BOBP/REP/56

A Study On Dolphin Catches in Shri Lanka

BOBP For Fisheries Development
BAY OF BENGAL PROGRAMME

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Small-Scale Fisherfolk Communities GCP/RAS/118/MUL

A STUDY ON DOLPHIN CATCHES IN SHRI LANKA

by

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This report presents the results of a one-year study of dolphin catches in Shri Lanka. Very high estimates of dolphin landings, based on studies of limited coverage and questionable sampling techniques, had been made in the past and were causing much concern in the island. The study was, therefore, commissioned to obtain a reliable estimate of dolphin catches and their economic importance as well as to gather information on the attitudes to and perceptions cf dolphin catching, trading and consumption.

The study, carried out from September 1991 to September 1992, included both bioeconomic and socioeconomic components. It was made by the National Aquatic Resources Agency (NARA) of Shri Lanka and was sponsored by a Bay of Bengal Programme (BOBP) project, "Small-Scale Fisherfolk Communities in the Bay of Bengal" (GCP/RAS/1 1 8/MUL). The authors gratefully acknowledge the assistance rendered by K. Sivasubramaniam, Senior Fishery Biologist, FAO/BOBP, in the technical supervision of the study, Inge Jungeling, Socioeconomist (APO), FAO/BOBP, for assisting in the socioeconomic component of the study and Kanthi Subasinghe, Mahendra Fernando and R. Samarakoon, Research Assistants of NARA, in monitoring the bioeconomic component of the study.

The Bay of Bengal Programme (BOBP) is a multiagency regional fisheries programme which covers seven countries around the Bay of Bengal — Bangladesh, India, Indonesia, Malaysia, Maldives, Shri Lanka and Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new technologies, methodologies and ideas to help improve the conditions of small-scale fisherfolk communities in member countries. The BOBP is sponsored by the governments of Denmark, Sweden and the United Kingdom, and also by UNDP (United Nations Development Programme) and AGFUND (Arab Gulf Fund for United Nations Development Organizations). The main executing agency is the FAO (Food and Agriculture Organization of the United Nations).

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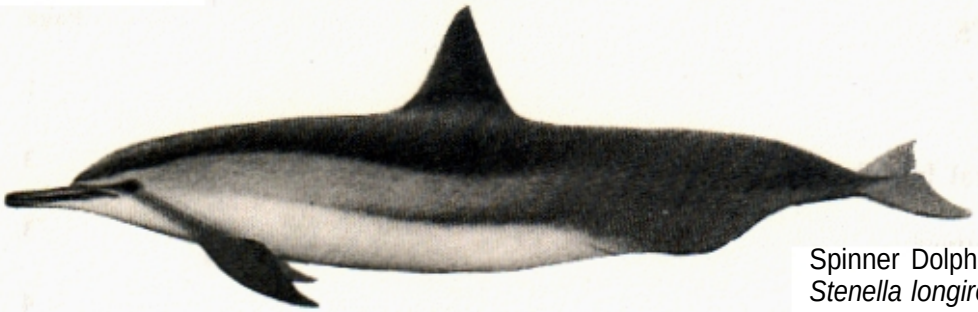
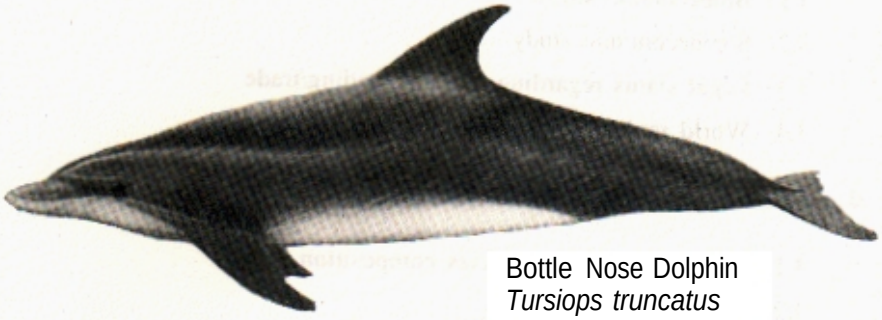
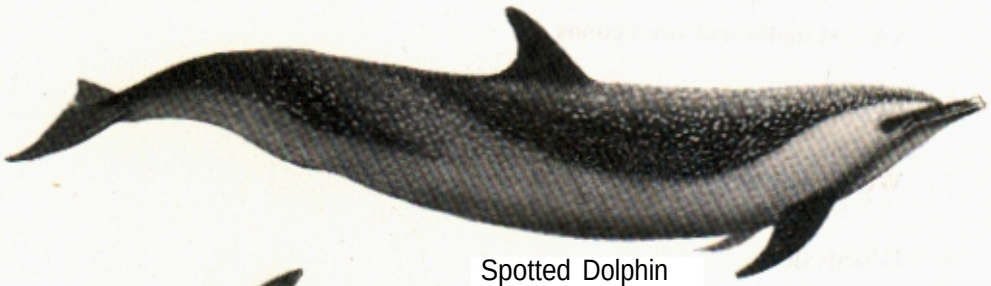


Spinner Dolphin
Stenella longirostris

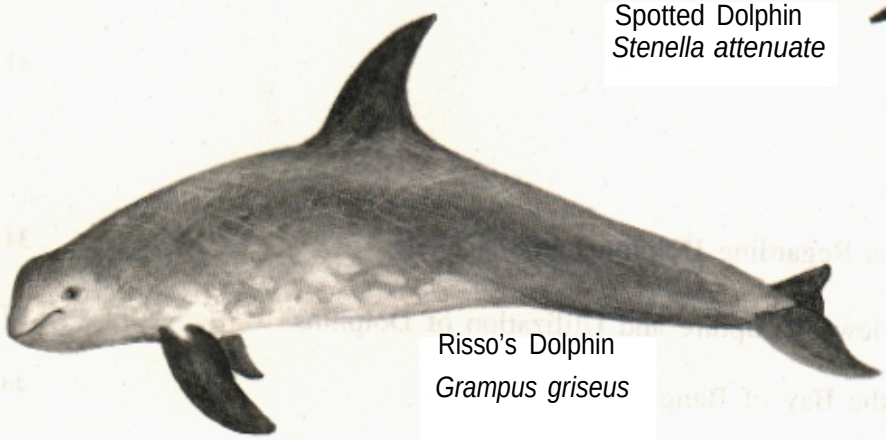


Bottle Nose Dolphin
Tursiops truncatus

Striped Dolphin
Stenella coeru/eo/ba



Spotted Dolphin
Stenella attenuate



Risso's Dolphin
Grampus griseus

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SUMMARY

The results of a one-year study of dolphin catches in Shri Lanka reveal that various high estimates of the catch made in the past had been based on studies that suffered greatly from inadequate geographical coverage and improper assessment of any fishing effort likely to cause dolphin mortalities. The study was undertaken by the National Aquatic Resources Agency (NARA), with financial and technical support from the Bay of Bengal Programme (BOBP), as a consequence of the concern of the Ministry of Fisheries and Aquatic Resources (MOFAR) over the local and international exposure the 'dolphin issue' had received in recent years.

The study consisted of two components — a bioeconomics sampling programme and a socioeconomic survey — covering all the coastal areas of the island except the North, where there are hardly any dolphin catches. The bioeconomic sampling programme was undertaken from September 1991 - September 1992 at 14 major fish landing centres around the island and indicated that a little over 5000 dolphins are caught artnually. This figure was arrived at by estimating dolphin catch rates and fishing effort of different categories of fishing boats catching dolphins, on a monthly basis for different subareas, thereby significantly reducing the bias inherent in previous studies.

Multiday offshore boats of 10- 11 m length accounted for over 70 per cent of the catches, while the balance came from the 3.5 GT (9 m) coastal boats making daily fishing trips. Seventy per cent of the dolphins were incidentally caught in the large mesh driftnets used for tuna and shark. Harpooning was responsible for 30 per cent of the catches. The practice of harpooning of dolphins has not spread beyond the centres (essentially three) identified in earlier studies.

Eight species of dolphins and .six species of small whale were identified from. the landings. Five of the dolphin species contributed over 85 per cent of the total catch. Dolphin catch rates showed marked seasonality. The species composition indicated differences in the relative distribution between subareas and the distances from the coast.

The socioeconomic survey did not identify fishermen as a strong consumer group for dolphin meat. It was found that harpooning was primarily started to provide bait for the shark longline fishery. But with the utilization of this meat by low income groups in rural areas, it became an additional source of income to the fishermen, particularly during the lean season for large mesh driftnetting. However, the income from fishing, in the areas where the intensity of harpooning is highest, is not very different to that earned by fishermen in other locations with little or no harpooning.

There is no available informafion on stock size or population of dolphins around Shri Lanka or in the Indian Ocean for assessment of the possible impact on stocks of fishery-related mortality. But in the eastern tropical Pacific, where during one year in the mid-1980s nearly 125,000 dolphins were caught incidentally in the tuna purse-seine fishing and where over 50,000 dolphins are still caught annually, dolphin stocks are not in any danger of extinction according to recent scientific studies. With about a dozen species of dolphins contributing to the 5000 or so dolphins landed every year in Shri Lanka, it can safely be assumed that none of the species is endangered.

Suggestions have been made to completely ban the landing of dolphins in Shri Lanka. Since dolphins are a small by-catch of the driftnet fishery, such a measure could endanger the livelihood of thousands of fisherfolk in the island and result in a loss of production of about 20,000 t of offshore fish.

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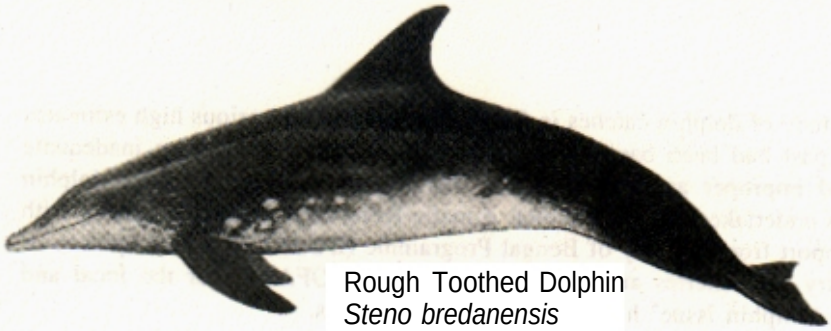
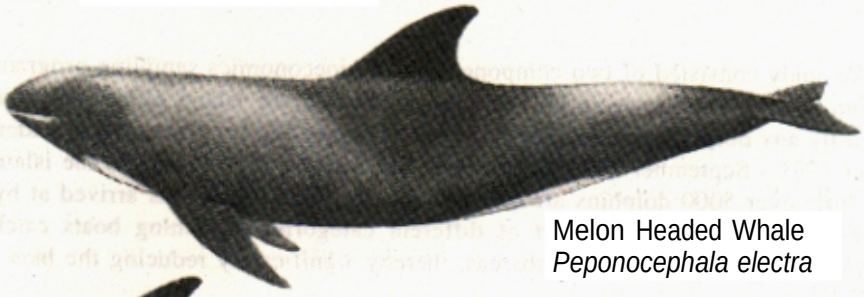
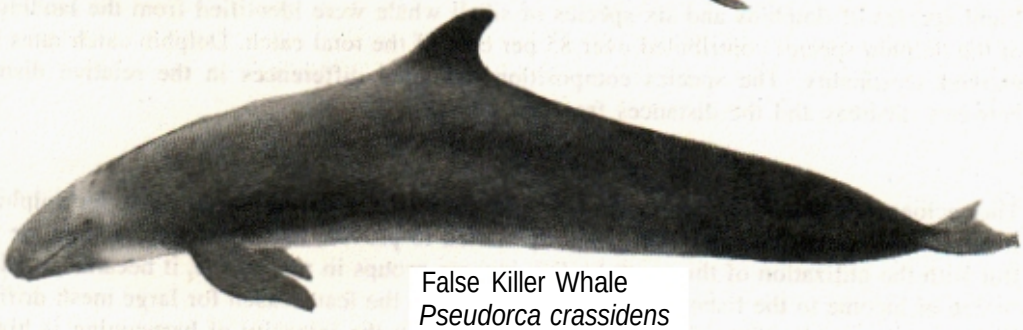


Rough Toothed Dolphin
Steno bredanensis

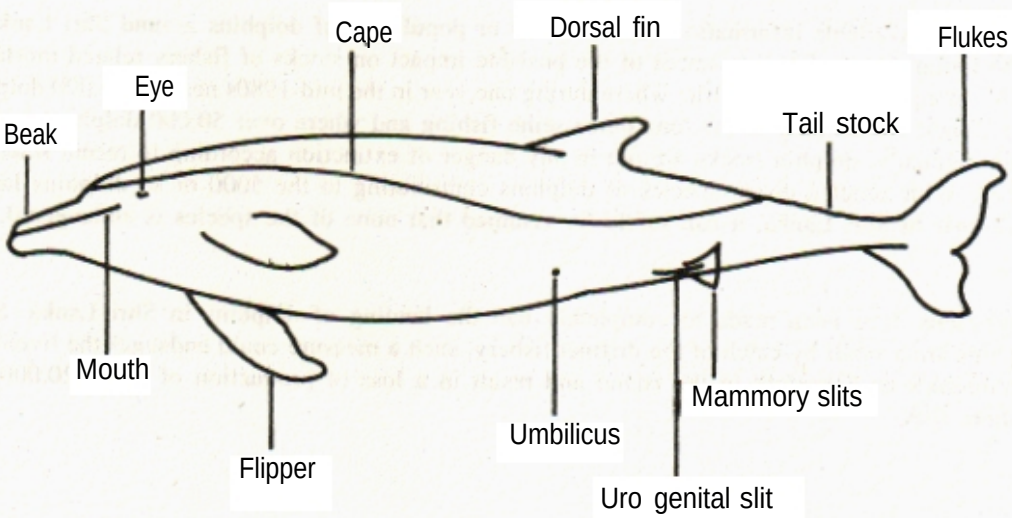


Melon Headed Whale
Peponocephala electra

Pygmy Killer Whale
Feresa attenuata



False Killer Whale
Pseudorca crassidens



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1. *GENERAL INTRODUCTION*

There has been worldwide concern in recent years over the incidental deaths of cetaceans, as well as other marine mammals and nontarget species, in many different fishing operations around the world. Large-scale driftnetting is reported to be very destructive not only to pelagic fish resources but also to dolphins. birds and other animals; it is said that such destructiveness could affect the biotopes and ecosystems of the marine environment. In some of the most publicized examples involving cetaceans, e.g. the Japanese, Taiwanese and Korean far seas pelagic driftnet fisheries, primarily for salmon. squid and tuna and the domestic driftnet fisheries for tuna, billfish, shark etc. in other localities, the levels of cetacean mortality have been found to be high and the impact on their population is suspected as being significant. Consequently, the General Assembly of the United Nations, in December 1989, adopted by Consensus Resolution (44/25) a moratorium on all large-scale pelagic driftnet fishing in the high seas to come into effect by June 30, 1992.

Shri Lanka has a very large component of pelagic driftnetting in her small-scale fisheries in the inshore and offshore ranges of her EEZ. Considerable information on the finfish species caught by pelagic driftnetting is available and more work on this is underway. Incidental catching of dolphins during commercial fishing operations in Shri Lanka has a long history, with available literature dating back to the late 19th Century. A fishery using harpoons, and targeting dolphins, has also been reported in certain areas.

A preliminary review by the Bay of Bengal Programme (BOBP), of available estimates of the catches of dolphins around Shri Lanka showed that almost all previous estimates, ranging from 9,000 to 60,000 animals, suffered from inadequacy of area and seasonal coverages during the studies and that there were improper estimates of the fishing effort by fisheries likely to cause the mortality of dolphins. Further, it was found that very little attention had been paid to the economic importance of dolphins, to the attitudes of fishermen, consumers and nonconsumers to the catching and utilization of dolphins and to their perceptions of these activities.

Despite the limitations mentioned, the high estimates of dolphin catches reported had resulted in Shri Lanka being identified at international meetings dealing with conservation of marine mammals as one of the countries with a considerable by-catch of dolphins. In view of the ongoing offshore fisheries development in Shri Lanka, with considerable emphasis on driftnetting, and the pressure from environmental concerns for the implementation of measures to eliminate, or reduce, accidental catching of dolphins, the Government of Shri Lanka decided to make a reliable estimate of the numbers of dolphins caught through commercial fishing activities and study their utilization as well as the attitudes of people to dolphin meat.

The Bay of Bengal Programme assisted the National Aquatic Resources Agency (NARA) of Shri Lanka in conducting a closely monitored study over a period of one year to obtain the required information. The results of this study are reported here.

The term 'dolphin' in this report refers to small cetaceans. including species of dolphins and some species of small whales.

2. OBJECTIVES

The study focussed on three objectives;

- Estimation of the total number of dolphins caught intentionally and incidentally.
- Assessment of the economic importance of dolphin catches to fishermen/fisherfolk and consumers.
- Assessment of attitudes and perceptions of fisherfolk. traders. consumers and nonconsumers. with regard to capture and utilization of dolphins.

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3. METHODOLOGY

The bioeconomic component of the study was conducted by NARA with technical assistance from BOBP. The socioeconomic aspects (second and third objectives) of the study was subcontracted to a leading market research organization in Colombo (Lanka Market Research Bureau - LMRB). Regular meetings between the two groups to exchange information ensured smooth execution of the two subactivities.

