Report on the Assessment of Implementation of Japan's National Plan of Action for the Conservation and Management of Sharks of FAO

(Preliminary version)

(Document for submission to the 25th FAO Committee on Fisheries)

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Fisheries Agency, Government of Japan

Introduction

At the 23rd FAO Committee on Fisheries in February 1999, an International Plan of Action on this subject (IPOA-SHARKS) was adopted. Following this decision, Japan developed its National Plan of Action (Shark-plan) through examination and deliberation by the national discussion committee as well as discussion within the government, and reported it to the 24th FAO Committee on Fisheries in March 2001.

Japan is now striving to ensure scientific knowledge and information regarding shark resources under this National Plan of Action, and also to ensure rational conservation and sustainable use of shark resources based on such proper knowledge.

This document reports to the 25th FAO Committee on Fisheries in February 2003 about assessment of the National Plan of Action and the situation of its implementation in accordance with paragraph 28 of the IPOA-SHARKS.

1. Skates

1) Fisheries harvesting skates

This species is harvested by kasube gillnet and also caught incidentally by trawling and flounder gillnet fishery. In Hokkaido, they are found largely along the coast of the Okhotsk Sea and the Sea of Japan. Along the coast of the Pacific coast, it is caught incidentally with other species of Raja (Nagasawa/Torisawa 1991). According to the catch statistics for 1968-2000, catch volume in the Soya District is high with 41% of the total. There are sizable catch volume along the coast of the Sea of Japan and the Okhotsk Sea, such as Shiribeshi (23%), Nemuro (13%), Rumoi (6%), and Abashiri (6%) (Table 1-1). By type of fisheries, catch volume by gillnet fisheries, such as flounder gillnet fishery, is high with 75% and followed by longline fishery with 11% and trawl fishery with 10% (Data for 1968-1998).(Table 1-2, Fig. 1-1).

2) Species of skates subjected to harvesting

Skates in this section deals with fishes belonging to Kwanggung skate Rajidae genus. Amaoka et al. (1995) recorded 23 species of Kwanggung skate Rajidae observed in the northern Japan area. Of them the fish species likely to be distributing in the area around Hokkaido are 21(Amaoka et al. 1995):

Kwanggung skate genus:
Mottled skate, Acutenose skate, Three star skate, Common skate,

Raspback skate genus:
Abyssal skate, File skate, Raspback skate, Challenger skate, Duskypink skate, Okhotsk skate, Duskypurple skate, Tsumura skate, Notoro skate, Lindberg skate, Whitehead skate, Fedorov skate, Aleutian skate, Golden skate, Thorn skate,

Dapple-bellied softnose skate genus:
Dapple-bellied softnose skate, White-bellied softnose skate.

Of those species, Mottled skate are harvested in the largest quantity, followed by Golden skate (Nagasawa/Torisawa 1991).

3) Biology of skates subjected to harvesting.

The fish commonly called "kasube" in Hokkaido are fishes belonging to Kwanggung skate family. They are classified into Kwanggung skate genus, Raspback skate genus, and Dapple-bellied softnose skate genus according to the shape of soft snout bone.

Fishes belonging to Kwanggung skate genus have thick and robust soft snout bone. This includes Mottled skate and Acutenose skate. Acutenose skate are often found along the Pacific coast, and they resemble Mottled skate. They can be distinguished by long and stick-like projecting snout, and the absence of clear spot marks on disks.

Fishes belonging to Raspback skate genus have soft snout bone. They include Golden skate and Raspback skate. Golden skates are caught in largest number only after Mottled skate, mainly in the Okhotsk Sea and northern part of the Sea of Japan.

Fishes belonging to Dapple-bellied softnose skate genus have slender soft snout bone. The snout is softest because it is not combined with skull.

Dapple-bellied softnose skate and White-bellied softnose skate are included in this genus. All of them are found in the deep sea of the Pacific (Nagasawa/Torisawa 1991).

i) Standard Japanese name, scientific name, English name, and identification issues

standard Japanese name / scientific name / English name

Megane kasube / *Raja pulchra* / Mottled skate

Tengu kasube / *Raja tengu* / Acutenose skate

Dobu kasube / *Bathyraja smirnovi* / Golden skate

Sokogangiei / *Bathyraja bergi* / Raspback skate

Kuji kasube / *Rhinoraja kujiensis* / Dapple-bellied softnose skate

Onaga kasube / *Rhinoraja longicauda* / White-bellied softnose skate

Catch volume of Mottled skate (regional name: Makasube) is the largest, followed by Golden skate. The regional names of Ainu kasube and Dorokasube probably mean Golden skate. There may be need to confirm this aspect.

ii) Distribution

Mottled skate is found at the sea depth of 50-100m, it is oviparous and its body size reaches 1m. It is distributed from Hokkaido, including the Okhotsk Sea, to the East China Sea.

Golden skate has been recorded at the sea depth of 100-950 m. It is distributed in northern Japan, the Okhotsk Sea, North Pacific, and the Bering Sea.

Raspback skate is found at the sea depth of 100-250m, and is distributed in the Pacific in northern Japan, the Sea of Japan, and the Okhotsk Sea.

Dapple-bellied softnose skate is mainly found at the sea depth of 600-800 m, and is distributed from the Chishima Islands to the East China Sea.

White-bellied softnose skate is mainly found at the sea depth of 300-1,000 m, and is distributed north of Choshi in the Pacific of northern Japan (Amaoka et al. 1995).

iii) Stock, etc.

Very little is known about stock of skates. There is a possibility that there exists a stock structure conforming to the shapes of sea-bottom, judging from the type of distribution complying with sea depth and the breeding patterns of spawning eggs wrapped by eggshell. Further research may be necessary.

4) Historical changes in catch volume

According to Hokkaido Statistical Annual Report on Agriculture, Forestry and Fisheries from 1968 to 1998, and the Annual Report on Fisheries and Aquaculture Production Statistics in 1999 and 2000, catch volume, which had stayed on the 2000-ton level in the latter half of the 1960s, fell to the 1000-ton mark by early 1970s, because of the decline in trawling catch volume. Along with the increase in gillnet catch from the mid-1970s; it reached the peak of 5,000 tons in 1980. In the peak year of 1980, catch volume of rays by cod gillnet fishery was at a very high level of 939 tons.

Later, catch volume by gillnet decline, and stayed at a stable level of around 2000 tons from 1991, but turned upward from 1999, reaching 2,800 tons in 2000 (Table 1-2, Fig. 1-1).

5) Fishing effort (number of vessels operating, number of fishing days, etc.)

Regarding catch volume by type of fisheries, flounder gillnet fishery has been catching rays relatively on a stable basis (Table 1-2). Although detailed data on fishing effort are not available, the number of fishery management units and number of fishing days of flounder gillnet fishery is available from Hokkaido Agriculture, Forestry and Fisheries Statistics Annual Report. Data on the number of fishery management units from 1968 to 1998 were made available, with the maximum of 4,598 in 1980 and the minimum of 3,461 in 1998 and the average value standing at 4,099. Data on number of fishing days from 1968 to 1987 were made available, with the average of 270,204 days (maximum 319,284 days in 1981; minimum 214,224 days in 1971) (Table 1-3).

6) Changes in stock status and fishing rate

Catch quantities of rays by flounder gillnet fishery, both in terms of number of fishery management units and number of fishing days, continued gradual decline after peaking out in 1971, staying at relative low level at present (Table 1-3, Fig. 1-2). These results are considered to be reflecting stock status of rays to some extent although there are problems such as that catch volume of rays by flounder gillnet fishery account 13% of the total and the number of fishery management units and fishing days are arbitrary in counting fishing effort.

7) Recommendations on Stock assessment and conservation and management

Although data on stock status by fish species are not available, catch volume of rays by flounder gillnet fishery, both in terms of number of fishery management units and number of fishing days, gradually declined after peaking out in 1971, now being stabilized at relative low levels in recent years.

8) References

Amaoka, K./Kazuhiro Nakaya/Yabe, M.. 1995. Illustrated Book of Fish in Northern Japan, North Japan Marine Center, Sapporo. 390pp.

Nagasawa, K./Torisawa, M. ed. 1991. Illustrated Book on Fishery Resources, Fishes in Northern Japan, North Japan Marine Center, Sapporo. 415pp.

Statistics Information Division, the Ministry of Agriculture, Forestry and Fisheries. 1999-2000. Annual Reports on Fisheries and Aquaculture Production Statistics.

Ministry of Agriculture, Forestry and Fisheries Hokkaido statistics information Office. 1968-1995. Hokkaido Agriculture, Forestry and Fisheries statistics Annual Report (Fisheries).

Schwartz, F. J. 1996. Biology of the clearnose skate, Raja tengu, from North Carolina. Biological Science. 59(2): 82-95.

Teshima, K. and S. Tomonaga. 1986. Reproduction of Aaleutian skate, Bathyraja aleutica with comments on embryonic development. Indo-Pacific Fish Biology: Proceedings of the Second International Conference on Indo-Pacific Fishes. Edited by

T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura. pp.303-309, Ichthyological Society of Japan, Tokyo.

Table 1-1. Catch volume of Skates by administrative area in Hokkaido in 1968-2000(ton)

Year	Soya	Abashiri	Nemuro	Kushiro	Tokachi	Hidaka	Iburi	Oshima	Hiyama	Shiribeshi	Ishikari	Rumoi	Total
1968	810	162	344	3	51	112	282	41	35	450	15	163	2,468
1969	387	227	376	2	49	103	213	49	44	317	21	191	1,979
1970	483	201	349	2	70	160	199	81	64	425	62	399	2,495
1971	72	8	323	1	33	59	234	11	48	476	39	249	1,553
1972	80	24	282	3	36	54	186	7	44	308	25	80	1,129
1973	130	78	563	1	49	75	161	4	30	191	13	86	1,381
1974	172	101	173	1	43	47	129	12	14	262	7	68	1,029
1975	787	110	179	1	36	32	127	15	34	478	27	269	2,095
1976	721	91	612	2	37	14	93	23	13	423	56	251	2,336
1977	1,884	97	273	2	20	8	87	3	6	1,242	16	167	3,805
1978	1,228	52	272	3	24	5	100	6	8	248	14	136	2,096
1979	2,389	40	290	3	11	2	82	6	5	184	10	112	3,134
1980	3,419	49	439	1	8	152	133	4	8	831	3	134	5,181
1981	595	39	420	2	16	104	74	3	4	1,817	3	52	3,129
1982	1,335	143	321	2	18	116	69	3	5	1,595	31	160	3,798
1983	1,134	41	556	1	5	60	40	3	5	593	23	179	2,640

1984	1,711	61	429	3	5	59	35	15	9	604	30	307	3,268
1985	533	48	445	11	1	1	51	107	5	410	11	106	1,729
1986	905	81	275	7	1	2	31	99	9	528	2	113	2,053
1987	1,143	115	275	4	23	1	28	73	5	866	30	128	2,691
1988	1,413	179	411	4	31	1	44	68	24	515	15	185	2,890
1989	970	230	362	6	26	0	31	19	5	259	14	82	2,004
1990	1,324	182	261	195	7	0	21	71	8	472	15	64	2,620
1991	1,138	187	237	3	0	0	9	63	28	293	19	139	2,116
1992	624	384	415	1	1	1	21	90	32	389	18	122	2,098
1993	909	130	266	2	5	1	45	48	29	457	14	124	2,030
1994	845	174	205	4	6	0	20	33	51	586	12	92	2,028
1995	680	234	166	4	4	1	22	33	85	560	22	109	1,920
1996	696	247	127	7	2	0	32	64	67	635	16	124	2,017
1997	677	282	159	45	2	1	22	50	83	425	26	157	1,929
1998	985	261	204	30	1	1	24	41	123	306	14	171	2,162
1999	1,054	308	244	27	1	1	84	42	103	384	13	149	2,410
2000	1,117	501	211	131	3	0	33	64	97	552	9	121	2,840
average	980	154	317	16	19	36	84	38	34	548	20	151	2,396
%	41	6	13	1	1	1	3	2	1	23	1	6	100

Table 1-2. Catch volume of Skates by type of fisheries in Hokkaido 1968-1998(tons)

Year	Offshore Trawl fishery	Small Type trawl	**Net Trawl subtotal**	Flounder gillnet	Pollock Gillnet	Cod Gillnet	Atka Mackerel gillnet	King Crab gillnet	Other Gillnet	**gillnet subtotal**	cod and shark longline	Baitless Longline	Pollock Longline	Other Longline	**Longline Subtotal**	Salmon set net	Other Large Type set net	Small Type set net	**set net subtotal**	**Others**	**Total**
1968	698	23	**721**	505	5	0	4	0	250	**764**	345	49	0	492	**886**	40	0	53	**93**	**4**	**2,468**
1969	491	36	**527**	327	5	0	6	1	415	**754**	224	16	0	368	**608**	32	4	54	**90**	**0**	**1,979**
1970	814	30	**844**	450	2	0	5	1	503	**961**	148	82	1	272	**503**	111	6	66	**183**	**4**	**2,495**
1971	0	15	**15**	658	8	0	2	0	645	**1,313**	48	24	8	51	**131**	38	1	39	**78**	**16**	**1,553**
1972	0	4	**4**	427	12	0	27	4	417	**887**	14	22	7	118	**161**	33	1	40	**74**	**3**	**1,129**
1973	0	13	**13**	362	23	0	3	23	557	**968**	94	13	32	182	**321**	40	0	39	**79**	**0**	**1,381**
1974	57	4	**61**	260	2	0	18	0	384	**664**	65	7	4	92	**168**	33	1	99	**133**	**3**	**1,029**
1975	37	8	**45**	330	0	0	9	10	1,310	**1,659**	79	13	6	158	**256**	25	1	108	**134**	**1**	**2,095**
1976	28	4	**32**	376	169	0	63	58	1,231	**1,897**	85	9	10	146	**250**	43	0	112	**155**	**2**	**2,336**
1977	41	4	**45**	304	11	0	9	54	3,065	**3,443**	68	2	5	105	**180**	43	0	91	**134**	**3**	**3,805**
1978	4	8	**12**	280	2	27	11	14	1,530	**1,864**	0	4	5	105	**114**	31	1	71	**103**	**2**	**2,095**
1979	25	5	**30**	262	4	598	22	0	2,025	**2,911**	0	0	1	100	**101**	13	1	79	**93**	**0**	**3,135**
1980	35	6	**41**	379	1	939	0	0	3,363	**4,682**	0	0	0	284	**284**	28	3	143	**174**	**0**	**5,181**
1981	34	8	**42**	360	2	257	2	3	2,123	**2,747**	0	0	0	244	**244**	35	2	59	**96**	**0**	**3,129**
1982	531	3	**534**	355	14	216	1	9	2,442	**3,037**	0	0	0	125	**125**	30	10	61	**101**	**0**	**3,797**
1983	307	2	**309**	456	0	94	1	0	1,476	**2,027**	0	0	0	155	**155**	29	19	101	**149**	**0**	**2,640**
1984	551	8	**559**	381	0	97	0	5	2,080	**2,563**	0	0	0	17	**17**	30	27	72	**129**	**0**	**3,268**
1985	28	11	**39**	240	1	120	2	20	1,186	**1,569**	0	0	0	14	**14**	10	7	90	**107**	**0**	**1,729**
1986	239	15	**254**	199	5	93	18	8	1,236	**1,559**	0	0	0	138	**138**	32	18	52	**102**	**0**	**2,053**
1987	223	6	**229**	218	0	72	3	4	1,909	**2,206**	0	0	0	193	**193**	20	9	34	**63**	**0**	**2,691**
1988	161	6	**167**	230	1	22	9	0	1,934	**2,196**	0	0	0	440	**440**	32	9	46	**87**	**0**	**2,890**
1989	132	3	**135**	214	0	68	3	0	1,194	**1,479**	0	0	0	327	**327**	29	3	31	**63**	**0**	**2,004**
1990	364	7	**371**	256	2	19	4	0	1,655	**1,936**	0	0	0	273	**273**	21	2	17	**40**	**0**	**2,620**
1991	184	3	**187**	364	0	10	1	0	1,231	**1,606**	0	1	0	256	**257**	32	3	30	**65**	**1**	**2,116**
1992	172	7	**179**	345	12	12	9	0	1,022	**1,400**	0	0	0	421	**421**	55	5	38	**98**	**0**	**2,098**
1993	253	13	**266**	186	7	17	5	0	1,205	**1,420**	0	1	0	286	**287**	13	5	39	**57**	**0**	**2,030**
1994	328	10	**338**	213	5	30	9	0	1,019	**1,276**	0	2	0	332	**334**	26	2	52	**80**	**0**	**2,028**
1995	283	9	**292**	207	2	26	1	0	1,118	**1,354**	0	0	0	189	**189**	30	4	51	**85**	**0**	**1,920**
1996	259	17	**276**	203	2	28	4	0	1,154	**1,391**	0	1	0	242	**244**	29	6	69	**104**	**2**	**2,017**
1997	242	45	**287**	204	3	25	128	0	882	**1,243**	0	15	0	247	**262**	44	7	78	**129**	**7**	**1,929**
1998	474	38	**512**	258	20	52	10	0	920	**1,260**	0	2	0	213	**215**	73	6	95	**174**	**1**	**2,162**
average	**226**	**12**	**238**	**316**	**10**	**91**	**13**	**7**	**1,338**	**1,775**	**38**	**8**	**3**	**212**	**261**	**35**	**5**	**65**	**105**	**2**	**2,381**
%	**9**	**1**	10	**13**	**0**	**4**	**1**	**0**	**56**	75	**2**	**0**	**0**	**9**	11	**1**	**0**	**3**	4	**0**	100

Table 1-3. Fishing unit, fishing days, catch volume, skates catch per fishing unit and skates catch per fishing days by flounder gillnet in Hokkaido 1968-1998

Year	Fishery unit	Fishing days	Catch volume(tons)	Skates catch volume(tons)	Skate catch per fishing unit x100	Skates catch per fishing days x10000
1968	4,025	244,855	26,428	505	12.5	20.6
1969	3,711	240,882	24,695	327	8.8	13.6
1970	3,830	238,647	29,275	450	11.7	18.9
1971	3,671	214,224	30,364	658	17.9	30.7
1972	3,655	222,603	27,047	427	11.7	19.2
1973	3,643	226,332	27,220	362	9.9	16.0
1974	3,841	234,715	27,690	260	6.8	11.1
1975	3,851	235,605	31,401	330	8.6	14.0
1976	3,819	238,307	31,918	376	9.8	15.8
1977	4,341	296,156	38,762	304	7.0	10.3
1978	4,283	302,691	36,540	280	6.5	9.3
1979	4,528	309,816	33,763	262	5.8	8.5
1980	4,598	318,855	31,700	379	8.2	11.9
1981	4,594	319,284	33,897	360	7.8	11.3
1982	4,551	302,855	34,433	355	7.8	11.7
1983	4,382	263,819	28,238	456	10.4	17.3
1984	4,466	289,723	32,480	381	8.5	13.2
1985	4,524	314,558	32,334	240	5.3	7.6
1986	4,363	289,393	27,808	199	4.6	6.9
1987	4,308	300,768	27,429	218	5.1	7.2
1988	4,391		27,133	230	5.2	
1989	4,376		26,715	214	4.9	
1990	4,464		28,377	256	5.7	
1991	4,249		26,610	364	8.6	
1992	4,234		26,250	345	8.1	
1993	4,059		23,250	186	4.6	
1994	3,727		19,227	213	5.7	
1995	3,714		21,527	207	5.6	
1996	3,742		22,299	203	5.4	
1997	3,710		23,742	204	5.5	
1998	3,416		22,091	258	7.6	
average	4,099	270,204	28,408	316	7.8	13.7

