

## YEARLY SIZE AND AGE DISTRIBUTION OF ATLANTIC ALBACORE CAUGHT BY TAIWANESE LONGLINE FLEET

Lee, L.K.<sup>1</sup>, S.Y. Yeh<sup>1</sup>

### INTRODUCTION

Catch-at-age data are one of the essential information needed in the analyses of age-structured stock assessment models, which may provide more subtle managerial advises in fisheries management. Catch-at-age data can be derived from catch-at-size data by using age-length relation, age-length key, or other length-age conversion algorithm. Recently, a critical review meeting on data collecting and processing system adopted and revised statistics for Taiwanese Longline fleet has been held in Taipei in July, 1997. It is a necessity, therefore, to re-examine the catch-at-size data of Atlantic albacore collected by Taiwanese longline fishery based on the new information obtained in that meeting.

### MATERIAL AND METHODS

Albacore size measurements submitted by Taiwanese fishing vessels operating in the Atlantic Ocean, dating from 1981 to 1995, are the major source of data used in this study for obtaining albacore size distribution in a particular area-time stratum. These size measurements data were kindly provided by Overseas Fisheries Cooperation Council of the Republic of China. These size distribution were firstly convert to weight by length/weight equation. The length/weight equations adopted in this study were: Santiago (1992) equation for the northern stock and Penney (1993) equation for the southern stock. The summarized total weight from size frequency will firstly justified by Task II catch in number then raised to its corresponding Task I catch in weight. Secondly, a knife-edge technique was adopted to convert catch-at-size data into catch-at-age data. In so doing, separate Bertalanffy growth equation was applied for each albacore stock in this study. In north Atlantic stock, the equation provided by Gonzalez and Perez (1983) was applied, i.e.,  $L_t = 140.1(1 - e^{-0.13(t-1.57)})$ . In southern Atlantic stock, we used the equation provided by Lee and Yeh (1993). The equation is  $L_t = 142.28(1 - e^{-0.15(t-0.67)})$ , where  $t$  is age,  $L_t$  is fork length.

### RESULTS

The result of yearly catch-at-size of albacore caught by Taiwanese longline fleet in the north Atlantic is shown in Table 1. As shown in Table 1, the majority of albacore caught by Taiwanese fleet were in the size range of 80-110 cm. The range of size distribution in the period of 1981 to 1995 appeared to be from 50-120 cm, except in the years of 1991 and 1992, where smaller sized albacore (less than 80 cm) were mission mainly due to sampling error. The result of converted catch-at-age of the same data file were shown in Table 2. As shown in Table 2, the majority of age caught by Taiwanese longline fleet were from age 4 to age 9, except in years 1991 and 1992, mainly due to sampling error.

Table 3 shows the result of catch-at-size of albacore caught by Taiwanese longline fleet in the south Atlantic. As shown, The majority of albacore caught by Taiwanese fleet were in the size range of 50-120 cm. The result of converted catch-at-age of the same data file were shown in Table 4. As shown in Table 4, the majority of age caught by Taiwanese longline fleet were from age 4 to age 10.

### Reference

- Gonzalez-Garces, A. and A.C. Farina-Perez. 1983. Determining age of young albacore, *Thunnus alalunga*, using dorsal spine. U. S. Dep. Commer., NOAA Tech. Rep. NMS 8:117-122.
- Lee L. K. and S. Y. Yeh. 1993. Studies on the age and growth of south Atlantic albacore (*Thunnus alalunga*) specimens collected from Taiwanese longliners. ICCAT Col. Vol. Sci. Pap. XL(2):354-360.
- Santiago, J. 1992. Application of 'MULTIFAN' to estimate the age composition of the North Atlantic albacore catches. ICCAT Col. Vol. Sci. Pap. XXXIX(1): 188-195.
- Penney, A. J. 1993. Morphometric relationships, annual catches and catch at size for South Africa caught South Atlantic albacore (*Thunnus alalunga*). SCRS/93/92.

<sup>1</sup> Institute of Oceanography, National University, Taipei.

Table 1. Fork length distribution of albacore caught by Taiwanese longline fisheries in North Atlantic from 1981 to 1995.