3.1 Bioeconomic study

Seven data collectors (all with G.C.E. Advanced Level Biological Science background and some awaiting entrance to Universities) were recruited to collect information on dolphin landings and the fish catch and effort data of fisheries associated with dolphin landings. They were recruited from the coastal areas of the northwest, west, southwest, south, east and northeast coasts in order to achieve the widest possible geographical coverage. All attempts to recruit a data collector for the North were unsuccessful. However, this was not expected to affect the estimates in any significant way, because dolphin catches in the North are believed to be negligible, or almost nil, in view of the absence of fisheries associated with dolphin catches.

The data collectors were given training, in identifying the species of marine mammals, in sampling the catch and effort and in gathering the cost and earnings data, in the laboratory and in the field. The laboratory training also provided them with an introduction to the fishing craft and gear in Shri Lanka, the aims and objectives of the study and the type of data to be collected. Two members of the Marine Mammal group and two Fisheries Research Officers of NARA, assisted by BOBP staff, acted as trainers. Field training in the identification of dolphins and collection of fish catch and effort data were given in Negombo, Beruwala and Mirissa, which are major fish landing centres known also for high dolphin landings. A manual for field identification of dolphins was also compiled and made available to the data collectors.

A frame survey of fishing craft and gear was conducted in the areas to be covered by the study. This survey was jointly conducted by the newly recruited data collectors and NARA staff. Based on information collected, the coastline of Shri Lanka was divided into seven areas, and 14 major fish landing centres were selected as sampling sites (Figure 1). The data sheets were also field-tested during the frame survey. Depending on the location of the sampling sites and transport facilities available, some data collectors covered only one site each, while others covered two or more. Motor cycles were provided for those covering sampling sites in remote areas and for those covering two or three sites. Each data collector was scheduled to achieve 20 sampling days/month, irrespective of the number of sites covered.

The work of the data collectors was closely monitored by the staff of NARA, assisted by BOBP staff, throughout the study. Frequent visits made to the sampling sites at the initial stages helped the data collectors to improve their skills in proper data collection, recording and identification of dolphin species. Surprise monitoring visits made later ensured adherence to the scheduled programme of work and maintenance of quality of data. All data collectors visited NARA at the end of every month, when the data were checked and common problems encountered in the field sorted out.

The following information was collected by the data collectors during sampling visits to fish landing centres over the 12-month period October 1991-September 1992:

- Total number of dolphins landed, biological information (species, sex, length), method of capture (entangled/harpooned) and type of boat and gear combination associated with the capture.

- Utilization of dolphins, beach price of fish and dolphins, intended markets etc.

  The total number and type of boats associated with the landing of fish and dolphins on the sampling days.

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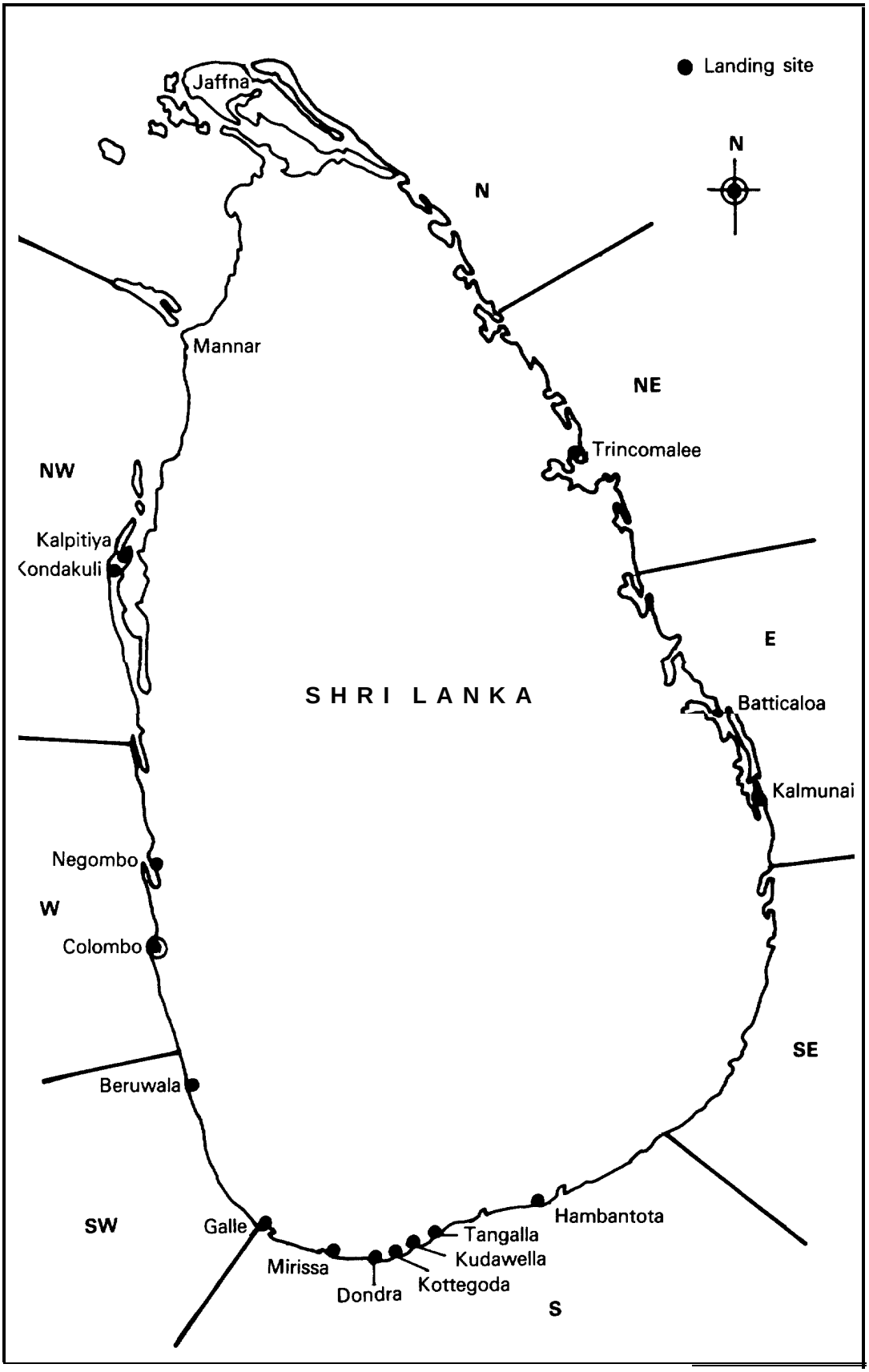
Fig. 1. The dolphin landing sites of Shri Lanka sampled during the survey and the stratification of the subareas for estimating the total catch.



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Fish catch data (species, weight, price etc.) from a maximum of ten boats of different types landing dolphins.

- Details of operational cost from two boats, preferably of those landing dolphins.

3.2 Socioeconomic study

Coordinating with the bioeconomic study, the Lanka Market Research Bureau (LMRB) conducted a preparatory study in November 1991 at five fish landing centres (Beruwala. Negombo, Mirissa, Kudawella and Kandakuliya) and the associated market hinterlands as a prelude to the preparation of a comprehensive proposal for the main study. Both quantitative and qualitative surveys were undertaken during the main study. Qualitative information was obtained from individuals during in-depth interviews. The quantitative survey adopted face-to-face interviews with selected samples, using structured questionnaires. The survey covered the following target groups:

Fisherfolk : Fishermen who use a class of boats which land dolphins.

Traders : Persons who buy fish and/or dolphins from fishermen or boat-owners and who are responsible for distribution.

Retailers : Those who obtain fish and/or dolphin from traders to sell to consumers.

Consumers : Persons who have purchased dolphin meat for consumption more than five times over a period of 12 months.

Nonconsumers : Persons who have never consumed dolphin meat but who are consumers of other animal proteins.

Agency officials : Fisheries Inspectors, officials of the Central Environmental Authority, Department of Wild Life, Department of Forestry and a group of environmental journalists.

Negombo, Kandakuliya, Beruwala and Mirissa were the four fish landing centres identified for the main survey. Interviews were carried out at these landing sites and selected retail outlets (depending on the dolphin meat distribution from the landing site), among fisherfolk, traders, retailers, consumers and nonconsumers. These were conducted by LMRB research executives and supervisors between November 1991 and May 1992.

The quantitative survey was conducted at the landing sites among fisherfolk and traders. The rest of the target groups were interviewed on dolphin meat consumption. The consumer areas were identified from response to the questionnaires targeted at fisherfolk and traders.

In view of difficulties in contacting an adequate cross-section of respondents during the lean season for tuna fishing (November-April), only a quantitative survey was conducted during this season. Both qualitative and quantitative surveys were conducted during the peak season (May-October). Some information on the socioeconomic aspects of dolphin catches and utilization was collected from the northeast coast through the sampler involved in the bioeconomic study in this area.

3.3 Legal status regarding dolphin landing/trade

The legal status of dolphin catching/landing, trading and consumption in Shri Lanka has become a sensitive issue in the recent past. In a few isolated incidents, people involved in dolphin landings and trading have been apprehended by the armed forces and the Police. Environmentalists and journalists have also voiced concern in the national media, following the international publicity. A lawyer was subcontracted to review all existing legislation/ordinances pertaining to living aquatic resources in general and marine mammals/dolphins in particular. His review appears in this Report as Appendix I.

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3.4 World review of capture and utilization of dolphins

A world review of the capture and utilization of dolphins was undertaken as a part of this study, in order to obtain a better understanding of the wider and more complex issues involved in the capture of dolphins during fishing operations. The review summarizes available information on fisheries — both large- and small-scale — with dolphin by-catch, their utilization, impact of fishery-related mortality on dolphin populations, management and technical developments geared towards reducing such mortalities etc. This review appears in this Report as Appendix II.

4. RESULTS OF BIOECONOMIC SAMPLING

4.1 *Dolphin catch and species composition*

The seven data collectors achieved a total of 1546 man-days of field sampling (averaging 18.4 days/person/month) over the 12-month period. The number of sampling days and the number of dolphins recorded at the sampling stations in each subarea are given in Table I.

The 2791 dolphins recorded during the study were distributed amongst 14 species — eight species of dolphins and six species of small whales (Table 2).

Table 1: Sampling days and numbers of dolphins recorded at sampling stations

Subarea	*Sampling day (no.)*	*Dolphins (no.)*
Northwest	*172*	*22*
West	*238*	*477*
Southwest	*273*	*771*
South	*419*	*1172*
East	*232*	*173*
Northeast	*212*	*176*
Total	**1546**	*2791*

Table 2: Overall species composition of dolphins landed in Shri Lanka

Species	*Male*	*Female*	*M/F*	*Total*	*Percentage*
I. Spinner Dolphin *Stenella longirostris*	*824*	*683*	**114**	**1621**	*58.2*
2. Bottlenose Dolphin *Tursiops* **sp.**	**118**	*98*	**19**	*235*	*8.4*
3. Striped Dolphin *S. coeruleoalba*	**106**	*89*	**5**	*200*	*7.2*
4. Spotted Dolphin **S. attentuata**	**110**	*62*	**21**	**193**	*6.9*
5. Risso's Dolphin *Grampus grisus*	*61*	**51**	**5**	**123**	*4.4*
6. Roughtoothed Dolphin *Steno bredanensis*	**21**	**14**		*35*	**1.3**
7. Fraser's Dolphin *Lagenodelphis hosei*	*9*	*6*		**15**	**0.5**
8. Common Dolphin **Delphinus delphis**	*3*			**3**	**0.1**
9. Melonheaded Whale *Peponocephala electra*	**41**	*30*	*2*	*73*	*2.6*
10. Pygmy Killer Whale *Feresa attenuata*	*29*	**21**		*50*	*1.8*
1 I. False Killer Whale *Pseudocra* **rrassidens**	**19**	*9*	*5*	*33*	**1.2**
12. Dwarf Sperm Whale *Kogia simus*	**9**	*7*		**16**	**0.5**
13. Pygmy Sperm Whale *Kogia breviceps*	**11**	*4*	1	**16**	**0.5**
14. Southern Bottlenose Whale *Hyperoodon planifrons*	**2**	1		*3*	**0.1**
15. Unidentified dolphins and small whales			**175**	**175**	*6.3*
Total	1369	1075	*347*	*2791*	100

All dolphins caught in the east coast area (122 in Kalmunai and 5 1 in Batticaloa) could not he identified up to species level as they were not landed ashore but were discarded at sea by the predominantly Muslim fishermen. The sex was not determined for about six per cent of all the dolphins landed. Most of these were from Mirissa, where heavy dolphin landings on certain days made it difficult for the data collector to obtain all the biological information, such as length and sex, before the dolphins were removed from the landing site.

Five species of dolphins (the Spinner, Bottlenose, Striped, Spotted and Risso's) made up 85 per cent of the total dolphin catch, with the Spinner contributing 58 per cent to the total. The sex ratio showed a preponderance of males over females, in almost all the species. However, some species exhibited noticeable differences in the sex ratio, in some subareas, and during certain periods:

-- Females outnumbered males in the overall sex ratio of Striped Dolphins in the Northeast (1: 1.3) and Spinner Dolphins (l : 1.2) and Bottlenose Dolphins (1: 1.7) in the West.

Striped Dolphin females were nearly twice the number of males (I: 1.9) in the South during the period September-November, 1991.

The species composition of the dolphins landed in different subareas is presented in Table 3. Spinner Dolphins are the dominant species in all subareas except in the Northeast where Bottlenose Dolphin catches were higher. Among the other species of dolphins, Striped Dolphin catches were higher in the South/Southwest, Risso's Dolphin in the West/Southwest and Spotted Dolphin in the South. Melonheaded Whale (South/Northeast), Pygmy Killer Whale (Southwest/Northeast) and False Killer Whale (Southwest) were the main species of small whales landed.

Very little information is available from the past on the species of dolphins interacting with various fisheries. Lantz and Gunasekera (1955) referred to Common and Bottlenose Dolphins. Medcof (1963) identified Bottlenose Dolphins caught in beach seines. Almost all recent studies on marine mamma1 interaction with fisheries have yielded more information on the species of dolphins involved.

A comparison of the species composition obtained during the present study with those reported from other more recent studies is presented in Table 4. Two species of small whales, the Melonheaded Whale and the Southern Bottlenose Whale, have not been reported in previous studies. However, all the species identified during the present study have been reported as occurring in the Indian Ocean (Leatherwood, 1986: Leatherwood and Clarke, 1983; Nishiwaki, 1983; and Alling et al.. 1983). Tropical penetration of the normally subtemperate to polar Bottlenose Whale is considered rare and only occasional sightings, near the Equator, have been reported (Leatherwood and Clarke, 1983). Three specimens of Southern Bottlenose Whale were identified during this study, from the South and the Southwest. Daraniyagala (1960) had previously reported on the stranding of a Southern Bottlenose Whale in Colombo harbour in June 1939; this identification, however, has been contested by Santerre and Santerre (1983). More recently, Alling et al. (1984) have reported an observation of two Southern Bottlenose Whales off Shri lanka.

The studies listed in Table 4 have collectively reported on ten species of dolphins and eight species of small whales. The five commonest species in the dolphin landings were, the Spinner, Bottlenose, Striped, Risso's and Spotted Dolphin. Pygmy Sperm Whale, Dwarf Sperm Whale. Pygmy Killer Whale and False Killer Whale were the most commonly occurring small whale species.

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Table 3: Species composition of dolphins landed by all categories of boats in different subareas

Species	Northwest		West		Southwest		South		Northeast	
	No.	%	No.	%	No.	%	No.	%	No.	%
Spinner Dolphin	16	72.8	373	78.2	436	56.5	735	62.7	61	34.7
Bottlenose Dolphin	3	13.6	41	8.6	40	5.2	80	6.8	71	40.4
Striped Dolphin			7	I.5	74	9.6	103	8.8	16	9.1
Spotted Dolphin					35	4.5	155	13.2	3	1.7
Risso's Dolphin			32	6.7	67	8.7	23	2.0	I	0.6
Roughtoothed Dolphin			I	0.2	26	3.4	8	0.7	·	·
Fraser's Dolphin			3	0.6	9	1.2	3	0.3		·
Common Dolphin							I	6.1	2	1.1
Melonheaded whale			7	1.5	14	1.8	41	3.5	II	6.3
Pygmy Killer Whale			5	I.0	33	4.4	3	0.3	9	5.1
False Killer Whale			I	0.2	19	2.3	12	1.0	1	0.5
Dwarf Sperm Whale	3	13.6	7	I.5	I	0.1	5	0.4	·	·
Pygmy Sperm Whale					13	1.7	2	0.1	I	0.5
Southern Bottlenose Whale					2	0.3	I	0.1	·	·
Unidentified Species					2	0.3	·	·	·	·
Total No. of Dolphins	22		477		771		1172		176	

Table 4: Percentage species composition of dolphin catches in different studies

	J&S	A83	A85	L&R	P
Spinner Dolphin	34.1	40	46	45.3	58.2
Bottlenose Dolphin	25.4	7	4	5.4	8.4
Striped Dolphin	10.9	8	7	8.1	7.2
Spotted Dolphin		13	14	16.7	6.9
Risso's Dolphin	6.5	17	19	14.7	4.4
Roughtoothed dolphin		4	I	0.6	1.3
Fraser's Dolphin				0.1	0.5
Common Dolphin	3.6	·			0.1
Shortsnout Dolphin	2.2	·			
Bridled Dolphin	0.7				
Unidentified dolphins	5.1	·			6.3
Melonheaded Whale					2.6
Pygmy Killer Whale	0.7	4	1	1.8	1.8
False Killer Whale		I	1	1.4	1.2
Dwarf Sperm Whale	2.9	4	3	2.6	0.5
Pygmy Sperm Whale	6.5			0.8	0.5
Southern Bottlenose Whale	-	-			0.1
Shortfinned Pilot Whale			2	11	
Cuvier's Beaked Whale		I			
Unidentified whales	1.4	I		0.8	
Number sampled	138	72	297	810	2791

Source: J&S · Joseph & Siddeek (1985) Negombo/Beruwala
A83 Alling, A (1983) Beruwala
A85 Alling, A (1985) Trincomalee (1984)
L&R · Leatherwood & Reeves (1989) · Trincomalee (1984-1986)
P Present study

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4.2 Method of capture

Dolphin landings, distinguished by method of capture (entangled in large mesh driftnets. harpooned etc.), are presented in Table 5. Harpooned dolphins were observed only in Negombo (West), Beruwala (Southwest), Mirissa and Dondra (South). They made up 31 .5 per cent of all dolphin landings. Of the harpooned dolphins, 85 per cent were from Mirissa and 11 per cent from Beruwala. They also constituted 85 per cent of all the dolphins landed at Mirissa and 13 per cent at Beruwala.