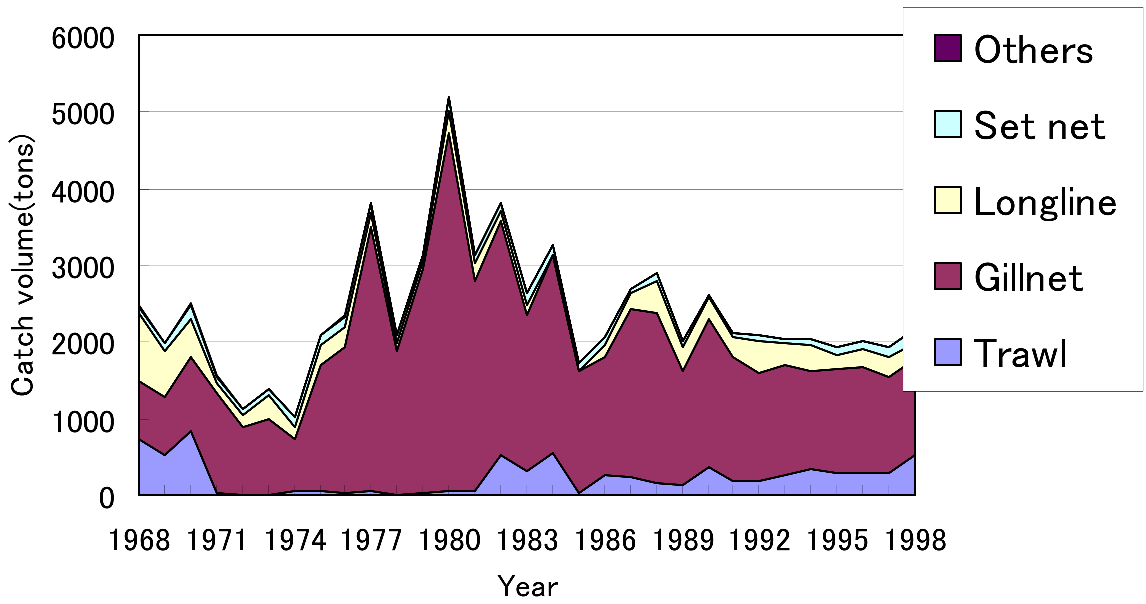
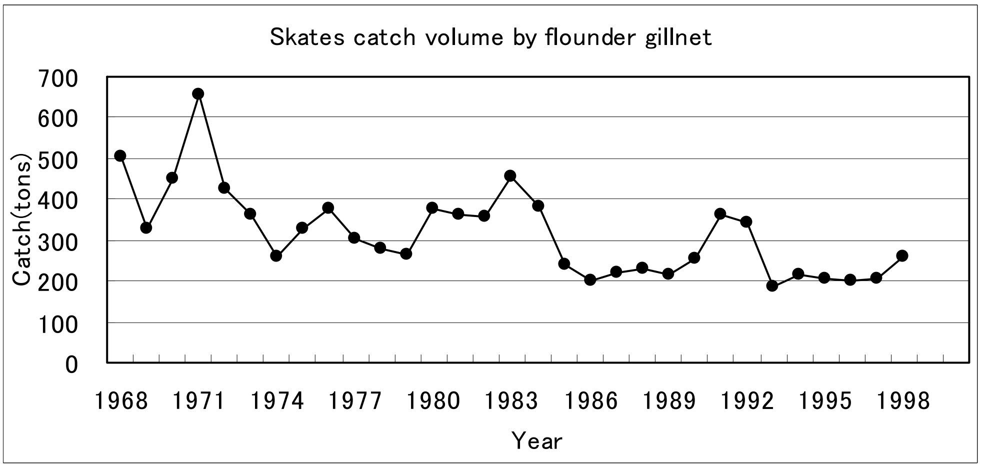
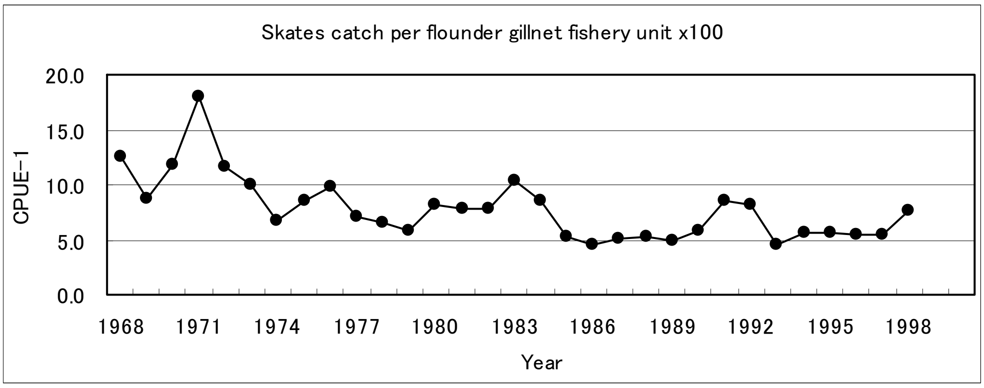


Fig.1-1.Catch volume of Skates by type of fisheries in Hokkaido





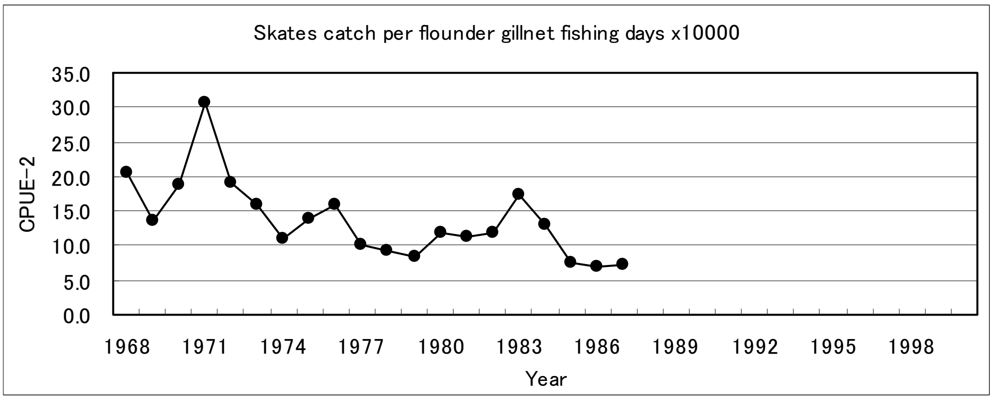


Fig.1-2 Skates catch volume, catch per fishery unit and catch per fishing days by flounder gillnet

2. Pacific North Area Spiny dogfish

1) Catch volume

The catch volume of Spiny dogfish by offshore trawl fishery in the Pacific North Area (from Aomori to Chiba Prefectures) was over 700 tons in 1974-1979. Subsequently, the catch volume gradually declined after repeated fluctuations, and fell below 200 tons since 1996. In 1999, the catch volume hit the lowest level of 115 tons since 1971, but went upward to 232 tons in 2000. The catch volume in 2001 was 203 tons, slightly lower from the previous year.

By sea area, the catch volume in Shiriyazaki Area increased from 56 tons in 2000 to 86 tons in 2001. On the other hand the catch volume in Kinkazan Area dropped from 95 tons in 2000 to 53 tons in 2001. Similarly, the catch volume in Joban Area also fell from 55 tons to 41 tons.

2) Fishing method (number of net settings) and CPUE (catch volume per net)

In offshore trawl fishery in Pacific North Area, three operation methods are used: Japanese Danish seine fishery in Aomori Prefecture, bull trawl and Japanese Danish seine fishery in Iwate Prefecture and otter trawl in Miyagi, Fukushima, Ibaraki and Chiba Prefectures.

In Japanese Danish seine fishery in Shiriyazaki Area, the number of net settings in 2001 was 7,530 times, which was an increase from 5,351 times in 2000. The number of net settings in Japanese Danish seine fishery in Iwate Prefecture in 2001 was 1,012 times, which was more or less the same level as 2000 (1,060 times). The number of net settings in bull trawl in Iwate Area was 2,068 times, more or less the same as 2,191 times in 2000, like the case of Japanese Danish seine fishery. On the other hand, in otter trawl in Kinkazan and Joban Areas, the number of net settings in 2001 was 7,723 times and 3,002 times, which was a decline from times 9,181 times and 4,138 times in 2000, respectively. The number of net settings in Boso Area was 100 times in 2000 and 176 times in 2001.

Next, we will look at CPUE. CPUE for 2001 in Shiriyazaki Area was 10.9, an increase from 10.5 in the previous year. In bull trawl in Iwate Area in 2001 somewhat improved to 9.8 from 8.6 in 2000. On the other hand, in Kinkazan Area, CPUE stood at 6.6 in 2001, showing a decline from 2000 (10.1). In Joban Area, CPUE slightly increased from 13.2 to 13.7. On the whole, CPUE is said to remain unchanged.

3) Stock status

The catch volume of Spiny dogfish in the Pacific North Area was extremely low at 115-191 tons in 1996-1999. In 2000, the catch volume increased to 232 tons but dipped to 203 tons in 2001. In Shiriyazaki, Kinkazan and Joban Areas, on the other hand, fishing effort (the number of net settings) in 2000 and 2001 considerably increased from the previous years. However, in the Kinkazan-Joban Areas, operation targeting at Spiny dogfish seldom occurs. Therefore the increase in the number of net settings is deemed due to the increasing number of incidental take of this species. From the trend in catch volume and CPUE, it is judged that Pacific North Area Spiny dogfish are at a low stock level in recent years, but are fairly constant with little fluctuations.

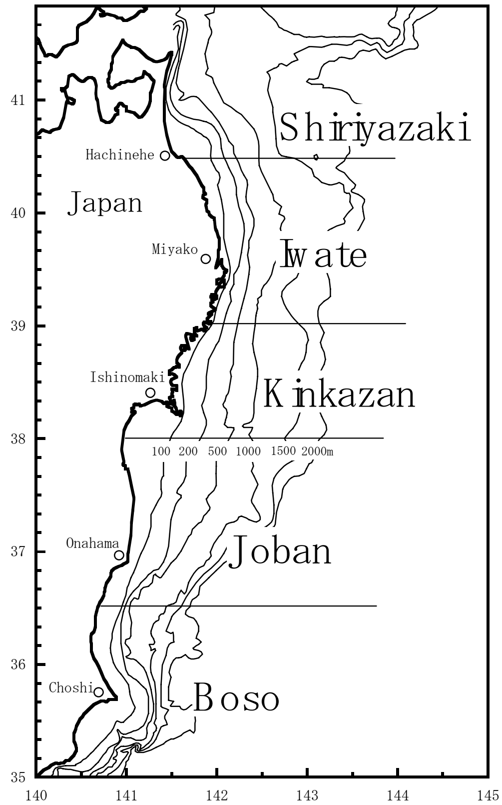


Fig. 2-1. Map of northeastern Pacific coastal area in offshre trawl fishery.

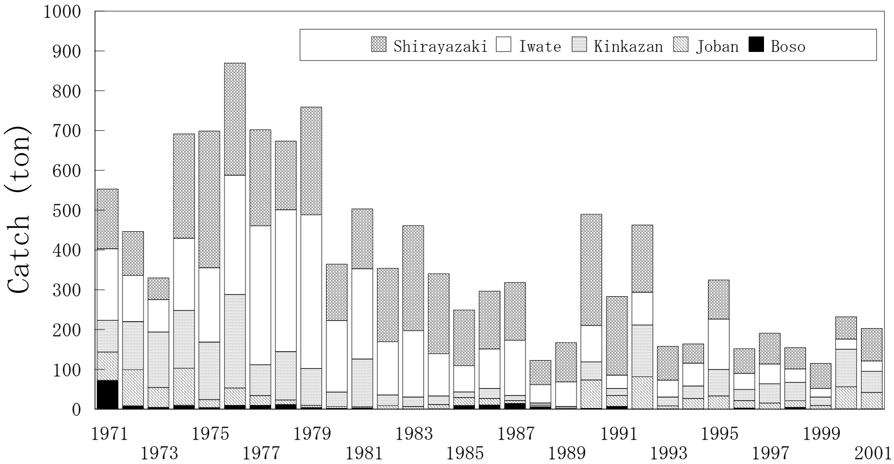


Fig. 2-2 Annual change of the catch of spiny dogfish by offshore trawl fishery in northeastern Japan.

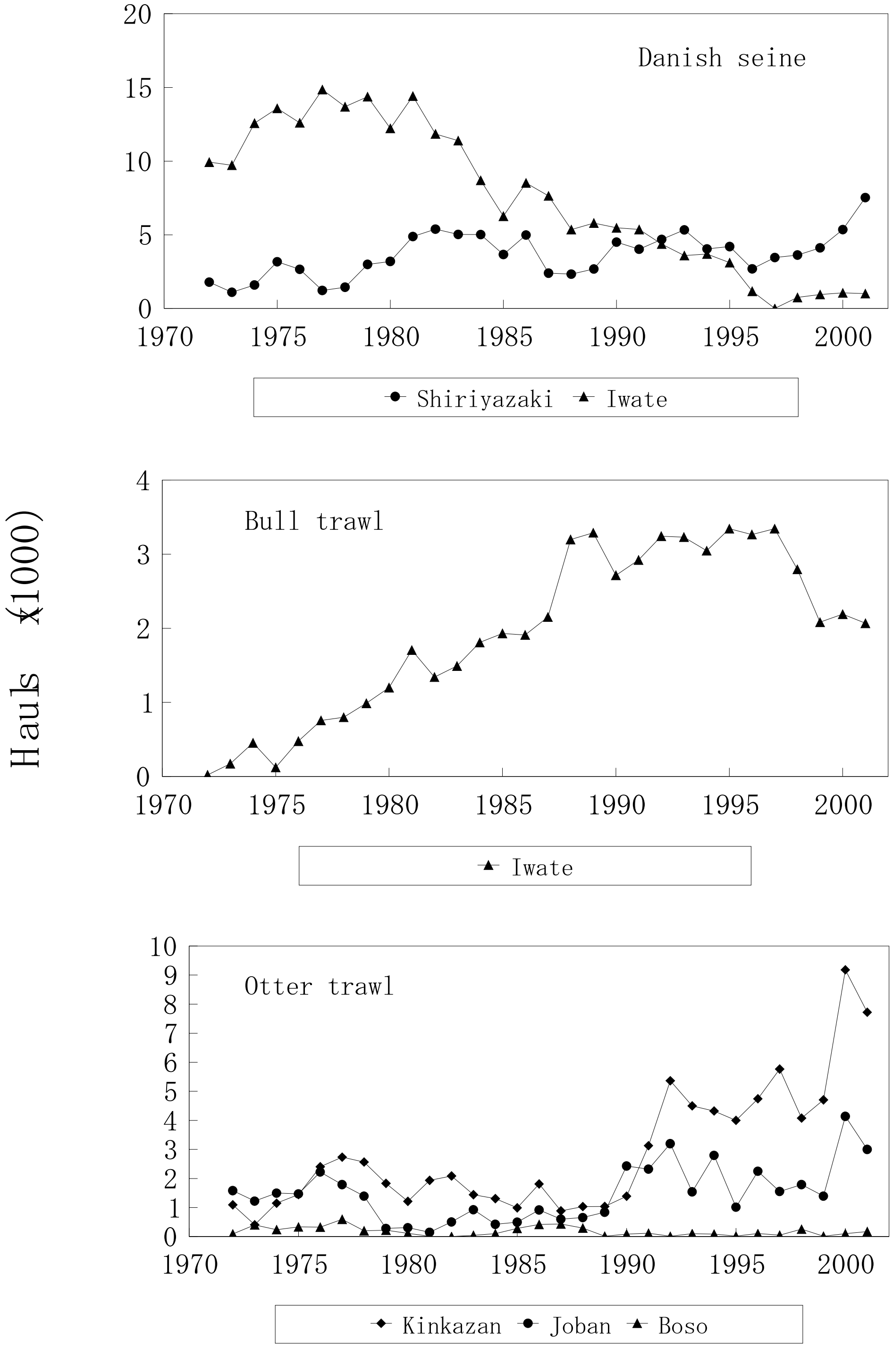


Fig.2-3. Annual changes of the effort (hauls) in spiny dogfish by three fishing methods of offshore trawl fishery in northeastern Japan.

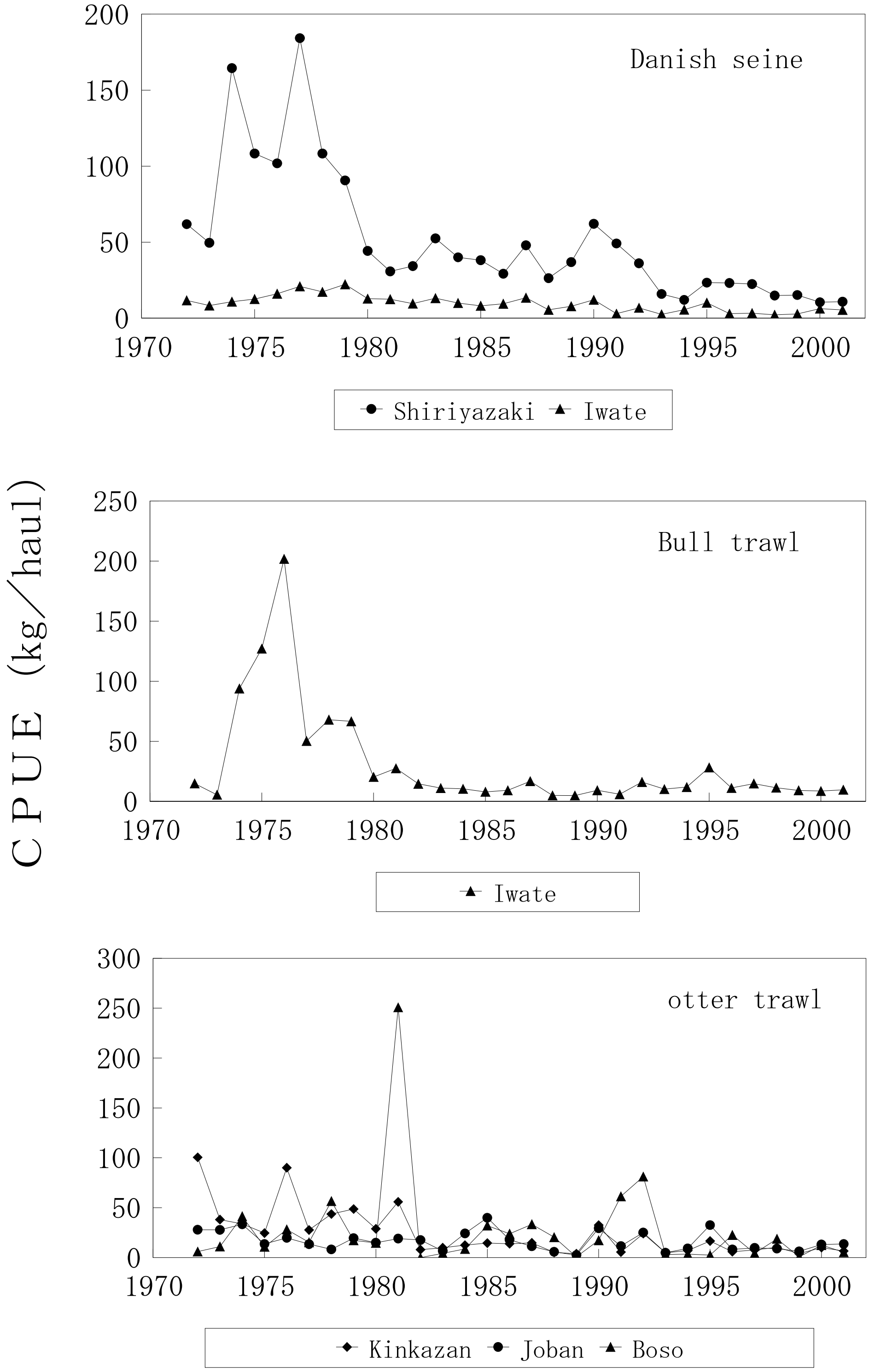


Fig. 2-4. Annual changes of CPUE (kg/haul) of spiny dogfish by three fishing methods of offshore trawl fishery in northeastern Japan.

