5.30	-34.3	-50.72	0.0228	17
	78	4.81	-34.3	-51.43	0.0194	23
NEW_RICHMOND	79	5.99	-32.37	-52.36	0.0100	
23-Sep	80	5.96	-32.37	-49.71	0.0184	
	81	6.35	-32.37	-49.27	0.0204	
	82	5.41	-32.37	-45.64	0.0471	26
	83	8.94	-32.37	-53.37	0.0079	
	84	10.09	-32.37	-53.70	0.0074	
BELLEDUNE	85	1.48	-32.37	-54.14	0.0067	
24-Sep	86	6.30	-32.37	-54.62	0.0060	
	87	4.37	-32.37	-55.74	0.0046	
	88	4.18	-32.37	-54.06	0.0068	
	89	4.91	-32.37	-48.26	0.0257	28
	90	6.10	-32.37	-55.38	0.0050	
	91	6.62	-32.37	-60.93	0.0014	
	92	6.65	-32.37	-57.39	0.0031	
	94	8.51	-32.37	-54.63	0.0059	
	95	9.65	-32.37	-52.11	0.0106	27
NEPISIGUIT	97	7.92	-35.3	-1015.98	0.0000	
25-Sep	98	8.55	-35.3	-69.45	0.0004	
	99	8.68	-35.3	-53.26	0.0160	
	100	8.59	-35.3	-53.61	0.0148	
	102	11.00	-35.3	-51.68	0.0230	29
	103	11.19	-35.3	-52.25	0.0202	
	105	10.09	-35.3	-48.68	0.0460	30
	107	8.44	-35.3	-56.60	0.0074	
	108	6.83	-35.3	-46.01	0.0851	31
	109	6.68	-35.3	-42.34	0.1980	34
	110	6.42	-35.3	-46.03	0.0846	35
	111	6.42	-35.3	-48.58	0.0470	36
	112	6.18	-35.3	-52.25	0.0202	
MAISONNETTE	113	4.36	-35.38	-49.14	0.0422	32
26-Sep	114	4.87	-35.38	-50.88	0.0282	
	115	4.25	-35.38	-52.14	0.0211	33
	116	3.93	-35.38	-54.85	0.0113	
	117	4.62	-35.38	-54.69	0.0117	
	118	4.56	-35.38	-52.25	0.0206	38
	119	5.44	-35.38	-57.11	0.0067	
	120	5.56	-35.38	-49.34	0.0403	37
	121	5.72	-35.38	-51.40	0.0250	
	122	5.64	-35.38	-50.02	0.0344	1
	124	5.07	-35.38	-49.43	0.0394	
	125	5.85	-35.38	-54.17	0.0132	
	126	6.26	-35.38	-51.14	0.0266	2
	127	7.79	-35.38	-46.91	0.0703	39
	129	8.34	-35.38	-49.43	0.0394	40
	130	8.54	-35.38	-47.77	0.0578	41
WEST_MISCOU	131	7.25	-35.04	-46.65	0.0689	
26-Sep	133	3.84	-35.04	-42.85	0.1654	42
	135	6.51	-35.04	-44.28	0.1190	43
	137	8.75	-35.04	-48.49	0.0452	
	139	3.92	-35.04	-48.02	0.0503	
	140	5.13	-35.04	-46.46	0.0720	
	141	5.82	-35.04	-44.52	0.1127	44
	142	5.20	-35.04	-42.16	0.1939	45
	143	6.27	-35.04	-45.90	0.0821	

Appendix 1c (cont.)

