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SEERFISH FISHERY OF THE WORLD

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ABSTRACT

The annual world seerfish production, inspite of some fluctuations (and decrease in 1978, 1984 & 1992) steadily increased from 128,100t in 1973 to 210,089t in 1977 and then to an all time peak of 492,011t in 1991. During the period 1970-'80, the leading countries in seerfish production were Indonesia (33,672t), India (22,342t), China (16,669t), Mexico (10,557t), Korea (10,367t), Philippines (10,329t), Thailand (9,885t), Malaysia (9,469t), USA (7,741t) and Japan (5,142t). But during 1981-'90 China (101,143t), became the leading country in seerfish production followed by Indonesia (51,517t), India (34,336t), Korea (19,274t), Philippines (15,860t) Malaysia (13,503t), Mexico (13,231t), Thailand (12,510t), Oman (10,655t) and Pakistan (7,737t). During 1991-'93 production was in the order: China (164,293t) followed by Indonesia (69,306t), India (39,334t), Malaysia (19,762t), Korea (17,669t), Mexico (17,271t), Philippines (12,741t), Thailand (11,829t), Pakistan (10,219t) and UAE (7,043t). During this period Korea, Philippines and Thailand registered a decline of 8.3%, 19.7% and 5.5% from the 1981-'90 level. On an average the Pacific Ocean contributed 64%, the Indian Ocean 26% and the Atlantic Ocean 10% to the total seerfish production. Unlike the Pacific and the Indian oceans, the Atlantic Ocean showed an overall decline in the production trend in recent years. The Pacific Ocean indicated a better trend in production compared to the Indian Ocean.

During 1991-'93 in the seerfish landing from the Pacific Ocean was dominated by *Scomberomorus niphonius* (56.4%) followed by *S. commerson* (15.9%), *Scomberomorus spp.* (13.3%), *S. guttatus* (3.1%), *S. sierra* (2.2%) and *Acanthocybium solandri* (0.1%). In the Indian Ocean *S. commerson* (49.3%), *S. guttatus* (23.5%), *Scomberomorus spp.* (25.7%), *S. lineolatus* (1.3%) and *A solandri* (0.2%) constituted the catches. India was the leading country followed by Indonesia, Oman, Pakistan, Saudi Arabia, Kuwait, UAE, Iran, Sri Lanka, Thailand and Yemen. The landings from the Atlantic Ocean were dominated by *S. maculatus* (59.9%), followed by *S. cavalla* (24.6%), *S. tritor* (8.1%), *A solandri* (4.2%), *Scomberomorus spp.* (2.1%) and *S. regalis* (1.1%). The leading seerfish producing countries included Mexico, Venezuela, USA, Trinidad, Ghana, Senegal and Dominican Republic. The overall species composition indicates that *S. commerson* was the dominant species (34.1%) followed by *S. niphonius* (17.6%), *S. maculatus* (8.2%), *S. guttatus* (8.1%), *S. sierra* (2.9%), *S. cavalla* (2.0%), *S. tritor* (1.0%), *S. regalis* (0.1) and the other minor species have been pooled as *Scomberomorus spp.* (26.2%).

INTRODUCTION

THE FAMILY Scombridae comprises fishes of the genera *Scomberomorus* Lacepede, *Acanthocybium* Gill and *Grammatorcynus* Gill and among them *Scomberomorus* contains about sixteen valid species which are popularly known as the seerfishes in the Indian Ocean region and the Spanish mackerels in the Pacific and Atlantic Ocean regions. *Acanthocybium* and *Grammatorcynus* are monotypic, represented by single species each. The wahoo, *A solandri* (Cuvier and Valenciennes) represents the former while the lone double-lined mackerel *G. bicarinatus* (Quoy and Gaimard) represents the latter. These species are widely distributed in the tropical and subtropical seas. They are pelagic and bathypelagic inhabiting the inshore waters (surface to 100 m or even 150 m depth). *A solandri* alone is reported to stray into the oceanic waters beyond the continental shelf. The scomberomorinids are ranked worldwide as high quality table fishes both in fresh and processed conditions.

Species such as *S. commerson, S. guttatus, S. lineolatus, S. niphonius, S. sierra, S. tritor, S. regalis, S. maculatus* and *S. cavalla* are widely distributed compared to the other forms such as *S. chinensis, S. multiradiatus, S. concolax, S. koreanus* etc., which are limited in distribution. They are grouped as *Scomberomorus spp.* for catch statistics purpose by the FAO. Considering the commercial and economic importance of the seerfishes a comprehensive account on the global production of seerfish/Spanish mackerels is attempted in this paper to obtain a clear picture of the countrywise, areawise and specieswise production trends based on the 1973-93 data.

DATABASE

World marine fish catch statistics collected by the FAO for the period 1973-'93 has been used as the database for this study.

CATCH STATISTICS

Overall production

The annual world seerfish production from 1973 to 1993 is given in Fig. 1. Though the landing steadily increased from 128,100 t in 1973 to an all-time peak of 492,011 t in 1991, there was a decline in 1978, 1984 and 1992. During 1973-'80, thirty nine countries landed an annual average catch of 177,296 t, which fluctuated from 128,100 t in 1973 to 222,886 t in 1980. The first ten leading countries include Indonesia (33,672 t), India (22,342 t), China (16,669 t), Mexico (10,557 t), Korea (10,367 t), Philippines (10,329 t), Thailand (9,885 t), Malaysia (9,469 t), USA (7,741 t) and Japan (5,142 t).

During 1981-'90, 59 countries landed an annual average catch of 352,372t. The first ten leading countries include China (101,143t), Indonesia (51,517t), India (34,336t), Korea (19,274t), Philippines (15,860t), Malaysia (13,502t), Mexico (13,231t), Thailand (12,510t), Oman (10, 655t) and Pakistan (7,737t). During 1991-93, sixty one countries landed an average annual catch of 448,164t. Among them China topped with 164,293t followed by Indonesia (69,306t), India (39,334t), Malaysia (19,762t), Korea (17,669t), Mexico (17,271t), Philippines (12,741t), Thailand (11,829t), Pakistan (10,219t) and UAE (7,043t). Almost all the leading ten countries registered an increase in the production of seerfish during 1981-'90 over the previous decade. Though Korea, Philippines and Thailand