3. Spiny dogfish in the Sea-of-Japan Area

1) An outline of fisheries

Catch of Spiny dogfish seemed to have taken place in the Sea of Japan from many years ago. It was since around the end of the decade from 1897 that this fishery was treated as full-scale catch. Initially, it was incidental take in longline fisheries targeting at Pacific cod along the coast of Aomori, Akita, and Ishikawa Prefectures. But gradually, full-scale fishery targeting at Spiny dogfish developed using longline and trawl-nets.

In Aomori Prefecture, experimental bottom fishing was conducted jointly with Hokkaido, and this fishing was encouraged. As a result, this fishery expanded and thrived on the Sea-of-Japan side of Aomori Prefecture by around 1914-1915. However, it declined in three to four years, and many fishermen converted again to bottom longline fisheries. Longline fisheries mainly targeting at Spiny dogfish in Aomori Prefecture entered into full-scale operation in early Showa period (1926-1989). Catch by engine-powered trawl-net fishery started around 1932-1933.

In Akita Prefecture, this species was caught by longline fisheries by 1921, and bottom gillnet catch started from around 1922. Since around 1926, this fishery was operated extensively in the prefecture along with the expansion of the use of engine-powered fishing vessels.

In Ishikawa Prefecture, longline fisheries targeting Spiny dogfish (a species damaging nets in longline fisheries for Pacific cod) was started around 1918. From around 1924, this fishery expanded, with the peak period coming in early 1950s. Since the 1930s, harvests using trawl-nets started, and the number of fishing vessels newly launching into this fishery increased and the catch volume also expanded. The harvests in the Sea of Japan from 1927 to 1929 totaled 7,500 tons to 11,250 tons, accounting for 1/4 to 1/6 of the nation's overall catch.

In postwar years, the value of Spiny dogfish increased because of the development of paste products production and increasing demand for vitamin oil and fat, and fisheries on this species expanded mainly centering on the northern part of the Sea of Japan.

Nowadays this species is caught mainly by such fisheries as trawl-net, bottom gillnet and floating longline fisheries. Because of lower demand for Spiny dogfish, new launching of fisheries targeting this species largely decreased.

The harvest season in the Sea of Japan is December-January (i.e. the period of southward migration) and March-April (i.e. the period of northward migration) in the northern part. In the area south of Ishikawa Prefecture, catch volume increases in January-April.

2) Types of sharks being caught

Most of sharks caught in the Sea of Japan are Spiny dogfish. Other species harvested are Starspotted smooth hounds and Salmon sharks. At times, Banded houndshark, Bullhead sharks, Shortfin mako, Hammerhead sharks are caught incidentally.

3) Distribution

Spiny dogfish is distributed in extensive sea areas ranging in both eastern and western coasts of the Pacific. In the waters surrounding the Japanese Archipelago as well, they are distributed in the entire area of the Sea of Japan, and north of Choshi, Chiba Prefecture, on the Pacific side.

This species moves and migrates extensively. In the Sea of Japan, it migrates northward in the offshore area of the Honshu Island in March and April, with some moving toward Sakhalin Island and others moving southward to the area on the Okhotsk Sea side via the Soya Strait around June and migrating to Abashiri and South Kurile Islands.

In July-September, they move from Hokkaido to Sakhalin Island and approach again the Hokkaido coast from around October. Then they migrate southward along the western coast and reach west southern tip of Hokkaido in December-January and to the offshore areas of Shimane and Yamaguchi Prefectures and east southern coast of the Korean Peninsula in February and March.

4) Stocks

There is no knowledge available on the stock of Spiny dogfish distributed in the Sea of Japan. However, according to the results of mark recapture experiment, it has been confirmed that the stock is engaged in a fairly extensive range of migration. Therefore, it is estimated that there is extensive interaction in the North Pacific.

5) Changes in catch volume

There is no information available on the catch volume of Spiny dogfish in the Sea of Japan other than that known through prefectural statistics compiled under the category of "sharks." In the Sea of Japan, the proportion of Spiny dogfish in all sharks is very large. Therefore, it is possible to estimate the trend of Spiny dogfish from the catch volume of sharks.

It is difficult to identify accurate catch volume of Spiny dogfish because catch statistics before 1951 had been compiled under the category of sharks.

With respect to prefectural statistics, Ishikawa Prefecture has data since 1951, and Toyoma Prefecture only for the period since 1972. As shown in Table 1, no data are available for all prefectures with respect to the 1950s. Catch volume by each prefecture is considerably large as compared with recent years, and a trend of conspicuous decline is observed.

Regarding catch volume data only of Spiny dogfish, there exist data for offshore trawl fishery. (The data have been published by the Sea-of-Japan Area Fisheries Research Institute since 1970. The data were compiled under the category of "sharks" only for 1989.)

Those data show that catch volume was over 1,700 tons in 1973. catch volume gradually declined to 188 tons in 1999, and to the lowest level of 77 tons in 2000, while a slight increase to 112 tons was observed in 2001 (Table 2).

6) Catch effort

Catch effort for Spiny dogfish in offshore trawl-net fishery in the Sea of Japan showed an upward trend with continued fluctuations from the 1970s to 1990. From 1990, however, it declined gradually, reaching the bottom in 2000 (Table 2).

7) State of the resources

When we look at annual changes of the state of the resources on the basis of calculation of stock index from catch volume by offshore trawl fishery and the number of effective nets, we find that the value is on a gradual decline by making fluctuations after it showed the highest value in 1974. In 2000, it hit the bottom value of 929kg. As a result, it is estimated that Spiny dogfish resources have been at an extremely low in recent years (Table 2).

8) References

Ugawa, M. (1954), A survey on the growth of foetus of Spiny dogfish. Report on the development research on Tsushima Warm Current. Paper presented to the first symposium , 213-223

The Sea-of-Japan Area Fisheries Research Institute (1969); Catch statistics data by fishing ground of the Sea-of-Japan offshore trawl fishery.

Ohuchi, A. (1956) Fishery biological research on important fish species: Spiny dogfish. Nippon Suisan Research News (4), 141-158.

Kanno, Y. (1954) About the ecology of Spiny dogfish. Report on the development research on Tsushima Warm Current. Paper presented to the first symposium , 209-211

Tanabu, M.; Fukuhara, A.; Kanno, Y.; Ugawa, M.; Yusa, T.; Kojima, I.; Nagamine, Y. (1958) Report on the development research on Tsushima Warm Current. No.4, pp 84, the Fisheries Agency_

Table3-1.Catch volume data of sharks in the Sea of Japan(Prefectural statistics, unit :ton)

year	Aomiri	Akita	Yamagata	Niigata	Toyama	Ishikawa	Fukui	Kyoto	Hyogo	Tottori	Simane	Yamaguchi
1951						629						
1952						885	131				774	
1953						787	84			321	946	
1954						911	68	42		185	583	
1955						568	102	29		217	684	2603
1956				982		336	99	55		176	755	2139
1957				642		1121	63	50		115	717	2481
1958				684		165	34	31	201	90	663	2254
1959				420		177	28	26	166	88	543	2638
1960			519	734		97	38	35	132	76	480	2805
1961			473	416		79	40	37	111	78	369	1882
1962			305	199		57	31	21	104	76	596	1239
1963			305	218		76	44	25	121	118	447	1069
1964		960	694	416		167	48	10	61	55	293	1302
1965		864	377	503		128	74	9	27	88	409	966
1966		795	330	463		169	65	21	14	83	243	785
1967	517	869	517	353		341	54	20	14	87	270	688
1968	354	712	555	593		209	29	12	6	54	237	968
1969	894	777	476	356		926	33	10	5	46	205	455
1970	1193	575	537	602		387	25	7	3	46	169	437
1971	552	802	544	681		279	10	23	3	14	71	449
1972	924	990	562	700	24	451	6	10	2	26	79	500
1973	786	1706	589	253	106	87	6	7	4	12	109	503
1974	960	912	879	1326	136	372	23	3	5	12	159	279
1975	499	1643	254	459	82	164	10	2	1	20	73	273
1976	1089	966	801	1257	98	126	2	2	1	15	95	471
1977	712	1033	278	1407	98	138	5	4	3	12	97	956
1978	1005	789	465	994	68	79	94	4	3	12	54	556
1979	763	643	277	531	52	58	48	3	0	31	64	221
1980	580	646	315	289	15	38	40	4	0	15	67	117
1981	147	612	403	314	98	20	22	6	1	3	93	101
1982	229	620	546	249	89	50	37	8	7	29	98	90
1983	260	476	267	765	67	20	24	2	0	30	71	177
1984	465	700	265	397	7	78	9	5	1	33	86	365
1985	337	387	403	569	24	55	2	6	2	8	94	25
1986	580	230	471	491	26	61	11	4	1	0	83	17
1987	394	400	324	777	77	39	2	2	2	0	70	30
1988	414	281	207	274	31	27	7	2	3	0	45	42
1989	1053	321	191	114	47	43	6	3	1	1	55	41
1990	285	190	145	78	88	25	5	3	2	5	58	31
1991	326	256	85	185	60	27	6	3	1	7	56	37
1992	521	183	102	125	79	18	7	4	0	9	66	33
1993	250	228	113	170	13	28	6	3	2	8	54	34
1994	230	158	86	114	117	60	5	4	2	8	34	31
1995	326	114	79	75	32	22	3	3	2	5	40	29
1996	400	115	58	95	1	15	5	2	1	4	35	36
1997	262	116	37	53	0	13	1	3	1	4	34	40
1998	196	89	28	35	0	7	2		1	2	43	54
1999	253	76	24	44	0	12	4	5	1	1	35	34
2000	195	104	26	34	0	12	2	2	1		26	41

Table3-2. Catch volume, effort and the states of resources for Spiny dogfish in offshore trawl-net-fishery in the Sea of Japan

year	Catch volume (kg)	Effort (net)	States of resources (kg)	Reference
1970	1,359,259			
1971	1,041,076	29,613	13,786	
1972	913,648	24,551	17,313	
1973	1,708,914	36,799	13,801	
1974	1,620,037	32,734	28,895	
1975	1,171,508	26,305	8,374	
1976	1,023,681	34,004	18,077	
1977	868,826	22,295	23,458	
1978	986,873	29,246	12,229	
1979	814,964	36,991	10,658	
1980	879,974	41,808	10,464	
1981	372,632	36,216	3,240	
1982	474,080	42,652	4,795	
1983	529,765	33,347	5,745	
1984	699,556	47,478	7,685	
1985	381,186	42,683	4,041	
1986	581,039	46,260	11,218	
1987	534,730	34,188	8,478	
1988	510,919	41,996	4,315	
1989	1,181,630	46,558	7,982	Category of ‘sharks’
1990	270,305	45,995	3,245	
1991	340,029	36,544	6,243	
1992	301,366	38,349	4,344	
1993	308,667	28,102	10,339	
1994	297,517	26,140	2,999	
1995	209,545	24,189	3,654	
1996	399,741	25,425	5,026	
1997	219,941	26,116	3,380	
1998	231,790	22,120	3,111	
1999	188,371	17,590	1,753	
2000	76,879	16,238	929	
2001	111,554	14,895	2,182	

4. Trawl fishery operated in the East China Sea (bottom sharks, rays)

1) Outline of the fishery

Trawl fishery operated in the East China Sea (East China Sea trawling) started early 20th century, targeting yellow sea bream (Dentex tumifrons) in the continental shelf edge in the East China Sea. As resource status of sea breams such as yellow sea bream soon deteriorated, target species was shifted to other fish species such as croakers, but the status of those resources worsened in the 1930s. The resources are considered to have recovered substantially in the first half of the 1940s because fisheries were halted during the war time. This trawl fishery saw a remarkable growth in postwar years helped by recovery of the resources due to suspension of fishing and the national policy to increase supply of animal protein. The number of licensed fishing vessels in 1949 reached 968 for two-boat trawl and 58 for one boat trawl.

For this reason, fishing effort became excessive, in the fishing ground which had been restricted in postwar years under the MacArthur Line, and in 1950, the first vessel reduction program (about 180 vessels) was implemented. Later, along with the abolition of the MacArthur Line, fishing ground was expanded to the East China Sea and the Yellow Sea. The peak year of this fishery was 1960, with catch volume reaching 360,000 tons. Fish species composition then showed that the top 5 species were yellow croaker (Larimichthys polyactis), hairtail, pike eel (Muraenosox cinereus), silver jew-fish (Pennahia argentata), lizardfish (Saurida species.), all of them materials for paste products. The 5 fish species accounted for 54% of total catch volume. However, because of deterioration of resource status, changes in vessel pattern (from side trawler to stern trawler), employment of larger sized fishing vessels, and shortage in crew, both catch volume and the number of fishing vessels gradually decreased. Catch volume fell below 100,000 tons in 1988, as compared with 300,000 tons in the 1960s and 200,000 tons up to 1976. In 1999, catch volume further dropped to about 20,000 tons. The number of fishing vessels was 625 in 1971. After drastic reduction by 71 vessels in 1989 and 1990, the number of licensed vessels as of January 1998 came to 54, and that as of April 2000 was 16 belonging to a group in Nagasaki.

The composition of catch also changed. In 1997, catch volume of species for use as fresh fish increased while that of the 5 species for fish paste products mentioned above decreased 7% from the previous year to 2,000 tons. Also, changes were observed in the fish species for use as fresh fish. In the 1970s, flounders and butterfishes (Pamps species.) saw a significant decrease. At present, dependence increase on fish species distributed in the fishing ground of the shelf edge area near Japan, such as squids, mostly swordtip squid (Loligo (photololigo) edulis) and yellow sea bream.

Such drastic shrinkage and changes in patterns of fisheries have been caused by complex international situation. In the 1950s when no fisheries treaty existed, there were many cases of capture of Japanese fishing vessels by China and ROK. The international relations were stabilized after the Japan-China private-level treaty was concluded in 1955, followed by the Japan-ROK Fisheries Treaty in 1965 and the Japan-China Fisheries Treaty in 1975. However, in the latter half of the 1970s, impact of the exclusive economic zone (EEZ) system came to be felt in the East China Sea and the Yellow Sea. In August 1977, this fishery lost fishing ground north of 38 degrees north as a result of declaration of exclusive economic zone by North Korea. In relations with ROK, a closed area was established on the southwestern side of Saishu Island in November 1980, and in 1984, restrictions on this area was further strengthened. In the relations with China, the issue that first occurred was that of protection of juvenile fishes of hairtail (Trichiurus japonicus) and large yellow croaker (Larymichthys crocea). Later, at the Japan-China fisheries joint commission meeting held in March, 1984, further closed areas and seasons were introduced, which led to closure of East China Sea trawling fishing ground from the coastal areas of the countries involved.

Conversely, from the 1970s, fisheries in ROK saw a drastic growth. From the 1980s, Chinese fisheries also developed remarkably. Fishing vessels of these two countries came into harsh competition with Japanese fisheries in the areas near Japan. In Nagasaki, Fukuoka, Shimonoseki and other Japanese ports where landing from East China Sea trawling decreased, imports of Spanish mackerel (Scomberomorus niphonius) and Japanese tilefish (Branchiostegus japonicus) from China visibly increased to replace landing from the East China Sea trawling fishery. This caused decline in fish prices as well as increase in operation by Chinese fishing vessels in Japan's off-shore area, constituting one of the causes affecting the entrepreneurial management of East China Sea trawling.

Under such circumstances, Japan ratified the United Nations Convention on the Law of the Sea (UNCLOS) in 1996 to review fisheries order with other countries involved. As a result, a new fisheries treaty with the ROK went into force in January 1999, and a fisheries treaty with China took effect in June 2000. Because of this development, competition with Chinese and Korean fisheries in fishing operation was held in check and the operation itself was improved. But it is not likely that this fishery will recover its force swiftly because wide-range of provisional areas are established under the current two treaties and operation of fishing vessels of China and ROK is admitted within Japanese exclusive economic zone.

2) Species of sharks/rays harvested

Western Division Fisheries Research Institute of Fisheries Agency determined the following 121 species are identifiable as species of sharks/rays appearing in the East China Sea and the which is the fishing ground of the East China Sea trawling, by means of samples among actually sampled or photographed fishes and recorded in previous materials (Ida et al. unpublished).

Heterodontus japonicus, Heterodontus zebra, Orectolobus japonicus, Cirhoscyllium japonicum, Chiloscyllium indicum, Chiloscyllium punctatum, Chiloscyllium plagiosum, Rhincodon typus, Carcharodon carcharias, Isurus oxyrinchus, Cetorhinus maximus, Eugomphodus taurus, Alopias pelagicus, Alopias vulpinus, Parmaturus pilosus, Galeus eastmani, Halaelurus buergeri, Cephaloscyllium isbaellum, Scyliorhinus torazame, Apristurus platyrhynchus, Apristurus longicephalus, Apristurus japonicus, Apristurus herklotsi, Procyllium venustum, Procyllium habereri, Musterus manazo, Musterus griseus, Triakis scyllium, Hemitriakis japonica, Scoliodon laticaudus, Galeocerdo cuvier, Carcharhinus plumbeus, Carcharhinus sorrah, Carcharhinus latistomus, Carcharhinus melanopterus, Sphyrna lewini, Sphyrna zygaena, Chlamydoselachus anguineus, Heptranchias perlo, Hexanchus griseus, *Notorynchus cepedianus, Notorynchus Platycephalus, Centroscyllium kamoharai, Etrmopterus splendidus, Etmopterus pusillus, Etmopterus lucifer, Etmopterus brachyurus, Etmopterus molleri, Zameus squamulosus, Dalauas licha, Isistius brasiliensis, Squaliolus aliae, Squaliolus laticaudus, Deania calea, Centrophorus moluccensis, Centrophorus acus, Centrophorus squamosus, Centrophorus squamosus, Cirrhigaleus barbifer, Squalus acanthias, Squalus japonicus, Squalus brevirostris, Squalus sp., Squalus mitsukurii, Squalus sp.1, Squalus sp.2, Squatina japonica, Squatina nebulosa, Pristiophorus japonicus, Torpedo tokionis, Crassinarke dormitor, Narke japonica, Narke dipterygia, Benthobatis moresbyi, Rhina ancylostoma, Rhynchobatus djiddensis, Rhinobatos granulatus, Rhinobatus schlegelii, Rhinobatos hynnicephalus, Platyrhina sinensis, Rhinoraja kujiensis, Notoraja tobitukai, Bathyuraja fedorovi, Raja pulchra, Dipturus gigas, Dipturus kwangtungensis, Dipturus macrocauda, Dipturus tengu, Dipturus kenojei, Dipturus meerdervoortii, Dipturus boesemani, Dipturus hollandi, Dipturusacutispina, Anacanthobatis borneensis, Raja koreana, Plesiobatis daviesi, Hexatrigon longirostra, Urolophus aurantiacus, Taeniura melanospilos, Dasyatis acutirostra, Dasyatis zugei, Dasyatis ushiei, Dasyatis akajei, Dasyatis laevigatus, Dasyatis navarrae, Dasyatis sinensis, Dasyatis kuhlii, Dasyatis gerrardi, Dasyatis bennetti, Dasyatis microphthalmus, Gymnura japonica, Gymnura poeciloura, Myliobatis tobijei, Aetobatus flagellum, Aetobatus guttatus, Aetomylaeus nichofii, Aetobatus narinari, Aetobatus maculatus, Mobula japonica, Manta birostris*

3) Biology of sharks/rays subject to harvesting

Among the above sharks/rays, those species caught in large quantities in trawling surveys (JAMARC 2000) up to sea depth of 500m are Cloudy catshark, Blackbelly lantern shark, Slendertail Blackbelly lantern shark, Japanese spurdog, Shortnose dogfish, Angel shark, Kwanggung skate, Raja acutispina, Deepwater stingray, and Sepia stingray. Main species subject to catch in sea depth layer where the East China Sea trawl fishery operate are:

-for use as fresh fish (for yubiki)
Japanese wobbegong, Draughtsboard shark, Angel fosu, Angel shark, Starspotted smooth-hound, Zebra bullhead shark, and Japanese bullhead shark;

-for processing (dried ray fin, etc.),
Black sand skate, Raja acutispina, Kwanggung skate, etc.