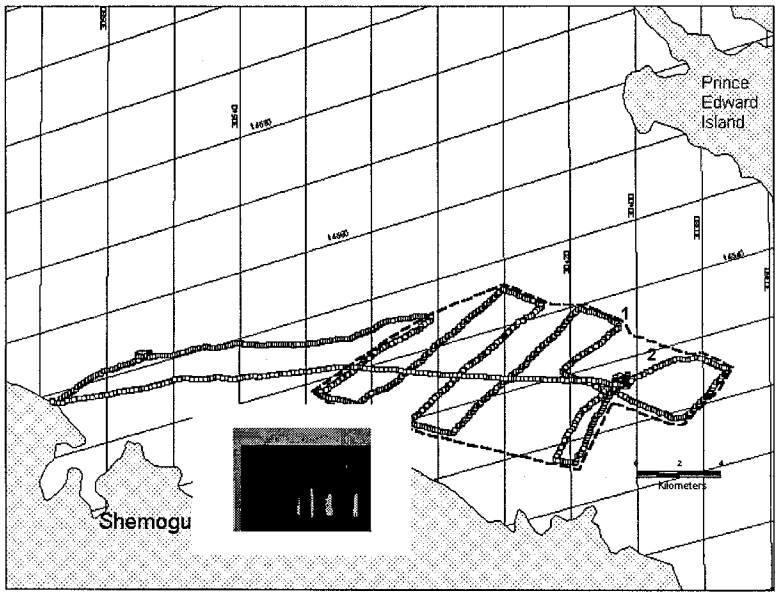
Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
NORTH_MISCOU	144	5.37	-34.65	-44.68	0.0995	
27-Sep	145	3.83	-34.65	-40.67	0.2502	50
	146	3.24	-34.65	-41.57	0.2034	51
	147	6.02	-34.65	-43.41	0.1332	52
	148	6.21	-34.65	-47.71	0.0495	
	149	7.37	-34.65	-67.09	0.0006	
	150	7.20	-34.65	-1015.56	0.0000	
	151	9.17	-34.65	-53.74	0.0123	
	152	9.11	-34.65	-53.52	0.0130	
	153	7.15	-34.65	-1015.53	0.0000	
	154	5.20	-34.65	-1014.15	0.0000	
MISCOU_NW	155	12.47	-34.65	-1017.95	0.0000	
28-Sep	158	12.93	-34.65	-1018.10	0.0000	
	160	12.58	-34.65	-50.42	0.0265	
	161	12.52	-34.65	-48.74	0.0391	
	163	13.01	-34.65	-49.40	0.0336	
	164	12.74	-34.65	-53.34	0.0135	
	167	12.72	-34.65	-55.09	0.0090	
	169	12.25	-34.65	-46.71	0.0623	
MISCOU_NE	156	6.84	-34.65	-1015.34	0.0000	
29-Sep	157	5.76	-34.65	-1014.59	0.0000	
	165	6.17	-34.65	-47.14	0.0564	
	166	6.36	-34.65	-46.73	0.0620	
	170	6.27	-34.65	-58.46	0.0042	
MISCOU_SE	173	5.96	-34.65	-56.65	0.0063	
1-Oct	176	6.42	-34.65	-53.25	0.0138	
	178	6.09	-34.65	-47.79	0.0486	
MISCOU_SW	172	12.26	-34.65	-63.07	0.0014	
30-Sep	174	12.63	-34.65	-55.84	0.0076	
	175	12.60	-34.65	-60.14	0.0028	
	179	12.95	-34.65	-65.27	0.0009	