year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33	0	13	0	7	26	0	16	3	2	0	0	0	0	0	0	
35	0	0	0	0	12	13	0	0	0	0	0	0	0	142	0	
37	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	
39	0	6	0	36	35	18	16	3	2	0	0	0	0	0	101	
41	0	24	123	214	120	575	16	3	2	0	0	0	236	0	101	
43	0	0	48	255	94	542	16	3	3	0	0	0	0	0	0	
45	0	20	59	466	87	1307	82	15	12	1	0	0	0	0	49	
47	16	73	69	665	97	950	609	111	92	10	0	0	0	0	49	
49	58	94	192	525	221	1064	1222	228	183	20	0	0	236	0	867	
51	475	181	169	880	217	1815	1756	339	280	31	0	0	534	0	1477	
53	138	241	325	447	310	1403	2643	511	416	47	0	0	710	0	306	
55	441	401	561	760	778	1718	3261	628	510	58	0	0	0	752	1378	
57	344	511	404	569	472	1470	3136	606	494	56	0	0	337	1018	356	
59	351	708	1164	1107	510	2425	3788	651	525	60	0	0	657	1832	24	
61	5485	2723	949	1559	340	5829	11774	5650	1207	138	0	7	184	5558	3201	
63	1692	4486	1467	8184	828	6087	17403	6694	1506	172	0	16	359	12123	5376	
65	3566	4947	3284	15599	1508	10611	19213	6157	1629	186	0	7	544	6439	2553	
67	1788	5085	1715	10938	1465	9527	13337	1763	1310	149	0	0	0	1340	26	
69	1561	10811	4151	7985	4079	10229	13533	1844	1240	141	0	0	184	2452	13	
71	7748	15887	9429	9918	11429	7365	10912	3800	929	106	0	0	3048	3051	6153	
73	4806	15750	16783	8335	10189	11294	9715	1729	831	95	0	0	2534	3023	3211	
75	8870	20102	15611	13142	11641	18633	15198	5072	1148	131	0	0	12125	7270	10298	
77	5670	18895	17146	16854	8375	16038	12701	3348	919	105	0	0	5481	4645	8247	
79	10971	27692	23146	23261	15071	27646	12980	4104	881	97	0	0	15781	10821	11042	
81	18638	26678	31889	28810	20983	42253	23050	8150	4955	2387	11856	1	25691	21506	27774	
83	17778	30035	42530	29563	29023	49345	16275	7751	5658	3755	15888	3	16567	12813	21081	
85	25068	31080	49564	37464	36856	55481	27127	11703	6353	4555	14702	51	32865	19268	30189	
87	18891	22859	63417	45704	40066	49798	18105	10087	6585	4939	18654	51	18625	14377	24602	
89	19396	25204	50809	29167	32576	46712	19221	9626	4741	4969	7601	1048	17646	9231	18578	
91	28650	34183	70235	60438	47677	72683	17372	8750	8312	13580	28252	11482	20967	7758	17168	
93	21504	34177	67604	49227	58541	70685	10928	8152	9233	15167	61019	31445	22837	4202	8691	
95	14470	27977	52448	57173	65145	67403	13480	6636	8636	17057	41107	20002	25877	9291	14712	
97	11972	21031	46621	48708	57209	55000	12733	5498	8954	13932	27764	13010	12859	9415	9323	
99	12439	22103	38305	51868	46477	50563	10493	4693	3979	5682	17214	8520	11504	10068	11020	
101	16605	21642	42628	38817	41827	60333	9537	3023	2014	1828	2411	1393	26355	23695	12325	
103	17103	22823	30466	41899	38732	60945	16164	3676	1137	256	495	932	9540	7328	4347	
105	16866	21340	21321	33559	35961	52887	20099	3290	337	132	284	291	23723	13645	8592	
107	12535	20114	17933	25340	21691	28745	11517	1668	144	49	227	1296	8917	5071	3342	
109	10239	19937	24499	17334	18640	23000	8552	1270	74	99	683	3423	12891	6205	2542	
111	9753	9615	11439	14843	17309	27634	7765	1812	82	44	1537	5853	7445	3359	365	
113	5144	12109	11200	12965	21399	43147	7015	1501	123	20	797	5165	1242	826	359	
115	8394	9228	9607	14193	23741	28748	12828	2216	257	34	0	2859	1985	587	208	
117	2224	8671	7762	9941	12405	8461	6289	927	38	21	0	138	3534	383	101	
119	1436	7231	5360	6392	6752	3979	3750	571	25	276	284	0	534	525	33	
121	5918	7176	3566	7310	6242	5001	1307	220	0	917	341	0	2203	7952	167	
123	691	4724	1001	3299	1104	123	83	17	0	490	0	0	0	19020	0	
125	2433	3004	1063	4331	1494	352	424	95	0	522	0	0	733	15966	0	
127	294	1899	318	3266	645	158	26	1	0	81	0	0	1008	9245	0	
129	128	480	46	1255	96	82	10	3	0	54	0	0	0	4203	0	
131	1411	882	47	844	164	285	9	1	0	0	0	0	435	1759	24	
133	140	183	13	77	25	7	9	1	0	0	0	0	0	236	1603	0
135	240	42	4	111	92	7	0	0	0	0	0	0	0	0	0	0
137	18	95	0	53	21	13	0	0	0	0	0	0	0	0	0	0
139	4	3	0	20	8	23	0	0	0	0	0	0	0	0	525	0