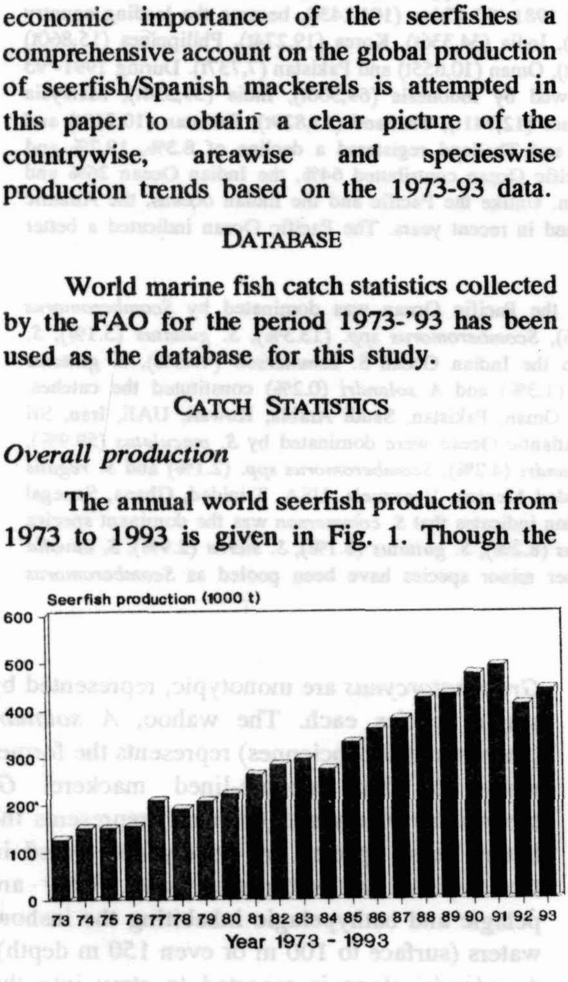

FIG. 1. *Seerfish production in the world during 1973-1993.*

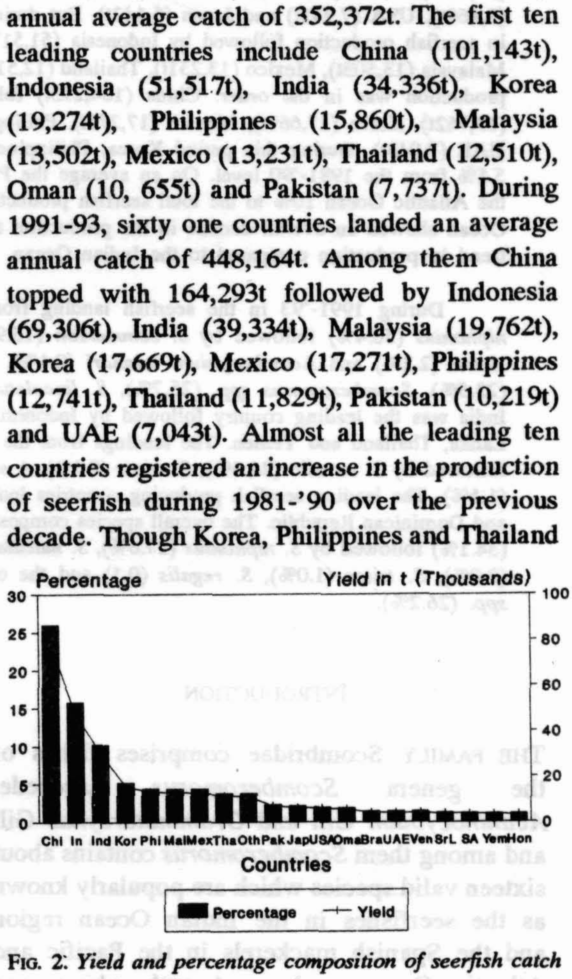

FIG. 2: *Yield and percentage composition of seerfish catch by different countries.*

were among the ten leading countries during 1991-'93 their production declined by 8.3%, 19.7% and 5.5% respectively from the 1981-'90 level.

The overall production during 1973-'93 shows that China was the leading country with a production of 26% followed by Indonesia 15.8%, India 10.2%, Korea 5.2%, Philippines 4.4%, Malaysia 4.3%, Mexico 4.3%, Thailand 3.8%, Pakistan 2.2%, Japan 2.1%, USA 1.9%,

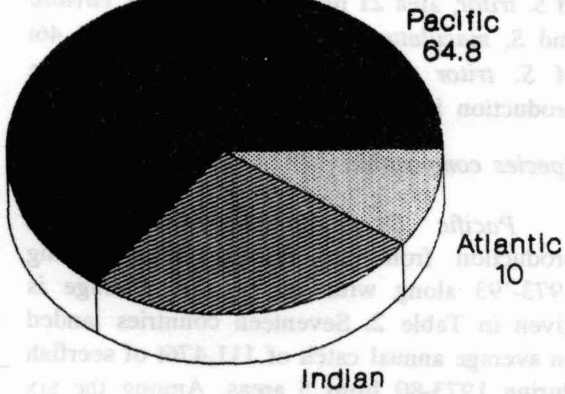

FIG. 3. *Seerfish production from Pacific, Indian and Atlantic Oceans.*

Oman 1.4%, Brazil 1.4%, UAE 1.4%, Venezuela 1.3%, Sri Lanka 1.2%, Saudi Arabia 1.1% and Yemen 1.1% (Fig. 2).

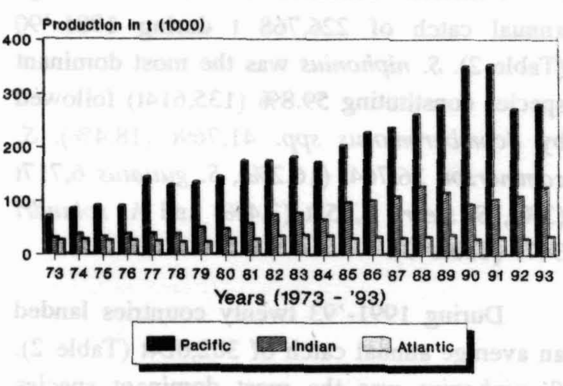

FIG. 4. *Seerfish production from Pacific, Indian and Atlantic Oceans.*

Production from different Oceans

The production from all the three oceans in general increased from 128,100 t in 1973 to 222,886 to in 1980 (Fig. 3). The Pacific Ocean contributed an average of 111,476 t (62.9%), followed by the Indian Ocean 39,767t (22.4%) and the Atlantic Ocean 26,053t (14.7%) The landings from the Pacific Ocean continued to increase from 70,800 in 1973 to 144,964 t in 1980. From the Indian Ocean it varied from 30,900 t in 1973 to 50,553 t in 1979 compared to 22,583 t in 1979 to 29,747t in 1980 from the Atlantic Ocean (Fig. 4).

During 1981-'90 the total landings increased from 263,242t in 1981 to 475,150t in 1990 (Fig. 4) and the average annual seerfish production was 352,372 t in which the Pacific Ocean registered an increase from 173,413t in 1984 to 351,051 t in 1990 with an average of 226,768t (64.4%), compared to an increase from 58,916 t in 1981 to 127,773 t in 1988 with an average of 92,288t (26.2%) in the Indian Ocean and an increase from 29,664 t in 1981 to 37,046 t in 1983 with an average of 33,315t (9.5%) in the Atlantic Ocean.