Aopendix 1d. Acoustic survey Cape Breton transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
MARGAREE	221	2.84	-35.31	-50.32	0.0315	53
7-Oct	222	5.32	-35.31	-59.09	0.0042	
	223	5.54	-35.31	-54.42	0.0123	
	224	6.82	-35.31	-57.22	0.0064	
	227	5.53	-35.31	-56.09	0.0083	
WHITE_CAPES	229	5.88	-35.31	-49.28	0.0401	
7-Oct	230	6.00	-35.31	-45.90	0.0874	
	231	4.84	-35.31	-45.74	0.0906	
	232	4.22	-35.31	-50.38	0.0311	
	234	3.83	-35.31	-51.15	0.0261	
PLEASANT_BAY	235	6.02	-35.31	-41.83	0.2230	54
8-Oct	237	5.93	-35.31	-48.58	0.0471	
	238	6.66	-35.31	-57.39	0.0062	
	239	5.13	-35.31	-62.25	0.0020	
	240	3.26	-35.31	-74.70	0.0001	
BAY_ST.LAWRENCE	242	4.85	-35.27	-44.98	0.1069	
8-Oct	243	7.14	-35.27	-49.44	0.0383	
	244	7.52	-35.27	-49.93	0.0342	
	245	4.52	-35.27	-42.78	0.1775	55
ASPY_BAY	248	2.59	-35.27	-47.16	0.0648	
8-Oct	249	7.93	-35.27	-51.03	0.0266	
	250	10.01	-35.27	-47.37	0.0617	
	251	10.12	-35.27	-47.01	0.0671	56
	252	10.30	-35.27	-49.43	0.0384	
	253	8.94	-35.27	-57.05	0.0066	
	254	5.37	-35.27	-56.88	0.0069	
NEILS_HARBOUR	255	5.41	-35.27	-62.62	0.0018	
9-Oct	257	6.01	-35.27	-46.98	0.0675	57
	258	6.05	-35.27	-52.27	0.0199	
	259	8.08	-35.27	-47.49	0.0599	
	260	11.28	-35.27	-47.96	0.0539	
WRECK_COVE	262	3.36	-35.27	-48.33	0.0494	
9-Oct	263	3.73	-35.27	-46.90	0.0686	
	264	4.47	-35.27	-50.19	0.0322	
	265	5.16	-35.27	-55.00	0.0106	
	266	5.14	-35.27	-56.11	0.0082	
ST_ANNS_BAY	267	8.88	-34.56	-57.20	0.0054	
9-Oct	268	6.48	-34.56	-1015.11	0.0000	
	269	6.83	-34.56	-1015.33	0.0000	
	270	7.33	-34.56	-1015.64	0.0000	
HADDOCK_BANK	271	12.68	-34.56	-55.39	0.0083	
9-Oct	272	10.03	-34.56	-45.63	0.0782	58
	273	8.16	-34.56	-49.02	0.0358	
	274	8.27	-34.56	-46.90	0.0584	
SYDNEY	276	7.82	-34.56	-50.75	0.0241	
10-Oct	277	9.34	-34.56	-50.84	0.0236	
	279	10.45	-34.56	-101.05	0.0000	
	280	9.85	-34.56	-1016.92	0.0000	
NEW_WATERFORD	282	7.34	-34.56	-1015.65	0.0000	
10-Oct	283	7.31	-34.56	-62.81	0.0015	
	284	7.71	-34.56	-59.64	0.0031	
	285	6.83	-34.56	-57.80	0.0047	

Appendix 1e. Acoustic survey Chaleur – Miscou same strata comparison of transect length surveyed, proportion with herring backscatter detected and resulting biomass estimates.

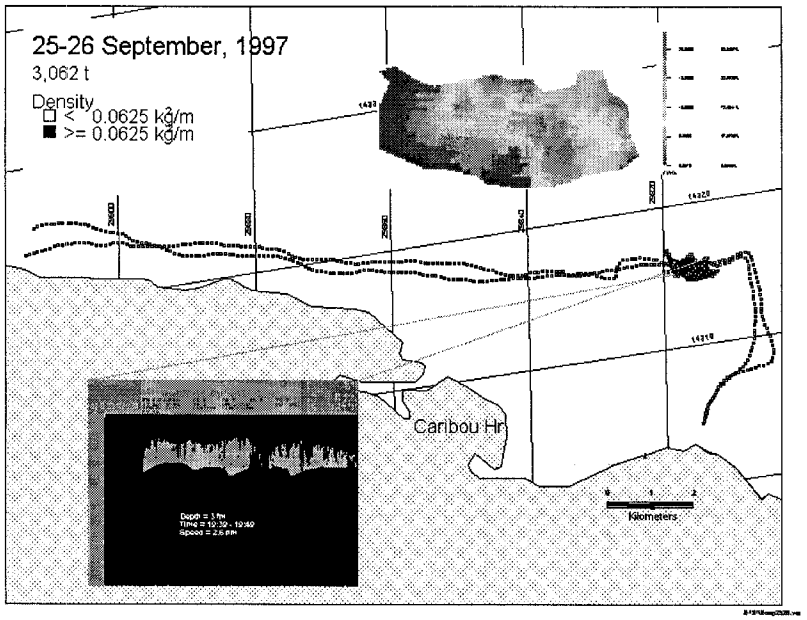
Stratum Name	Transect Length surveyed per stratum (km)				
	1998	1997	1996	1995	1994
Grande Riviere	37.0	58.2	74.8	64.5	61.4
Newport	46.5	51.8	79.2	72.5	85.6
Shigawake	112.9	120.0	128.9	123.0	100.2
New Carlilse	37.0	44.3	52.4	57.1	68.5
New Richmond	42.7	32.0	37.2	42.0	84.5
Belledune	58.8	37.3	35.4	40.1	53.4
Nepisiguit	107.0	58.8	82.7	79.4	66.3
Maisonnette	90.9	70.2	68.3	73.9	69.6
E Miscou NW	101.2	100.0	89.1	50.6	76.0
E Miscou NE	31.4	64.6	63.2	91.3	78.3
E Miscou SW	50.4	88.2	90.9	88.2	61.7
E Miscou SE	18.5	64.1	63.1	75.7	50.5
Total Distance Surveyed (km)	734.1	789.5	865.2	858.3	856.1
Distance with backscatter (km)	145.0	82.4	140.0	92.9	136.6
Total Biomass index (t)	83349	171830	163195	63676	159983
Percent of Total Distance Surveyed with bacscatter	19.8	10.4	16.2	10.8	16.0