Main species which are not targeted in fishing but caught incidentally are Cloudy catshark, Blackspotted catshark, Shortnose dogfish, and Sepia stingray.

To sum up, major species of sharks/rays targeted in East China Sea trawling and caught incidentally are as follows.

i) Standard Japanese names (Scientific names were taken from Nakabo et al. 1993 and Yoda unpublished. English names were taken from Yoda published.)

standard Japanese name / scientific name / English name

Ohse / *Orectolobus japonicus* / Japanese wobbegong

Nanukazame / *Cephaloscyllium isbaellum* / draughtsboard shark

Kasuzame / *Squatina japonica* / angel fosu

Korozame / *Squatina nebulosa* / angel shark

Hoshizame / *Musterus manazo* / starspotted smooth-hound

Shimanekozame / *Heterodontus zebra* / zebra bullhead shark

Nekozame / *Heterodontus japonicus* / Japanese bullhead shark

Nagasaki-torazame / *Halaelurus buergeri* / blackspotted catshark

Torazame / *Scyliorhinus torazame* / cloudy catshark

Taiwanzame / *Procyllium habereri* / graceful catshark

Tsumaritsunozame / *Squalus brevirostris* / shortnose dogfish

Isagogangiei / *Raja boesemani* / black sand skate

Moyoukasube / *Raja acutispina* / not defined

Gangiei Kwanggung skate / *Raja kwangtungensis* / Kwanggung skate

Komon-kasube Ocellate spot skate / *Raja kenojei* / ocellate spot skate

Hirata-ei Sepia stingray / *Urolophus aurantiacus* / sepia stingray

ii) Distribution (according to Yamada et al. 1986 regarding the species without note)

Japanese wobbegong

This species is distributed in the shallow water area. It is considered to be distribued along the coasts of the countries near the East China Sea, the Yellow Sea, and the South China Sea (Yamada personal communication).

Draughtsboard shark

In the fishing ground of East China Sea trawling, this species is distributed in two areas: southern Yellow Sea and the areas near the continental shelf edge of the East China Sea, which is of relatively crude bottom with sea depth of around 200m or deeper.

Angel fosu

This species is distributed along the coast of sea depth of around 100m. Along the Japanese coast, a large distribution is found in the area near Gotoh Islands (Yamada personal communication)

Angel shark

This species is distributed at the sea depth of 100-300m at the continental shelf edge of the East China Sea, which is more offshore than all the other species.

Starspotted smooth-hound

In the fishing ground of East China Sea trawling, this species is distributed extensively in the Yellow Sea and the East China Sea the areas near the continental shelf edge. It is found in large quantities in the muddy and sandy areas of sea depth of 200m or shallower.

Zebra bullhead shark

In the fishing ground of East China Sea trawling, this species is distributed at the sea depth of 90m or deeper in the areas near the continental shelf edge of southern the East China Sea. It is not found in the Yellow Sea. It is more prone to warm water than its like species, Japanese bullhead shark.

Japanese bullhead shark

In the fishing ground of East China Sea trawling, this species is distributed from southern Yellow Sea to southern the East China Sea. It is found in larger quantity in the area from eastern Tsushima to northern Taiwan.

Blackspotted catshark

In the fishing ground of East China Sea trawling, it is mainly distributed from south of 30 degrees north to above the continental shelf in northern Taiwan.

Cloudy catshark

In the fishing ground of East China Sea trawling, this species is distributed in southern Yellow Sea and the areas near the continental shelf edge of the East China Sea.

Graceful catshark

In the fishing ground of East China Sea trawling, this species is mainly distributed at sea depth of 80-100 m in the area south of 30 degrees north.

Shortnose dogfish

In the fishing ground of East China Sea trawling, this species is largely distributed in the East China Sea south of 32 degrees north.

Black sand skate

In the fishing ground of East China Sea trawling, this species is mainly distributed in the area south of 31 degrees north of the East China Sea, especially in large numbers in the area off Chekiang Province in China.

Raja acutispina

In the fishing ground of East China Sea trawling, this species is mainly distributed in the areas near the continental shelf edge of the East China Sea in the vicinity of 29-31 degrees North.

Kwanggung skate

In the fishing ground of East China Sea trawling, this species is mainly distributed in the Yellow Sea and the East China Sea north of 31 degrees north. A small quantity is distributed at the sea depth of about 200m in the East China Sea south of 31 degrees north.

Sepia stingray

In the fishing ground of East China Sea trawling, this species is distributed at sea depth of 90m or deeper in the area of the East China Sea south of 32 degrees north.

iii) Stocks, etc.

With respect to Japanese spurdog (Chen et al.1981) and Starspotted smooth-hound (Taniuchi et al. 1983) in the fishing ground of East China Sea trawling and other areas, sharks from the East China Sea differ from those of the same species from other areas such as Choshi in terms of growth, sexual maturity and calving rate (parturition number). And there is suggestion that it constitutes a different stock. For this reason, the possibility is suggested that the stock in this area constitutes a different stock from those in other areas with respect to sharks/rays for which mechanism of dispersion is limited. Although there have been no case of studies on the presence of stocks within the fishing ground of East China Sea trawling, further surveys will be necessary on whether the distribution in the two areas are due to migration in the process of growth or it indicates the presence of different stocks with respect to fish species, such as Draughtsboard shark, Starspotted smooth-hound, and Shortnose dogfish, which are distributed in the Yellow Sea and the East China Sea.

4) Historical changes in catch volume

i) Catch report

According to catch report of East China Sea trawling, sharks/rays are deal under two categories, and there are no species-to-species statistics. The report shows that East China Sea trawling as a whole harvested 9475 tons in 1948. Later, it saw continual decline to reach 9 tons in 2001(Fig.4-1.). A total of 17084 tons of rays were harvested in 1958 by East China Sea trawling as a whole, and then catch volume continued to decrease to reach 149 tons in 2001(Fig.4-1.).

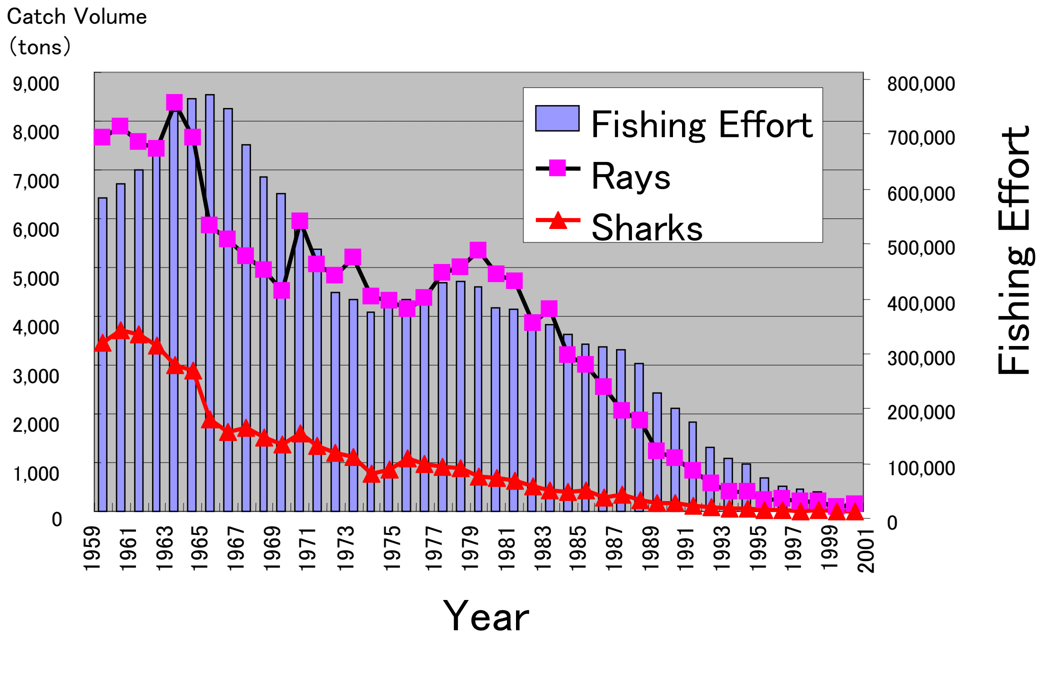


Fig. 4-1. Catch efforts for trawl fishery operated in the East China Sea (two-boat trawling) and catch volume of sharks and rays

5) Fishing effort

Fishing effort of two-boat trawl fisheries representing East China Sea trawling peaked out at about 780000 times in 1965, five years later than 1960 when overall catch volume peaked out. Later, the number of trawling declined as the number of fishing vessels continued to decline for the reasons give above, fishing effort in 1969 fell below 600000 times. Subsequently, catch efforts were maintained around 400,000 times in 1972-1980. In 1981, catch effort stayed at 400,000 times, but declined to 300,000 times in 1988, to 200,000 times in 1991 and fell below 100,000 times in 1994. Later, declines continued consistently, with the present level falling to approximately 2% of the peak period (Fig.4-1).Further, fishing ground had extended in the entire area of the East China Sea and the Yellow Sea in the 1960s, as stated in the foregoing. Later, operation in the Yellow Sea areas gradually decreased, and at present concentrates in the areas near the continental shelf edge of the East China Sea near Japan (Tokimura 1998、1999).

6) Changes in resource status and catch rates

Sharks are on a declining trend both for catch volume and CPUE by two-boat trawl East China Sea trawling, and stay at a very low level in recent years. Although catch volume of rays is on a downward trend, CPUE recovered slightly in the 1970s, and then decreased in the 1980s. It remains level at a low level in the 1990s. From these, it is suggested that sharks/rays in the East China Sea stay at a lower resource level compared with past years.

However, it is not possible to determine based only on catch statistics of the fishery because the proportion of catch volume by Japan's trawling in the East China Sea in the overall catch volume of bottom fish by countries involved in the East China Sea and the Yellow Sea is less than 1%, the fishing ground of East China Sea trawling is limited to the areas near the continental shelf edge (Tokimura 1999), the most important species for that fishery in recent years is swordtip squid (Loligo (Photololigo) edulis). As no fisheries mainly targeting sharks and rays exist, it is difficult to make a precise judgment based on catch statistics of those fisheries.

7) Recommendation for resource assessment and conservation and management

The stock level of sharks and rays in the East China Sea and the Yellow Sea is thought to be at a considerably lower level as compared with the peak period judging from the catch statistics of the Japanese trawl fishery operated in the East China Sea.
Therefore, there is a need to closely monitor the trend of the stock. >From the international perspective, it is necessary to carry out monitoring of the stock in cooperation with other countries concerned as the share of this stock in this fishery is low.
However, as the system of species-to-species catch statistics for these fish species is not adequate among countries concerned, it seems realistic to build up Japan's own data collection system and grasp the stock trend of sharks and rays in the East China Sea and the Yellow Sea on the species-to-species basis.

Shown below as a reference is the stock monitoring survey conducted now by research vessels.

i) Surveys on the stock size in the winter by trawling carried out by Western

Division Fisheries Research Institute of Fisheries Agency (Yamada et al. 1998)

Since 1995, surveys on the present stock size has been conducted during winter (January and February) by means of half an hour trawling at 60-120 points in the zone of sea depth of 50m-140m in the entire the East China Sea and the Yellow Sea. Sharks and rays have all been subjected to surveys. However, it had become impossible to secure the survey areas because the period from 1997 and afterwards coincided with the renewal period for fisheries treaties with countries in the region. This situation persists even to this day. There is a need to continue monitoring after building up a system to cover as wide a sea area as possible.

ii) Trawling surveys in the shelf edge area in summer under the entrusted project by the Fisheries Agency (JAMARC 2000)

Since 1998, Fisheries Agency has entrusted the JAMARC to conduct survey on the stock size by trawling in the area of sea depth 80-500m in the shelf edge area of the East China Sea during summer. There are 300-400 surveys items. All the fishes including sharks/rays are made target in surveys on stock size and distribution. It is difficult to grasp the stock level as the survey period is short. It is deemed possible to grasp resource status accurately regarding the species mainly distributed in the areas near the continental shelf edge by continuing monitoring activities in the years ahead.

8) References

JAMARC 2000: Report on Emergency Survey on land shelf resource in the waters surrounding Japan (Fisheries Agency entrusted project)

Chen, C., Taniuchi, T., and Nose, Y. 1981: Some Aspects of Reproduction in the Pointed-snout Dogfish Squalus japonicus Taken off Nagasaki and Choshi. Bull Jap. Soc. Sci. Fish., 47(9), 1157-1164.

Nakabo, T. 1993: Fishes In Japan: Index. Tokai University Press, Tokyo. 1474pp.

Taniuchi, T., Kuroda, N., Nose, Y. 1983: Age, growth, breeding and dietary habit of Starspotted smooth-hound in Choshi. Japan Suisan Gakkai Bulletin 49(9), 1325-1334.

Tokimura, M. 1998: Issues in management of bottomfish resources in the East China Sea and the Yellow Sea: Technique for management of fishery resources/fisheries (Fishereis Science Series 118), Kitahara, T. (ed.), Koseisha Koseikaku, Tokyo, 36-P44

Tokimura, M. 1999: Fisheries in Japan. Monthly Kaiyo, Vol. 31, No. 10 (Special issue: Living resources in the East China Sea and Yellow Sea), P637-P644

Yamada, Y., Kosuge, J., Tokimura, M., Yamamoto, K. 1998: Report on bottom fish resource survey in the East China Sea and the Yellow Sea in 1994. Western Division Fisheries Research Institute, Studies on resource survey, No. 78, 173PP.

Yamada, U., Tagawa, M., Kishida, S., Honjo, Y., 1986: Fishes in the East China Sea/Yellow Sea. Western Division Fisheries Research Institute 501pp.

5 Distant-water fisheries (oceanic sharks)

1) Outline of fisheries

In Japan, tuna fishery began in various places in the Edo Period (1603-1868), using nets, harpoons and angling. It was in the middle of the Meiji Period (1868-1912) when offshore fishing started after sail boats came in use for fishing vessels (Hirayama 1985). Introduction of powered fishing vessels gradually advanced from late in the Meiji Period, and in 1912 the number of longline fishing vessels reached 166, centering on Chiba, Shizuoka, and Wakayama Prefectures. By 1922, most of longline fishing vessels came to be powered, and some steel longline fishing vessels of over 100 tons appeared--which was an epochmaking progress at that time. In line with the motorization of fishing vessels, driftnet fishing methods came to be in use, beside longline fishing method. The number of driftnet fishing vessels belonging to Ibaraki, Chiba, and Fukushima Prefectures exceeded 200, and catches mainly centered on bluefin tuna in Hokkaido and the area off Sanriku.

In prewar years, tuna longline fisheries had been treated as secondary operation carried out while the skipjack angling in summer was not taking place. Therefore, it was carried out mainly in winter. But gradually it came to be operated throughout the year. Later, in response to rising demand internationally, fishing ground was enlarged and operation expanded to southern areas. In 1941, longline fishing vessels operating in this area totaled 76, and the number of operation counted 246.

The Pacific War dealt a catastrophic blow to tuna longline fisheries. In addition to destruction of fishing vessels and shortage of the crew, an overall limitation to fishing activities (MacArthur Line) was established by the Occupation Forces. However, in view of the food shortage, the Occupation Forces alleviated restrictions on tuna longline fishery at a relatively early period when the Japanese distant-water fisheries were placed under control. In 1945-1949, the first to third rounds of permission to expand fishing ground were issued and in May 1950, an area for factory-type tuna fisheries was established in the Southern area as a specially permitted area.

This had a great significance to the promotion of the Japanese fisheries and the future of tuna fisheries. Namely, the way was paved for expansion of fishing ground as a result of the abolition of the MacArthur Line in 1952. It is right to observe that Japanese tuna longline fisheries have fostered strength to expand in the entire area of the Indian Ocean and the Pacific in two to three years from then. In 1957, Japanese tuna longline fisheries advanced into the Atlantic. Later, catch volume continued increasing steadily to the peak of 450,000 tons in 1973, and then started to decline.

According to the Annual Report on Fisheries and Aquaculture Production Statistics in 2002, the vessels engaging in tuna longline fisheries in 2000 were 541 distant-water tuna longline vessels (gross tonnage 120 tons or over), 145 off-shore tuna longline vessels (gross tonnage 20 tons or over, less than 120 tons), and 732 coastal tuna longline vessels (gross tonnage 10 tons or over, less than 20 tons). Further, catch volume of tuna and tuna-like species by tuna longline fisheries in 1997 were 185,000 tons.

2) Species of shark/rays subjected to harvesting

Taniuchi (1997) identified 26 species of sharks caught incidentally in Japanese tuna longline fishing, and recognized 7 species caught often: Crocodile shark, Shortfin mako shark, Longfin mako, Bigeye thresher, Blue shark, Silky shark, and Oceanic whitetip shark. Nakano (1996) reported 15 species of sharks and their catch composition from the survey materials of prefectural vessels in the Pacific. The species holding 1% or more in the catch composition were 6: Blue shark, Shortfin mako shark, Crocodile shark, Oceanic whitetip shark, Silky shark, and Bigeye thresher. Further, Matsunaga/Nakano (1996) identified 25 species from the survey data from the Japan Marine Research Center as well as prefectural vessels. From these data, six species of Blue shark, Shortfin mako shark, Crocodile shark, Oceanic whitetip shark, Silky shark, and Bigeye thresher will be selected this year as the subject of discussion on the species often caught in tuna longline fisheries.