During 1991-'93 the average production from the Atlantic Ocean was 32,518t, which was lower than the average landing of the previous decade. The landings from the Indian Ocean was 112,959t, which formed 25.2% of the global seerfish production. On the other hand, though the production from the Pacific Ocean declined, the average landing of 302,624t was higher than the previous decadal average and formed 67.5% of total global catch. The production during 1991-'93 declined from 492,011 t in 1991 to 410,507 in 1992 and then increased marginally to 441,977 t in 1993 (Fig. 1).

The production from the three oceans indicated that the landings in the Atlantic Ocean showed an overall declining trend compared to the Pacific and the Indian oceans. Between the Pacific and the Indian oceans, the former registered much higher production than the latter.

Areawise production

The areawise average annual production of seerfish during the 1970s, the 1980s and the 1990s from the three oceans are given in Table 1 along with the species composition. Among the major fishing areas delineated by FAO: 61,67,71,77,81 and 87 in the Pacific Ocean, area 61 produced an overall average catch of 129,363t followed by area 71 (76,918t); the catch was comprised by *S. niphonius, S. guttatus, Scomberomorus spp.* and *A. solandri* in both these two areas. Area 77 landed 4,871t constituted by *S. sierra, A. solandri* and *Scomberomorus spp.* while area 81 landed 1,525t of *Scomberomorus spp.* The entire catch of 946t landed from area 87 was constituted

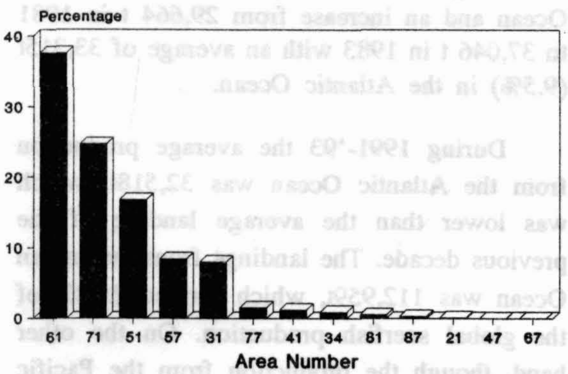

FIG. 5. *Areawise productions (%) of seerfish in the world during 1973-93.*

by *S. sierra* while area 67 landed only 1.2t of *Scomberomorus spp.* In the Indian Ocean, area 51 produced an overall average of 53,330t while area 57 yielded 28,341t. The dominant species in the Indian Ocean include *S. commerson, S. guttatus, S. lineolatus, A. solandri* and other *Scomberomorus spp.* while *S. niphonius* is also available in area 57. Among the areas 21,31,34,41 and 47 of the Atlantic Ocean area 31 was the leading producer with 24,963t which was constituted by *S. maculatus S. cavalla, S. traitor, S. regalis, A. solandri* and other *Scomberomorus spp.* followed by area 41 with 2,723t, which was comprised of all the species available in area 31 except. *S. tritor and S. regalis.* Area 34 produced 2,493t of *S. tritor,* area 21 produced 425t of *S. cavalla* and *S. maculatus* while area 47 produced 46t of *S. tritor* and *A. solandri.* The areawise production in percentage is given in Fig. 5.

Species composition

Pacific Ocean: Countrywise seerfish production from the Pacific Ocean during 1973-'93 along with the decadal average is given in Table 2. Seventeen countries landed an average annual catch of 111,476t of seerfish during 1973-80 from 5 areas. Among the six species *S. niphonius* dominated forming 31,133t (27.9%), *S. commerson* 28,306t (25.4%), *S. guttatus* 13,926t (12.5%), *S. sierra* 5,121t (4.6%), *A.solandri* a meagre 4t and *Scomberomorus spp.* 29.6% (Table 3).

Nineteen countries landed an average annual catch of 226,768 t during 1981-'90 (Table 2). *S. niphonius* was the most dominant species constituting 59.8% (135,614t) followed by *Scomberomorus spp.* 41,769t (18.4%). *S. commerson* 36,764t (16.2%), *S. guttatus* 6,717t (3%), *S. sierra* 5,557t (2.4%) and *A. solandri* 347t (Table 3).

During 1991-'93 twenty countries landed an average annual catch of 302,624t (Table 2). *S. niphonius* was the most dominant species constituting 197,81t (56.4%) followed by *S.*

TABLE 1. *Areawise average production of seerfish and species composition from Pacific, Indian and Atlantic oceans.*

	Zone No.	Species	1970's	1980's	1990's	Average
Pacific Ocean	61	*S. niphonius* *A. solandri* *Scomberomorus* spp. *S. guttatus*	44216	140083	203790	129363
	71	*Scomberomorus* spp. *S. guttatus* *S. niphonius* *A. solandri*	61042	79678	90035	76918
	77	*S. sierra* *Scomberomorus* spp. *A. solandri*	3923	4578	6111	4871
	81	*Scomberomorus* spp.	1096	1445	2033	1525
	87	*S. sierra*	1201	982	655	946
	67	*Scomberomorus* spp.	0	3	1	1
Indian Ocean	51	*S. commerson* *Scomberomorus* spp. *S. lineolatus* *A. solandri* *S. guttatus*	26527	62995	70469	53330
	57	*S. commerson* *A. solandri* *S. lineolatus* *S. guttatus* *S. niphonius* *Scomberomorus* spp.	13240	29293	42489	28341
Atlantic Ocean	31	*A. solandri* *Scomberomorus* spp. *S. cavalla* *S. maculatus* *S. tritor*	21919	23663	29308	24963
	41	*Scomberomorus* spp. *S. maculatus* *S. cavalla* *A. solandri*	2317	5783	67	2723
	34	*S. tritor*	1642	3415	2421	2493
	21	*S. cavalla* *S. maculatus*	94	418	763	425
	47	*S. tritor* *A. solandri*	81	36	21	46
	Total		177297	352372	448164	325944