Table 2. Estimated age composition of albacore caught by Taiwanese longline fisheries in North Atlantic from 1981 to 1995.

year	age	0-2	3	4	5	6	7	8	9	10	11	12	13'			
1981		0	1472	12882	22985	53057	63355	64624	41016	33969	22774	14897	23331			
1982		63	1501	17949	62550	103300	79143	96337	64776	44163	40051	21724	43618			
1983		230	1720	8579	45974	114711	163790	190287	127554	51787	42432	22639	28787			
1984		978	3646	37387	39380	98488	112335	166838	139393	75458	42674	27808	51092			
1985		394	2095	4651	37338	73452	109498	171363	145513	74693	40331	38708	52789			
1986		2455	8420	34479	47521	135282	151991	210771	165896	113832	51745	70781	47239			
1987		146	12627	65515	49358	65006	64453	41780	32763	36263	20069	14780	24735			
85		25068	31080	49564	37464	36856	55481	27127	11703	6353	4555	14702	51	32865	19268	30189
1988		27	2423	20915	12445	23353	31416	23538	13214	6966	2938	3313	4052			
1989		21	1975	6177	4148	12413	17679	26181	14947	1474	218	205	320			
1990		1	222	705	473	6344	14463	45804	21442	388	148	64	2395			
1991		0	0	0	0	27744	40957	130378	47389	779	910	2334	625			
1992		0	0	30	0	4	1150	62929	22923	1223	4719	11018	2997			
1993		236	1817	1744	17891	63520	69136	69681	50718	33263	21808	8687	10668			
1994		142	1770	27292	15796	49785	42876	21251	43178	20973	11276	4185	61768			
1995		251	4433	11180	19675	68144	73369	40571	32668	12939	5884	724	533			

Table 3. Fork length distribution of albacore caught by Taiwanese longline fisheries in South Atlantic from 1981 to 1995.