Table 5-1. Composition of shark species caught by longline fisheries research of incidental take using local government vessels

Japanese name	Scientific name	Species compisition （%）
Salmon shark	*Lamna ditropis*	0.13
Shortfin mako shark	*Isurus oxyrinchus*	1.33
Longfin mako	*Isurus paucas*	0.46
Pelagic thresher	*Alopias pelagicus*	0.46
Bigeye thresher shark	*Alopias superciliosus*	14.73
Thintail thresher	*Alopias vulpinus*	0.04
Crocodile shark	*Pseudocarcharias kamoharai*	1.21
Silky shark	*Carcharias falciformis*	1.71
Oceanic whitetip shark	*Carcharias longimanus*	3.91
Tiger shark	*Galeocerdo cuvier*	*
Blue shark	*Prionace glauca*	75.34
Hammerhead sharks	*Hammerhead sharks*	0.04
Pelagic stingray	*Dasyatis violacea*	*

3) Biology of shark/rays subjected to harvesting

i) Standard Japanese name, scientific name, and English name; issues in identification

Table 5-2. Standard Japanese name, scientific name, and English name of the 6 shark species taken up in this report

Standard Japanese name / scientific name / English name

Yoshikirizame / *Prionace glauca* / Blue shark

Aozame / *Isurus oxyrinchus* / Shortfin mako shark

Mizuwani / *Pseudocarcharias kamoharai* / Crocodile shark

Yogore / *Carcharhinus longimanus* / Oceanic whitetip shark

Kurotogarizame / *Carcharhinus falciformis* / Silky shark

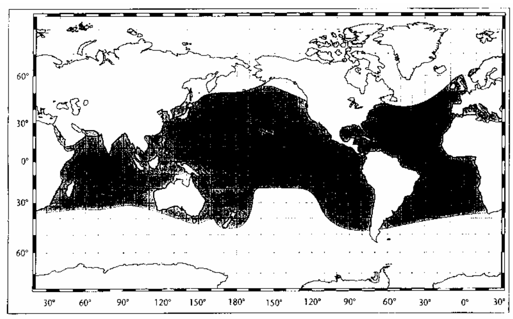
Hachiware / *Alopias superciliosus* / Bigeye thresher shark

As issues in species identification, Shortfin mako shark looks alike Longfin mako; and Bigeye thresher can be easily confused with other two species of Thresher sharks. Keys to identification are given in "Manual to identification of bycatch species in the southern bluefin tuna fishing grounds" (Nakaya/Nakano 1995) prepared by the National Research Institute on Farseas Fisheries. This manual has been distributed to related research institutions.

ii) Distribution

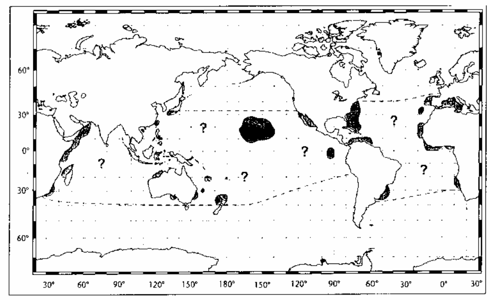
The figure below shows the distribution of major six shark species caught incidentally in tuna longline fisheries (Last and Stevens 1994). Blue shark and Shortfin mako shark are distributed extensively from tropical to temperate zones of the southern part of the North Pacific, southern part of the North Atlantic, and the Indian Ocean. Crocodile shark, Oceanic whitetip shark, Silky shark and Bigeye thresher are mainly distributed in tropical areas of the three oceans. Further, according to the figure of distribution by Last and Stevens (1994), question marks were attached sporadically for distribution of Silky shark, and many marks for the distribution of Bigeye thresher and Crocodile shark. But surveys by the Fisheries Agency's National Research Institute on Farseas Fisheries showed that these species are widely distributed in the tropical zone.

Fig.5-1. Distribution of major six shark species caught incidentally in tuna longline fisheries



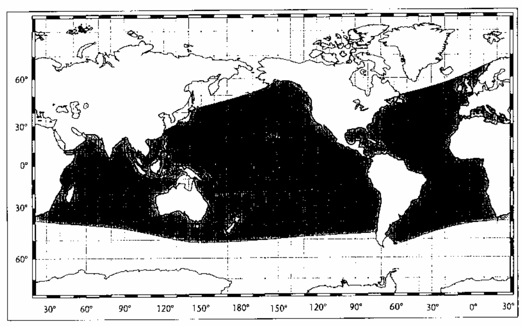
Shortfine mako

deep.

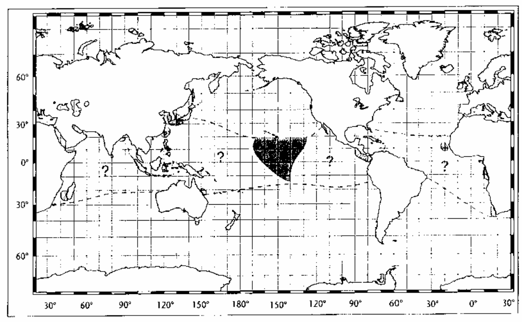


Bigeye thresher

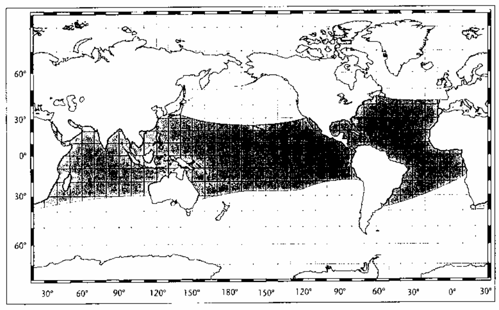
ence: Stevens (1984).



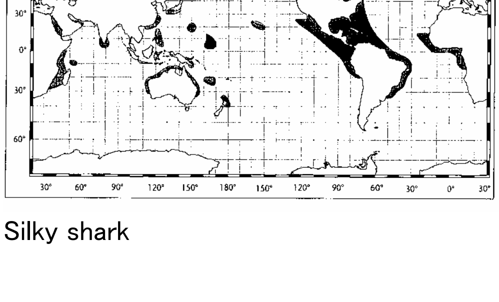
Blueshark



Crocodile shark



Oceanic whitetip shark



Silky shark

iii) Breeding patterns, number of calves, and body length at birth

The breeding patterns of cartilaginous fishes (sharks and rays) are diverse and are largely classified into oviparity and viviparity. Taniuchi (1988) has defined breeding patterns from the viewpoint of furnishing of nutrition from mother's body. According to Taniuchi, viviparity is further divided into facultative viviparity and obligate viviparity. Obligate viviparity is divided into lecithotrophy and matrotrophy. Further, matrotrophy is divided into three categories: oophagy/adelphagy, placental analogues, and yolk sac placenta. What follows is the definition of breeding patterns of sharks by Taniuchi (1988).

Table 5.3.Breeding patterns of cartilaginous fishes seen from furnishing of nutrition (Taniuchi 1988)

1 oviparity
2 viviparity
- Ⅰ facultative viviparity
- Ⅱ obligate viviparity
  - A lecithotrophy
  - B matrotrophy
    - 1) oophagy and adelphagy
    - 2) placental analogues
    - 3) yolk sac placenta

Breeding patterns of 6 major species of sharks caught incidentally in tuna longline fisheries are:
Blue shark, Oceanic whitetip shark, Silky shark -- viviparity and yolk sac placenta;
Shortfin mako, Crocodile sharks, and Bigeye threshers -- viviparity and oophagy-adelphagy.
The average value and range of the number of calves produced are:
Blue shark: 25.6, 1-135 (Nakano 1994, Gubanov and Grigoryev 1975),
Shortfin mako: 4, 2-16 (Tanaka 1984),
Crocodile shark: 4 (Compagno 1984),
Oceanic whitetip shark: 6.2, 1-15 (Seki et al. 1998),
Silky shark: 6.2, 1-16 (Oshitani et al. in press),
Bigeye thresher: 2-4 (Compagno 1984)

The length at the time of birth:
Blue shark: 30-43cm (Nakano 1994),
Shortfin mako: 60-70cm (total length) (Compagno 1984),
Crocodile shark: 41cm (total length) (Compagno 1984),
Oceanic whitetip shark: 40-55cm (Seki et al. 1998)
Silky shark: 48-60cm (Oshitani et al. in press),
Bigeye thresher: 60-140cm (total length) (Compagno 1984)
When there is no explanation on body length, it means precaudal length.

Table 5－4. Breeding patterns, number of calves born, and body length at the time of birth of 6 major species of sharks caught in tuna longline fisheries

Species	Breeding patterns	Number of calves(average, extent)	Body length at birth (cm)
Blue sharks	viviparity, yolk sac placenta	25.6,1−135	30−43(precaudal length)
Shortfin mako	viviparity, oophagy/adelphagy	4,2−16	60−90（total length）
Crocodile sharks	viviparity, oophagy/adelphagy	4	41（total length）
Oceanic whitetip	sharks viviparity, yolk sac placenta	6.2,1−15	40−55（precaudal length）

Silky sharks	viviparity, yolk sac placenta	6.2,1-16	48-60 (precaudal length)
Bigeye threshers	viviparity, oophagy/adelphagy	2-4	60-140 (total length)

iv) Age and growth

Growth formula is estimated for 6 major species of sharks caught in tuna longline fisheries has been estimated, except for Crocodile sharks. However, as measured position for length is uneven at precaudal length, fork length, total length according to researchers, conversion formula between measured position, made public so far, are given below.

Table 5－5. conversion formula among measured position for length of six major sharks species caught in tuna longline fisheries

Species	Measured position (x-y)	Conversion formula	Research area	Researcher
Blue sharks:	TL-FL	FL=1.3908+0.8313xTL	Atlantic	Kohler *et al.* (1995)
	PL-FL	FL=3.0850+1.0754xPL	Pacific	Nakano (1994b)
Shortfin mako	TL-FL	FL=-1.7101+0.9286xTL	Atlantic	Kohler *et al.* (1995)
	PL-FL	FL=-4.2694+1.1283xPL	Pacific	Nakano (1994b)
Crocodile sharks		Unknown		
Oceanic whitetip sharks	PL-TL	TL=1.397xPL	Pacific	Seki *et al.* (1998)
Silky sharks	TL-PL	TL=2.08+1.32xPL	Pacific	Oshitani *et al.*(in press)
	FL-PL	FL=1.09+1.03xPL	Pacific	
	PL-TL	TL=3.4378+1.3358xPL	Atlantic	Bonfil *et al.* (1993)
	PL-FL	FL=1.3017+1.0758xPL	Atlantic	
	FL-TL	TL=1.8878+1.2412xFL	Atlantic	
	TL-FL	FL=-2.6510+0.8388xTL	Atlantic	Kohler *et al.* (1995)
Bigeye threshers	PL-TL	Female:TL=15.3+1.81xPL	Pacific	Liu *et al.* (1998)
	PL-TL	Male:TL=15.1+1.76xPL	Pacific	
	FL-TL	Female:TL=13.3+1.69xFL	Pacific	
	FL-TL	Male:TL=26.3+1.56xFL	Pacific	

Growth formula of Blue sharks by sex was reported by Cailiet and Bedford (1983), Tanaka (1984), and Nakano (1994) from the Pacific. Cailiet and Bedford (1983) reported about Shortfin mako from the Pacific, and Pratt and Casey (1983) from the Atlantic. Seki et al. (1998) reported about Oceanic whitetip sharks from the Pacific. Branstetter (1987) and Bonfil (1993) reported about Silky sharks in the Atlantic, and Oshitani et al. (in press) from the Pacific. Liu et al. (1998) reported about Bigeye threshers from the Pacific. There are no data published about growth of Crocodile sharks.

Table 5－6. Growth formula of 6 major species of sharks caught in tuna longline fisheries

Species	Growth formula	Measured position	Researched area	Researcher
Blue sharks:	Female: $Lt=241.9(1-e^{-0.251(t-(-0.795))})$	total length	Pacific	Cailiet and Bedford (1983)
	Male: $Lt=295.3(1-e^{-0.175(t-(-1.113))})$	total length	Pacific	
	Female: $Lt=256.1(1-e^{-0.116(t-(-1.306))})$	precaudal length	Pacific	Tanaka (1984)
	Male: $Lt=308.2(1-e^{-0.094(t-(-0.993))})$	Precaudal length	Pacific	
	Female: $Lt=243.3(1-e^{-0.144(t-(-0.849))})$	Precaudal	Pacific	Nakano (1994)

		length		
	Male: $L_t=289.7(1-e^{-0.129(t-(-0.756))})$	precaudal length	Pacific	
Shortfin mako	$L_t=321.0(1-e^{-0.072(t-(-3.75))})$	total length	Pacific	Cailiet and Bedford (1983)
	Female: $L_t=345.0(1-e^{-0.203(t-(-1.00))})$	fork length	Atlantic	Pratt and Casey (1983)
	Male: $L_t=302.0(1-e^{-0.266(t-(-1.00))})$	fork length	Atlantic	
Crocodile sharks	Unkown			
Oceanic whitetip sharks	$L_t=244.58(1-e^{-0.103(t-(-2.697))})$	precaudal length	Pacific	Seki *et al.* (1998)
Silky sharks	$L_t=290.5(1-e^{-0.153(t-(-2.2))})$	total length	Atlantic	Branstetter (1987)
	$L_t=313.1(1-e^{-0.089(t-(-3.3))})$	total length	Atlantic	Bonfil *et al.* (1993)
	$L_t=216.4\ (1-e^{-0.148(t-(-1.76))})$	precaudal length	Pacific	Oshitani *et al.* (in press)
Bigeye threshers	Female: $L_t=224.6(1-e^{-0.092(t-(-4.21))})$	precaudal length	Pacific	Liu *et al.* (1998)
	Male: $L_t=218.8(1-e^{-0.088(t-(-4.24))})$	precaudal length	Pacific	

v) Stocks

Almost nothing is known about the stocks of oceanic sharks. Judging from distribution and ecology of oceanic sharks, it seems reasonable to consider that Crocodile sharks, Oceanic whitetip sharks, Silky sharks, Bigeye threshers mainly distributed in the tropical zone are single stocks in the Pacific, Atlantic, and the Indian Ocean, respectively. With respect to Blue sharks and Shortfin mako distributed from tropical to temperate zones, as their breeding cycle is reverse in the south and north of the ocean, it may be reasonable to assume that there are two stocks in the south and north Pacific and two stocks in the north and south Atlantic. However, for Blue sharks, there is a possibility of interaction because there are reports on marked individuals recaptured beyond the equator (Casey et al. 1989). With respect to the stock of oceanic sharks, it is necessary to study distribution, migration, mark recapture, and analysis of study genetic characteristics.

vi) Photos

What follows are photos of 6 major shark species caught in tuna longline fisheries.

Fig. 5－2. Photos of 6 major shark species caught in tuna longline fisheries

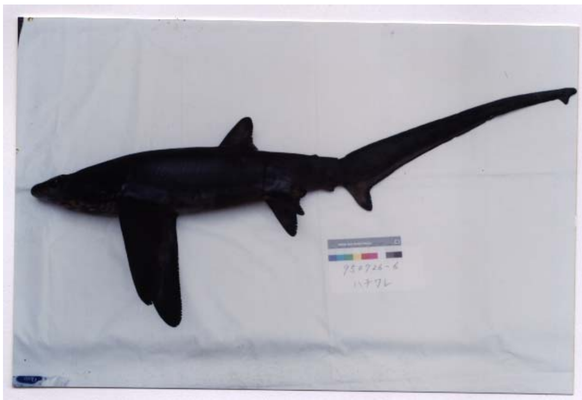
Blue shark

Shortfin mako

Crocodile shark

Oceanic whitetip shark

Silky shark



Bigeye thresher

4) Historical changes of catch volume

i) FAO catch statistics

Given below is sharks catch volume in Japan according to FAO Annual Report on Catch Statistics. The catch volume stayed at 20,000-50,000 tons between 1976 and 2000, showing annual declines. This is considered mainly due to the fact that catch volume in the Pacific includes that in the area around Japan and sharks catch volume in trawl net fishery are declining. FAO Catch Statistics is not compiled by type of fisheries and by species of sharks. Further, FAO Catch Statistics are made up of submission of national catch statistics and are considered to be underestimated because discarded volume of sharks are not included as "catch" in Japan's statistics.

Table 5－7. Catch volume of sharks by sea area in Japan according to FAO Annual Report on Catch Statistics (tons)

AREA / YEAR	Pacific	Atlantic	Indian	Total
1976	44,006	677	380	45,063
1977	49,269	759	321	50,349
1978	41,570	887	461	42,918
1979	42,236	600	678	43,514
1980	40,574	1,232	610	42,416
1981	36,328	1,669	675	38,672
1982	35,186	1,648	530	37,364
1983	34,137	646	747	35,530
1984	34,332	1,544	816	36,692
1985	29,319	2,072	1,253	32,644
1986	34,617	1,886	1,069	37,572
1987	33,510	1,511	825	35,846
1988	19,791	1,377	643	21,811
1989	25,884	1,836	658	28,378
1990	24,391	1,713	367	26,471
1991	26,018	1,683	685	28,386
1992	31,572	1,479	485	33,536
1993	30,372	2,927	440	33,739

1994	26,084	3,056	687	29,827
1995	23,861	2,067	836	26,764
1996	17,542	1,340	1,057	19,939
1997	24,621	1,257	1,120	26,998
1998	28,435	1,039	459	29,933
1999	30,180	1,239	693	32,112
2000	26,380	1,003	301	27,684

ii) Agriculture, Forestry and Fisheries Statistics (annual statistics on fisheries, aquaculture production)

Given below is sharks catch volume by tuna longline fisheries as described in "Annual Report on Fisheries and Aquaculture Production Statistics" published by the Agriculture, Forestry and Fisheries Statistics Division. In Agriculture, Forestry and Fisheries Statistics, tuna longline fisheries are classified in three categories of distant-water, off-shore and coastal fisheries. The total production for the three categories stayed around 13,000 tons to 30,000 tons, but shows a trend of annual decline. The reason for decreasing volume as compared with FAO Statistics is that catch volume from fisheries other than tuna longline fisheries is not included. However, like FAO Catch Statistics, species identification, catch volume and discarded volume are not known and are underestimated on the whole.

Table 5－8. Catch volume of sharks (tons) by tuna longline fisheries given in Agriculture, Forestry and Fisheries Statistics

Year	Distant-water	Off-shore	Coasta	Total
1971	10,782	16,698	1,833	29,313
1972	8,588	14,207	1,992	24,787
1973	9,219	13,878	2,316	25,413
1974	6,866	13,054	2,357	22,277
1975	7,898	14,389	1,325	23,612
1976	7,142	14,167	2,615	23,924
1977	6,590	16,352	2,321	25,263
1978	7,718	13,189	3,116	24,023
1979	8,211	17,025	2,832	28,068
1980	8,811	18,639	2,242	29,692
1981	8,716	13,623	2,237	24,576

1982	8,090	12,567	1,713	22,370
1983	9,496	14,025	749	24,270
1984	9,009	11,871	2,336	23,216
1985	8,042	12,341	2,524	22,907
1986	7,750	13,952	2,116	23,818
1987	8,676	11,506	2,302	22,484
1988	10,240	10,884	2,115	23,239
1989	6,565	8,211	1,863	16,639
1990	4,387	8,293	1,838	14,518
1991	5,940	10,139	1,680	17,759
1992	7,130	10,753	1,719	19,602
1993	6,960	10,882	1,812	19,654
1994	5,625	8,207	2,052	15,884
1995	2,947	8,054	1,683	12,684
1996	3,093	9,143	1,954	14,190
1997	3,258	10,844	2,128	16,230
1998	7,720	9,089	2,551	19,360
1999	8,649	9,011	2,345	20,005
2000	6,897	7,782	2,031	16,710

iii) Entrusted research projects (entrusted project to research bluefin tuna near Japan)

In the research project entrusted by the Fisheries Agency in the waters surrounding Japan (1992-1996) the entrusted research project for highly migratory fish stocks in the waters surrounding Japan (from 1997), landing of sharks by species by tuna longline fisheries at major landing ports are being surveyed. According to the surveys, major species caught in tuna longline fisheries and their proportion to the total value in 1992-2000 were as follows:

Blue sharks (72.2%),
Salmon sharks (12.5%),
Shortfin mako (6.9%),
Thresher sharks (3.5%),
Sandbar sharks (0.5%),
Oceanic whitetip sharks (0.4%)

Major fisheries landing sharks in Japan are off-shore tuna longline fisheries.