TABLE 2 *Countrywise seerfish production from Pacific Ocean during 1973-93*

COUNTRY	1973	1974	1975	1976	1977	1978	1979	1980	AVERAGE
INDONESIA	33200	37414	30198	31498	26170	26497	29959	31262	30775
CHINA	0	0	0	0	38223	34530	30000	30600	16669
KOREA	6800	10727	5241	5355	14876	10258	12166	17511	10367
PHILIPPINES	2900	5443	10435	7838	15718	11924	14821	13549	10329
OTHER NE	4700	7874	7874	7874	14063	10838	14039	14768	10254
MALAYSIA	6200	7566	8194	7855	9990	11211	11215	13521	9469
THAILAND	5200	4900	14641	14832	10415	8090	6469	8339	9111
JAPAN	3600	2607	4065	4857	5898	6989	6140	6977	5142
MEXICO	3300	3350	4239	4089	3378	3644	4064	4028	3762
HONGKONG	2400	2403	2734	3639	3047	3211	3058	2136	2829
PERU	1000	2037	2279	1252	1314	682	454	579	1200
AUSTRALIA	1200	1097	585	1150	1168	1216	890	898	1026
FIJI	100	56	60	55	247	293	1135	393	292
COLUMBIA	100	45	77	111	148	296	236	266	160
SINGAPORE	100	106	93	28	6	109	150	137	91
GILBERT	0	10	10	10	0	0	0	0	4
USA	0	2	0	0	0	0	0	0	0
TOTAL	70800	85637	90725	90443	144661	129788	134796	144964	111477

TABLE 2. *Contd...*

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
CHINA	48148	60935	62102	74937	90623	94218	99006	124810	148079	208569	101143
INDONESIA	37910	41802	47384	22647	41132	45331	43490	43450	45900	49296	41834
KOREA	13960	10677	16224	24252	13633	22543	27104	28624	17627	17925	19257
PHILIPPINES	16897	17269	18266	13725	12746	15150	17852	13796	17908	14995	15860
OTHER NE	12190	10926	8044	8458	8731	8294	9420	10370	11667	18967	10707
THAILAND	11207	8365	8177	9373	9683	12474	11307	13319	10395	9995	10430
MALAYSIA	16455	10103	8639	7214	5673	7488	10027	10403	7984	8025	9201
JAPAN	6181	5742	6124	3030	11650	11748	9666	7973	5187	7617	7492
MEXICO	5666	4200	2606	3014	3832	3024	3108	2585	4328	7147	3951
HONGKONG	2525	2393	2767	3287	3161	3138	3437	3706	4805	4169	3339
FIJI	1846	1980	1202	815	402	779	712	948	1678	2110	1247
PERU	354	446	430	914	702	1713	1229	1576	1726	731	982
AUSTRALIA	1017	239	268	357	376	369	350	367	644	789	478
COLUMBIA	160	37	83	611	638	549	512	281	367	225	346
PANAMA	0	0	212	406	369	121	113	630	567	360	278
SINGAPORE	138	184	197	328	285	277	144	26	24	34	164
GUAM	0	0	40	32	78	82	29	30	65	16	37
NEW CALA	8	16	14	13	17	7	29	5	44	25	18
ST. VINCE	0	0	0	0	0	0	0	0	0	56	6
TOTAL	174662	175314	182779	173413	203731	227305	237535	262899	278995	351051	226768

TABLE 2 *Contd......*

COUNTRY	1991	1992	1993	AVERAGE
CHINA	200643	146756	145480	164293
INDONESIA	51632	55498	58200	55110
KOREA	26689	9628	16613	17643
OTHER NE	21512	13961	11511	15661
PHILIPPINES	16187	9072	12963	12741
MALAYSIA	10097	10400	10520	10339
THAILAND	7549	8414	8713	8225
JAPAN	6686	5232	4039	5319
MEXICO	5404	4599	5756	5253
HONGKONG	4654	4252	3093	4000
FIJI	1870	1559	875	1435
AUSTRALIA	739	1574	1417	1243
PANAMA	767	282	576	542
PERU	269	300	410	326
COLUMBIA	217	285	444	315
SINGAPORE	33	47	98	59
ST. VINCE	66	51	41	53
GUAM	46	28	36	37
NEW CALA	22	35	20	36
N. MANAMA	1	6	6	4
TOTAL	355083	271979	280811	302624

commerson 48,228t (15.9%), *Scomberomorus spp.* 40.128t (13.3%), *S. guttatus* 9,294t (3.1%), *S. sierra* 6,765t (2.2%) and *A. solandri* 398t (Table 3).

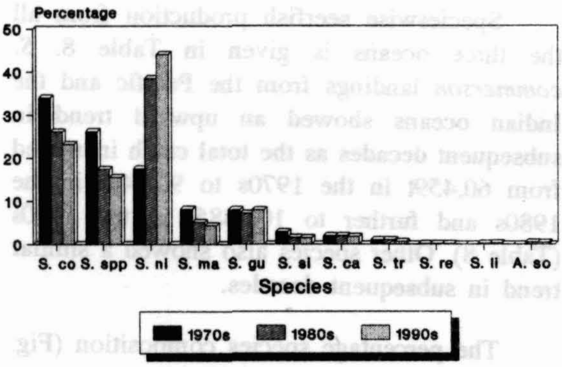

FIG. 6. *Species composition of seerfish in percentage during 1970s, 1980s and 1990s.*

Indian Ocean : Thirteen countries produced an average annual catch of 39,767t during 1973-'93 (Table 4). *S. commerson* dominated forming 80.9% (32,153t) followed by *Scomberomorus spp.* 7,234t (18.1%) and *S. guttatus* constituted a meagre 1% (379t) (Table 5). During this decade an increasing trend was noticed in the seerfish production from the Indian Ocean.

During 1981-'90 twenty three countries landed an average annual production of 92,288t (Table 4) from the Indian Ocean in which *S. commerson* continued to be the dominant species forming 59.9% (55,278t) while *S. guttatus* increased to 20.2% (18,667t) followed by *Scomberomorus spp.* 19.1% (17,599t), *S. lineolatus* 0.8% (717t) and *S. solandri* a meagre (27t) (Table 5).

During 1991-'93 twenty countries produced an average annual catch of 112,959t (Table 4). A further increase was noticed in the production during the 90's. The percentage composition showed that *S. commerson* declined further to 49.3% (55,657 t), *S. guttatus* increased to 23.5% (28,978 t) and *Scomberomorus spp.* to 25.7% (26,583t) followed by *S. lineolatus* 1.3% (1,496t) and *A. solandri* (245t) (Table 5).

Atlantic Ocean: Countrywise seerfish production from the Atlantic Ocean during 1973-'93 is given in Table 6. In all six species were landed from five areas by 16 countries. *S. maculatus* was the dominant species 14,454 (55.5%) followed by *Scomberomorus spp.* 6,202t (23.8%), *S. cavalla* 3,507t (13.5%), *S. tritor* 1,718t (6.5%), *S. regalis* 96t and *A. solandri* 76t (Table 7).