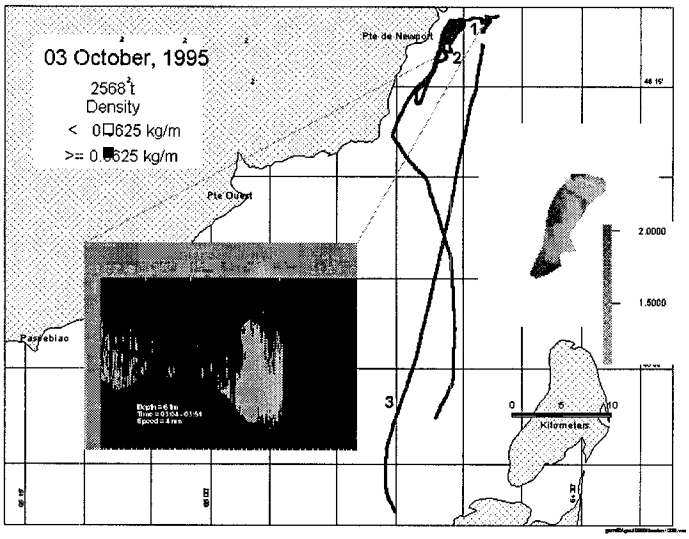
Appendix 2a. Example of survey map for southeast New Brunswick spring projects.

Appendix 2b. Biomass estimates from spring spawner surveys done by inshore fishing vessel in southeast New Brunswick, 1998.

Month	Day	Area (km2)	Number of Transects	Biomass Estimate	Standard Error
April	30	138	9	660	433
May	3	114	8	34	22
May	13	134	11	105	65
May	19	142	8	49	42
June	8	93	7	1127	712
June	12	52	5	342	254
June	18	43	5	62	50



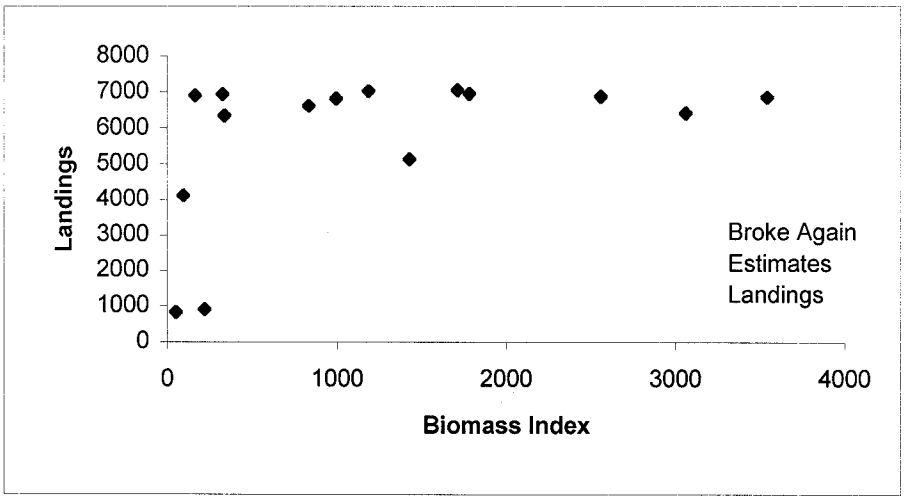
Appendix 3a. Map of typical data collected by boat with FEMTO – HDPS system recording data while fishing during southern Gulf of St. Lawrence Nova Scotia fall herring fishery.