Especially in Miyagi Prefecture almost all sharks are brought back. It is therefore considered that species composition in the catch is reflected accurately to some extent. However, as stated in the section on "types of sharks and rays harvested, " Crocodile sharks that have no commercial value are not landed. Further, Silky sharks are compiled as "sandbar sharks" or other sharks in the process of species assessment.

Table 5－9. Landing of sharks at major ports as collected under the Fisheries Agency's entrusted research project (Unit: tons)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	%
Species										
Salmon sharks	1748	1352	2357	1738	2172	2527	2222	2868	2932	12.49
Shortfin mako	1479	1175	1197	944	833	944	1055	1001	1135	6.90
Longfin mako	5	4	4	6	6	6	12	4	8	0.03
Blue sharks	12250	13548	10500	10839	10589	10998	12427	14298	15870	72.18
Oceanic whitetip sharks	65	77	53	83	41	39	85	66	12	0.38
Sandbar sharks	126	103	65	91	29	28	30	43	21	0.46
Hammerhead	38	41	23	20	33	21	16	26	34	0.18
Thresher sharks	706	553	498	537	514	485	455	473	536	3.46
Other sharks	1217	129	461	644	552	724	611	861	598	3.91
Total	17635	16981	15157	14901	14770	15772	16913	19640	21146	

vi) Estimation of discarded volume and overall catch volume

As mentioned in the foregoing, it is considered that existing statistics regarding catch volume of sharks is underestimated as it does not include discarded volume. For this reason, a number of researchers conducted estimation of catch volume. Taniuchi (1990) obtained the proportion between the number of sharks caught and tuna and swordfish caught from the catch report of prefectural government vessels, and applied the figure to the catch volume of tuna and swordfish by tuna longline fisheries fishing vessels and determined about 30% is catch volume of sharks. From this he determined that catch volume of tuna and swordfish was about 30,0000 tons and that of sharks was about 9,0000 tons.

Taniuchi (1995) revised his estimates, and determined in a similar manner that about one fourth (about 25%) of catch volume of tuna and swordfish was that of sharks. He applied it to the catch volume of tuna and swordfish in 1991, and reported that the catch volume of sharks was approximately 53,000 tons, and 38,000 tons only for distant-water tuna longline fisheries.

Bonfil (1994) estimated catch volume of sharks by Japanese longline fisheries at 115,000 tons from the existing fishing rate and fishing effort. When these estimates are compared with the catch volume reported in Japan's Agriculture, Forestry and Fisheries Statistics (13,000 tons-3 0000 tons), discarding is estimated at 23,000 tons-102,000 tons (43.4-88.7%). However, as the existing catch volume estimates are rough, it will be necessary to obtain accurate catch volume estimate or statistics values.

5) Catch effort (the number of operating vessels, and the number of operation days, etc.)

What follows are fishing effort by ocean and combined fishing effort for the three oceans by Japan's tuna longline fisheries vessels

(National Research Institute of Far Seas Fisheries: internal materials)

Fishing effort for all the Japanese vessels increased from 116 million hooks in 1952 to over 400 million hooks in 1962. It stayed at the level of 400-470 million hooks by 1978. Subsequently, it was at the level of 500-560 million hooks by 1991, but since 1992, decreased, falling below 400 million hooks in 1999 and 2000.

When we look at the changes in catch effort by ocean, the number of hooks increased to 110 million to 300 million hooks in the Pacific from 1952 to 1962. It stayed around 300 million hooks by 1975, and increased to 320 million-400 million hooks in 1976-1994. For the six years from 1995 to 2000, continuous decline was observed, with the number falling below 200 million in 2000.

In the Atlantic, tuna longline fisheries operation started in 1956. The number of hooks increased until 1965, reaching 90 million. Later, it stayed at the level of 30 million to 80 million hooks by 1966-1988. Then it increased by 1997, staying at a stable level of around 100 million hooks.

In the Indian Ocean, increase was observed from 1952 to 1967, reaching 130 million hooks in 1967. Subsequently, it stayed around 100 million hooks (60 million-130 million hooks) by 1987, and declined in 1988, and were around 50 million hooks in 1990-1993. Later they increased, and the 2000 level is around 100 million hooks.

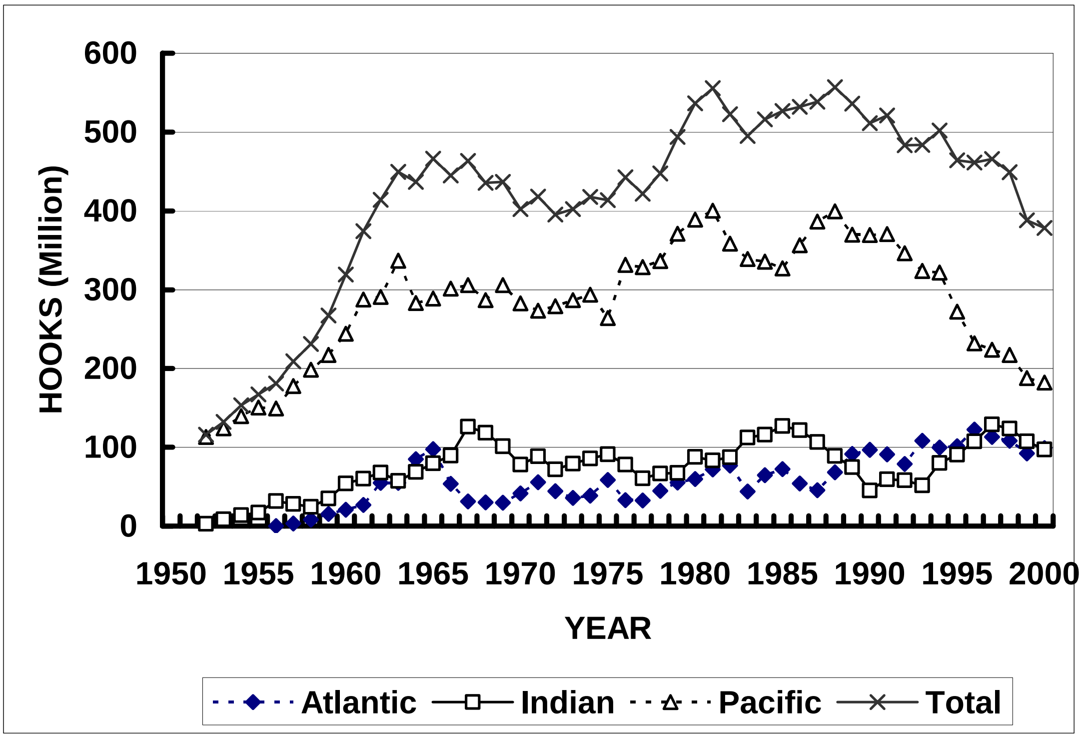


Fig.5.3. Fishing effort used by Japanese tuna longline fisheries in the three major oceans (number of hooks)

4) State of the resources, changes in fishing rate, etc.

Taniuchi (1990) analyzed catch reports by Japan's prefectural government vessels in the Pacific and the Indian Ocean, and reported that fishing rate of sharks caught in tuna longline research was more or less constant between 1973 and 1985. Nakano (1996) analyzed the catch reports of tuna longline fishing vessels between 1971 and 1993, and reported that no declining trend was observed in standardized CPUE for Blue sharks on the basis of the relations between species composition of sharks and incidental catch report rate for sharks (proportion of the days in which incidental takes of sharks were reported per cruise), after showing that the data of 70% or over of reporting rate can become CPUE indicator for Blue sharks, and the data of less than 20% can become CPUE indicator for Shortfin mako. What follows are standardized CPUE for Blue sharks. Further, Matsunaga and Nakano (1999) stated that no conspicuous changes were observed in fishing rates for Oceanic whitetip sharks, Silky sharks, Blue sharks, Thresher sharks as obtained in the research on sharks by prefectural government vessels between 1967 and 1970 and between 1992 and 1995. (Figs.4, 5).

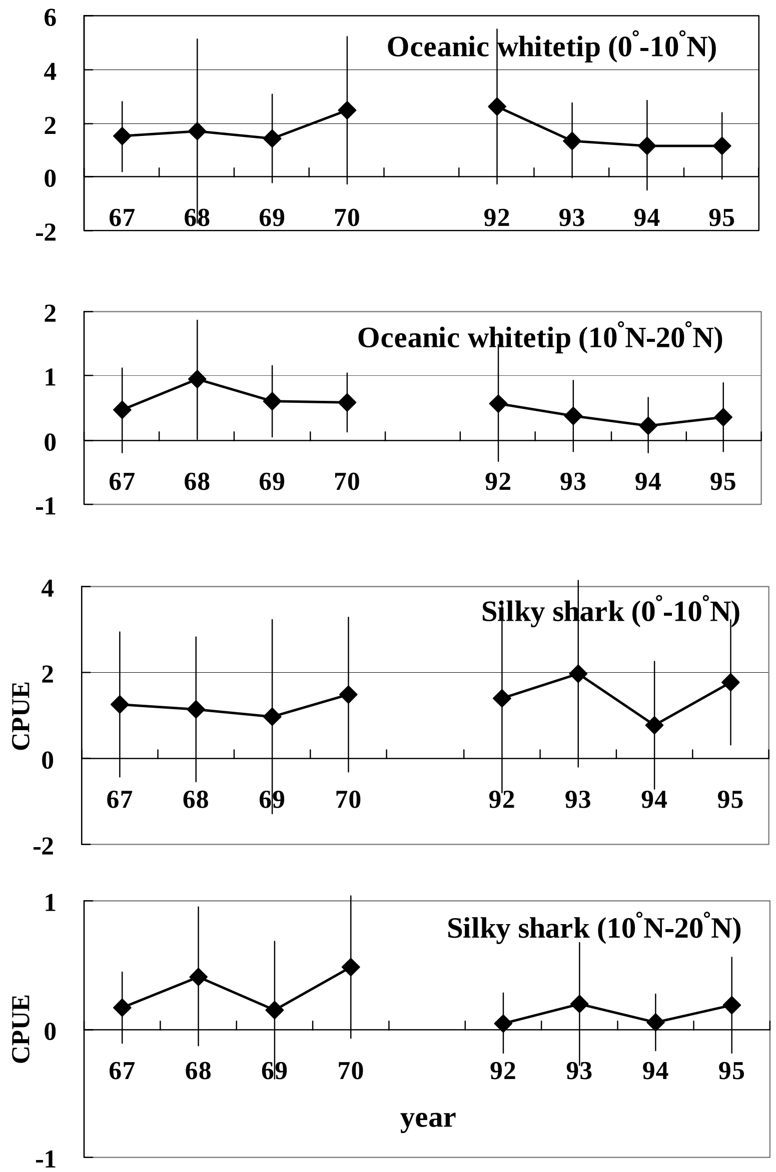


Fig.5-4. CPUE and standard deviation of Oceanic whitetip sharks (Figure above) and Silky sharks (figure below) for each research year, as observed in the sharks research conducted by prefectural government vessels.

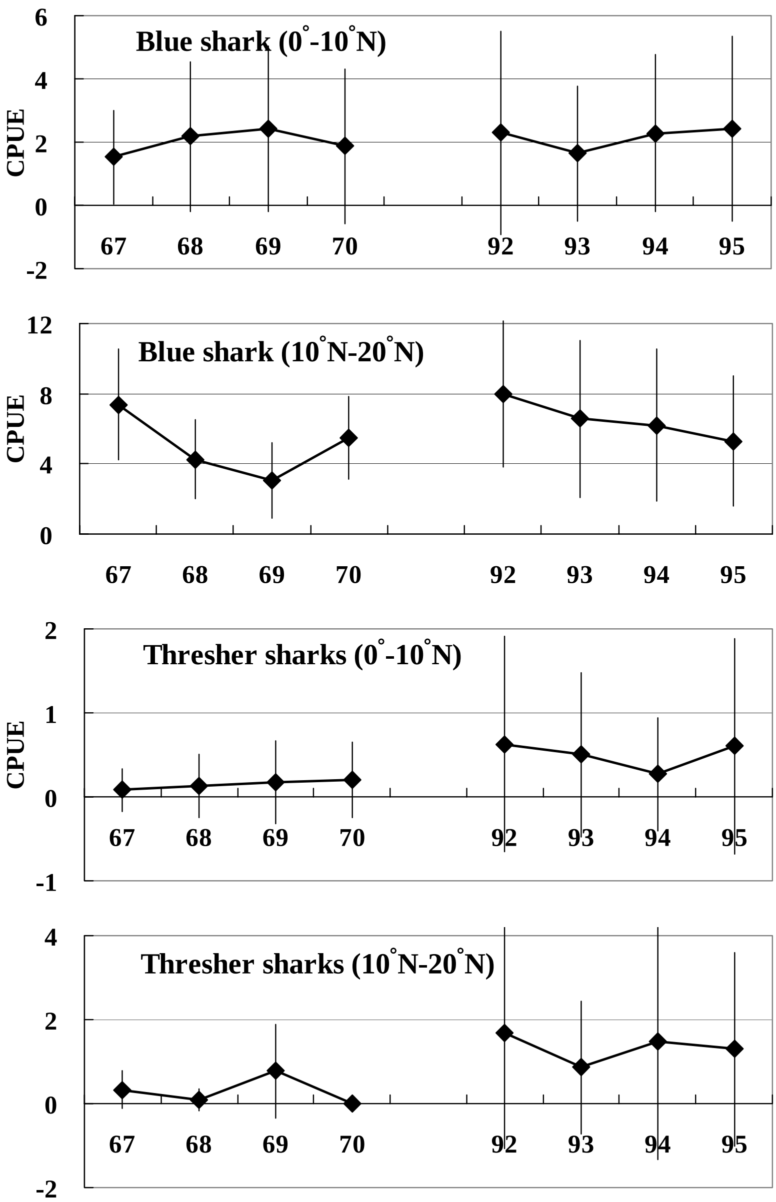
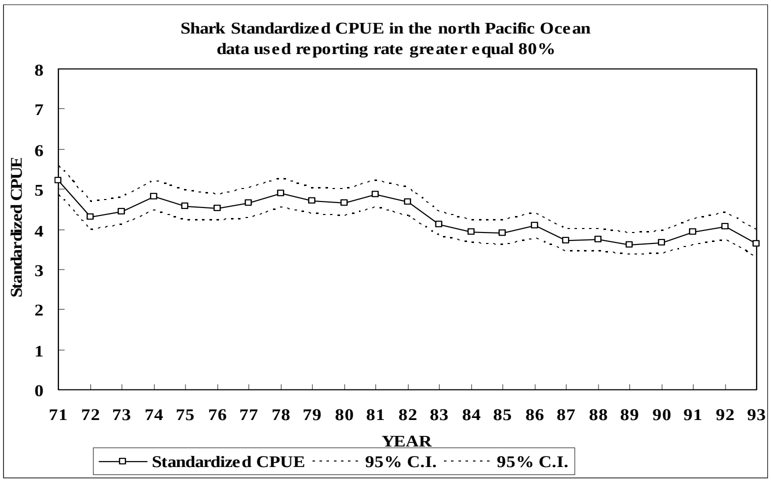


Fig.5-5. CPUE and standard deviation of Blue sharks (Figure above) and Thresher sharks (figure below) for each research year, as observed in the research on sharks conducted by prefectural government vessels.



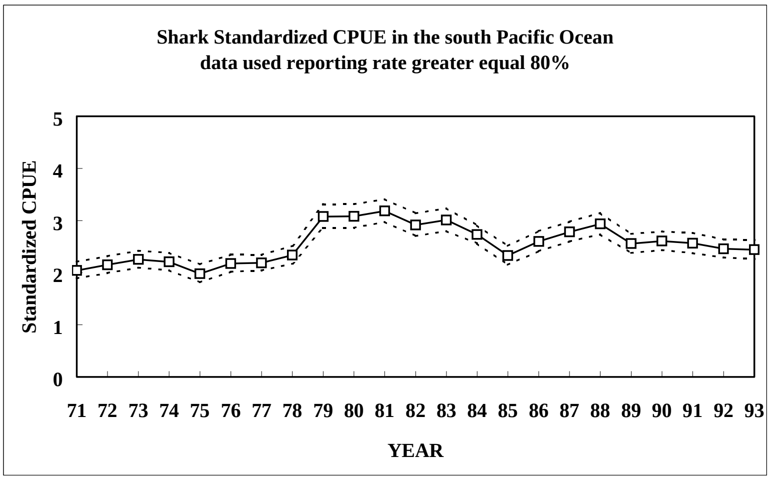
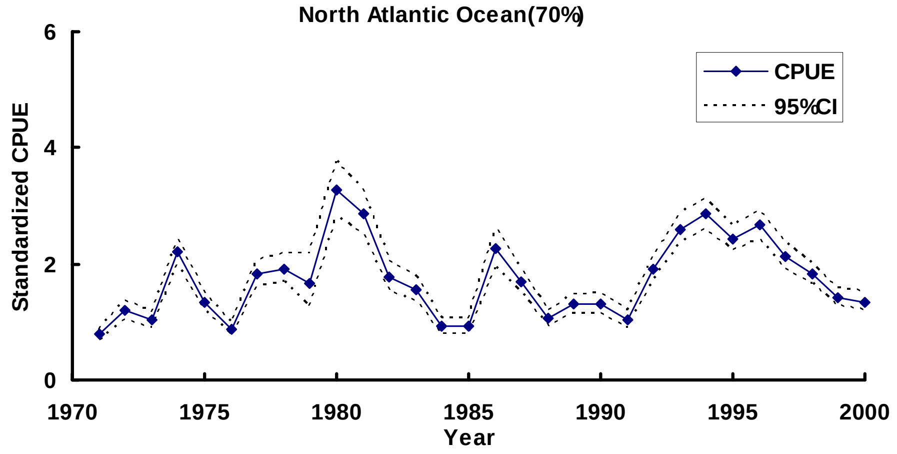


Fig.5－6. Standardized CPUE for Blue sharks as observed in the Pacific



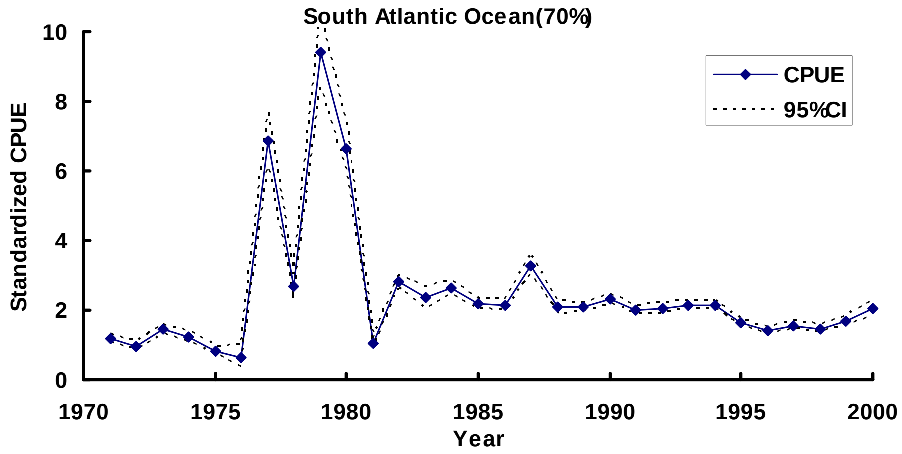


Fig.5－7. Standardized CPUE for Blue sharks as observed in the Atlantic

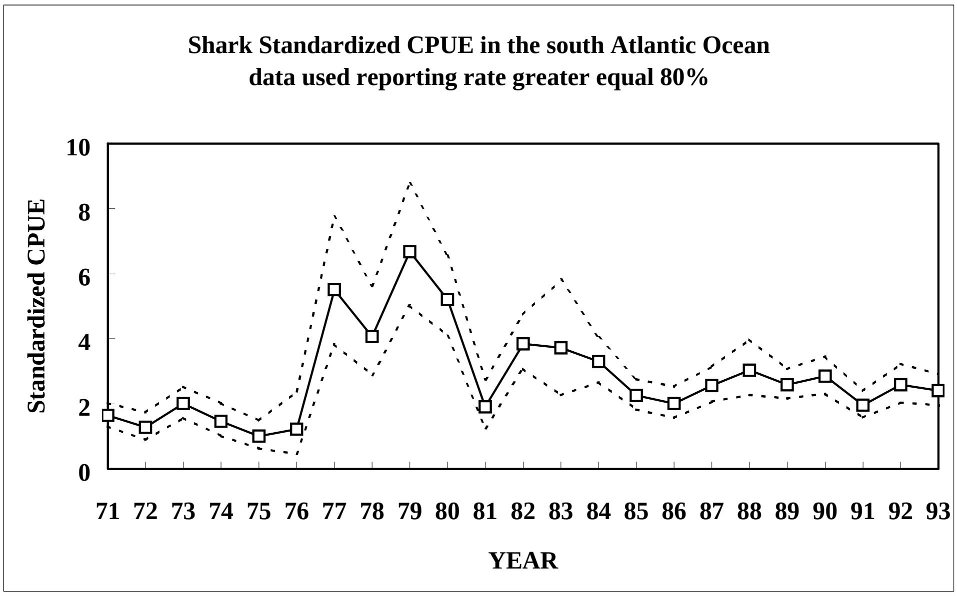


Fig.5－8. Standardized CPUE for Blue sharks as observed in the Indian Ocean

5) Recommendations for stock assessment and protection and management

There is no special recommendations for protection and management of Blue sharks, Oceanic whitetip sharks, Silky sharks, and Bigeye threshers because no conspicuous changes have been observed in the resources status. However, there is a need to continue observation on the state of the resources.