Table 5: Numbers of dolphins entangled (in large mesh driftnets) and harpooned at different sampling sites.

Sampling Site	*Subarea*	*Entangled*	*Harpooned*	*Total*
Kalpitiya				
Kandakuliya		22		22
	Northwest	22		22
Negomho	West	460	17	477
Beruwala		639	99	738
Galle		33		33
	Southwest	672	99	771
Mirissa		126	*149*	875
Dondra		148	13	161
Kottegoda		62		62
Kudawella		30		30
Tangalle		41		41
Hambantota		3		3
	South	410	762	1172
Kalmunai		122		122
Batticaloa		51		51
	East	173		173
Trincomalee	Northeast	176		176
Total		1913	878	2791
Percentage		68.5	31.5	100

Although Negomho fishermen have historically been involved in harpooning of dolphins. the current landings from harpooning are less significant compared to Mirissa. Harpooning of dolphins began in Mirissa and Dondra only in 198 1 -82 (Leatherwood and Reeves, 1989). Alling (1983) and Joseph and Siddeek (1985) observed no harpooned dolphins at Beruwala during their studies in 1982/83 and 1985. Although Leathcrwood and Reeves (1989) report on harpooning of dolphins by fishermen in the villages of Chilaw (Northwest) and Wadduwa (Southwest), these are probably accounted in the landings of Negombo and Beruwala respectively, as tuna boats from these areas usually land at Ncgombo and Beruwala. It is quite conceivable that the harpooning of dolphins has not spread during the last decade (1982-1992). beyond the four centres — Negombo, Beruwala, Mirissa and Dondra.

Species compositions of entangled and harpooned dolphins from Mirissa and Beruwala are presented in Table 6 (on facing page). The following differences are evident:

— Spinner and Spotted Dolphins are represented more amongst the harpooned dolphins compared to the entangled ones.

-- Striped and Risso's Dolphins are represented more amongst entangled dolphins, compared to the harpooned ones.

Bottlenose Dolphins are more or less equally represented amongst both entangled and harpooned dolphins.

--- Although the number caught are small, most of the small whale species also are more represented amongst the entangled than amongst the harpooned.

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Table 6: Species composition of entangled and harpooned dolphins in Mirissa and Beruwala

Species	MIRISSA				BERUWALA			
	Entangled		Harpooned		Entangled		Harpooned	
	NO.	%	NO.	%	No.	%	No.	%
Spinner Dolphin	65	51.6	540	72.2	343	53.7	74	74.7
Bottlenose Dolphin	8	6.3	54	7.2	33	5.2	5	5.1
Striped Dolphin	21	16.7	24	3.2	66	10.3	6	6.1
Spotted Dolphin	9	7.1	112	15	22	3.4	9	9.1
Risso's Dolphin	4	3.2			66	10.3	1	1
Roughtoothed Dolphin	3	2.4	1	0.1	23	3.6	2	2
Fraser's Dolphin			1	0.1	8	1.3	1	1
Melonheaded Dolphin	12	9.5	7	0.9	9	1.4		
Pygmy Killer Whale					32	5	1	1
False Killer Whale	2	1.6	10	1.3	19	3.1		
Dwarf Sperm Whale	2	1.6			1	0.1	-	-
Pygmy Sperm Whale					13	2	-	-
Southern Bottlenose Whale					2	0.3	-	-
Unidentified					2	0.3	-	-
Total	126		149		639		99	

It is widely believed that most fishermen resort to harpooning to compensate for poor fishing and that it often occurs closer to the coast, during their return from fishing trips. The above differences could, therefore, reflect differences in relative abundance of various dolphin species. Those species with a greater representation in the 'entangled' category (Striped Dolphin, Risso's Dolphin and small whales) may have a higher relative abundance in the more offshore waters, while Spinner and Spotted Dolphins may be more abundant in the near coastal waters compared to the offshore. Bottlenose Dolphins being equally represented among both entangled and harpooned catches, perhaps a more or less uniform distribution is likely.

4.3 Landings by type of fishing boat

About 25,600 Shri Lankan fishing craft are reported to have been engaged in fishing activities during 1992. These were grouped into:

Craft with inboard engines: Multiday-boats of over 10 m — 118; Multiday-boats of 9-10 m — 1,083; Day-boats of 9 m — 1,258: Total : 2,459

— **Craft with outboard motors:** 5-6 m FRP craft — 7,004; Traditional craft — 1,749; Total : 8,753

Non-motorized traditional craft: Total : 14.377

The non-motorized traditional craft and those motorized with outboard motors generally fish inshore, within a range of 8-10 n miles from the coast, and, using a variety of fishing methods, target small to medium size pelagic and demersal fish. Nearly all the boats with inboard engines mainly use largemesh driftnets, drift longlines and trolls for tuna, shark and billfish. The multiday-boats may spend 5-10 days at sea during fishing operations, venturing over 100 n miles offshore.

All the dolphins sampled during this study were landed by boats with inboard engines.

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These boats were grouped into three categories, as follows:

C_3 - 3.5 GT, 9 m day-boats

C_4 - 3.5 GT, Y-10 m multiday-boats

C_5 - I I t, >10 m multiday-boats

Two-thirds of the dolphin catch was landed by medium size multiday-boats, particularly off the west, southwest and south coasts (Table 7).

The 3.5 GT day-boats accounted for just over a quarter of the catch, with major contributions from the South, East and Northeast. The majority of the larger boats (I 1 t type) operate from the West (Negombo) and conduct multiday driftnet/longline fishing in offshore waters. Over 85 per cent of the dolphins landed by this category of boats, therefore, comes from the west. Nearly all the larger I I t type boats operating in the Northwest are engaged in shrimp trawling and no dolphins were caught in these operations.

Table 7: Numbers of dolphins landed by different boat types

Area	Boat Type C_3 9m	C_4 9-10m	C_5 > 10m	Total
Northwest	18	4		22
West	57	278	142	417
Southwest	9	762	·	771
South	331	817	24	1172
East	173	·		173
Northeast	176	·	·	176
Total	764	1861	166	2791
Percentage	21.4	66.7	5.9	100.0
Total no. of craft in island	1258	1083	118	2459

A significant change in the tuna fisheries has been witnessed during the last decade. With the success of the offshore multiday-boats introduced through the Abu Dhabi Fund in the early 1980s (the North West Coast Fisheries Development Project), smaller multiday-boats of 9-10m class began to enter the fishery in the late 1980s. Most of the 3.5 GT day boats were also converted to multiday-boats with the provision of insulated ice boxes. These changes are reflected in the composition of the all-island fleet of fishing boats. Consequent to the above changes, more dolphin landings are now recorded from multiday-boats than from the 3.5 GT day-boats.

The species compositions of dolphins landed by different boats in Mirissa (South) and Negombo (West) is examined in Table 8 for possible differences in the relative abundance of various species in different oceanic ranges. While the 3.5 GT day-boats operate within a range of 25 n miles from the shore, the medium-sized multiday-boats (9-10 m) are reported to fish beyond 60 n miles, and the larger I It class of boats even further. The species compositions obtained for 9-I 0m and > I 0m categories of boats in Negombo are remarkably similar. In Mirissa, the Spinner Dolphin has a greater representation among the dolphins caught by 9m boats, whereas Bottlenose, Striped, Risso's and Spotted Dolphins and the small whales are represented relatively more amongst the dolphin catches recorded for 9-10 m and > 10 m boats. The inferences drawn from the data presented in Table 8 with regard to relative distribution of dolphins are similar to those made from data presented in Table 6, except in the case of Spotted and Bottlenose Dolphins.

Table 8: Species composition of dolphins landed by different types of boats

AREA	NEGOMBO				MIRISSA					
Boat type	9-10m		>10m		9m		9-10m		>10m	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
Spinner Dolphin	215	81.4	83	7.2	95	96.9	384	64.4	6	50.0
Bottlenose Dolphin	27	10.2	11	9.6			43	7.2	I	8.3
Striped Dolphin	1	0.4	I	0.9	3	3.1	33	5.5	I	8.3
Spotted Dolphin							98	16.4	2	16.7
Risso's Dolphin	12	4.5	6	5.2			3	0.5	I	8.3
Roughtoothed Dolphin	I	0.4					3	0.5	I	8.3
Fraser's Dolphin			I	0.9			I	0.2		
Melonheaded Whale	2	0.8	I	0.9			17	1.8		
Pygmy Killer Whale			5	4.3						
False Killer Whale			2	1.7			12	2.0		
Dwarf Sperm Whale	6	2.3					2	0.3		
Pygmy Killer Whale			5	4.3						
Total	264		115		98		596			

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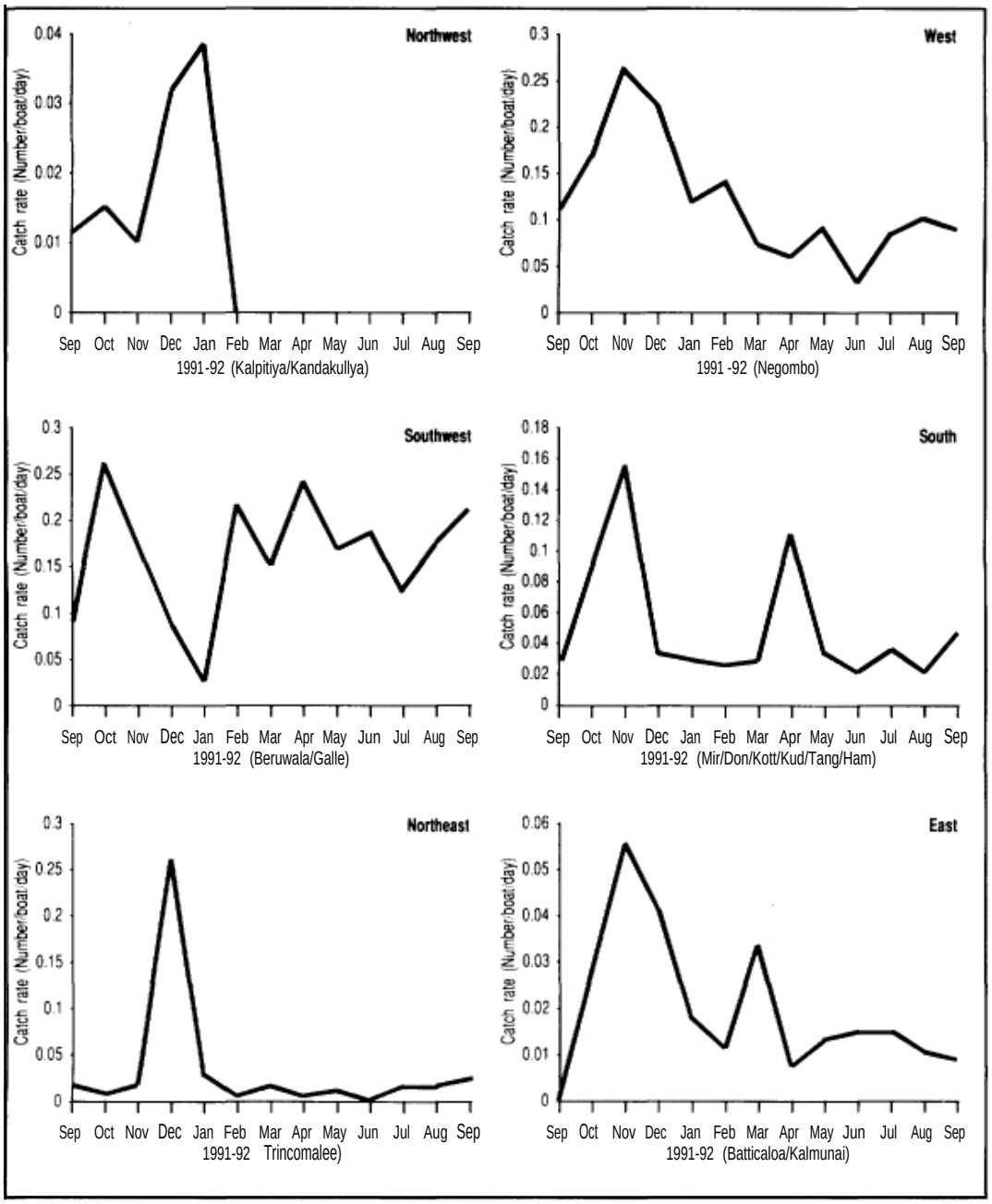
4.4 Catch rates and seasonal variations

Monthly mean catch rates (number caught per boat per fishing day) of the dolphins were determined for different subareas and for different boat types, utilizing data collected on the dolphins landed and the number of boats operated on sampling days. Seasonal variations in the overall catch rate for boats (pooled data) in the different subareas are shown in Figures 2 a-f for the Northwest, West, Southwest, South, East and Northeast respectively. The following trends are observed;

— A peak catch rate in the November-January period in all aleas.

Catch rates in all areas show a declining trend after the November-January peak. A second peak is, however, observed during March in the East and April in the South and Southwest.

Fig 2a-f. Seasonal variation in the catch rates of dolphin in the different subareas (1991-92)



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In Beruwala, Ailing (1983) observed high landings during June, July and December. Joseph and Siddeek (1985) observed high dolphin landings during April, May and August in Beruwala and Negombo.

Within the peak November-January season, the catch rate was highest in the West, Southwest and Northeast, followed by the South. Consistently high monthly catch rates were obtained from the Southwest, followed by the West.

Seasonal variations in the catch rates for different boats in the West and South are shown in Figures 3a and b respectively. The seasonal variation in catch rates is similar for the 9-10 m boats and the>10 m boats in the west. Although showing monthly fluctuations, there are no significant differences between the catch rates of the two boat types. On the other hand, catch rates obtained by the 9 m boats were lower than those obtained by the 9-lOm boats in the south: The two seasonal peaks in November and April were also more pronounced for the 9-10 m boats.

Fig 3(a). Seasonal variation in the dolphin catch rates for the 9-10 m and > 10 m sizes of boats, on the west coast

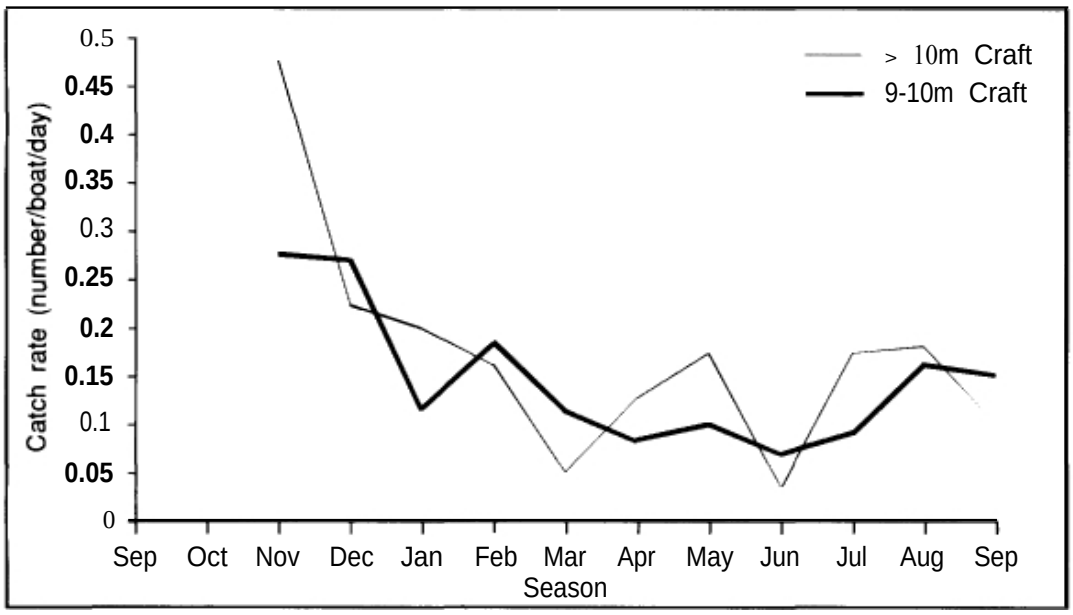
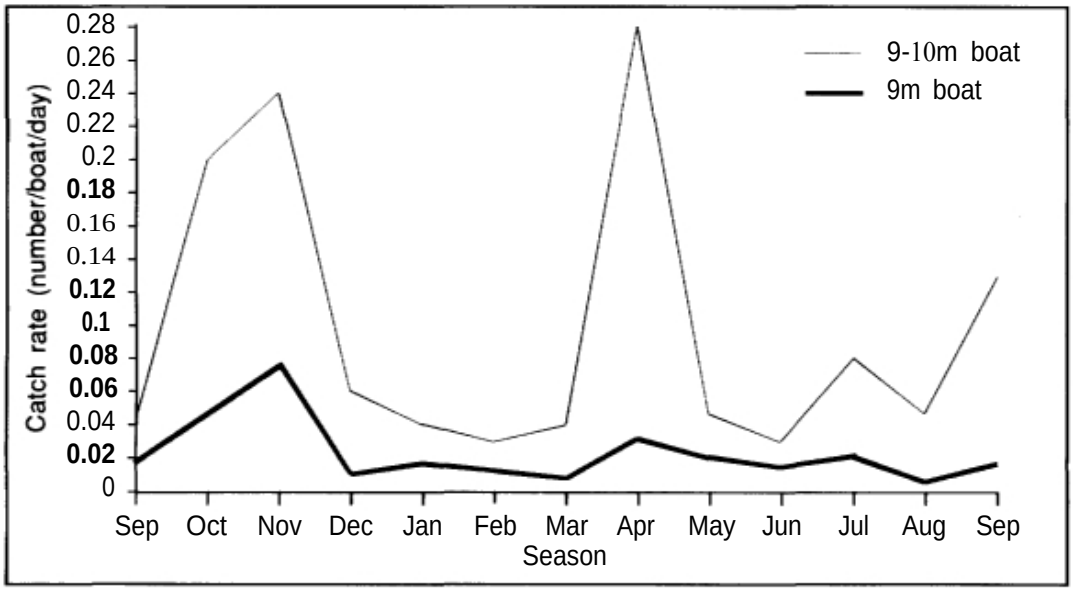