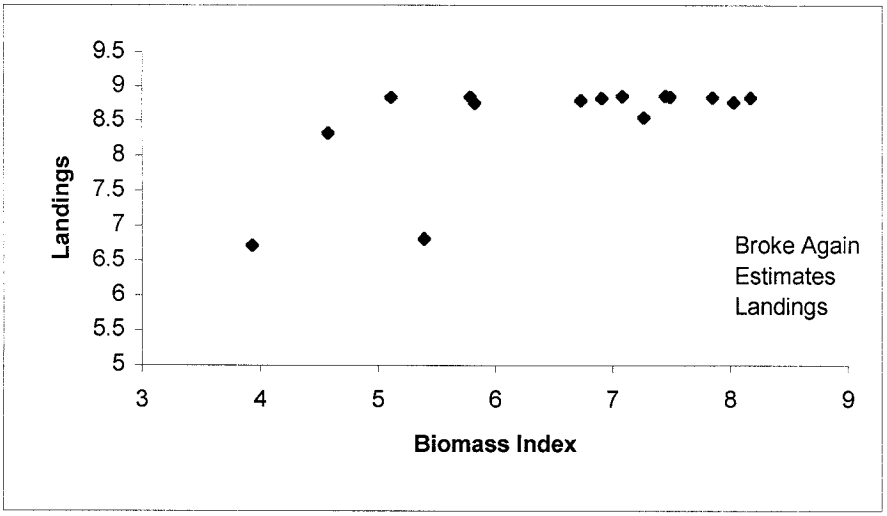


Appendix 3b. Map of typical data collected by herring purse seiner with FEMTO – HDPS system recording data while fishing during southern Gulf of St. Lawrence Chaleur Bay fall herring fishery.

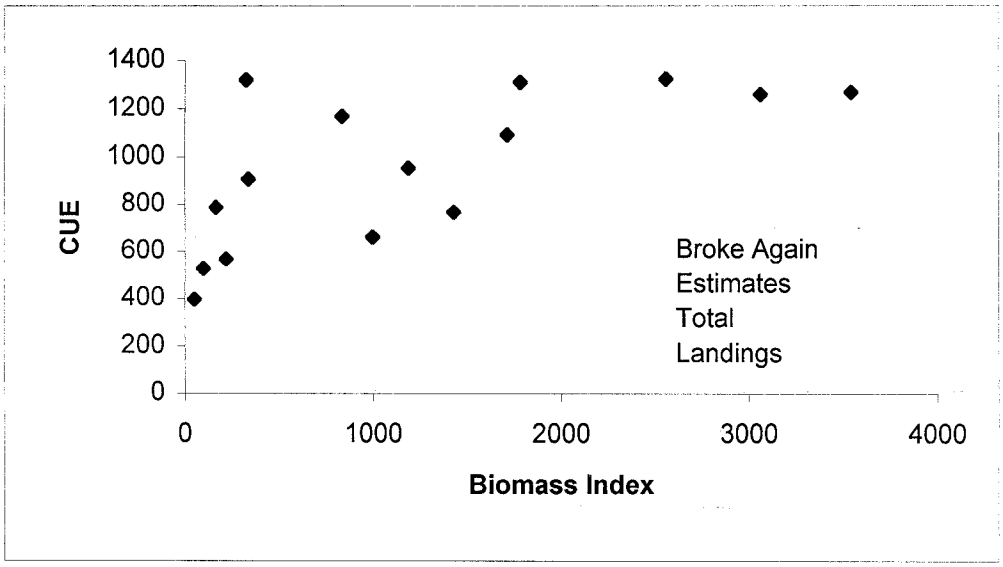
Appendix 3c. Estimates using arithmetic average of all points in school compared to estimates obtained using kriging (for all dates) and inverse distance weighting (IDW) and natural neighbor analysis (NN) (for two days). Data comes from a single inshore boat collecting data in the southern Gulf of St. Lawrence Nova Scotia fall herring fishery using a Femto HDPS system. An ne indicates no estimate for those days.