For Shortfin mako and Crocodile sharks, there is a need to discuss in the future as data showing the state of the resources are rare or almost none.

6) Issues in stock assessment

It is a problem that statistical data are not sufficient for catch volume by species that is necessary for conducting stock assessment. The Fisheries Agency revised the catch report submission form in tuna longline fisheries in recent years, and is reporting catch volume of 5 species of sharks. But, there remain some problems as there are no records for the cases where sharks are discarded. Further, it is difficult to grasp the actual state of discarded volume by species. In order to accurately estimate the species of sharks caught or estimate discarded volume of sharks caught in tuna longline fishing vessels, there is a need to collect, together with reports from fishermen, the data not depending on fishermen such as data collection by research vessels and observer programs. There is a need to discuss this matter, including improvement of data collection methods.

References

Anon. 2001: 2002 Annual Statistical Report on Fisheries and Aquaculture Production. Statistics and Information Division, the Ministry of Agriculture, Forestry and Fisheries.

Bonfil, R., R. Mena, and D. de Anda 1993: Biological parameters of commercially exploited silky sharks, Carcharhinus falciformis, from the Campeche bank, Mexico. NOAA Tech. Rep. NMFS 115: 73-86.

Bonfil, R. 1994: Overview of world elasmobranch fisheries, FAO Fisheries Technical Paper, No. 341. United Nations, Food and Agriculture Organisation, Rome, 119pp.

Branstetter, S. 1987: Age, growth and reproductive biology of the silky shark, Carcharhinus falciformis, and the scalloped hammerhead, Sphyrna lewini, from the northwestern Gulf of Mexico. Environ. Biol. Fishes 19: 161-173.

Cailliet, G.M. and D.W. Bedford 1983: The biology of three pelagic sharks from California waters, and their emerging fisheries: A review. Cal. COFI Rep., XXIV: 57-69.

Casey, J.G., H.W. Pratt Jr., N. Kohler and C.E. Stillwell 1989: The shark Tagger, 1988 summary. Newsletter of the Cooperative Shark Tagging Program, NOAA, Northeast Fisheries Center. 12pp.

Compagno, L.J.V. 1984: FAO species catalog, Vol.4: Sharks of the world; Part 2 ? Carcharhiniformes, Fisheries Synopsis No. 125., Food and Agricultural Organization of the United Nations. Rome, Italy, 655pp.

Gubanov, Ye.P. and V.N. Grigoryev 1975: Observation on the distribution and biology of the blue shark Prionace glauca (Carcharhinidae) of the Indian Ocean. Vopr. Ikhtiol., 15 (1): 43-50.

Hirayama 1985: Chapter 4 tuna fishery resoruces and its fishing gear and fishing method, tuna --from production to consumption. Tokyo University of Fisheries 7th Open seminar Edition Committee (ed.),Seizando Shoten, Tokyo 1985. 285pp.

Kohler, N.E., J.G. Casey and P.A. Turner 1995: Length-weight relationships for 13 species of
sharks from the western North Atlantic. Fish. Bull., 93: 412-418.

Last, P.R. and J.D. Stevens 1994: Sharks and Rays of Australia. CSIRO, Australia 513pp.

Liu, K., P. Chiang and C. Chen 1998: Age and growth estimates of the bigeye thresher shark, Alopias superciliosus, in northeastern Taiwan waters., Fish. Bull., 96: 482-491.

Oshitani, S., H. Nakano and S. Tanaka (in press): Age and growth of the silky shark Carcharhinus Falciformis from the Pacific Ocean. Fish. Sci.

Pratt, H.L.Jr. and J.G. Casey 1983: Age and growth of the shortfin mako, Isurus oxyrinchus, using four methods. Can. J. Fish. Aquat. Sci., 40: 1944-1957.

Seki, T., T. Taniuchi, H. Nakano and M. Shimizu 1998: Age, Growth and Reproduction of the Oceanic Whitetip Shark from the Pacific Ocean. Fish. Sci., 64 (1): 14-20.

Tanaka, A. 1984: 4. Present situation of studies on resources. Taniuchi, T and Suyama, M. (ed.), Sharks and Rays as Living Resources, 46-59p., Koseisha-Koseikaku, Tokyo. 136pp.

Taniuchi, T. 1990: The role of elasmobran research in Japanese fisheries. NOAA Tech. Rep. NMFS 90: 415-426.

Taniuchi, T. 1995: Should Sharks Be Protected? Taniuchi, T. and Hirano, R. (ed.), Productivity of the Sea and Fishes. Koseisha-Koseikaku, Tokyo,73-95p.

Taniuchi, T. 1997: National history of sharks. Tokyo Universotu Press, 1997, Tokyo, 270pp.

Taniuchi, T. 1988: Taxonomy and evolution of cartilogenous fishes. Ueno, T. and Okiyama, M. (ed.) "Modern Ichthyology", Asakura Shoten, Tokyo,p.34-60.

Nakano, H. 1994a: Ecological studies on age, breeding and migration of Blue sharks distributed in the North Pacific. Bulletin of National Research Institute for Far Seas Fisheries,31: 141-256.

Nakano, H. 1994b: Report on the research onboard tuna longline fishing vessel. (central North Pacific area). National Research Institute for Far Seas Fisheries and the Pelagic Fish Resource Division. 73pp.

Nakano, H. 1996: Distribution of oceanic hanshirui in the North Pacific. Monthly Kaiyo,28: 407-415.

Matsunaga, H. and Nakano, H. 1996: Distribution of hanshi-rui occurring in the outer water in the Southern Hemisphere. Monthly Kaiyo, 28: 430-436.

Nakaya, K. and Nakano, H. 1995: I. Species identification of sharks. Nakaya, K.,Nakano, H.,Nakamura, I.,Okamoto, H. (co-authored), Manufal for species identification of living things caught incidentally in the southern bluefin tuna fishing ground. National Research Institute for Far Seas Fisheries 61pp.

6. Large sharks (Whale sharks, Basking sharks, and White sharks)

1) An outline of fisheries

There exist no fisheries targeting Whale sharks in Japan. It is considered there are considerable incidental takes in set nets, but Whale sharks are either released or discarded as they have no commercial value. There are very few cases of this species to be landed at the market. Incidental takes in set nets mainly occur in Okinawa's main island, and the Pacific coast of Kyushu and Shikoku (Uchida 1995).

Basking sharks had been harvested by harpoon fisheries in Nakiri, Mie Prefecture in Japan, but it no longer takes place because of small amount of catches. As more than 1,200 individuals were landed in the 12 years between 1967 and 1978, the average annual catch stands at about 100 individuals. The harvest in 1975 was about 150, with 20 in 1976, 9 in 1977 and 6 in 1978 (Yano 1978). Further, Basking sharks are caught incidentally in set nets along the coast of Tohoku region and Hokkaido from spring to autumn.

There exist no fisheries targeting Great white shark. There is no accurate catch information, but it is caught incidentally in set nets randomly. Female individuals of 520cm and 580cm were caught by set nets in Hokkaido on May 30 and 31, 1985, respectively, and a female individual was caught by set nets along the coast of Kochi Prefecture on May 22, 1992. Although no official records remain, it is conjectured that a number of incidental takes occur besides the cases cited above.

2) Biology of sharks and rays harvested

i) Standard Japanese name, scientific name, English name, and issues regarding identification

Standard Japanese name	scientific name	English name
Jimbeizame	*Rhincodon typus*	Whale shark
Ubazame	*Cetorhinus maximus*	Basking shark
Hohojirozame	*Carcharodon carcharias*	Great white shark

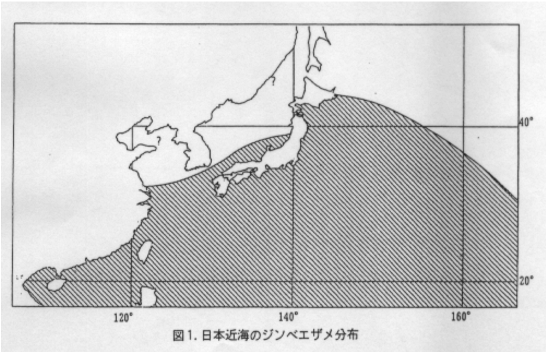
Whale sharks are easiest to identify from other species, with its huge body, square head, and loud body color. When a juvenile of 4-5m is seen from the side in the water, there is a risk of confusing it with a large Tiger shark when it is dark and less transparent. But, when white spots on the side of the body and square head are recognized, there is no possibility of misidentification. Basking sharks have a body shape similar to the species of Lamnidae, and there is a possibility of confusing it with large White shark in the water. However, identification is easy under the situation where extremely long gill slit can be sighted. White sharks are similar in proportion to other sharks of Lamnidae, Salmon sharks, Shortfin mako, and Longfin mako. The point of identification is that its jaw teeth are shaped as isosceles triangle and it has strong saw tooth edge.

ii) Distribution

Whale sharks are distributed in the high temperature water of tropical and temperate zones throughout the world. They migrate both in outer water and coastal waters.

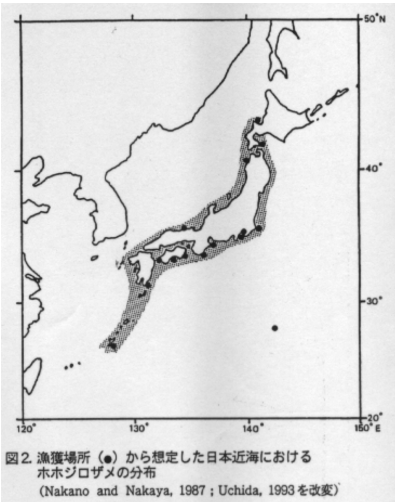
Their distribution is outlined centering on the equator. They are distributed in the zone from 35 degrees S to 30 degrees N, and occur also in the high latitudinal areas depending on the movement of warm currents (Fig. 6-1). Examples are seen in their occurrences in the summer in such areas as off Hokkaido on the Pacific west coast (43 degrees N) and off New England of the Atlantic west coast. It is certain that they migrate following favorable water temperature and feed organisms, (Iwasaki 1970, Clark 1992). It is totally unclear what distance and in what way they migrate, and the depth of their living sphere is uncertain.

Basking sharks are distributed in near waters of both poles to the temperate zone. They are found from coastal areas to offshore areas. Very rarely, they occur in the tropical zones, but this is considered as a straying behavior, and occurrences in this zone are considered to be rare. Taiwan is the southern boundary for this species in the western Pacific. In the Pacific coastal areas near Japan, they occur from spring to summer, and in the Sea of Japan side mostly from winter to spring (Fig. 6-1). The cases of occurrences in Okinawa, the southernmost area, were observed in July.



Distribution area of Whale sharks

Distribution area of Basking sharks



Distribution area of Great white sharks

Fig. 6-1. Distribution area of Whale sharks (top), Basking sharks (middle), and Great white sharks (bottom) in the waters surrounding Japan. Quoted from Uchida (1995a, 1996b) and Teshima (1994).

Distribution of Great white sharks in the waters surrounding Japan is considered to range from the area near Okinawa to the waters of Hokkaido (Fig. 6-1). This species is considered to migrate longitudinally according to the seasonal changes of water temperature. It is possible that they engage in seasonal migrations in relation to parturition of foetus. At present, much is still unknown.

iii) Breeding patterns, number of calves born, and body length at birth

Little has been known about breeding of Whale sharks. A pregnant female individual of 11m was caught in Taiwan in 1995. It had 300 individuals of foetuses and eggshells in both uteruses. One of those foetuses lived 143 days in an aquarium in Japan. It was clarified by this instance that Whale sharks are ovoviviparous. There have been only 9 cases of reports for small-size individuals of 55cm to 93cm in the world. Size at the time of birth is considered to be in this range, but it has not been specified clearly.

There have been rare instances of occurrences of small-size Basking sharks, and research have been scarce. The smallest swimming individual based on a record in the mid-19th century was 1.65m (Bigelow and Schroeder 1948). From this it is estimated that the body length at the time of birth is from 1.7 to 1.8m. It is also estimated that they are viviparous and oophagous because of similarity with sharks belonging to the Lamniformes from the viewpoint of the quality and taxonomy of uterus having inner wall covered with ciliform tissues (Matthews 1950; Compagno 1984).

The reproductive pattern of Great white sharks belongs to viviparity and non-yolk sac placenta, and is very different from many other sharks belonging to this pattern. For viviparous and non-yolk sac placentiform sharks, foetuses grow by absorbing egg yolk of external yolk sac they have. However, in this species, several of fertilized eggs that went down to uterus, generate and grow by eating in the uterus the mature ovum ovulated from ovaries. This pattern is called oophagy and yolk stomach type, and several species of the Lamniformes are considered to have a similar pattern.

According to the results of recent observation, Great white shark juveniles immediately after parturition are considered to already have functional teeth because a large number of fragments of skin of foetuses and teeth were found from the intestines of Great white shark foetuses (body length: 130-150cm) immediately before the birth. There is the possibility of adelphagy among foetuses and molting of teeth in the uterus.

Female Great white sharks with a foetus considered to be in the state immediately before parturition (body length: 130-150cm) were captured in the coastal areas of Taiji, Wakayama Prefecture, in April 1986, Uchinoura, Kagoshima Prefecture in May 1992, and Toyocho, Kochi Prefecture in May 1992. Further, small Great white shark of 170cm and 140cm were captured in Yahatahama, Ehime Prefecture in 1974 and near Yakushima in 1978, respectively. Judging from the size of small Great white sharks and their foetuses as well as the period and location of the capture, it is estimated that this species living in the waters near Japan gives birth to foetuses of the length of 130-150cm in the coastal areas in southwestern Japan from April to May (Teshima 1994).

Table 6-1.Breeding patterns, number of calves born, body length at the time of birth and weight of the three species of large sharks

Species	Breeding pattern	Number of calves born (average, extent)	Body length at the time of birth	Weight
Whale sharks	ovoviviparous	300	?	
Basking sharks	viviparous and non placental?	6	1.7–1.8m	
Great white sharks	Viviparous and non placnetal	4–14	120–150cm (total length)	12–32kg

iv) Age and growth

With respect to the growth of Whale sharks in captivity, in the case of aquarium of

1,100t, annual growth was 29.5cm (total length; length at the time of carrying-in--3.65m; captivity of 5 years and 7 months) and 46cm (length at the time of carrying-in -- 4.4m; in captivity for 1 year and 9 months). In the case of aquarium of 5,400t, annual growth was 45.5cm (length at the time of carrying-in--4.1m; in captivity for 4 years and 4 months) (Uchida 1995). In the case of an annual growth of 29.5cm, it is estimated that annual average growth rate was low as physical conditions were not good for a long time in the latter half of the captivity period. A juvenile individual of this species of body length of 3-6m is estimated to grow about 45cm a year.

Length at sexual maturity of female Basking sharks is not clear. It is estimated that males reaches the sexual maturity at the length of 6.4-7.4m at the age of 6-8, and parturition period is 3.5 years (Parker and Stott 1965). This is a conjecture on the results surveyed on growth ring of vertibral centrum, with respect to this species of eastern north Atlantic. As this is a result on the assumption of two growth rings, the possibility of one ring a year is also considered. Therefore, there is a view that the maturity age may be 12-16 (Compagno 1984). Bigelow & Schroeder (1948) estimated sexual maturity of male at 4.6-6.1m from research on changes in body shape, the state of clasper and testis.

Table 6-2. Growth formula of the three species of large sharks, research area and researchers.

Species	Growth formula	Measured position	Sea area	Researchers
Whale shark	about 45cm/year ?	total length	Pacific	Uchida (1995)
Basking shark	about 70cm/year ?	total length	Atlantic	Parker and Stott (1965)
Great white shark	$Lt=763.7(1-e^{-0.058(t+3.53)})$	total length	Pacific	Cailliet *et al.* (1985)

Table 6-2. shows growth formula of Great white sharks based on 21 individuals caught in U.S. western coastal area.
Male individuals of this species become mature at the total body length of 442cm, and those of 366-381cm were immature (Florida) and over 457cm (U.S. eastern coast). It is estimated that they get mature at around 440-460cm. Females are considered to reach maturity between 420cm and 460cm, from 396-426cm or larger (Florida), 457cm or larger (U.S. eastern coast), and 420cm or larger (Australia).

v) Photos

Illustrations of Whale sharks, Basking sharks, and Great white sharks are given from Last and Stevens (1994) in order to show the shape of the three species.

Fig. 6-2. Three species of large sharks: Whale shark (top), Basking shark (middle), Great white shark (bottom).

vi) Stocks

Almost no knowledge is available about stock structure of the three species of large sharks discussed in this paper. As Whale sharks are distributed from tropical to temperate zones, the stocks in the Atlantic may be segregated from those in the Pacific and the Indian Ocean. However, it is entirely unclear whether or not there exist east-west or north-south stocks in the Atlantic. In the Pacific, there may be east-west interactions of stocks as latitudinal migration is known for many years. The situation in the Indian Ocean is totally unknown.

No accurate knowledge on Basking shark stocks has been obtained. This species occur along the eastern and western coast of the Pacific, but nothing is known about their interaction. Also, knowledge has not been made available regarding this species occurring on both coasts of northern Atlantic.