Fig 3(b). Seasonal variation in the dolphin catch rates for the 9 m and 9-10 m sizes of boats, on the south coast



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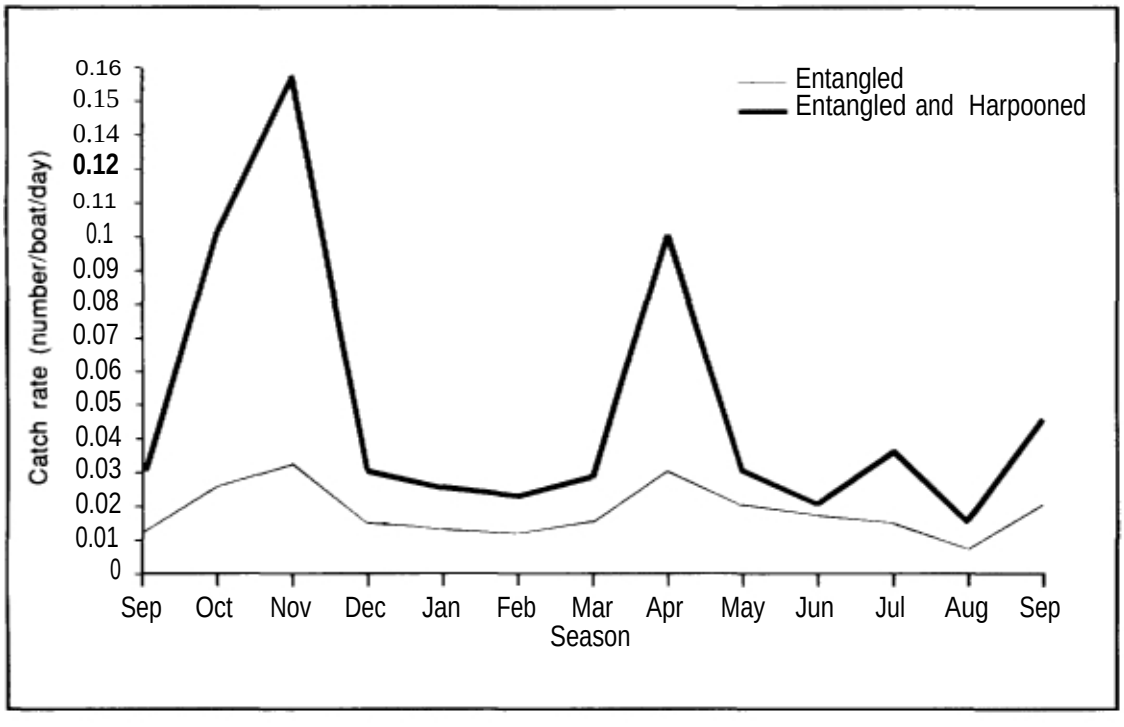
Within subareas in the west and the south, the catch rates obtained by the 9m boats were lower than those obtained by the 9-10 m boats. These, in turn, were lower than those obtained by the >10 m class of boats.

The monthly mean catch rate of dolphins entangled in the nets in the South is plotted in Figure 4 against the overall monthly mean catch rate established for the same areas to emphasize the influence of harpooned dolphins on the overall catch rate in this area. Figures 3 and 4, which show seasonal variations in dolphin catch rates for different boats and for different methods of capture, are also potential indicators of the seasonal variations in the relative abundance of dolphin populations around Shri Lanka.

Fig 4. Seasonal variation in the catch rates of dolphin entangled (–) and entangled and harpooned (—), on the south coast



4.5 Sizes of animals caught

All the dolphins and small whales encountered during the study were between 70 and 330 cm in length. Among the dolphins, the largest were Bottlenose and Risso's, measuring 330 cm and 320 cm respectively. The Spinner, Spotted, Striped, Roughtoothed and Fraser's Dolphins all included large-sized ones in a 240-270 cm range. The Common Dolphin specimens measured were 100-120 cm in length. The smallest animals (70 cm) were found among the Spinner, Bottlenose and Spotted Dolphins.

Among the small whales, the largest encountered was the Southern Bottlenose Whale (330 cm) followed by the False Killer Whale and Melonheaded Whale (290 cm) and the Pygmy Killer Whale (270 cm). The largest among the Dwarf Sperm Whales and Pygmy Sperm Whales measured 230 cm and 250 cm respectively. Except for the Southern Bottlenose Whale, all other whale species had smaller individuals, in the 100-130 cm length range.

The length-frequency distributions of the five main dolphin species are presented in Figures 5 a-c for different subareas.

In the case of the Spinner Dolphin (Figure 5a), the 70-250 cm size range was observed in the catches from the West, Southwest, South and Northeast. Two modal groups were observed; one between 100 and 130cm and the second between 160 and 190 cm. The first modal group was more pronounced in the West and Northeast, whereas the second modal group was more pronounced in the West, Southwest and South.

There were indications of four modal groups for Bottlenose Dolphin (Figure Sb, size range 70-330 cm). The first modal group, in the 80-1 10 cm range, was best seen in the Northeast. The second modal group, around 140-160 cm range, was observed in the Northeast, West, Southwest and South. The third modal group, in the 210-240 cm range, was more pronounced in the West, Southwest and South. Signs of a possible fourth modal group were observed in the Southwest and South, where the first modal group was weakly represented.

Fig 5(a). Length **frequency distribution of Spinner Dolphin landed in the different subareas**

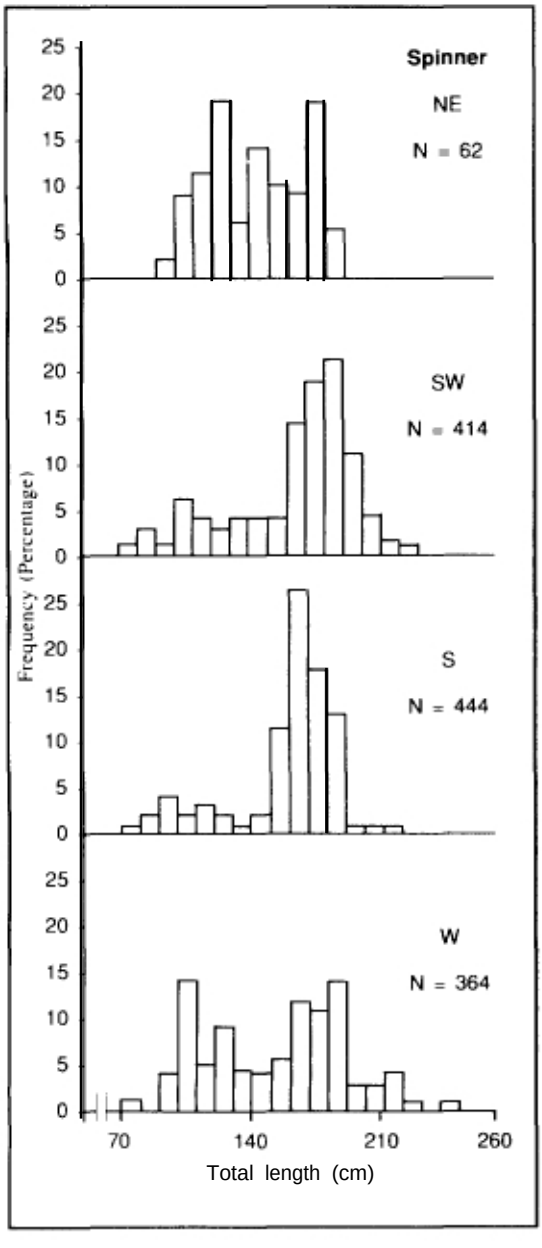
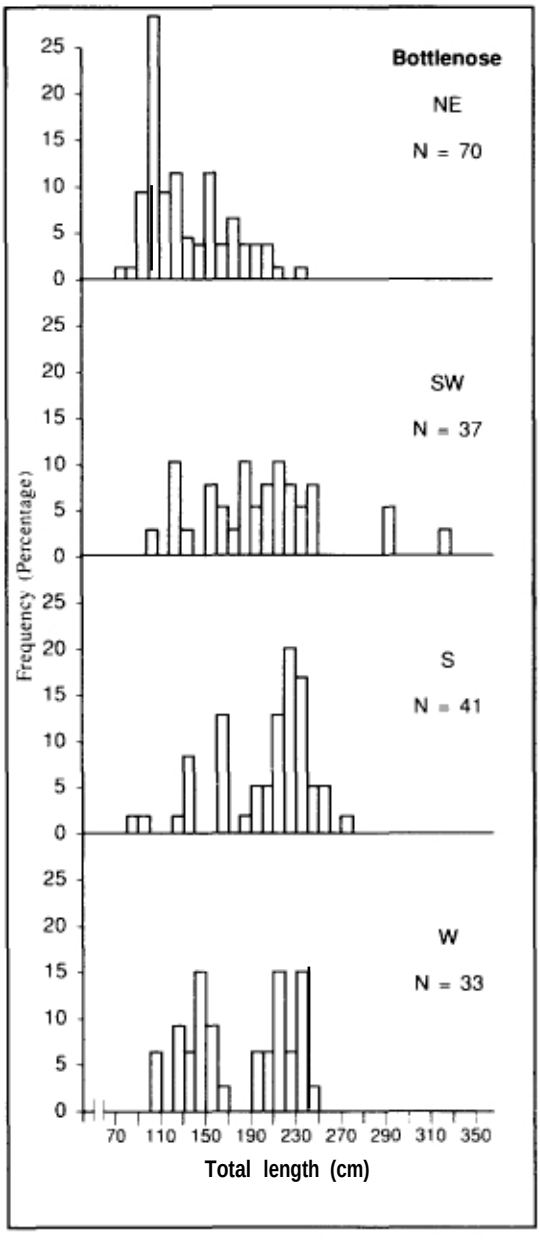


Fig 5(b). Length frequency distribution of Bottlenose Dolphin landed in **the different subareas**



The Striped Dolphin landings in the southwest and south (Figure Sc, size range 80-260 cm) showed two distinct modal groups, at 100-130 cm and 190-230 cm size ranges. The Spotted Dolphin landings, predominant in the Southwest and South, showed more or less similar size distributions (Figure Sd, size range 70-240 cm). The size range of Spotted Dolphins sampled was similar to that of the Spinner Dolphin and, assuming similar growth rates for the two species, two modal groups were observed at similar size ranges, 100-130 cm and 160-200cm. There was also an additional modal group of Spotted Dolphins 60-90 cm, which was not observed in the case of Spinner Dolphin.

Four possible modal groups were observed for the Risso's Dolphin (Figure 5e, size range 100-320 cm) in the West, Southwest and South. The first was below 110 cm, the second 150-180 cm, the third 220-240 cm and the fourth 260-280 cm.

Fig 5(c). Length frequency distribution of Striped Dolphin landed in different subareas

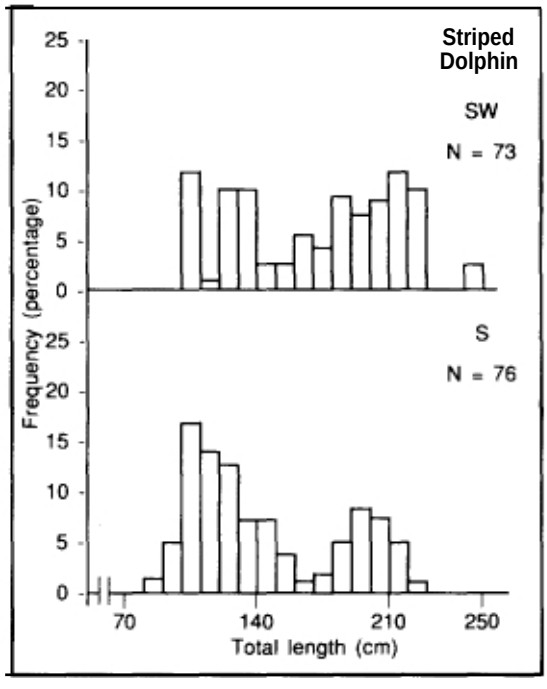


Fig 5(d). Length frequency distribution of Spotted Dolphin landed in different subareas

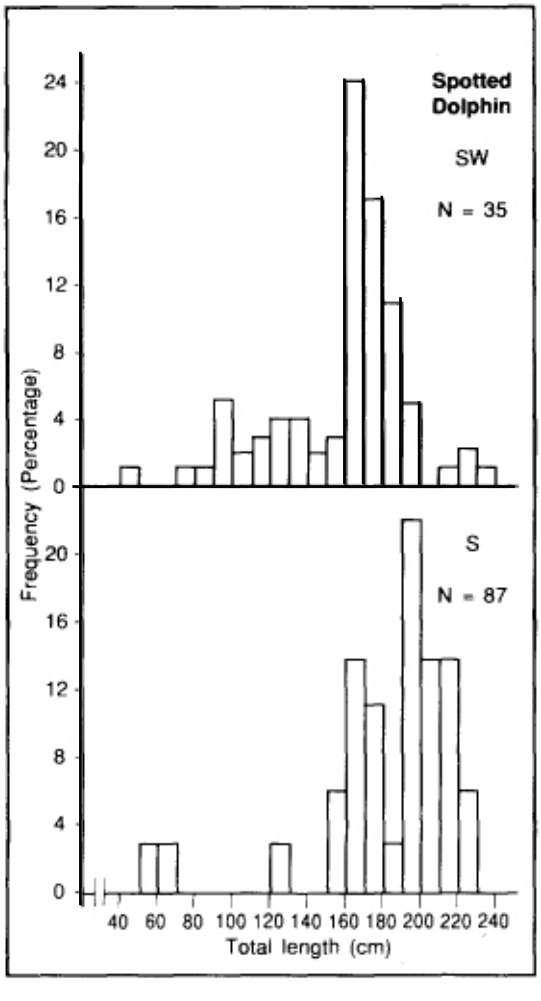
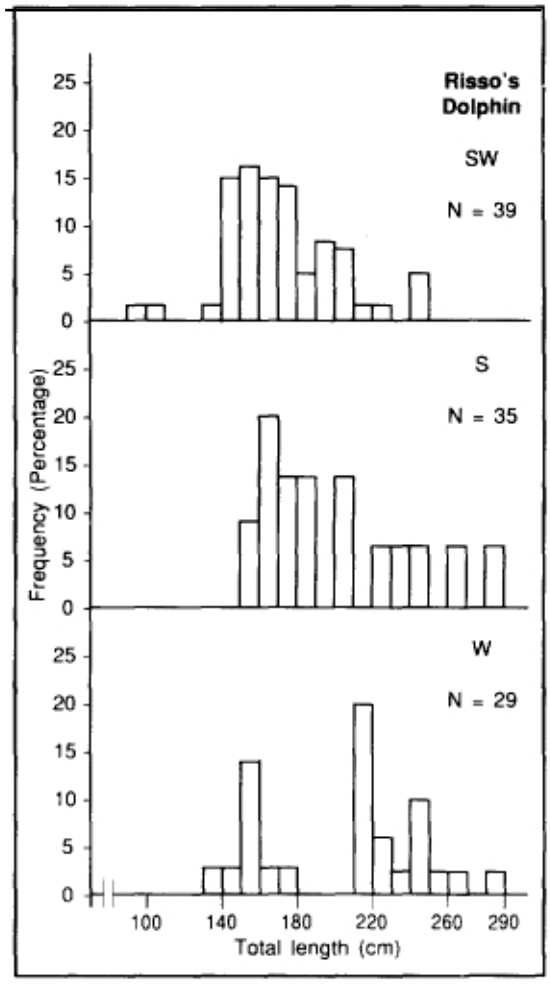


Fig 5(e). Length frequency distribution of Risso's Dolphin landed in different subareas



Available information from literature, on maximum recorded length, size at birth and size/age at maturity of various species of dolphins is presented in Table 9. Although this information refers more to some species inhabiting other oceans, a comparison with the length data obtained for the landings in Shri Lanka yields the following preliminary inferences:

- Some specimens of Spinner Dolphins measured in Shri Lanka are larger than the maximum recorded length.
- Around 70 per cent of Striped Dolphin landings in Shri Lanka could be immature (less than 190 cm length).
- Over 90 per cent of Bottlenose Dolphin landings in Shri Lanka could be immature (less than 250 cm length).
- Over 90 per cent of Risso's Dolphin landings could also be immature (less than 300 cm length).