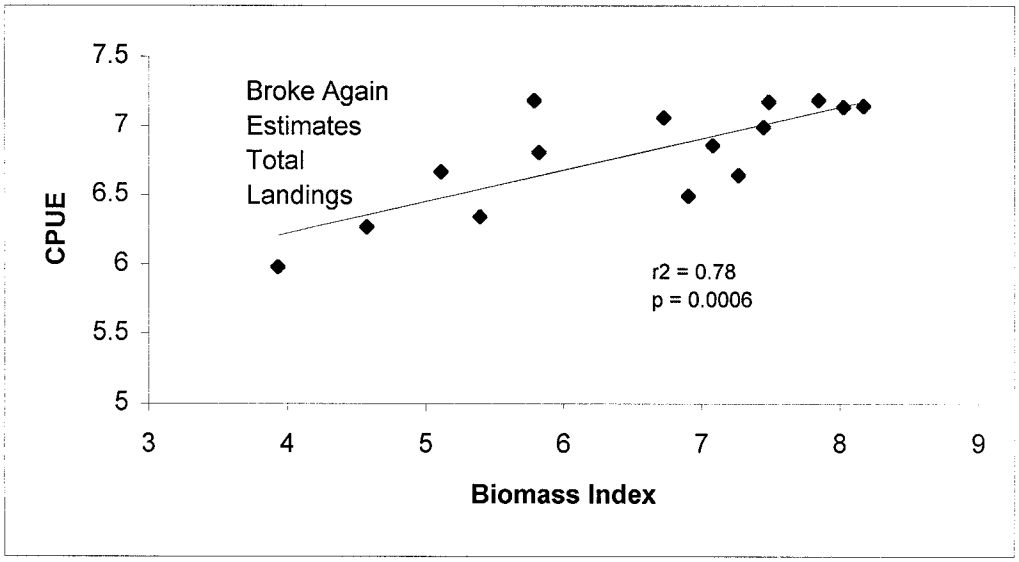
	Estimates				Landings	
Day	Arithmetic	Kriging	IDW	NN	Acoustic Boat	Total Fleet
7-Sep	2299	1429	1261	1421	5144	218943
8-Sep	79	51	47	45	827	100704
9-Sep	187	166			6904	159896
10-Sep	296	220			907	75170
11-Sep	404	338			6348	100566
14-Sep	ne	ne			4534	166843
16-Sep	ne	ne				197877
16-Sep	1070	996			6824	122290
17-Sep	1285	1187			7027	536711
19-Sep	92	97			4115	62958
22-Sep	345	834			6618	736133
23-Sep	1472	1713			7058	463635
25-Sep	3905	3543			6864	508077
25-Sep	3668	3062			6428	766805
28-Sep	1908	1782			6960	761208
29-Sep	452	326			6935	432364
30-Sep	2690	2560			6887	714589