During 1981-'90 out of twenty five countries Mexico landed 9,280t followed by

TABLE 3 *Species composition of seerfish landings from Pacific Ocean during 1973-93*

SPECIES	1973	1974	1975	1976	1977	1978	1979	1980	Average
Scomberomorus spp.	16900	20515	36580	34199	47429	34825	35742	37702	32987
S. niphonius	10400	13334	9300	10206	50888	51549	48306	55083	31133
S. commerson	30600	34296	28184	30422	23964	24057	27035	27889	28306
S. guttatus	8500	12050	10060	10155	17540	14728	18959	19417	13926
S. *sierra*	4400	5430	6591	5451	4840	4929	4754	4873	5121
S. solandri	0	12	10	10	0	0	0	0	4
Total	70800	856437	90725	90443	144661	129788	134796	144964	111476

SPECIES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Average
S. niphonius	78824	88216	92431	108024	121135	134771	141886	169816	175056	245980	135614
Scomberomorus spp	47254	38497	38240	36749	35231	40727	46256	43373	48361	43001	41769
S. commerson	35975	39179	42450	18307	36204	39781	38344	36846	36613	43938	36764
S. guttatus	4774	4694	6242	5309	5486	6475	6017	7678	11553	8946	6717
S. sierra	6180	4683	3331	4945	5541	5407	4962	5072	6988	8463	5557
A. solandri	1655	45	85	79	134	144	70	114	424	723	347
Total	174662	175314	182779	173413	203731	227305	237335	262899	278995	351051	2267468

SPECIES	1991	1992	1993	Average
S. niphonius	249282	171552	172600	197811
S. commerson	46250	48724	49709	48228
Scomberomorus spp	43326	36454	40605	40128
S. guttatus	7977	9369	10536	9294
S. sierra	7644	5466	7186	6765
A. solandri	604	414	175	398
Total	355083	271979	280811	302624

Brazil 5,767t, USA 5,250t, Venezuela 3,326t, Trinidad 2,961t, Ghana 1,908t and Dominican 1,081t (Table 6) *S. maculatus* was the most dominant species 18,349t (55.1%) followed by *S. cavalla* 7,221t (21.7%), *S. tritor 3,529t (10.6%), Scomberomorus spp.* 2,239t (6.7%), *A. solandri* 1,494t (4.5%) and *S. regalis* 482t(1.4%) (Table 7). During 1991-'93 twenty seven countries landed seerfish led by Mexico with 12,018t followed by Venezuela 6,703t, USA 4621t, Trinidad 3772t, Ghana 138 t, Senegal 832t and Dominican Republic 789 t. The dominant species was *S. maculatus* 19,527t (59.9%) followed by *S. cavalla* 8,012t (24.6%), *S. tritor* 2,631t (8.1%), *A. solandri* 1,359t (4.2%), *Scomberomorus spp.* 681t (2.1%) and *S. regalis* 371t (1.1%).

Specieswise seerfish production from all the three oceans is given in Table 8. *S. commerson* landings from the Pacific and the Indian oceans showed an upward trend in subsequent decades as the total catch increased from 60,459t in the 1970s to 92,041t in the 1980s and further to 103,885t in the 1990s (Table 8). Other species also showed a similar trend in subsequent decades.

The percentage species composition (Fig. 6) indicates that the production of *S. commerson* declined from 34% in the 1970s to 26% in

TABLE 4 *Countrywise seerfish production from Indian Ocean during 1973-93*

COUNTRY	1973	1974	1975	1976	1977	1978	1979	1980	AVERAGE
INDIA	17700	24033	20579	23401	18610	17781	27371	29262	22342
PAKISTAN	5000	4470	3077	3731	5512	6003	9438	1963	4899
SRI LANKA	3600	4400	3477	4675	3774	3714	4323	6229	4274
YEMEN	2500	3008	3818	3818	3675	4000	4000	2800	3452
INDONESIA	2000	1963	2218	2400	3766	3944	2917	3971	2897
THAILAND	0	0	74	0	1931	1286	1050	1853	774
TANZANIA	0	0	0	0	1955	1683	897	1600	767
COMOROS	0	0	0	0	300	300	300	300	150
AUSTRALIA	100	85	69	89	66	99	126	131	96
KUWAIT	0	87	135	144	148	161	33	37	93
KENYA	0	0	0	0	20	24	30	29	13
S. AFRICA	0	0	0	0	0	0	68	0	9
JAPAN	0	0	0	1	0	0	0	0	0
TOTAL	30900	38046	33447	38259	39757	38995	50553	48175	39767

TABLE 4 *Contd.....*

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
INDIA	27553	33199	35614	31817	33646	35276	31170	43295	42144	29650	34336
OMAN	0	0	0	0	20270	14316	25378	27834	11111	7638	10655
INDONESIA	4721	6578	7027	5746	6355	7549	8837	17798	19920	12299	9683
PAKISTAN	7490	7535	8243	7148	7582	8010	8088	10497	6834	5941	7737
UAE	3490	6580	6292	6292	4934	7835	6630	7140	7416	7333	6394
SAUDI AR	0	542	0	0	8046	8864	8860	3047	8461	8662	4648
KUWAIT	3820	5496	4072	2261	3194	4902	7734	4986	3920	3340	4373
SRI LANKA	4561	3354	3455	3299	3475	3574	3698	3842	3899	3314	3647
YEMEN	2640	4110	4588	4595	3245	3563	3192	2568	2719	2834	3405
IRAN	0	1496	3097	1544	1225	1162	1769	1667	4183	5632	2178
THAILAND	2482	1887	1892	991	1951	2283	1911	1939	2503	2967	2081
TANZANIA	1298	1822	1760	840	1400	1470	1071	1489	1334	2831	1532
COMOROS	340	360	380	400	4200	420	420	440	200	200	358
AUSTRALIA	151	248	231	256	300	300	230	310	326	343	270
MOSAMBIQ	0	0	0	0	385	380	380	380	380	400	231
S. AFRICA	127	1085	265	266	329	21	11	89	85	10	229
QATAR	0	177	158	304	289	124	114	143	213	582	210
BAHRAIN	200	1998	191	221	141	290	294	189	241	92	206
KENYA	43	39	47	55	57	60	82	52	71	99	61
DJIBOULI	0	0	32	73	76	110	91	26	37	57	50
ISRAEL	0	0	0	0	0	0	0	40	0	0	4
SEYCHELL	0	0	0	0	1	6	10	2	2	4	3
JAPAN	0	0	0	0	0	2	0	0	0	0	0
TOTAL	58916	74706	77344	66108	97321	100517	109970	127773	1159992	94228	92288

TABLE 4 *Contd....*

COUNTRY	1991	1992	1993	AVERAGE
INDIA	37749	35565	44689	39334
INDONESIA	12569	10958	19060	14196
PAKISTAN	6272	12133	12252	10219
SAUDI AR	8768	9872	10374	9671
KUWAIT	9204	9605	9749	9519
UAE	6970	7179	6980	7043
IRAN	6196	5546	5963	5902
SRI LANKA	3919	3824	3769	3837
THAILAND	2848	3912	4051	3604
OMAN	3609	3517	3148	3425
YEMEN	3145	3051	3281	3159
TANZANIA	1381	1500	1215	1365
AUSTRALIA	540	711	799	683
QATAR	42	766	636	481
COMOROS	200	300	260	253
BAHARAIN	131	114	71	105
KENYA	146	75	46	89
DJIBOULI	46	52	57	52
S. AFRICA	23	17	0	13
SEYCHELL	8	3	3	3
FRANCE	1	9	0	3
TOTAL	103766	108709	126403	112959

the 1980s and further down to 23% in the 1990s. Similar trend was observed in respect of *S. maculatus, S. sierra, S. tritor, S. cavalla* and *Scomberomorus spp.* Though the percentage of *S. guttatus* declined to 7% in the 1980s it revived to 8% in the 1990s. The only species which registered an emphatic increase was *S. niphonius* which shot up from 17% in the 1970s to 38% in the 1980s and then further to 44% in the 1990s (Fig. 6).