Table 9: Maximum recorded length, size at birth and maturity of the dolphin species*

Species	Maximum length (cm)	Size at birth (cm)	Size/Age at maturity (cm/yrs)
Spinner Dolphin	210 (A)	*	
	220 (B)	-	
Bottlenose Dolphin	390 (A)	100 (A)	12-13 yrs (A)
	400 (B)	100-130 (A)	250 (B)
Striped Dolphin	328 (A)	100 (A)	7-8 yrs (A)
	230 (B)	100 (B)	190 (B)
Spotted Dolphin	244 (A)	. (A)	
	260 (B)	80 (B)	160 (B)
Risso's Dolphin	360-400 (A)	4'6" - 5'5" (A)	
	400 (B)	I50 (B)	300 (B)
Roughtoothed Dolphin	240 (A)	-	
	280 (B)	-	
Fraser's Dolphin	226 (A)	.	
	250 (B)	100 (B)	
Common Dolphin	240 (A)	-	
	250 (B)	80 (B)	
Melonheaded Whale	270 (A)	.	
	270 (B)		
Pygmy Killer Whale	244 (A)	-	
	270 (B)	100 (B)	
False Killer Whale	600 (A)		
	600 (B)	80 (B)	
Dwarf Sperm Whale	600 (A)	.	
	600 (B)	80 (B)	
Pygmy Sperm Whale	370 (B)	100 (B)	280 (B)

*Source A = Richard Ellis, 1982
B = Leatherwood, et al 1982

Nearly 70 per cent of the Spotted dolphin landings could be mature (more than 160 cm length).

In the case of Striped, Bottlenose. Spotted and Risso's Dolphins, specimens smaller than the size at birth given in Table 9 have been sampled, implying smaller sizes at birth in Shri Lankan/Indian Ocean waters. If size at birth is smaller than recorded elsewhere, it is also conceivable that size at maturity may also be smaller than those indicated in Table 9.

The size ranges of other species of dolphins and smaller whale landed in Shri Lanka are given below.

	Size range (cm)
Roughtoothed Dolphin	100 - 260
Fraser's Dolphin	130 - 270
Common Dolphin	100 - 120
Melonheaded Whale	100 - 290
Dwarf Sperm Whale	110 - 230
Pygmy Killer Whale	120 - 270
False Killer Whale	130 - 290
Pygmy Sperm Whale	110 - 250
Southern Bottlenose Whale	270 - 330

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4.6 Estimation of all-island dolphin landings

The distribution of the different types of boats reported to be landing dolphins in the different subareas and the distribution of these types of boats at **the** sampling sites within the subareas are presented in Table 10.

Table 10: Distribution of different types of boats at sampling sites and in subareas

Subarea	Boat *type* / **Sampling** *site*	*9m* / *9 m day-boats*	9-10 *m* / 9-10 *m Muitiday-boats*	*>10 m* / *>10 m Multiday-boats*
Northwest	Kalpitiya		30	12
	Kandakuliya	15		
	Total	15	30	12
	Total in subarea	227	170	57
	Negombo	27	37	34
West	**Total**	**21**	**37**	**34**
	Total in subarea	158	74	41
	Beruwala		**88**	**4**
	Galle	**16**	**46**	**8**
Southwest	**Total**	**16**	**134**	**12**
	Total in subarea	**174**	**213**	**12**
	Mirissa	**19**	**120**	**8**
	Dondra	**21**	**100**	
	Kottegoda	29	**11**	
	Kudawella	**41**	**11**	
	Tangalle	**21**	**15**	
	Hambantota	13		
South	Total	144	257	8
	Total in subarea	**155**	626	8
	Kalmunai	**125**		
	Batticaloa	75		
East	**Total**	200		
	Total in subarea	358		
	Trincomalee	**150**		
Northeast	**Total**	**150**		
	Total in subarea	**176**		
A) Total in all sampling sites		**552**	458	66
B) Total in all subareas		1248	1083	**118**
C) All island total		**1258**	**1083**	**118**

Over 40 per cent of the boats were located at the sampling sites. Moreover, except for ten boats of 9 m day-boat category operating in Mannar District, all the boats that operated in the island during 1992 were located in the subareas covered during this study.

The annual dolphin catch from the total fleet operating within each subarea was estimated separately,

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on a monthly basis, for each boat type. These estimates were then pooled to obtain an all-island estimate.

In estimating the ail-island annual dolphin catch, each boat has been assumed to fish for 22 days a month. In the case of the multiday-boats, the number of fishing days could be much less. The fishing effort (number of boats operating per day) calculated for each type of boat on a monthly basis was extrapolated for the total fleet operating in the subarea. The monthly mean catch rate for dolphins, established for each boat type, was then applied to the total monthly fishing effort of that boat type to generate total monthly dolphin mortality.

The results obtained are presented in Table I 1. The estimated total annual mortality of dolphins is 5181. The medium-sized (9- 10m) multiday-boats accounted for 61 percent, while the balance came mostly from the 3.5 GT (9m) day-boats.

Table 11: Estimated numbers of dolphins landed in Shri Lanka, by subarea and type of boat

	Boat			
Area	*9m*	*9-10m*	*>10m*	**Total**
Northwest	380	14		394
West	255	661	258	1174
Southwest	167	1112		1279
South	214	1355	8	1577
East	373			373
Northeast	384			384
Total	1773	3142	266	5181
Percentage	34.2	60.7	5.1	100
Total no. of boats	1258	1083	118	2459

This estimate also assumes that all boats with inboard engines are engaged in fishing operations likely to cause dolphin mortalities—e.g. drift-netting. However, the majority of the 11-tonners (> 10m) in the Northwest and over 125 day-boats (3.5 t, 9 m) in the same area are engaged in bottom trawling for shrimp, with no likelihood of causing dolphin deaths.

A summary of information of previous studies that led to estimates of annual dolphin mortalities in Shri Lanka is presented in Table 12.

Table 12 : Comparison of studies leading to estimates of dolphin mortality in Shri Lanka

Author	*Area corered*	Duration of *study*	*Craft type sampled*	*All-island estimate*	*Method of estimation*
Alling. A (1983)	Beruwala (S'West)	7 months (1983)	3.5 GT day-boats	13.500 (15,200 revised)	A single mean catch rate estimated for Beruwala applied to all 3.5 GT class boats in Shri Lanka
Joseph. L and Siddeek. M.S.M. (1985)	Beruwaia (S'West) Negombo (West)	1 year (1985) (56 sampling days)	3.5 GT day-boats	9129	A single mean catch rate from study area applied to all 3.5 GT boats in Shri Lanka excluding those engaged in shrimp trawling in Chilaw. Gulf of Mannar and the North.
Alling. A (19X.5,	Beruwala (S'West) Trincomaler Valachchenai (East)	May 1982 Oct. 1984 (6X sampling days)	?	42.480	A single mean catch rate from the three areas applied to all 3.5 GT and 6.7 m FRP (OBM) boats in Shri Lanka.
Leatherwood. S. and Reevel. R.R (1989) (Report on NARA/UNEP study)	West. Southwest South. Northeast	1985 · 1986	?	26,332 · 49,863	Series of total mortalities estimated for two areas, using two mean catch rates for 3.5 GT boats

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In all these studies, a single annual dolphin catch rate (two in Leatherwood & Reeves, 1989) calculated from the study area has been applied to the total fleet or a portion of the fleet in the whole island. Some studies covered only a few months, while most of them have not attempted to assess the fishing effort of boats landing dolphins.

The number of dolphins landed at the selected landing site on the sampling day and the number of boats (out of the total operating from that site) which landed on that day are basic requirements necessary to estimate dolphin catch rates and fishing effort. As seen in the present study, different boat types fishing in different ranges may have different dolphin catch rates as well as fishing effort. Fishing effort has been properly estimated only in the study of Joseph and Siddeek (1985). Even in the NARA/UNEP study (Leatherwood and Reeves, 1989), the number of boats landing (fishing effort) has not been recorded for most of the areas covered.

Fisheries in Shri Lanka are greatly influenced by the monsoonal weather and fishing effort for any fishery and/or craft will, therefore, not be the same throughout the year. Similarly, abundance of dolphins around Shri Lanka cannot be expected to be uniform throughout the year or all around the country, an implication that has to be made when using a single catch rate to estimate total annual mortality for the whole island. Compared to the previous studies, the method of estimation of annual dolphin mortality adopted in the present study (estimating monthly fishing effort and dolphin catch rates for boats landing dolphins and estimating total dolphin landings on a monthly and subarea basis) significantly reduces the bias inherent in applying a single dolphin catch rate and fishing effort values.

It has also been reported that preliminary estimates by NARA (Joseph, 1986) of dolphin catches by the Abu Dhabi gillnetters were in the region of 1000 animals per month, of which 25 per cent were used as bait. During the NARA/UNEP study of 1985-86, Leatherwood and Reeves (1989) admitted that this class of boats was not adequately sampled for dolphin landings. It is highly unlikely that this was done prior to the commencement of the NARA/UNEP study. In the absence of a well coordinated and executed sampling programme directed towards this class of boats and in the absence of technical documentation substantiating the above, the validity of the above estimate is very doubtful.

The only reliable data available on dolphin catches by the Abu Dhabi gillnetters gives a somewhat different picture. The Abu Dhabi boat operated by NARA during its exploratory tuna resources survey in 1987/88 (an FAO/TCP project) caught only six dolphins during 119 fishing days in 1987 and five dolphins during 129 fishing days in 1988. Records made available by the skipper of another Abu Dhabi boat from Galle (who has been scrupulously maintaining daily records of fishing operations data including information on weather and oceanographical observations) showed a catch of **eight** dolphins during 183 fishing days in 1988 and only **two** dolphins during 156 fishing days in 1989.

Leatherwood (1990) has reassessed the estimates presented in Leatherwood and Reeves (1989), as the earlier estimates have been made using an erroneous catch rate. The revised annual mortality is 8,042-11,821. Even in these calculations, no actual fishing effort data have been used.

No attempt was made to compare the catch rates obtained during the present study with those recorded from previous studies. In most of these studies, particularly those leading to high estimates of dolphin mortalities, the authors have admitted that no proper records were taken of numbers of boats actually fishing on sampling days. Dolphin catch rates may have been estimated only by considering the number of boats actually landing dolphins.

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4.7 Disposal and economic importance of dolphin landings

The disposal of dolphins shown in Table 13 indicates that over 80 per cent of the dolphins were landed ashore and eventually utilized for human consumption.

Table 13 : Disposal of dolphins

Subarea	*Landed ashore*	*Used as bait*	*Discarded at sea*	*Total*
Northwest	22			22
West	426	51		477
Southwest	707	64		771
South	1032	140		1172
East	31		142	173
Northeast	130	46		176
Total	2348	301	142	2791
Percentage	84.1	10.8	5.1	100

The 2791 dolphins sampled during the study were estimated to have a landed value of Rs. 1.6 million (Table 14) *i.e.* the estimated yearly landings would be worth about Rs 3 million.

Table14: Weight and value of dolphins landed at different sampling sites

Sampling sire	**No.of** *dolphins*	*Total weight (k/g)*	*Total value (SL Rs)*	*Average weightl dolphin (kg)*	*Average value/ dolphin (kg)*	*Average value (SL Rs/kg)*
Kandakuliya	22	801	4,945	36.4	224.77	6.17
Negombo	477	25,838	276,740	54.2	580.17	10.71
Beruwala	738	43,246	591,455	58.6	801.43	13.68
Galle	33	974	10,600	29.5	321.21	10.88
Mirissa	875	27,606	530,670	31.6	606.4	19.22
Dondra	161	4,350	62,558	27	388.56	14.38
Kottegoda	62	2,857	38,700	46.1	624.19	13.55
Kudawella	30	1.188	14,508	39.6	483.6	12.21
Tangalle	41	1,259	14,400	30.7	351.22	11.44
Hambantota	3	15	150	5	50	10
Kalmunai	122	4,745	12,775	38.9	104.71	2.69
Batticaloa	51	1,805	2,082	35.4	40.82	I.15
Trincomalee	176	6,934	32,746	39.4	I86.06	4.72
Total	2791	121,618	1,592,329	43.6	570.52	13.09

The average value per kg of dolphin showed significant differences at different landing centres. Highest prices were recorded at centres which supply to established consumer markets, e.g. Mirissa, Dondra and Beruwala.

Operational data (income and expenditure) collected from fishing boats during the study were utilized to calculate the average income per crew member per fishing day for different types of boats during different months. Dolphin catch rates estimated for different boats at different sampling centres and the average price of dolphin were utilized to calculate the income per fishing day derived by a fisherman from the sale of dolphins. Very often, the boat-owners do not claim any share from the sale of dolphins. The monthly income earned by a fisherman at a few selected

* US $ I = St. Rs 45 (appx.)

<<

sampling sites and in selected craft types are shown in Table 15. The actual number of fishing days are also shown for multiday-boats, whereas for day-boats in Trincomalee a monthly average of 22 fishing days was used in estimations.

Table 15: Monthly income of a fisherman from fishing and sale of dolphin by sampling site and type of boat

	MIRISSA (9-10M)				NEGOMBO (9-10)				NEGOMBO > 10m)				TRINCOMALEE (9m	
Momh	Income from fishing (SL Rs.)	Income from dolphins SL Rs.	No. of sea days	No, of fishing days	Income from fishing SL Rs)	Income from dolphins SL Rs.)	No. of sea days	No. of fishing days	Income from fishing SL Rs,)	Income from dolphins (SL Rs)	No, of sea days	No, of fishing days	income from fishing (SL Rs	Income from dolphins SL Rs)
Oct.91	2520	2226	20	14	2.740	140	22	14	8268	288	20	12	3718	29
Nov.	3420	2880	18	12	3472	448	20	14	4368	715	21	13	1430	66
Dec.	2775	585	18	15	5423	132	20	11	11.050	390	22	13	3740	078
Jan. 92	7150	377	17	13	2220	130	9	10	7579	264	23	11	276	20
Feb.	5335	209	17	11	727	242	20	11	11,165	198	20	11	2288	16
Mar.	5988	420	20	12	1920	130	7	10	9295	66	20	11	6622	53
Apr.	6214	3315	20	13	2912	117	15	13	7044	80	19	12	8272	6
May	9334	637	20	13	4238	156	18	3	4356	252	20	2	3344	42
June	8879	377	18	13	5278	78	20	13	9996	48	19	l2	5434	4
July	6432	020	8	12	6482	154	22	14	8294	231	20	11	4950	66
Aug.	6656	637	18	3	8080	90	17	10	9456	168	19	12	2892	66
Sep.	4572	4020	17	12	7320	192	20	12	12.432	120	20	12	3036	95
Total	69,275	16,703	221	153	61,812	2109	230	145	1,03,303	2920	243	142	47,002	1551

In Mirissa, where the intensity of harpooning is the highest recorded, the income from dolphins gave each fisherman in 9-10m multiday-boats an additional annual income of Rs. 16.703. equivalent to 24 per cent of his annual earnings from fishing. On a monthly basis, this additional income was very significant from September to November and in April and July. In Negombo, a fisherman in the same class of boat earned only Rs. 2109 during the year. equivalent to 3.4 per cent of his earnings from fishing. Similarly, a fishermen in a larger (> lOm) class of multiday-craft in Negombo also earned an income equivalent to less than 3 per cent of his earnings from fishing. Unlike in Mirissa, there were no months in which income from dolphin landings were significant. A fisherman in a 3.5 GT day-boat in Trincomalee earned Rs. 1551 during the year from dolphin landings, equivalent to only 3.3 per cent of his annual earnings from fishing.

A little over 85 per cent of the income earned by a fisherman in Mirissa from dolphins could he attributed to those landed by harpooning. In the absence of such activity, his annual income from dolphins landed solely due to entanglement in nets would be Rs. 2500, equivalent to the annual income earned by other fishermen from sale of entangled dolphins in other areas.

The average monthly income earned from dolphin landings by a fisherman in a 9-lOm boat in Mirissa. Beruwala and Negombo is plotted against the monthly mean fish catch rate for the same

boat and is shown in Figures 6a - c. The inverse relationship between fish catch rate and income from dolphins observed for most months in Mirissa suggests that fishermen in Mirissa have resorted to active harpooning of dolphins when fish catches were low. A similar trend is seen in Beruwala too, during some months. In Negombo, where the intensity of harpooning is comparatively low, the fish catch rate and monthly income from dolphin landings follow a similar trend, except for few months.

Fishermen in medium-sized 9-10m multiday-boats recorded high earnings from dolphin catches from September to December and in April and July in Mirissa, November in Beruwala and November and February in Negombo. Fishermen in the larger multiday-boats (>10m) in Negombo also recorded their highest daily income from dolphins during November.