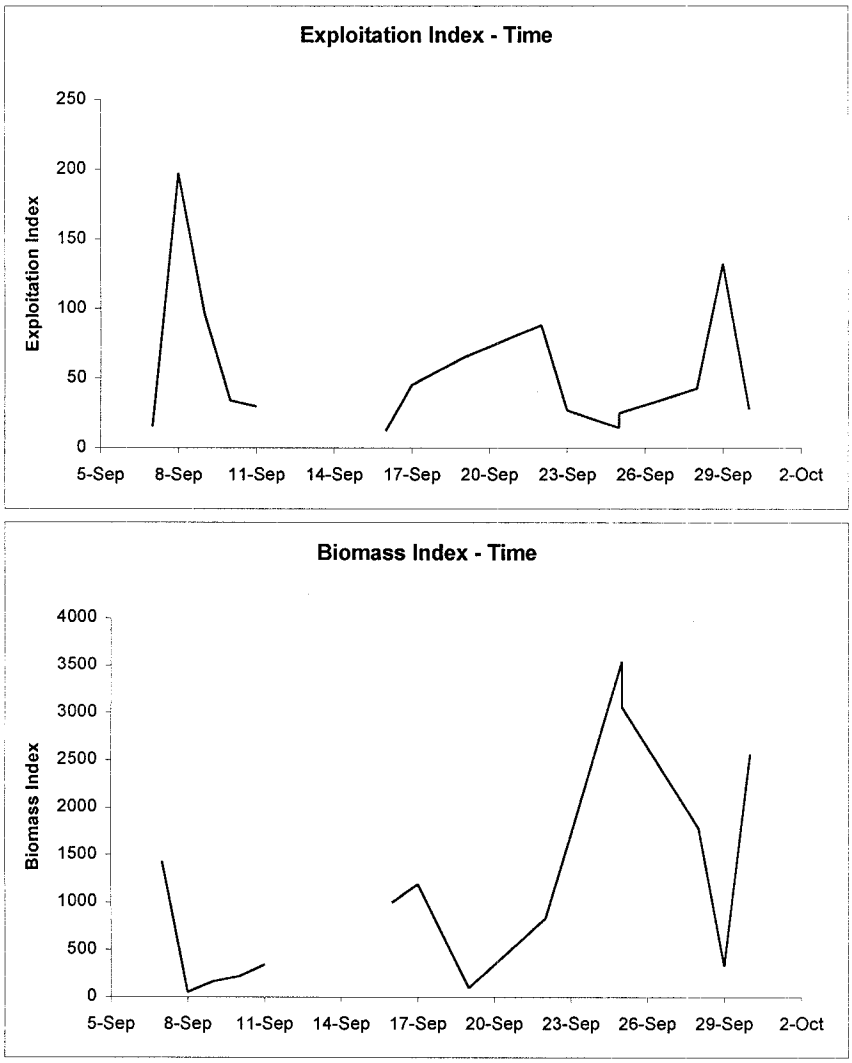


Appendix 3d. Scatterplots of landings by boat collecting acoustic data versus biomass index estimated by kriging for each day indicated in Appendix 3c. Top figure arithmetic scale, bottom figure ln scale. Broke Again is the inshore boat used to collect the data.