Detailed information is not available for Great white sharks as well. This species occurs along the eastern and western coasts of the Pacific. But as they have stronger coastal nature than the other two species, the possibility is suggested that their breeding groups are segregated latitudinally.

3) Historical changes in the catch volume

The three species of large sharks are caught incidentally by set nets along the coast. Their disposal is random with some landed at the market and others released. For this reason, no official catch statistics remain. Basking shark's liver had value for use, and a large number were caught in Nakiri in Mie Prefecture from the 1960s to the 1970s. More than 1200 individuals were landed for the 12-year period between 1967 and 1978, with an average of about 100 individual a year. In 1975, about 150 were landed, followed by about 20 in 1976, 9 in 1977, and 6 in 1978 (Yano 1978).

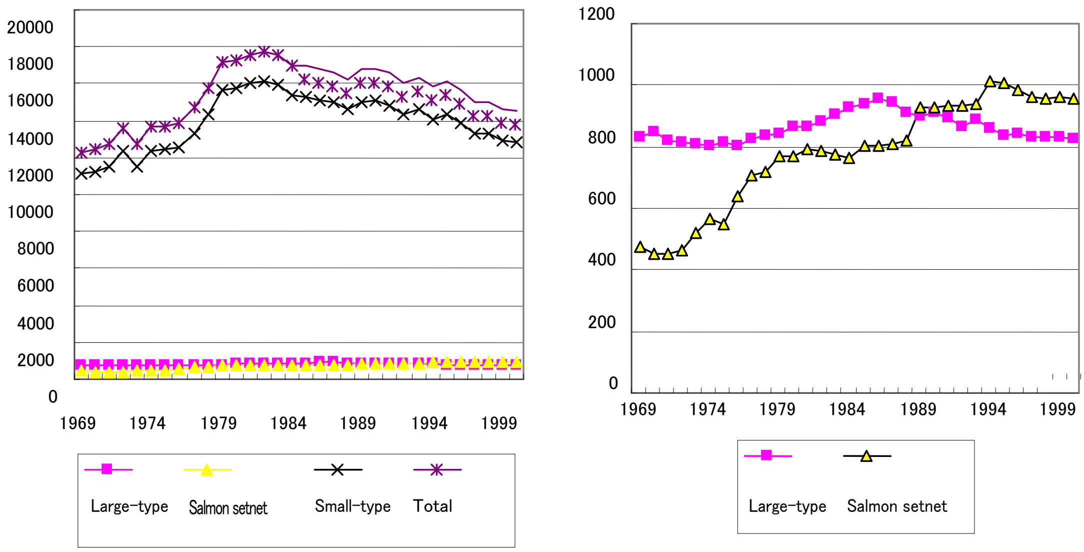


Fig. 3.Changes in setting of set nets along the coast of Japan from 1969 to 2000

4) Fishing effort (number of operating fishing vessels, number of fishing days, etc.)

In the absence of fisheries directly targeting three species of large sharks, the number of settings of set nets, which is considered to catch sharks incidentally, was discussed (Fig. 6-3). In the past 30 years, the number of operative large-type set nets increased from 800 to 900 in the 1980s, and decreased again to around 800 in the 1990s. The number of operative small-type set nets reached 16,000 in the first half of the 1980s, and decreased to about 12,900 in 2000. The number of salmon set nets increased from around 400 to 900 during the same period. The total number of set nets with respect to the three types of sharks increased from about 12000 in 1970 to peak at about 18,000 in the first half of the 1980s. Then they gradually decreased to about 4,500 in 2000. It is not clear whether those set nets constitute fishing pressures to the three types of sharks. But if they did, the pressures must have gradually decreased from the 1980s to the 1990s.

5) The state of stocks and changes in fishing rate.

There exist no fisheries targeting Whale sharks. It is considered that there are considerable numbers caught incidentally by set nets, but they are either released or discarded because they have no commercial value. There are very few cases of Whale sharks landed at the market. According to Uchida (1995), 78 individuals were caught incidentally in 16 years from 1979 to 1994 in set nets in Okinawa's main island. The annual average number was 4.9, and incidental takes occur between March and September, mostly in summer. Along the Pacific coast of Shikoku, 25 individuals were caught incidentally in 5 years from 1989 to 1993. The average number of incidental takes in this area is 5 in a year, and June and July is the high season.

Fig. 6-4 shows annual changes in Japan's eastern offshore fishing grounds and southern fishing grounds for purse-seine and changes in operation targeting fish schools associated with Whale sharks obtained from purse-seine catch reports in Japan (National Research Institute of Far Seas Fisheries inside materials). In the eastern offshore fishing grounds in Japan, the number of operations had stayed at 10-50 times a year in the 1970s-1980s but rapidly increased to 50-200 times in the 1990s. This is due to movement of northern purse-seine vessels to the operation mainly targeting at skipjack, causing increase in the operation(Tanaka, pers. comm.). In the southern fishing grounds, the number of the operations was 20-100 times a year from 1980s to early 1990s. It is now examined what frequency of occurrence those materials show. At least, there is no indication that occurrence of Whale shark declined historically.

Table 6-3 summarizes the number of occurrence of Whale sharks by year in the area surrounding Japan. It seems that in the coastal areas of Okinawa, Kagoshima, and Shikoku, there occurred incidental takes (entrance in set nets) of about 5-10 individuals a year. No significant annual changes have been observed.

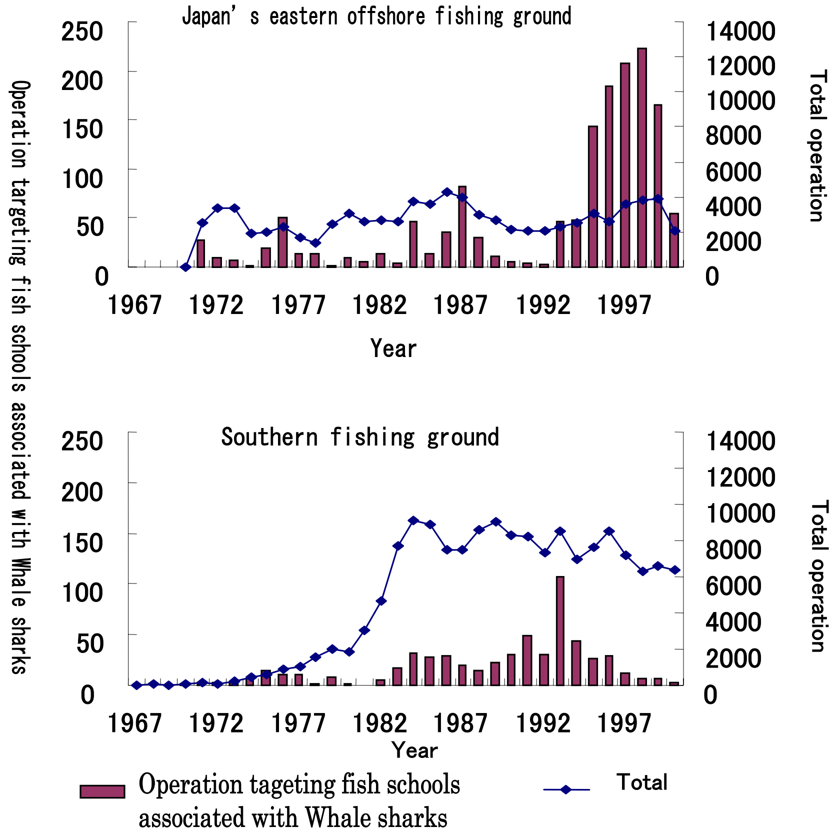


Fig. 6-4. Annual changes in the number of fishing operations and changes in the number of operations involving incidental takes of sharks in Japan's eastern offshore fishing grounds and southern fishing grounds for purse-seine fishery as compiled from data on purse-seine catch reports in Japan

Basking sharks had been taken by harpoon fishery in Nakiri, Mie Prefecture in Japan. The harvest no longer takes place because of small catch volume.
The average number of landing was about 100 individuals, as over 1200 individuals were landed during the 12 years from 1967 to 1978. The number of individuals landed in 1975 was about 150, with about 20 in 1976, 9 in 1977 and 6 in 1978 (Yano 1978). Fishing effort was not constant every year, and there were changes in demand.
Table 4 summarizes the number of occurrences of Basking sharks by age in the waters near Japan.

Harpoon fishing of about 100 Basking sharks occurred in Nakiri, Mie Prefecture, from latter half of the 1960s to first half of the 1970s. Later there was not directed fisheries but only incidental catch in set nets. In many cases, the records of entrance of Basking sharks into set nets were taken up by the news media. and it is difficult to quantify frequency of occurrences. However, there remain records of several individuals entering into set nets, indicating that set-net entries are taking place constantly.

Table 6-5 summarizes year-to-year occurrences of Great white sharks in the area surrounding Japan. Although there exist few records of occurrences from many years ago, records have been kept at an equal frequency during past 50 years. Reports of 12 cases of occurrences in 1992 and 6 in 1993 are probably because more attention was given to reporting of incidental take of Great white sharks than in previous years as media interest in the accidents caused by Great white sharks in 1992.

Table 6-3.Records of year-to-year occurrences of Whale sharks in the waters surrounding Japan

Records of occurrences were summarized from document information, etc. The operations targeting fish school associated with Whale sharks in the waters near Japan is that of purse-seine fishing vessels.

Year	(1)+(2)	Number of Operations (1)	Number of occurrences (2)	Places of occurrences (Prefecture)
1970	1	1		
1971	31	31		
1972	15	13	2	Fukui[1)]、Wakayama[6)]
1973	12	10	2	Kagoshima、Niigata[1)]
1974	7	7		
1975	34	34		
1976	60	60		
1977	24	24		
1978	15	15		
1979	15	9	6	Okinawa(５)、Kyoto[1)]
1980	17	11	6	Okinawa(５)、Fukui[1)]
1981	10	5	5	Okinawa(５)[1)]
1982	24	19	5	Okinawa(５)[1)]
1983	27	21	6	Okinawa(５)、Shimane[1)]
1984	86	79	7	Okinawa(５)、Kyoto、Ishikawa[1)]
1985	50	42	8	Okinawa(５)、Ishikawa、Niigata、Shizuoka[1)]
1986	74	65	9	Okinawa(５)、Kyoto(2)、Fukui、Ishikawa[1)]
1987	107	102	5	Okinawa(５)[1)]
1988	49	44	5	Okinawa(５)[1)]
1989	45	34	11	Okinawa(５)、Shikoku Pacific coast(５)、Kagoshima[1)]
1990	45	35	10	Okinawa(５)、Shikoku Pacific coast(５)[1)]
1991	69	53	16	Okinawa(５)、Shikoku Pacific coast(５)、Tokushima、Wakayama(2)、Chiba、Kyoto、Saga[1)]
1992	43	33	10	Okinawa(５)、Shikoku Pacific coast(５)[1)]
1993	168	153	15	Okinawa(１０)[6)]、Shikoku Pacific coast(５)[1)]
1994	101	92	9	Okinawa(５)、Ishikawa[1)]、Kochi(3)[5)]
1995	180	171	9	Kochi(9)[5)]
1996	218	214	4	Okinawa(4)[6)]
1997	231	219	12	Kagoshima(５)[3)]、Kochi(４)[5)]、Wakayama[7)]、Okinawa[6)]
1998	231	229	2	Kochi[5)]、Okinawa[6)]
1999	174	172	2	Okinawa[4)]、Kochi[5)]
2000	72	56	16	Kagoshima(８)[2)]、Kochi(２)[5)]、

				Okinawa（6）[6]
2001	10	n.a.	10	Kagoshima（5）[3]、Oita、Mie[4]、Okinawa（3）[6]
2002	7	n.a.	7	Kagoshima（6）[3]、Aomori[4]

Sources::

1) Uchida, S. 1995: 3.Whale shark. Basic data on rare aquatic wildlife in Japan (II). 146–153. Japan Fisheries Resource Conservation Association. Tokyo .751pp.

2) Anon 2001: Whale sharks migrating to the sea of Kagoshima Prefecture Sea near Sakurajima. Vol 4, No.13, 2001: 2–3.

3) Kagoshima Aquarium, Nakahata (pers. comm.)

4) Internet

5) Osaka Kaiyukan, Nishida (pers. comm.)

6) Report on Entrusted Project by the Fisheries Agency for Fiscal 2001 (GLOBAL GURADIAN TRUST)

7) Report on Entrusted Project by the Fisheries Agency for Fiscal 2002 (GLOBAL GURADIAN TRUST)

Table 6-4. Records on the occurrences of Basking shark by age in the waters near Japan

Year	No.of occurrences	Place of occurrences(Pref.)
1967	100	Nakiri[1]
1968	100	Nakiri[1]
1969	100	Nakiri[1]
1970	100	Nakiri[1]
1971	101	Nakiri、Fukushima[1]
1972	100	Nakiri[1]
1973	100	Nakiri[1]
1974	100	Nakiri[1]
1975	152	Mie、Yamaguchi、Nakiri[1]
1976	20	Nakiri[1]
1977	10	Mie、Nakiri[1]
1978	6	Nakiri[1]
1979	11	Ishikawa[1]、Mie （10）[3]
1980	2	Hyogo、Shizuoka[1]
1981	4	Okinawa[1]、Mie （３）[3]
1982	1	Nagasaki[1]
1983		
1984	2	Hokkaido、Niigata[1]
1985	3	Hokkaido、Ishikawa、Shimane[1]
1986	3	Nagasaki （2）、Shizuoka[1]
1987	1	Okinawa[1]
1988	2	Ishikawa[1]
1989	1	Shizuoka[1]
1990		
1991	1	Fukuoka[1]
1992	1	Totori[1]
1993	3	Kochi、Hyogo[1]、Fukuoka[2]
1994	2	Kochi、Ishikawa[1]
1995	2	Iwate[5]
1996	1	Miyagi[5]
1997	4	Wakayama[4]
1998		
1999	1	Iwate[5]
2000		
2001	1	Miyagi[5]
2002		

Sources:

1) Uchida, S. 1995b: 5.Basking shark. Basic data on rare aquatic wildlife (II). 159-167. Japan Fisheries Resource Conservation Association.Tokyo .751pp.

2) Internet

3) Yano, K.1981: Visit of sharks to Ise Shrine. Anima No.99: 20-26.

4) Report on Entrusted Project by the Fisheries Agency for Fiscal 2002 (GLOBAL GURADIAN TRUST)

5) Report on Entrusted Project by the Fisheries Agency for Fiscal 2001 (GLOBAL GURADIAN TRUST)

Table 6-5. Records on occurrences by year of Great white sharks in the water near Japan

Records of occurrences were summarized from document information, etc.

Year	No.of occurrences	Place of occurrences (Pref.)
1956	1	Hyogo[2)]
1957		
1958	1	Kochi[2)]
1959		
1960		
1961		
1962	1	Chiba[2)]
1963		
1964		
1965		
1966		
1967		
1968		
1969		
1970		
1971	1	Aomori[2)]
1972		
1973		
1974		
1975	1	Okinawa[3)]
1976		
1977	2	Okinawa[3)]
1978		
1979	2	Kochi、Okinawa[2)]
1980	1	Okinawa[3)]
1981	1	Okinawa[3)]
1982		
1983		
1984	1	Okinawa[3)]
1985	3	Hokkaido(2)[2)]、Okinawa[3)]
1986	1	Wakayama[3)]
1987		
1988	1	Okinawa[3)]
1989	3	Okinawa[3)]
1990	2	Okinawa[3)]
1991		
1992	12	Ehime(2)、Kagoshima(2)、Kochi(2)、Hokkaido(2)、Miyagi、Wakayama、Chiba、Hyogo[5)]
1993	6	Shimane(2)、Fukuoka、Kagoshima、Oita、Chiba[5)]
1994	3	Okinawa、Kochi[3)]、Shizuoka[5)]
1995	2	Tokyo（Izu Islands）[4)]、Okinawa[6)]
1996		
1997	3	Mie[4)]、Wakayama（２）[7)]
1998	1	Miyagi[6)]
1999	1	Yamaguchi[4)]
2000	2	Akita[4)]、Iwate[6)]
2001		

References

2)Nakano and Nakaya 1987: Records of the white shark Carcharodon carcharias from Hokkaido, Japan. Jap. J. Ichthy. 33 (4): 414-416.
3) Uchida, Toda 1996: Records on Pregnant Japan White shark in the off-shore area of Japan. Monthly Kaiyo 28 (6): 371-376.
4) Internet
5)Nakaya 1994: Distribution of white shark in Japanese water. Fish. Sci. 60 (5): 515-518.
6) Report on Entrusted Project by the Fisheries Agency for Fiscal 2001 (GLOBAL GURADIAN TRUST)
7) Report on Entrusted Project by the Fisheries Agency for Fiscal 2002 (GLOBAL GURADIAN TRUST)

6) Stock assessment and recommendations for conservation and management

As there exist no fisheries targeting at three species of large sharks (Whale shark, Basking shark, Great white shark) in Japan, it is considered there is no active fishing effort. However, in the neighboring countries (Taiwan, the Philippines, etc.), there exist commercial fisheries of Whale shark, there may be need for Japan to closely monitor increase and decrease of those species.

7) Issues regarding stock assessment

In Japan, no system to collect incidental take information systematically has been arranged regarding set nets fisheries that catch those species incidentally. For this reason, incidental take information for those three species cannot be collected. It is an urgent task to establish information collection system in order to implement stock assessment and protective measures.

References:
Bigelow, H.B. and W.C. Schroeder 1948: Fishes of the western North Atlantic. I. Sharks. Mem. Sears Found. Mar. Res., pp.189-195.

Cailliet, G.M., L.J. Natason, B.A. Welden and D.A. Ebert 1985: Preliminary studies on the age and growth of the white shark, Carcharodon carcharias, using vertebral bands. Mem.
South Calif. Acad. Sci., 9: 49-60.

Clark, E. 1992: Whale sharks. National Geographic, 182 (6): 120-138.

Compagno, L.J.V. 1984: Sharks of the world. An annotated and illustrated catalogue of shark species known to date. FAO Fisheries Synopsis., 4 (125) Part 1: 233-236.

Iwasaki, Y.1970: Distribution of White Sharks in the western Pacific skipjack fishing ground and a few living conditions. Oceanic Department, Tokai University, 4: 37-51.

Last, P.R. and J.D. Stevens 1994: Sharks and Rays of Australia. CSIRO, Australia. 513pp.

Matthews, L.H. 1950: Reproduction in the basking shark, Cetorhinus maximus (Gunnerus).

Philos. Trans. R. Soc. Lond. B Biol. Sci., 234: 247-316.

Parker, H.W. and F.C. Stott 1965: Age, size and vertebral calcification in the basking shark, Cetorhinus maximus (Gunnerus). Zool. Meded., 40: 305-319.

Teshima, K. 1994: White shark. Basic data concerning rare aquatic wildlife in Japan. 134-143. Fisheries Agency.Tokyo .696pp.

Uchida, S. 1995a: 3.Whale sharks. White sharks. Basic data concerning rare aquatic wildlife in Japan (II). 146-153. Japan Fisheries Resource Conservation Association.Tokyo .751pp.

Uchida, S. 1995b: 5.Basking sharks. Basic data concerning rare aquatic wildlife in Japan. (II). 159-167. Japan Fisheries Resource Conservation Association.Tokyo .751pp.

Yano, K. 1976: The World of Sharks. Shinchosha, 230pp.

Yano, K. 1978: About Basking sharks. Cartilagenous Fish Study Group, (3): 8-9.