Fig. 6 (a). Seasonal variation in catch rate of finfish and monthly income from dolphin catches, during the corresponding season at Mirissa (South)

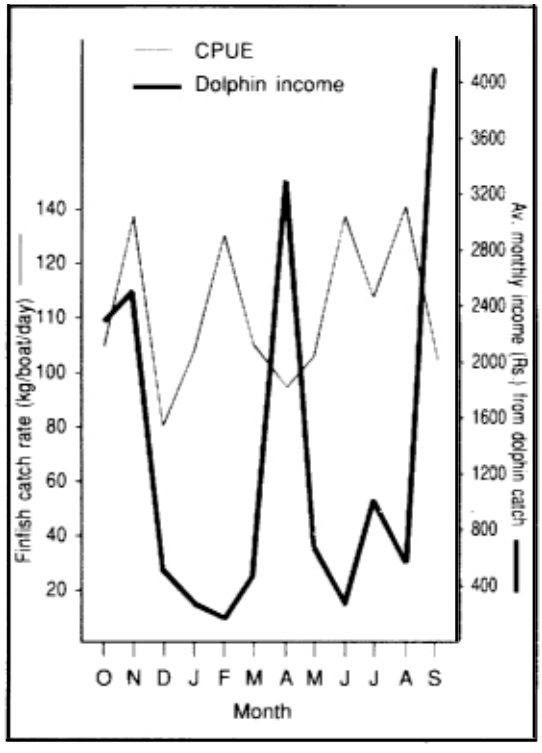


Fig. 6 (b). Seasonal variation in catch rate of finfish and monthly income from dolphin catches, during the corresponding season at Beruwala (Southwest)

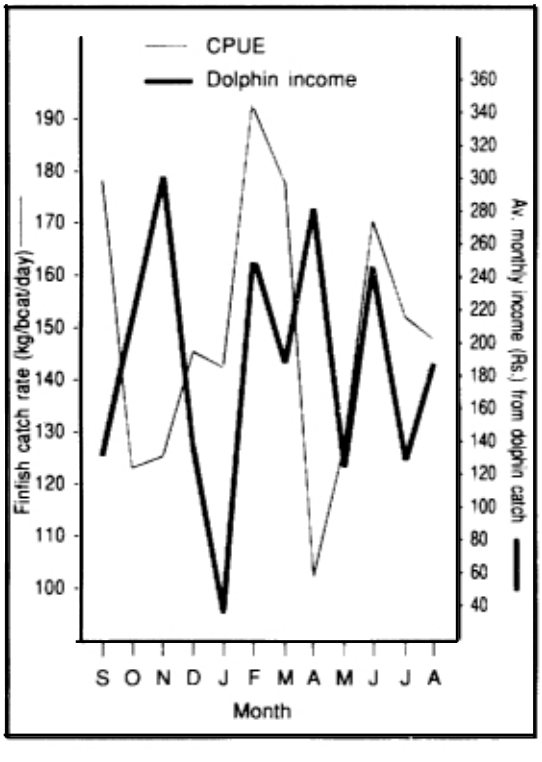
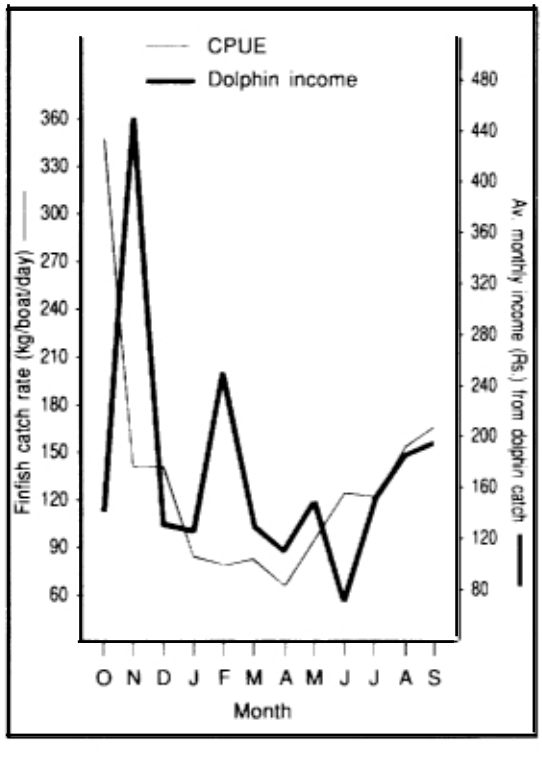


Fig. 6 (c). Seasonal variation in catch rate of finfish and monthly income from dolphin catches, during the corresponding season at Negombo (West)



5. RESULTS OF SOCIO-ECONOMIC STUDY

The quantitative survey was carried out during both the lean (November to April) and peak (May to October) tuna fishing seasons at fish landing centres and dolphin consumer areas. The retailers, consumers and nonconsumers were selected by observation and/or by using a selection questionnaire. The numbers sampled in various categories are given in Table 16.

Table 16: Numbers and categories of respondents during the socioeconomic study

	Lean season	*Peak season*	*Total*
Fishermen	**58**	**63**	**121**
Traders	**25**	**15**	**40**
Retailers	**13**	**10**	**23**
Consumers	**95**	**189**	**284**
Nonconsumers	**64**	**60**	**124**
Total	**255**	**337**	**592**

In-depth interviews for the qualitative survey were carried out at the selected fish landing sites and at selected retail outlets which were identified from the quantitative survey conducted during the lean season. The 71 persons from the selected target group interviewed during the peak season comprised: fishermen - 24; traders - 7; retailers - 8; consumers - 12; nonconsumers - 12; fishery officials - 3; and environmentalists/journalists - 5.

Over 90 per cent of the fishermen interviewed worked on multiday-boats. All of the respondents from Negombo and Beruwala were fishermen from multiday-boats, while all the respondents from Trincomalee were from day-boats.

5.1 Fishermen's reasons for landing dolphins

The main reasons given by the fishermen for catching and or landing dolphins were:

- They get entangled in the nets - 41
- They are caught when other fish are scarce - **24**
- They help cover cost of fishing - 12
- They can be caught easily 5

The fishermen's response with regard to the advantages and disadvantages of landing dolphins is arranged below in order of ranking (Table 17).

Table 17: Advantages and disadvantages of landing dolphins

	Advantages	*Disadvantages*
1	**Can be used as a cheap bait**	**Difficult to locate big fish (Yellowfin) if** dolphins are **caught**
2	**Can be easily sold for human consumption. even under different names**	**Cannot sell for higher prices**
3	Covers **fuel costs**	**Damage nets**
4	**Can be sold quickly**	**Catching is illegal**
5	**Boat-owners do not take money earned from sale of dolphins**	**All traders do not buy dolphins**

About one-third of the fishermen did not perceive any disadvantages in landing dolphins. Fishermen in Mirissa were concerned that removal of dolphins might affect the Yellowfin Tuna fishery, as dolphins help locate schools of big Yellowfin Tuna.

5.2 Disposal of dolphins

Table 18: Methods of disposal of dolphins

	Number of respondents 119(%)
1. Sold to traders/retailers	53.6
2. Kept for bait	42.8
3. Sold to dryfish makers	2.9
3. Others	0.7

Once landed, dolphins are disposed of in the same way as other fish. In certain places, dolphin transactions take place somewhat discreetly, often in the early hours of the morning, before disposal of the other fish. Fishermen in most areas found that dolphins sold almost equally well as bait and as meat for the table (Table 18).

Dolphins provide a cheap source of bait for fishermen in Beruwala, Negombo and Mirissa. While dolphin meat for 100 hooks of longline costs Rs. 500-800. other varieties of bait fish could cost as much as Rs. 2000-3000 for the same requirements. Dolphin meat is the favoured bait for shark longlining, as the pieces do not easily disintegrate in water and the blood helps to attract shark.

In Mirissa, the importance of dolphin as bait is relatively low during the peak tuna fishing season (20 per cent) compared to the lean season (94 per cent), presumably due to high availability of other bait varieties from their own catches. The importance of dolphin as a bait in Negombo is lower than in other areas, except Kandakuliya where, according to the reporting, it is not at all used as bait.

5.3 Trade in dolphin meat

Table 19: Advantages of trading in dolphin meat

	No. of respondents (%)
1 Can sell at a good profit	51.4
2. Sells fast/easily	19.7
3. Good demand	18.0
4. Tasty/nourishing	3.3
5. Can keep parts like liver for themselves	1.6

The main advantages of trading in dolphin meat listed by traders/ retailers arc given in Table 19.

Although half the traders/retailers found no apparent disadvantage in trading in dolphin meat, IO-20 per cent of them complained of difficulties in selling dolphin meat on rainy days as the meat tended to get soft and squashy and there were difficulties in preserving it for long without ice. Some 11 per cent of them (all from Mirissa) were also under the impression that trading in dolphin meat is banned by law. Two-thirds (62 per cent) of the traders/retailers preferred the dolphin body parts for trade. The liver and heart were the second preference of half of them. One-third of them listed the rail portion as the third preferred body part for sale.

The main marketing/consumer areas served by the five fish landing centres from which the traders/ retailers obtain their supplies of fish/dolphins are shown in Figure 7.

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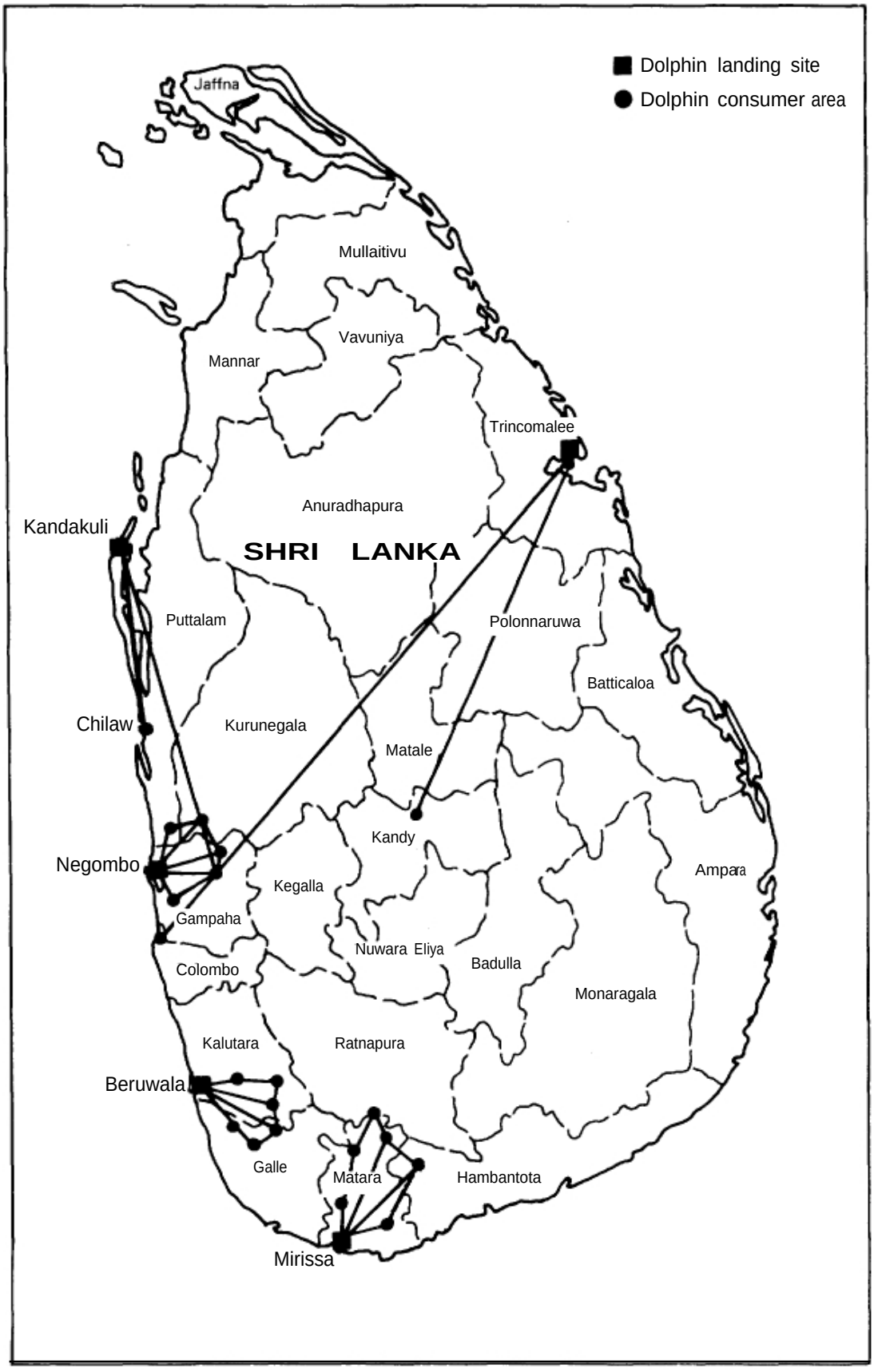
Fig. 7. Main landing sites and consumer areas radiating from the centres studied during the socioeconomic survey.



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The trading prices of fish and dolphin at fishermen, trader/retailer and consumer levels are presented in Table 20. The table enables a comparison of the trading prices of dolphin with the prices of other varieties of fish. Prices of other nonfish protein commodities, such as beef, chicken, pork etc. are also given for comparison in Table 20. Dolphin prices are comparable with cheap varieties of fish such as Sardine, Skate etc.

Table 20: The trading prices (SL Rs.) of fish varieties, dolphins and meats

Variety	Fishermen		Trader/Retailer		Consumer	
	P	L	P	L	P	L
Sardine (Salaya)	23	38	28-30	45	32	50
Trenched. Sardine (Hurulla)	34	50	36-40	50-53	43	60
Scad Mackerel (Bolla)	33	55	33	55	43	75
Dolphin	17	31	24-28	31-55	40	50
Skate	22	36	33	46	28	50
Shark	32	36	40	56-60	40	16
Mullet/Bream (Rockfish)	32	58	32	67	50	75
Skipjack Tuna	37	60	49	81	61	100
Yellowfin Tuna	43	67	52-60	80	60	110
Carangids (Paraw)	47	Xl	63	113	90	145
Martin	64	Xl	75	112		
Seerfish	73	99	93	142		
Beef					75	80
Chicken					70	80
Mutton					100	125
Pork					60	80

P = Peak tuna fisher season

L = Lean tuna fishery season

5.4 Consumption pattern

The majority of the consumers of dolphin meat admitted to a frequency of consumption of at least once a month, with the quantity purchased at any one time being 0.5-1.0 kg, mainly from the weekly fair in the village (Table 21).

Table 21: Consumption frequency and source of supply of dolphin meat

Frequancy		Quantity		Source	
	%	g	%		%
Twice/week	3	250	11	Market/ beach	33
Once/week	8	500	36	Weekly fair	62
Twice/month	8	1000	53	Cycle vendor	5
Once/month	73				
Once every two months	8				
Respondents (No.)	36		36		93

<<

According to consumers, dolphin meat compared favourably with other varieties of fish mainly due to the reasons mentioned in Table 22.

Approximately 7() per cent of the consumers were skilled/unskilled labourers and farmers in rural areas. A similar percentage of consumers earned an income of less than Rs. 2000/month. Very few claimed to have earned more than Rs. 3000.

Table 22: **Comparision of dolphin meat with other varieties of** fish

	Lean season		*Peak season*	
	Count	*%*	*Count*	*%*
Cheaper	63	46	73	39
Similar to meat	32	32	23	12
Nourishing	17	12	16	8
Tasty	15	11	28	15
Less hones	11	8	76	40
Respondents (No.)	95	100	189	100

5.5 *Attitudes and percepno ns*

The attitudes and opinions of fishermen, traders/retailers and consurners/nonconsumers on some issues of dolphin catching and consumption are presented in Table 23. The responses are given as percentages. Except for the nonconsumers. the niajority of other categories perceive dolphin as

Table 23: **The attitudes and opinions of fishermen, traders, consumers and nonconsumers to dolphin meat**

Statement/Response	*Fishermen*	*Traders/retailers*	*Consumers*	*Nonconsumers*
Nutritious food				
Agree	71	80	77	28
Disagree	17	IS	17	24
Don't know	2	5	6	48
Comparatively cheaper				
Agree	96	96	94	86
Disagree	3	4	4	5
Don't know	I	-	2	9
*Consumed due to scarcity of other **fish in** the market*				
Agree	17	IS	25	8
Disagree	78	85	69	80
Don't know	5	-	6	12
***Tasty when** cooked*				
Agree	66	81	98	24
Disagree	9	5		7
Don't know	25	14	I	69
A vailable everywhere				
Agree	36	42	55	39
Disagree	63	52	39	46
Don't know	I	6	6	IS
Feel unhappy about consuming				
Agree	54	34	19	56
Disagree	40	46	39	11
Don't know	6	20	42	33
Are an endangered species				
Agree	54	34	19	56
Disagree	40	46	39	11
Don't know	6	20	42	33
Respondents (No.)	**121**	**63**	**284**	**124**

a nutritious and tasty food. All categories agree that dolphin meat is comparatively cheaper than all other varieties of fish and meat, but do not agree that dolphin consumption is linked to scarcity of other varieties of fish. Except for the consumers, all other categories felt unhappy about consuming dolphin meat. The response from traders/retailers on this issue was somewhat mixed.

The consumer's perception of the availability of dolphin meat is not shared by the other categories of respondents. Similarly, the fishermen's and nonconsumer's perception of the dolphin as an endangered species is not shared by a large proportion of consumers and traders/retailers.

6. LEGAL ASPECTS

Eleven legislation/ordinances pertaining to fisheries and other aquatic resources in Shri Lanka were reviewed by the legal consultant. A summary of the review is given in Appendix I. The consultant was of the view that there is no existing legislation which specifically restricts or prohibits the taking, killing etc. of dolphins.

Table 24: Awareness of legality of dolphin catching and trading among fishermen

	Illegal	Not illegal	Don't know	Total no. of fishermen interviewed
Beruwala	34	5	4	43
Mirissa	33	11	4	49
Negombo	43	13	4	60
Kandakuliya	13	2	-	15
Trincomalee	9	1	2	12
Total	133	32	14	179

Nearly 75 per cent of the fishermen were of the view that landing dolphins is illegal (Table 24). At a regional level, the largest proportion (22 per cent) who thought it **not** illegal were from Mirissa. Among the traders/retailers, 60 per cent assumed that trading in dolphin meat was illegal, while 30 per cent assumed it to be not illegal. The largest proportion (42 per cent) who thought trading in dolphin meat was **not** illegal came from Negombo.