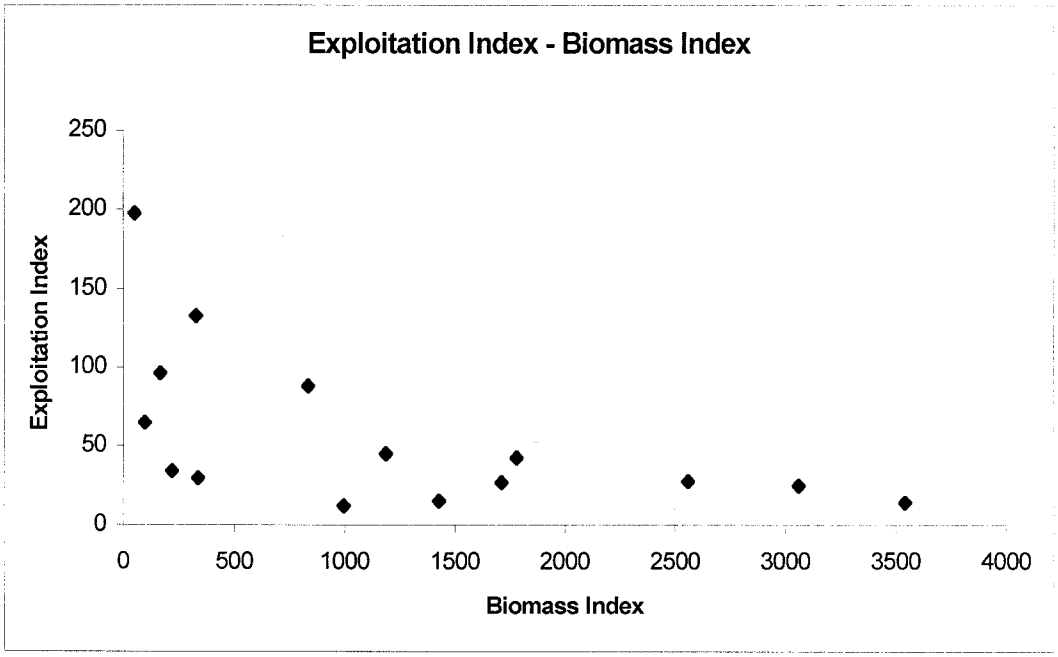


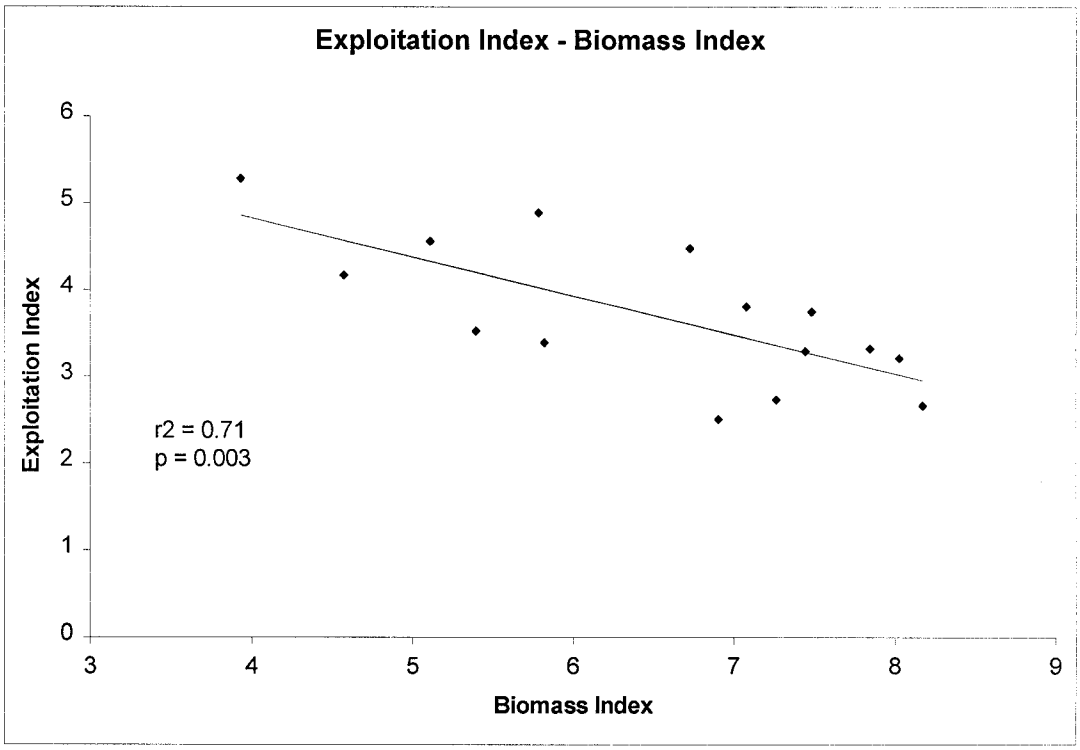


Appendix 3e. Relationship between catch rate (CPUE) from all boats participating in southern Gulf of St. Lawrence fall herring fishery and biomass indices estimated from inshore boat collecting acoustic data during the fishery. Top figure arithmetic scale, bottom figure ln scale. Broke Again is the inshore boat used to collect the data.



Appendix 3f. Exploitation rate index and biomass index trends over time in southern Gulf of St. Lawrence fall herring fishery. Exploitation rate index calculated as total landings by fleet divided by biomass index as estimated from boat recording acoustic data.





Appendix 3g. Scatterplots of exploitation index versus biomass index for southern Gulf of St. Lawrence fall herring fishery.