year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	6	15	135	79	0	0	0	0	0	0	67	0
35	84	0	0	7	28	617	598	0	0	0	0	0	25	87	0
37	12	7	7	30	102	711	597	0	0	0	0	0	63	422	0
39	59	13	0	30	28	2514	952	0	0	50	0	17	253	526	57
41	834	1206	1480	85	3438	2367	5061	0	0	0	0	0	53	143	77
43	346	938	364	55	4590	2937	1398	0	0	0	0	0	65	568	137
45	3160	674	1145	138	6722	5074	5272	0	74	0	0	0	0	480	300
47	1050	939	1118	35	7045	5540	5000	0	472	0	0	0	824	1377	899
49	2980	2837	881	615	8726	9647	4095	0	1412	110	115	93	5041	1137	11278
51	11770	2837	1580	474	8393	14010	9736	0	8155	50	115	0	1574	8334	16073
53	11769	3482	1429	526	5400	9451	3899	0	8091	202	231	258	5496	11495	24787
55	17359	5053	1501	897	5616	16490	9642	0	4713	557	0	17	1350	33250	38011
57	16888	7489	1751	671	5454	14614	10628	0	5051	456	347	116	9055	44460	49752
59	12473	10995	2059	1315	6978	22726	14400	128	1552	608	462	345	16468	55127	57695
61	13212	10701	2274	2203	16204	30496	37148	923	1035	2333	694	1193	16150	64154	74893
63	13262	11619	2274	2805	17793	29799	44773	1619	1132	3422	4166	1213	31844	70607	81277
65	17635	13979	6735	4915	38845	45832	47969	4090	2619	4356	11999	1662	19928	54103	55377
67	14038	12642	9109	4186	27951	32018	39628	5377	3048	4172	23659	1734	23475	28582	24956
69	24135	31214	17262	6950	34869	49061	46779	9671	7934	21518	74002	3482	31663	39983	42360
71	50661	65833	18791	12377	55331	67076	71550	9230	7457	19041	130105	10962	41104	41366	46792
73	57017	78334	21615	10517	41321	55934	55921	18162	8896	23020	95080	26847	39103	50288	52181
75	52574	84527	29180	17410	79585	94578	65622	35695	9087	53223	73678	32691	53721	61704	52349
77	32280	63380	30702	11329	67077	70650	53108	59446	6553	44796	18381	37870	41618	65033	42248
79	42843	98412	27668	20841	90671	98042	67672	77413	13552	73322	27722	49093	70800	90719	32021
81	52734	109361	39413	26426	130558	148985	125630	103679	40040	79771	86397	104527	70628	83539	46379
83	48036	90953	31645	27946	94950	96720	144919	92309	48851	78914	87678	107795	64461	70916	30518
85	58635	91464	40541	26293	100142	143630	151473	54178	70411	75903	77951	87621	88262	67334	42338
87	59142	80385	30769	17893	85514	97649	167694	97045	106863	72523	92307	132680	88462	105264	54630
89	44540	59360	20768	15054	70887	64839	87021	116863	63337	82517	21717	73550	59487	61425	39014
91	65346	65161	29548	13481	95556	84224	125465	112663	104195	141902	7488	72101	65960	53037	45745
93	53834	55491	18549	11672	68989	64793	96622	52999	84026	114346	5162	83436	85825	62603	33674
95	54638	53633	21718	9143	49860	74683	71476	38193	67211	65422	5753	72765	68327	41967	40745
97	37703	42385	15133	10464	29736	55167	55242	42284	44769	42354	6261	76639	56962	35773	31015
99	37629	39727	17744	10241	19526	47556	43393	34251	33426	37607	6321	67131	38526	26889	26765
101	45647	44167	18588	11435	23518	42055	42135	20659	40896	30781	5563	52738	32405	21928	37008
103	34895	47015	17664	13123	23730	25651	37865	21536	40444	34473	9211	54642	36736	31241	26709
105	33665	49234	15791	13498	28196	28958	37109	29056	54834	20227	6402	35638	41584	33817	41934
107	26007	38497	14020	13211	22317	23813	31861	34057	37851	9765	17970	14696	31113	50319	23670
109	23268	27897	13145	9641	18644	33140	32792	44875	32223	13484	76402	22756	25392	60664	30873
111	25925	26877	14141	8198	16053	39637	29554	19679	15451	7695	82397	28489	15196	54849	39841
113	25311	22380	11482	6617	10059	25454	22906	12690	7973	54603	51638	45851	11274	15672	32283
115	20445	16853	8179	7241	11556	25430	20044	21443	4890	35035	43636	31362	10620	11560	23222
117	9394	11596	8567	6815	9177	24508	15836	31794	22247	7164	54756	9079	7063	15165	14093
119	5436	7862	4968	5585	7008	21996	10965	16291	17837	1221	14445	1443	1999	8188	10284
121	7633	8566	6579	5521	4656	21068	12830	7198	1041	1133	0	1167	2620	6180	6530
123	3176	3169	2489	4201	704	5071	4663	2557	0	221	0	110	113	1099	2046
125	2935	2499	1900	7449	464	2754	5225	733	0	210	41	507	370	392	368
127	1338	1424	1553	7196	115	2452	1773	178	0	43	0	422	213	252	124
129	1283	487	843	5786	99	409	1335	0	0	43	0	0	96	76	247
131	721	890	1158	6936	53	4172	1349	0	36	197	0	258	162	195	1254
133	108	327	495	2568	22	50	70	0	29	0	0	63	35	0	66
135	141	291	341	2946	0	16	39	0	0	0	0	0	25	50	68
137	29	37	155	627	0	16	0	94	0	0	0	0	0	0	37
139	27	0	74	345	0	16	0	0	0	0	0	46	35	0	114

Table 4. Estimated age composition of albacore caught by Taiwanese longline fisheries in South Atlantic from 1981 to 1995.

year \ age	0 - 2	3	4	5	6	7	8	9	10	11	12	13'
1981	20295	84963	216060	175893	227663	146175	118171	82940	51236	29839	13069	9758
1982	9451	49339	286529	362106	296370	151509	130909	115628	49257	28449	16428	9124
1983	6575	11856	102692	129428	121626	55400	53996	42956	25623	16746	11347	9008
1984	1475	8417	56355	86542	72721	31279	34799	36350	14815	14056	11106	38054
1985	39087	57445	277902	383256	352099	148585	66774	69157	26112	20733	11664	1457
1986	43552	123576	344499	414397	390342	194643	115262	85911	65091	49938	43064	14956
1987	32788	120490	327469	391329	531653	223340	123393	101762	52460	35880	23795	14454
1988	0	2670	82225	332847	380749	133476	76446	107988	32369	53237	23489	3562
1989	10113	21574	39041	108996	344806	196006	114766	124908	23424	27137	18878	65
1990	210	7578	125330	276803	372845	222122	102861	43476	62298	42199	2354	714
1991	230	5900	408523	220178	199463	17176	21095	100774	134035	98392	14445	41
1992	110	3142	77378	299285	365952	232840	174511	73090	74340	40441	2610	1406
1993	7898	80363	208994	247507	302171	211114	107667	98089	26470	17683	4619	1049
1994	13141	279093	276026	310207	287060	140343	80058	144800	70521	26725	14368	2064
1995	28821	326415	254015	151166	181727	105434	90482	96477	72124	37315	16814	4324