DISCUSSION

The available literature reveals that very limited information is available on the seerfish fishery from different countries. In India the study on the stocks of individual species indicates that *S. commerson, S, guttatus* and *S. lineolatus* are exposed to higher fishing pressure along both the coasts. However, the assessment of seerfish stocks as a whole by the surplus production model indicates scope for increasing the production by increasing the effort especially Maharashtra and Gujarat (Devaraj *et. al.*, MS).

TABLE 5 *Species composition of seerfish landings from Indian Ocean during 1973-93*

SPECIES	1973	1974	1975	1976	1977	1978	1979	1980	AVERAGE
S. commerson	21700	28417	26324	29317	33652	33538	44634	39645	32153
Scoberomorus spp.	8600	8870	6628	8406	6005	5300	5674	8390	7234
S. guttatus	600	759	495	535	100	157	245	140	379
S. niphonius	0	0	0	1	0	0	0	0	0
TOTAL	30900	38046	33477	38259	39757	38995	50553	48175	39767

SPECIES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
S. commerson	33070	41712	47842	41342	58232	60809	69955	84625	64556	50634	55278
S. *guttatus*	13957	16125	16287	14661	19506	14515	14317	26809	29076	21421	18667
Scoberomorus spp.	11610	16703	12924	9833	19448	23012	24518	16042	21221	20679	17599
S. lineolatus	279	165	230	225	76	2175	1170	295	1144	1411	717
A solandri	0	1	61	47	59	6	10	22	2	83	27
TOTAL	58916	74706	77344	66108	97321	100517	109970	127773	115999	94228	92288

SPECIES	1991	1992	1993	AVERAGE
S. commerson	49402	56609	60960	55657
Scomberomorus spp.	26882	29652	30399	28978
S. guttatus	25873	20308	33569	26583
S. lineolatus	1600	1444	1444	1496
A. solandri	9	696	31	245
TOTAL	103766	108709	126403	112959

S. commerson, globally the most dominant species, has been studied in detail by various authors from different countries. The study

TABLE 6. *Countrywise seerfish production from Atlantic Ocean during 1973-93*

COUNTRY	1973	1974	1975	1976	1977	1978	1979	1980	AVERAGE
USA	7100	7110	8425	10438	9290	5818	5128	8620	7741
MEXICO	9100	6828	6148	4877	5762	6673	8000	6979	6796
VENEZUEL	4000	4767	4790	3778	3897	3344	2699	4360	3954
BRAZIL	2300	2300	2510	2850	2174	2485	2013	1904	2317
GHANA	1000	3513	598	555	740	807	1576	4412	1650
TRINIDAD	1000	826	1935	1543	1712	2108	1351	1478	1494
CUBA	700	1000	1000	1000	500	600	400	578	722
COLUMBIA	400	561	805	378	391	320	253	286	424
MARTINIQ	400	240	257	220	457	289	289	289	305
DOMINICA	100	100	100	105	293	279	455	455	236
PUERTO R	100	100	0	106	122	146	126	135	104
GUNDELOU	200	200	200	200	0	0	0	0	100
BARBADOS	0	0	0	0	135	157	189	116	75
ANGOLA	0	348	0	0	20	81	24	70	68
GRENEDA	0	0	0	0	172	185	73	55	61
ST. HELE	0	6	4	5	6	4	7	10	5
TOTAL	26400	27899	26772	26055	25671	23296	22583	29747	26053

TABLE 6. *Contd....*

COUNTRY	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
MEXICO	8648	12208	8796	7941	8092	8813	9528	8346	9542	10883	9280
BRAZIL	2350	1818	7950	9829	3159	8101	7098	7818	8797	749	5767
USA	6074	7461	5819	4298	5052	5415	5178	3876	4777	4549	5250
VENEZUEL	4018	3757	4097	2919	2977	2484	2517	3214	3587	3689	3326
TRINIDAD	1118	1421	1272	1105	3084	1230	2395	3064	3294	2961	2094
GHANA	1983	2982	2225	3022	3000	1453	0	1457	1457	1500	1908
DOMINICA	609	460	278	1164	1330	1323	1369	1472	1460	1340	1081
SENEGAL	0	0	1098	869	1145	1376	1700	1635	1067	717	961
CAPE VER	2307	1464	1588	1365	142	205	306	310	649	458	879
CUBA	657	476	6889	544	443	621	1606	802	746	665	725
MARTINIQ	522	611	567	574	511	448	344	162	175	175	409
USSR	0	602	1170	223	206	219	288	143	195	1240	403
NETHANTI	215	215	215	215	245	25	260	280	280	280	223
COLUMBIA	568	88	30	562	123	92	174	310	149	101	220
BARBADOS	144	219	222	219	120	138	159	332	68	51	167
GERMANY	0	851	537	33	1	0	0	0	16	0	144
ARUBA	115	115	115	115	115	120	120	120	120	70	113
BENIN	62	70	31	47	51	105	17	13	334	211	94
PUERTO R	116	145	147	105	70	65	54	38	79	87	91
GRENEDA	54	85	135	70	55	99	54	78	34	33	70
BERMUDA	24	40	49	46	46	65	43	61	63	74	51
ANGOLA	68	138	0	0	0	0	0	0	0	0	21
KOREA	0	0	0	0	0	72	0	98	0	0	17
ST. HELE	12	9	16	23	15	15	18	9	17	18	15
SPAIN	0	0	0	0	4	9	9	32	18	23	10
TOTAL	29664	35235	37046	35288	29986	32493	32977	33670	36924	29871	33315