Some of the environmental authorities and agency officials interviewed were of the view that the Wildlife Act provided legal protection to dolphins. Others found no such legal provision in the Wildlife Act, as the dolphin is not listed as a protected animal. Still others contended that the illegality of dolphin catching is implied by the fact that Shri Lanka is one of the countries in the International Marine Mammal Convention and the Indian Ocean Sanctuary for Whales.

7. WORLD REVIEW

The world review showed that dolphins are caught both accidentally as well as intentionally in countries all over the world. This happened both in small-scale artisanal fisheries as well as with large-scale industrialized fisheries. Although dolphin mortalities in association with artisanal small-scale fisheries may have a longer history, reliable information on numbers taken through interaction with such fisheries is scanty. By far the largest number of dolphin deaths are reported in association with large-scale industrialized fisheries.

Despite the worldwide concern for their conservation, it is seen that the large scale industrial fisheries still continue to take large numbers of dolphins as by-catch in their fisheries. The Japanese driftnet fishery for squid in the northern Pacific caught 26,000 marine mammals in 1990. The tuna purse-seine fishery in the eastern tropical Pacific had a by-catch of 52-56,000 dolphins in 1990. despite all the management and technological measures adopted to reduce such mortalities. The Japanese harpooned 29,000 Dall's porpoises in 1989 and the Peruvian fishermen took over 10,000 dolphins in directed fisheries.

Very little work has been done in assessing the impact of fishery-related mortalities on dolphin populations, except in the eastern tropical Pacific where recent studies have shown that dolphin populations are not in danger of extinction.

The review, presented in Appendix II, also summarizes information on management/regulation measures adopted by various countries to minimize dolphin deaths.

8. DISCUSSION

Interaction between marine mammals and fisheries is becoming an increasingly significant factor in the formulation of policy on the conservation and management of both kinds of resources. Such interactions can result in both revenue losses to fishermen and mortality of marine mammals. These interactions can involve damage to captured fish, damage to nets and gear, reduced catch rates due to scaring of target species, reduced availability of target species and incidental entanglement.

The earliest published reports on marine mammal interaction with fisheries in Shri Lanka focussed on the effect that smaller cetaceans, or dolphins, had on fisheries and fish catches. Dolphins were reported to interrupt fishing activities, damage fishing nets and steal fish from nets (Medcof, 1963). Lantz and Gunasekera (1955) even recommended fisheries targeting dolphins in order to minimize their interference with other fisheries. A harpoon fishery for dolphins was reported to have existed in some parts of the country prior to the middle of the 20th Century (Neville, 1887). Leatherwood and Reeves (1989) have described the role of foreign fishing advisers in introducing the practice of harpooning dolphins to the fishermen in Negombo in the early 1950s. Both locally and internationally, the emphasis on 'fisheries-marine mammal' interaction and related studies has now shifted to examining and reporting more on the effect of fishery-related mortalities than on the well-being of dolphin populations.

However, it is also important to recognize the need to look at the issue of 'dolphin-fish' interaction in a wider and more objective manner, particularly in developing countries, where gillnets deployed by small coastal vessels are fast becoming the method of choice in a growing number of fisheries. This is particularly significant in the case of Shri Lanka.

In many other parts of the world, dolphin casualties are caused by 'Walls of Death' created by deep sea gillnetters, using tens of kilometres of net or by large purse-seiners. **There is no possibility of this in Shri Lanka, where the offshore/deep sea fishery is only small-scale driftnetting for tuna and longlining for shark** and where, unlike elsewhere, the dolphin is not targeted. The only fishing opportunity Shri Lankan offshore fishermen have is what they now practice, during which some dolphins get entangled in the nets and have to be landed. **Dolphin behaviour being what it is, there is no alternative way a catch can be made avoiding dolphins.**

Only a total ban will ensure 'no dolphins', but such **a ban will mean abandoning the entire offshore/deep sea fishery and losing 20,000 t of fish catch a year** as a consequence. The offshore fishermen will then be forced to revert to coastal water fisheries and this, in turn, will create more problems, with **additional fishermen competing for an already dwindling resource in the extensively fished coastal areas.**

It should also be pointed out that **Man and the dolphin compete for the fishery resources.** Dolphins constitute an integral part of the marine ecosystem, usually as top predators. Fish consumed by marine mammals is about ten times the weight of its heart and it is therefore estimated that a dolphin eats about 5 kg of fish a day. On the current study's estimate of catch, this means that, **alive, these dolphins could tap the resource by about 10,000 t of fish a year.**

Any legislation being envisaged to 'Save the Dolphin' would have to take these two points into consideration.

Fishermen did not come out strongly as a group of consumers of dolphin meat, despite the fact that a large majority of them probably earn a monthly income of less than Rs. 2,000/-. Dolphins are landed primarily to earn an additional income. This additional income is insignificant when compared to the income from fishing, if the additional income is generated only from the sale of entangled dolphins. This is clearly evident in Mirissa where income from entangled dolphins is similar to that from other areas. It is the significant additional income from harpooned dolphins that seems to encourage the Mirissa fishermen to continue harpooning dolphins.

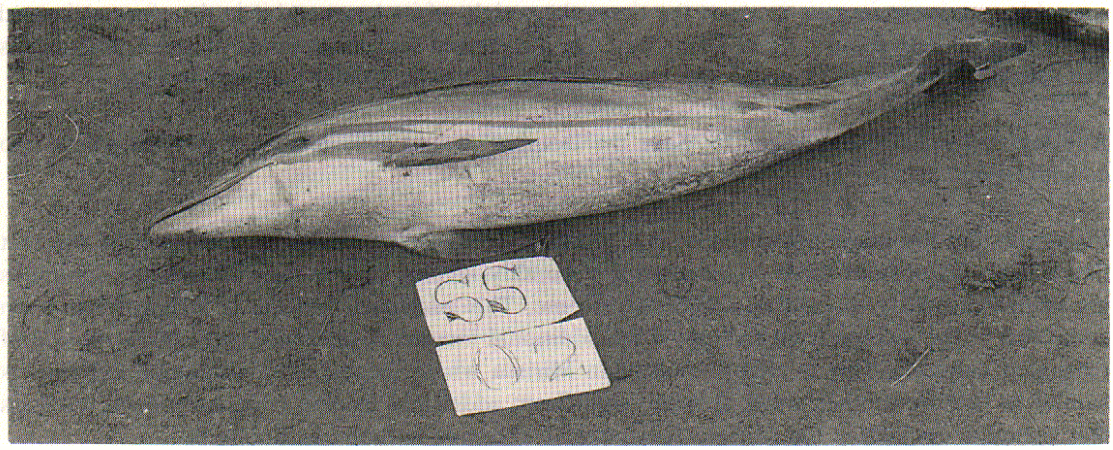
The uncertainty in respect of the legal status of dolphin catching. landing and trade is evident at the level of fishermen, traders, consumers as well as amongst environmentalist\, journalists etc. Given the sensitive nature of the issue, the reluctance to make an official clarification of the position is also quite understandable. Legal opinion is that there is no existing legislation/ ordinance which specifically restricts or prohibits the taking, killing etc. of dolphins.

No information is available of the populations or stock size of dolphins in the Indian Ocean or in, the seas around Shri Lanka. Without such information, it is not possible to assas the impact of fishery-related mortalities on dolphin populations. The eastern tropical Pacific is one area where dolphin abundance studier have been extensively carried out in recent years. These studies have indicated no evidence of any significant changes in the abundance of dolphin species since 1985. despite the recent fishery related deaths of over 50,000 animals every year.

With about a dozen species of dolphins contributing to the 5000 dolphins landed every year in Shri Lanka, it can safely be assumed that NO species is endangered. On the other hand, a blanket ban on landing dolphins could not only endanger the livelihood of thousands of fisherfolk in Shri Lanka hut also result in a loss of production of about 20.000 t of fish a year in the offshore region.

The results of the study do not call for any management measures to control or reduce dolphin deaths in Shri Lanka as yet. However, considering the sensitive nature and international appeal of the issue, there is a need for continuous monitoring of the 'dolphin-fish' interaction through proper sampling techniques. It is quite evident that considerable damage has been done in the past through improper and ill-conceived studies.

Landings recorded of Spinner Dolphin (above) and Striped Dolphin (below) during the Shri Lanka study



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APPENDIX I

Legal Status Regarding Dolphin Landing/Trade

Summary of Report by B.C.F Jayaratne. Attorney-at-Lat

These eleven legislative enactments/ordinances were reviewed and are briefly discussed below. with special reference to their applicability to the dolphin catch.

- National Aquatic Resources Research and Development Agency Act No. 54 of 1981.
- Fauna and Flora Protection Ordinance Cap. 469
- Fauna and Flora Protection (Amendment) Act No. 44 of 1964
- Fauna and Flora Protection (Amendment) Act No. I of 1970.
- Fisheries Ordinance Cap 212 and Amendments.
- Fisheries (Regulation of Foreign Fishing Boats) Act No. 59 of 1979.
- Fisheries (Regulation of Foreign Fishing Boats) Act No. 37 of 1982.
- Maritime Zones Law No. 22 of 1976.
- Chank Fisheries Cap. 213
- Pearl Fisheries Cap. 214
- Whaling Ordinance Cap. 215

1. National Aquatic Resources Research and Development Agency Act No. 54 of 1981.

It is designed for research, development and management of 'aquatic resources', which are all living and non-living resources in or beneath the medium of water and which, when subject to the sovereignty, jurisdiction or control of Shri Lanka, arc termed 'National Aquatic Resources'. Identification of aquatic resources is one of the Agency's functions; the Agency has powers to conduct research for, and to render technical services to, the Ministry of Fisheries.

The declared purpose of the Agency seems ideally designed for the study of aquatic resources in general and for the study of dolphins in particular. This Act, however, does **not** specify any species of aquatic animal **nor** does it provide for the control of the taking, killing etc.of fish or aquatic animals or dolphins.

2. Fauna and Flora Protection Ordinance

"The protection of the fauna and flora of Ceylon" is the purpose of the Fauna and Flora Protection Ordinance, Cap. 469 of the Legislative Enactments. The Ordinance declares certain areas as Strict Natural Reserves. National Parks, Nature Reserves, Jungle Corridors, Intermediate Zones and Sanctuaries. Entry into, and activities in, some of these areas are totally prohibited, in others, controlled by permits or licences, and, in yet others, totally free. 'Animal' includes 'fish' and 'wild animals': i.e., any animal other than a domestic animal (s.1 1). 'Fish' is, however, not further described or defined anywhere in the Ordinance.

Various species of animals, birds, beasts, elephants etc. are enumerated and provision is made. specifically, in substantive sections in the Ordinance, prohibiting the taking, killing etc. of such animals. Clear prohibitions are placed, leaving no room for doubt or argument. e.,q. sections 3.5.6.7.x and **so on. Dolphins are completely left out.** This position is not altered by the amend-ments to the Fauna and Flora Protection Ordinance, introduced by Act 44 of 1964 and Act I of 1970.

3. Fisheries Ordinance

The Fisheries Ordinance, Cap. 212 is intended "to amend and consolidate the law relating to Fisheries and to the taking and protection of fish in Ceylon waters. to provide for the registration of fishing boats. for the better regulation of the fishing industry and for purposes incidental to or connected with the matters aforesaid".

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'Fisheries' as such is not defined and Ceylon waters must today be construed, not as the three-mile limit of old, but as the 300 mile limit in operation after the Maritime Zones Law. No. 22 of 1976.

Section 5 of the Fisheries Ordinance provides for the taking of fish in Ceylon waters on a fishing licence. Though licences and registration are mentioned, there is nothing in the sections concerned to indicate any prohibitions or restrictions on the taking and killing of fish or any species of fish.

Sections 12 to 19 exhaust the part of the Ordinance intended for the "protection of fish" : but this protection has not extended to the making of any provision against the taking, killing etc. of fish.

Section 33 provides for the making of regulations for general purposes, but since there is no specific or substantive section of the Ordinance giving the right to restrict or prohibit the taking, killing etc. of fish, a regulation for such purposes cannot be made and, if made, would be ultra vires the powers in the Ordinance.

Section 35 of the Ordinance does define 'fish'; 'fish' means any variety of marine, fluviomarine or fresh-water fishes, crustacea or mollusca, and includes every aquatic animal which derives its sustenance wholly or mainly in water, but does not include

(a) chanks - Cap. 213,
(b) pearl oysters - Cap. 2 14,
(c) whales - Cap. 2 15, or
(d) any reptile for the time being included in Schedule I to the Flora and Fauna Protection Ordinance - Cap. 469.

While whales are specifically excluded, dolphins, which are ejusdem generis with whales, are not mentioned. It might be therefore argued that dolphins could be brought in under that portion of the definition which states that every aquatic animal deriving sustenance from water is included. As whales are specifically excluded, it does not seem logical to take in dolphins as a species ejusdem generis with an excluded species. It may be easier to classify dolphins with other "aquatic animals" and so take them in. It is. however, not conceivable why, if dolphins were intended to be taken in. dolphins were not specifically mentioned when, at the same time, whales are specifically excluded. The clue to it may be in the fact that when the Fisheries Ordinance came to be first enacted in 1940, dolphins were not a problem, or a known problem, and were therefore left out of consideration, unlike. whales, which have been exclusively covered under the Whaling Ordinance, in response to worldwide concern for whales threatened by the whaling industry.

4. Fisheries (Regulation of Foreign Fishing Boats) Act No.59 of 1979

This Act has been enacted to "regulate, control and manage fishing and related activities by Foreign Fishing Boats in Sri Lanka waters; and to provide for matters connected therewith or incidental thereto".

Foreign fishing boats (being boats other than local fishing boats -s.28) can fish in areas of Shri Lanka waters specified in a permit and at seasons specified in such permit (s.6). The Director of Fisheries was originally the authority for implementing the Act. but by Act 37 of 1982 amending Act 59 of 1979. "Secretary" was substituted for Director.

In granting permits the Secretary may attach special conditions which, however, are not specified (ss.8 and 9) and may also cancel or suspend such permits (s.10). Species of fish or other aquatic animals are not specified. Section 16 makes contravention of conditions an offence. But there is no substantial provision that the taking, killing etc. of fish or any variety of fish is prohibited.

Act 59 of 1979 also introduced another definition of "fish" (s-28): FISH means any aquatic animal. whether piscine or not and including any shell-fish, crustacean, mollusc, holothurian or aquatic mammal, also its young, fry. eggs or spawn. "Any aquatic animal, whether piscine or not", is

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extensive enough to cover dolphins. No excluded species are mentioned. However, the Act itself does not contain any section making the taking, killing etc. of any aquatic animal, whether piscine or not, lawful or unlawful except on a permit.

It is doubtful whether the Secretary has power to specify species of fish. Section 8 of the Act subjects permits under section 6 to "prescribed" conditions within the discretion of the Secretary. The conditions he may think fit to attach are themselves subject to certain circumscribing limits with regard to the period for which the permit is issued, the area of fishing, the methods employed and the type of gear that can be used by the boat (s.8). Species of fish are **not** mentioned.

In the circumstances, though the definition of fish in Act 59 of 1979 seems sufficient to cover the case of dolphins, the absence of any specific prohibition or restriction as to dolphins prevents any action being taken against their taking, killing etc.

SUMMARY

To summarize the position, there is no existing legislation which **specifically** restricts or prohibits the taking, killing etc. of dolphins. If total prohibition is contemplated, it is best to do so by a provision in the Fisheries Ordinance, or in any other legislation designed to handle the matter, clearly and specifically prohibiting the taking, killing etc. of dolphins. Where the intention is not to have a total prohibition but to introduce some degree of control over fishing activities, provision may be made by a section in the legislation clearly stating that the taking, killing etc. of dolphins (with or without mention of other species) is prohibited **except** on a permit or licence issued on certain terms, e.g. as to payment, areas of fishing, days of fishing, modes of fishing, fishing gear which may be used etc.

It is suggested that these matters be provided for either by suitable amendments to the Fisheries Ordinance or by new legislation enacted for the purpose, for which the Legal Draftsman should be consulted. It is also suggested that the prohibitions or restrictions should be made applicable to both local and foreign fishing boats.

APPENDIX II

World Review of Capture and Utilization of Dolphins

INTRODUCTION

Dolphins are caught the world over as incidental catches during fishing operations and as targeted catches of **some** fisheries. Incidental catches are reported from large-scale industrial fisheries as well as from small-scale fisheries, using gillnets, purse-seines etc, while harpooning is widely used in fisheries targeting dolphin. Dolphins caught as by-catch of large-scale industrial fisheries are often not utilized whereas those caught by both targeted and non-targeted small-scale fisheries find various uses, including human consumption.

***Dolphin by-catch from industrial* fisheries**

Large-scale, high seas driftnet fishing for tuna and squid is a relatively new phenomenon. The world's largest driftnet fisheries operate in the North Pacific. Fleets from Japan, Taiwan and Korea, totalling some 640 vessels, fish for squid using driftnets 45-50) km in length. Several hundred Japanese and Taiwanese vessels fish with large-mesh driftnets for tuna (mainly albacore) and billfish in the South Pacific. Taiwan began to operate high seas drift gillnetters from the mid- 1980's for albacore and squid in the North Pacific Ocean and for albacore in the Indian Ocean.

Small cetacean species which are known to be taken in large numbers in the North Pacific driftnet fisheries include the Northern Right Whale Dolphin (Lissodelphis borealis), Pacific Whitesided Dolphin (Lagenorhynchus *obliquidens)* and Dall's Porpoise (Phocoenoides dalli). The Japanese North Pacific driftnet fishery for salmon is reported to have incidentally killed l0,000-15,000 Dall's Porpoises a year, during fishing operations in the late 1970's (Ohsumi, 1990). Mortality is estimated in the hundreds of thousands a year for some seabirds. Leatherback, Loggerhead and Green Turtles are also caught incidentally in the North Pacific driftnet fisheries.