TABLE 6 *Contd....*

COUNTRY	1991	1992	1993	AVERAGE
MEXICO	10507	12195	13353	12018
VENEZUEL	6777	4704	8627	6703
USA	5333	3715	4816	4621
TRINIDAD	4021	3797	3499	3772
GHANA	2778	899	466	1381
SENEGAL	332	1075	1089	832
DOMINICA	773	814	780	789
CUBA	538	611	391	513
CAPE VER	351	547	500	466
MARTINIQ	330	310	300	313
NETHANTI	250	260	270	260
BENIN	214	202	214	210
USSR	242	0	19	87
COLUMBIA	44	107	79	77
PUERTO R	91	53	84	76
BERMUDA	67	80	58	68
BRAZIL	96	106	0	67
UKRAIN	94	90	0	61
ARUBA	60	50	50	53
GRENEDA	44	59	55	53
BARBADOS	45	51	56	51
SPAIN	28	32	22	27
ST. HELE	12	17	35	21
LITHUVAN	52	4	0	19
ESTONIA	49	0	0	16
KOREA	0	41	0	14
LATVIA	34	0	0	11
TOTAL	33162	29819	34763	32581

areas in India include the Palk Bay and the Gulf of Mannar (Devaraj, 1981, 1983), Tuticorin coast (Kasim and Hamsa, 1989), southeast coast (Thiagarajan, 1989), southwest coast (Pillai *et al.*, 1992), Indian coast (Yohannan *et. al.*, 1992).

These authors have studied in detail the growth and stock size of *S. commerson*. The study areas outside India include the Gulf of Thailand (Cheunpan, 1988), Djibouti (Bouhlel, 1985), Oman (Dudley and Aghanashinikar, 1988, 1989; Dudley *et. al.*, 1992) Sri Lanka (Dayaratne, 1989), Kenya (Nzioka, 1991) and Saudi Arabia (Kedidi and Abushusha, 1987). These authors have studied basically the growth of the king seer. Some of these authors have suggested that the present fishing is beyond the MSY and therefore recommended a reduction in exploitation rate (Yohannan *et. al.*, 1992; Dudley *et al.*, 1992).

Based on the study on the distribution, of biology and the fishery of *S. commerson* in

TABLE 7. *Species composition of seerfish landings from Atlantic Ocean during 1973-93*

SPECIES	1973	1974	1975	1976	1977	1978	1979	1980	AVERAGE
S. maculatus	15500	14156	15583	14413	14537	13370	12312	15758	14454
Scomberomorus spp.	6100	5930	6712	7633	6949	5796	4885	5607	6202
S. cavalla	3700	3742	3748	3291	3229	3094	3649	3604	3507
S. tritor	1000	3861	598	555	760	888	1600	4482	1718
S. regalis	100	100	100	105	119	90	78	78	96
A. solandri	0	110	31	58	77	58	59	218	76
TOTAL	26400	27899	26772	26055	25671	23296	22583	29747	26053

SPECIES	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
S. maculatus	15050	16440	17305	18331	16672	18647	20879	19046	23346	17778	18349
S. cavalla	8439	10711	8549	6420	6359	6005	6124	7057	6182	6363	7221
S. tritor	2111	4641	5060	4193	4402	3155	1745	3248	3069	3668	3529
Scomberomorus spp.	599	647	3249	3650	1192	3534	2911	3074	2813	723	2239
A. solandri	2837	2109	2196	2014	787	652	926	1026	1280	1114	1494
S. regalis	682	687	677	680	574	500	392	219	234	225	482
TOTAL	29664	35235	37036	35288	29986	32493	32977	33670	36924	29871	33313.4

SPECIES	1991	1992	1993	AVERAGE
S. maculatus	20494	17278	20808	19527
S. cavalla	6606	7595	9835	8012
S. tritor	3795	2311	1788	2631
Scomberomorus spp.	1115	1460	1503	1359
A. solandri	777	786	479	681
S. regalis	375	389	350	371
TOTAL	33162	29819	34763	32581

Queensland, Mcpherson (1992) reports that the prospects for the expansion of the fishery over the next few years appear favourable through improvements in trolling techniques.

Jinadasa (MS) reported the growth parameters of *S. commerson* in Nigambo waters as L_∞ 178 cm, K 0.2774, t_o 0.785 and W α 12 kg. The age of the fish exploited ranged from 2 to 5 in which the 3 year old fish formed the bulk of the catch.

Dudley and Aghanashinikar (1988) reported that in Oman waters *S. commerson* entered the fishery at 48 cm, probably at an age of one year and at two years the average length was 84 cm. Based on a preliminary analysis they reported that *S. commerson* was being caught at suboptimum size.

Kedidi and Abushusha (1987) reported from the southern Saudi Arabian Red Sea coast that Derak *(S. commerson)* was caught by artisanal methods throughout the year in Jizan areas and the spawning took place from April to June. They estimated the growth parameters to be L_∞ 153 cm, K 0.38 and t_0 -0.26 and a preliminary analysis of the yield per recruit indicated that no increase in the yield was expected by changing the exploitation level to higher or lower values while keeping the mean length at first capture at its contemporary size of L_c = 50 cm.

Johnson *et al.* (1983) studied the age, growth and mortality of the king mackerel, *S. cavalla* from southeastern United States by analysing the otoliths. The von Bertalanffy growth equations proposed by them was males : $l_t = 965\ (1-e^{-0.28(t+117)})$ and females : $l_t = 1067\ (1-e^{-0.29(t+0.97)})$.

Kishida *et al.* (1985) studied the age and growth using the scales of the Japanese Spanish mackerel *S. niphonius*. They expressed the growth by the von Bertalanffy growth equation as follows: males : $l_t = 804\ (1-e^{-0.908(t-0.105)})$, females: $l_t = 1011\ (1-e^{-0.518(t+0.222)})$.

Collette and Russo (1984, 1985) conducted a detailed study on the morphology, systematics and biology of the Spanish mackerels, while Van Der Elst and Collette (1984) studied the systematic status of the queen mackerel, *S. plurilineatus*. Srinivasa Rao (1975) studied the morphometrics of *S. guttatus* in the Indian waters and found significant variation in morphometric characteristics among the samples from Bombay, Kakinada and Waltair. However, the Bombay and Kakinada samples appear to be closer to each other more than with the Waltair samples.

Lewis (1981) used the electrophoretic techniques to clarify taxonomic problems and infer phylogenetic relationships.