International monitoring of high seas driftnet fisheries began in 1989 with placement of US and Canadian observers on Japanese driftnetters fishing for squid in the North Pacific. The Japanese North Pacific driftnet fishery for squid, in 1990, was estimated to have caused the deaths of over 270,000 sea birds, 26,000 marine mammals and about 400 turtles (Anon 1992a). It has been shown that populations of the Northern Right Whale Dolphins and the Pacific Whitesided Dolphins have suffered declines as a result of these fisheries.

Approximately one quarter of the world's tuna catch (2.5 million tonnes in 1988) is taken from the Eastern Tropical Pacific Ocean (ETP). The most economically important tuna species in this area is the Yellowfin (Thunnus albacares), which is often found in association with various species of dolphins. Tuna fishermen have taken advantage of this association and have caught tuna by setting their purse-seine nets on highly visible herds of dolphins. Since the early Seventies (1973 to 1990), over 1.25 million dolphins have been incidentally killed in purse-seine fishing for Yellowfin Tuna in the Eastern Tropical Pacific Ocean (De Master et al, 1992). The Spotted Dolphin (Stenella attenuata) is the major dolphin species taken by the purse-seine fishery for Yellowfin Tuna in the ETP. The Spinner Dolphin (S.longirostris) and the Common Dolphin (Dolphinus delphis) are also taken. In addition, the Striped Dolphin *(S.coeruleoalba)* and the Fraser's Dolphin *(Lagenodelphis* hosei) are occasionally caught.

Until the 1970s. the tuna fishery in the ETP was dominated by the U.S. fleet and an average of 100.000 dolphins a year were estimated to have died as incidental catches during purse-seine operations in 1960-1972. The number of U.S. purse-seiners in the ETP tuna fishery decreased from an average of 45 vessels a year in the mid-1980s to 10 vessels in 1992. During recent years, several Latin American nations have developed large tuna fleets. Since the mid- 1980s. they have accounted for most of the catch of tuna and the most mortality of dolphins. The Inter-American Tropical Tuna Commission (IATTC) estimated that the total kill for 1990 was 52,000-56,000 dolphins, of which 5083 were attributed to the U.S. fleet (Anon, 1992b).

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Dolphin catches in small-scale fisheries

Small-scale fisheries in many parts of the world are also reported to catch dolphins as by-catch. Targeted fisheries also exist for a variety of uses, including human consumption. For example:

Gillnets are used all around the coast of India. Consequently, unknown numbers of small cetaceans are caught and killed incidentally. The five main species involved are the Indo-Pacific Humpbacked Dolphin (Sousa chinensis), Bottlenose Dolphin (Tursiops truncatus), Spinner Dolphin, Common Dolphin and Finless Porpoise (Neophocaena phocaenoides). The Finless Porpoise and the Common Dolphin have been reported to be accidentally taken in the shore seine fishery off Goa, India. The carcasses of these animals find their way into market places along with the fish (Thomas 1983).

Dolphin flesh is used as bait in the expanding shark fishery along the east cost of India (Rao, 1990). Dolphins taken by gillnet and harpoon are also being used as bait in shark fisheries along the southwest coast of India (Lal Mohan, 1991). Dolphin meat is also sold for human consumption in Kochi (Cochin). Consumption of dolphin meat is also reported from Lakshadweep (the Laccadive Islands) where the inhabitants of some islands catch dolphins, either by harpooning or by driving them into shallow lagoons (Mankifen, 1983).

There is a long history of subsistence take and incidental kill of small cetaceans in coastal fisheries of several West African nations — particularly Mauritania, Senegal and Ivory Coast. The species involved include the Common Dolphin, Bottlenose Dolphin, Spinner Dolphin, Atlantic Spotted Dolphin (S. frontalis), Clymene Dolphin (S. clymene), Roughtoothed Dolphin and Indo-Pacific Humpbacked Dolphin (Anon *1989c).*

A harpoon fishery for small cetaceans has long existed around Japan, with Dall's Porpoises amongst the target species. The annual take of Dall's Porpoises has been around 10,000 in the late 1970s and early 1980s. In 1986, fishermen took 13,406 Dall's porpoises in Japanese waters. This jumped to 41,455 in 1988, apparently to make up for the shortfall of whale meat brought about by decreased whaling. In response to concern expressed by the International Whaling Commission, the Japanese reduced the take of Dall's Porpoises to 29,000 in 1989 (Ohsumi, 1990).

— Small cetaceans are also killed incidentally in gillnets and seines and harpooned in many places along the central and northern coasts of Brazil. They are used for shark bait, for human consumption and as a source of 'love charms'. Harpooned dolphins are also used as shark bait in a fishery in northeastern Venezuela (Anon, 1990a). Small cetaceans are also killed in the gillnet fisheries in northern Argentina. In southern Argentina, dolphins are taken incidentally in crab nets, but harpooned for crab bait. Dolphins and porpoises are also harpooned for use as bait in the Chilean crab fishery, along with fur seals, Sea Lions and other wild life. The abundance of at least one dolphin, the Commerson's Dolphin *(Cephalorhynchus commersonii),* may have been drastically reduced. A wide variety of small cetaceans are taken incidentally in gillnets and deliberately in seines and by harpoon and landed at several fishing ports in Peru for human consumption (Anon, 1992a). The recent catch of dolphins in the directed fishery in Peru is reported to exceed 10,000 in some years.

Bottlenose Dolphin and other species of dolphins are captured in a 'drive fishery' and other fisheries in Taiwan and sold for human consumption within the country (Anon, *1989c).*

— The western Mediterranean population of Common Dolphin *(Delphinnus delphis)* seems to have declined precipitously in recent years. Possible causes for this apparent decline include pollution, overfishing of food resources, unregulated direct exploitation in Spain and other indirect catches in Spain, France and Italy (Anon 1989c).

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Maldivian fishermen have traditionally used dolphin meat as bait to catch Tiger Shark, whose oil is used for painting boat hulls. The dolphins caught by harpooning are allowed to rot for a day or two before being used as bait (Anderson. 1992).

In addition to targeted catch and incidental fishery-related mortalities, dolphins are also reported to be killed in anti-shark nets deployed for swimmer protection. The anti-shark nets off bathing beaches may have removed as much as 30-35 per cent of the local population of Bottlenose Dolphins off Southern Natal, in South Africa, during 19X0-85 (Anon 1989c). *Orcaella* and Sousa are the two cetacean species most frequently caught and drowned in shark nets set off northeastern Australian waters for swimmer protection (Heinshom. 1983).

Population studies and impact of fishery-related mortalities

Having low reproductive rates, dolphins are considered very vulnerable to consistently high mortalities. The mortality of dolphins associated with fishing operations is recognized as a major threat to many of their populations. The assessment of the biological impact of the fishery-related dolphin mortalities on their populations has been hampered by the lack of information of abundance, population dynamics and stock structure of these cetaceans. However, there is a great deal of investigation going on in many places on the subject of dolphin by-catch in commercial fisheries. Among the most active areas of investigation are the tuna/dolphin fishery of the ETP and the driftnet fishery of the North Pacific. The South-West Fisheries Center (La Jolla, California) was involved in the investigation of the dolphin by-catch problem with the tuna-dolphin issue in the ETP. Since IY77, the IATTC is heavily involved in this work, which includes estimating dolphin abundance and fishery-induced mortality as well as programmes to reduce such mortality. The NMFS is responsible for assessing the status of those dolphin stocks taken incidentally by the tuna purse-seiners in the ETP.

Over 90 per cent of the studies on dolphin interaction with fisheries have been conducted by the US (NMFS) and IATTC. Basically, three methods have been used in these studies. namely;

Observer programmes on board commercial fishing vessels:
Research vessel surveys: and
Aerial surveys

One of the objectives of the IATTC programme is to estimate the incidental mortality of dolphins caused by the international fleet.

Estimates provided by IATTC since 1979 indicate that mortality for 1990 (53-55,000) is significantly less than that of 1986 (124-129,000). This is attributed to improved fleet performance reduction in 'dolphin sets', increase in 'dolphin sets' with zero mortality. reduction in the proportion of night sets etc. (Hall and Boyer. 1'99 I).

Estimates of dolphin abundance in the ETP have been made by NMFS and IATTC on the basis of observations made from either research vessels or fishing boats. Other methods of estimating abundance, such as mark-recapture'experiments or other source of data (e.g, sightings from aerial surveys) have proved inadequate for this purpose. The best available estimate of the average total population of Common. Spinner. Striped and Offshore Spotted Dolphins in the ETP in 19X6-1900 is slightly over 8,000.000 (Anon, 1992b).

Incidental mortality of dolphins in the ETP tuna fishery since 1950 is reported to have affected the abundance of stocks of Spotted and Spinner Dolphins (Smith, 1983) and, possibly, of Common Dolphins (Hall and Boyer. 1990) However, based on an analysis of smoothed abundance indices. all stocks of ETP dolphins that interact with the tuna fishery have been shown to be more or less stable since 1985. The only exception to this conclusion is that the southern stock of offshore Spotted Dolphins may have increased during this period (Buckland et al. 1992). De Master et al. (1992) has reviewed the status of these species, relative to stock structure, current population size. levels of fishery-related mortality and trends in abundance. and found no evidence of any signifi-

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cant changes in abundance for any of these species since 1985. It is, however, stressed that better knowledge of recruitment rates and migration patterns of dolphins and better stock identification of individuals are needed for accurate assessment of population trends.

Regulationlmanagement of dolphin mortalities

Consequent to the recent worldwide concern over dolphin mortalities in both large and small-scale fisheries, a variety of regulatory/management mechanisms have been introduced in many parts of the world to address this issue.

The first and the most far-reaching regulations to eliminate or reduce incidental dolphin deaths during fishing operations were taken by the U.S. The Marine Mammal Protection Act (MMPA) was passed in 1972 in response to the public outcry over the depletion of whale populations. the incidental killing of hundreds of thousands of dolphins in the Yellowfin Tuna purse-seine fishery and the slaughter of Harp Seal pups in the northwest Atlantic.

An annual dolphin mortality quota of 20,500 for the U.S. feet in ETP was initiated in 1981. With the reduction in the size of the U.S. fleet and an increase in the fishing effort by the remaining fleet on nondolphin-associated tuna, the number of dolphins killed in 1990 was estimated at 5083. down 60 per cent from the estimated kill of 12,643 in 1989 (Jackson, A.R., 1991).

The U.S. MMPA was amended in 1988 and very strict new measures introduced for the protection of dolphins in the ETP tuna purse-seine fishery. One amendment prohibits import of Yellowfin Tuna or Yellowfin Tuna products from nations fishing in the ETP with tuna purse-seine but which do not have regulatory and enforcement programmes comparable to those of the U.S. and which have kill rates of dolphins well in excess of the U.S. fleet (Anon, 1989a).

Since early 1989, all nations initiating exports of Yellowfin Tuna to the U.S. were required to meet the new regulations under the amended MMPA. Intermediary nations, that fail to ban imports into their country of Yellowfin Tuna from an embargoed nation; were also not allowed to export Yellowfin Tuna to the U.S. (Anon, 1989b). In early 1990. the three biggest companies in the U.S. tuna industry announced that they would not buy or sell fish caught using methods that kill or injure dolphins (Anon, 1990 b).

The U.S. has thus embargoed imports of Yellowfin Tuna from twenty countries where processors use tuna that has been caught by methods harmful to dolphins (Anon, 1992c). The ban on the importation of Yellowfin Tuna into the U.S. from Spain was rescinded in February 1989 following Spain's conformance with the U.S. marine mammal regulations (Anon, 1989b). On an appeal made by Mexico. a tribunal of the Geneva-based General Agreement on Tariffs and Trade (GATT) in late 1991 ruled that one country may not impose sanctions on products that are taken outside its territorial jurisdiction. If GATT's General Assembly ratifies the decision, the U.S. must comply by amending the 19-year-old protection act and dropping the tuna import ban (Kronman, 1991).

The provision under the MMPA, which allowed continued incidental take of marine mammals, is due to expire in October 1993. Draft proposals issued by the NMFS for a set of new regulations include a proposal to set absolute quotas for the number of animals that can be killed — for any reason — for each marine mammal species. These quotas are to be based on a concept called Allowable Biological Removals (ABR). Quotas would be determined by factoring in three variables: minimum population estimate, maximum net productivity and a recovery factor (Campbell. 1991).

A number of other countries operating tuna purse-seinrrs and high seas driftnetters have followed the U.S. in imposing regulations to reduce fishery-induced dolphin mortalities. Ecuador has passed legislation in 1990. banning its fleet from purse-seining for tuna associated with marine mammals. Mexico, Panama, Vanavatu and Venezuela have also prohibited their fleets from making late sets (called 'sundown sets') that result in the dolphin release procedure occurring in darkness.

In mid- I99 1, Mexico announced a dolphin protection programme that will not significantly reduce the country's tuna catch. This programme included setting maximum allowable mortalities for each vessel, action against vessel captains reporting excessive mortalities and regular gear inspection to reduce mortalities caused by equipment malfunctions (Anon, 199la).

The Vanavatu Government in late 1990 introduced measures to reduce the dolphin kill rates in its ETP purse-seine fleet. These included regulations that the vessels must have trained crew and must use gear which aid in reducing dolphin mortality rates (Anon, 199lb).

Venezuela is reported to have reduced incidental marine mammal deaths over the past four years by 95 per cent — from 100,000 to 4000 a year (Anon, 1992c).

Countries with fish canning industries and countries which import canned fish have also adopted measures to restrict sale of fish (particularly tuna) caught in association with dolphins.

Tuna canners in Thailand, following the U.S. lead on this issue, have announced that they will not purchase, process or sell any tuna caught in association with dolphins (Anon, 1990c).

Australia announced its intentions to implement 'dolphin safe' measures for canned tuna by 1992. Once the law is enforced, all cans of tuna in Australia must carry a label saying that the contents are either 'dolphin safe' or caught by a method that is not harmful to dolphins.

Restricting the use of port facilities and conditional use of such facilities are also amongst measures adopted by countries to ensure reduced incidental mortality of dolphins. Since September 1990, Trinidad has banned driftnetters from using its port facilities, making it difficult for driftnetters to tranship their catches in Trinidad (Anon, 1990d). Mexico has implemented several new regulations since June 1987, designed to control the transshipment of tuna and to ensure that vessels are adequately equipped with gear to limit incidental dolphin mortality (Anon, 1988).

In recent years, a number of other countries also have amended their existing legislation related to marine mammals, or introduced new legislation with the aim of reducing incidental dolphin mortalities. For example;

— All cetaceans have been recently included in Schedule I of the Indian Wildlife Protection Act of 1972. The sale of cetacean products is prohibited, under penalty of up to two years in prison and a fine.

The Conservation Law of the Republic of China (Taiwan), enacted in June 1989, was amended in August 1990 when all cetaceans were added to the list of protected species (Anon, 1991c).

The Peruvian Government in November 1990 implemented national legislation prohibiting the taking and trading of cetaceans in Peruvian waters (Anon, 1992a). However. except in a very few locations, the ban has apparently been ineffective and cetacean meat is regularly offered for sale at public market places in Lima, at roughly US$ 1.60 per kg (beef is about double this price).

In Australia, the Commonwealth Whale Protection Act 1980 prohibits the killing, injuring, taking or interfering with cetaceans (whales, dolphins and porpoises) by all persons within the Australian Fishing Zone (AFZ) and by Australians anywhere in the world.

Technical developments for reducing dolphin mortalities

In addition to bans, quotas etc, there have also been technology oriented developments to achieve the lowest possible dolphin catch rates in fishing operations. The IATTC assisted vessels of the international tuna purse-seine fleet with dolphin safety panel alignments and dolphin safety gear

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inspections. Since 1970, the NMFS has been involved in research aimed at reducing incidental dolphin mortality in the U.S. tuna purse-seine fishery (Coe et al, 1991). Phase I of the programme, which spread over a decade, was focussed on immediate development of methods and gear to achieve the lowest possible dolphin kill rates using standard purse-seine methods. Development of alternative fishing systems which do not entail the capture of dolphins when harvesting the associated Yellowfin Tuna is the goal of Phase II. Net and vessel handling, so as to minimize net-configuration problems, were of primary importance along with the development and improvement of effective rescue and release techniques. The remarkable reduction in the annual estimated dolphin mortality in the U.S. tuna fleet from 315,000 animals in 1970 to 16,900 animals in 1980 is partly attributed to such developments.

Drifting fish-aggregating devices (FADS) are being deployed in the ETP in a joint venture between the IATTC and the NMFS of U.S. (Anon, 1991d). The goal of this project is to evaluate the capacity of artificial floating objects to attract and aggregate mature Yellowfin and Bigeye Tuna in areas where they are usually associated with dolphins, or in areas where naturally occurring floating objects are scarce. If successful, FADs are expected to enhance fishing opportunities by supplementing or replacing catches of dolphin-associated tuna and thus reduce dolphin mortalities in purse-seine operations.

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The BOBP brings out the following types of publications:

Reports (BOBP/REP/...) which describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and subprojects in member-countries for which BOBP inputs have ended.

Working Papers (BOBP/WP/...) which are progress reports that discuss the findings of ongoing work.

Manuals and Guides (BOBP/MAG/...) which are instructional documents for specific audiences.

Information Documents (BOBP/INF/...) which are bibliographies and descriptive documents on the fisheries of member-countries in the region.

Newsletters (Bay of Bengal News) which are issued quarterly and which contain illustrated articles and features in nontechnical style on BOBP work and related subjects.

Other publications which include books and other miscellaneous reports.

Those marked with an asterisk (*) are out of stock but photocopies can be. supplied.

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