Chisara (1986) reported the studies on the biology of and the fishery for *S. lineolatus* in the Zanzibar channel, Tanzania. Michele

TABLE 8. *Species composition (in t and in percentage) of seerfish landed from Pacific, Indian and Atlantic oceans during 1970s, 1980s and 1990s*

1970s					
SPECIES	**PACIFIC**	**INDIAN**	**ATLANTIC**	**TOTAL**	**%**
S. commerson	28306	32153	0	60459	34.1
Scomberomorus spp.	32987	7234	6202	46422	26.2
S. niphonius	31133	0	0	31133	17.6
S. maculatus	0	0	14454	14454	8.2
S. guttatus	13926	379	0	14305	8.1
S. sierra	5121	0	0	5121	2.9
S. cavalla	0	0	3507	3507	2.0
S. tritor	0	0	1718	1718	1.0
S. regalis	0	0	96	96	0.1
A. solandri	4	0	76	80	0.0
S. lineolatus	0	0	0	0	0.0
TOTAL	111477	39767	26053	177296	

1980s					
SPECIES	**PACIFIC**	**INDIAN**	**ATLANTIC**	**TOTAL**	**%**
S. niphonius	135614	0	0	135614	38.5
s. commerson	36764	55278	0	92041	26.1
Scomberomorus spp.	41769	17599	2239	61607	17.5
S. guttatus	6717	18667	0	25385	7.2
S. maculatus	0	0	18350	18350	5.2
S. cavalla	0	0	7221	7221	2.0
S. sierra	5557	0	0	5557	1.6
S. tritor	0	0	3529	3529	1.0
A. solandri	347	27	1494	1869	0.5
S. lineolatus	0	717	0	717	0.2
S. regalis	0	0	482	482	0.1
TOTAL	226768	92288	33315	352372	

1990s					
SPECIES	**PACIFIC**	**INDIAN**	**ATLANTIC**	**TOTAL**	**%**
S. commerson	48228	55657	0	103885	23.2
Scomberomorus spp.	40128	28978	681	69787	15.6
S. guttatus	9294	26583	0	35877	8.0
S. maculatus	0	0	19527	19527	4.4
S. cavalla	0	0	8012	8012	1.8
S. tritor	0	0	2631	2631	0.6
A. solandri	398	245	1359	2002	0.4
S. lineolatus	0	1496	0	1496	0.3
S. regalis	0	0	371	371	0.1
S. sierra	6765	0	0	6765	1.5
S. niphonius	197811	0	0	197811	44.1
	302624	112959	32581	448165	

Julien-Flus (1988) estimated the growth paramters of *S. brasiliensis* from the coastal areas of Trinidad, West Indies to be L_∞ 93.81 cm and K 0.1765/year, Nomura (1967) estimated the L_∞ and K of this species to be 83 cm and 0.2/yr. for the males and 94.4cm and 0.2/yr. for the females respectively from the Brailian waters, while Sturm (1974) found these values to be 71 cm and 0.26/yr. for the males and 83 cm and 0.23/yr. for the females from Trinidad waters. Kilma (1959) assessed the growth parameters L_∞ K to be 61.2 cm and 0.373/yr. for the males and 76.7 cm and 0.356/yr. for the females of *S. maculatus* from the Florida waters. Tagging and recapture of *S. cavalla* and *S. maculatus* by Sutherland and Fable Jr. (1980) indicated that *S. cavalla* undertook annual migration from the south Florida waters to the north of the northeast coast of the Gulf of Mexico and the west of the south Texas waters in the spring and returned to the south Florida in the fall. They obtained fragmented evidence that *S. maculatus* undertook annual migration from the wintering grounds off south Florida and Campeche-Yucatan to the summer grounds along the northern Gulf coast and a return migration in the fall.

CONCLUSIONS

World seerfish production, which continued to increase with minor fluctuations in subsequent years during 1973-93, may increase further in the coming years also mostly due to the sophistications in the harvest and post-harvest technologies and follow-ups.

The leading countries in seerfish production include China, Indonesia, India, Malaysia, Korea, Mexico, Philippines, Thailand, Pakistan and UAE. The Pacific Ocean lands the bulk of the seerfish catch followed by the Indian and the Atlantic Oceans. Areas 61 and 71 in the Pacific Ocean, 51 and 57 in the Indian Ocean and 31 in the Atlantic Ocean produce the major portion of seerfish. *S. niphonius* followed by *S. commerson* are the dominant species in the Pacific Ocean, *S. commerson* and *S. guttatus* in the Indian Ocean and *S. maculatus* and *S. cavalla* in the Atlantic Ocean. Though almost all the species registered an increase in the production in the subsequent years, the trend in *S. niphonius* was remarkable.

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FOOD AND FEEDING HABITS OF THE KINGSEER, *SCOMBEROMORUS COMMERSON* (LACEPEDE), IN THE SEAS AROUND THE INDIAN PENINSULA

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ABSTRACT

The kingseer prey on surface schooling species like the sardines and the whitebaits. Year-to-year changes in the abundance and recruitment of lesser sardine stocks reflect well in the abundance and size of the prey in the gut. The fish change over from whitebaits to sardines at a size which is about 1/13th its asymptotic length (2081 mm). A linear relation exists between the size of fish caught and the size of bait used for a given hook size of troll. The high incidence of anteroposterior orientation of prey (67.8%) in the gut, small number of gill rakers, strong dentition, larger prey size, and a more fusiform and robust body indicate the kingseer to be a very aggressive predator. Intraspecific competition is apparent from a drastic reduction in the ration level at the peak of kingseer abundance. Ration per unit body weight is much higher in the younger fish. Maturing and ripe fish increase their food intake considerably. Conversion factor and gross growth efficiency indicate considerable energy loss on account of the fast swimming and aggressive habits. The slope of the T-line, q=0.9106, shows that the fish live on optimum levels of diet in a normal nonstress state. The maximum level of growth efficiency at low feeding levels $K = e^{-a} = 0.23$, is outside the range of values, 0.25 to 0.75, obtained in feeding experiments. The von Bertalanffy model describes the weight growth of kingseer much better than the growth models built on food utilisation parameters.

INTRODUCTION

OUR PRESENT knowledge of the food of the kingseer in the Indian seas is limited to a few observations. Venkataraman (1960) examined the stomach of juvenile kingseer (138-207 mm in total length) from Calicut. Kumaran (1964) dealt with the percentage occurrence of the food items of 283 postlarval and juvenile kingseer in the three arbitrary fork length groups: 17-30 mm, 31-60 mm and 61-225 mm from Vizhinjam. Srinivasa Rao (1964) studied the food of 177 young kingseer measuring upto 200 mm in standard length from the Waltair coast. Deshpande and Sivan (1969) listed the food of 41 troll-caught seer from Cochin. Dhawan *et.al.* (1972) reported briefly on the food of the kingseer, 460-1252 mm range in length, from Goa. Very limited observations are available from the Indo-pacific regions where this species is quite abundant. Kingseer caught from the East African waters were examined by Williams (1964) for their food. The food of kingseer from Queensland was reported by Whitley (1964). However, information on food and feeding habits of the adults are too fragmentary to be of real value in elucidating the feeding habits and the dynamics of food intake and utilization. The present account complements our knowledge on the feeding biology of the kingseer.

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