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RECORDS OF ODONTOCETES IN THE NORTHERN INDIAN OCEAN (1981-1982) AND OFF THE COAST OF SRI LANKA (1982-1984)

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RECORDS OF ODONTOCETES IN THE NORTHERN INDIAN OCEAN (1981-1982) AND OFF THE COAST OF SRI LANKA (1982-1984)[1]

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(With six text-figures)

Surveys for cetaceans were conducted from a 9 m sloop, s/rv *Tulip* (29 November 1981-12 February 1982) in the northwest Indian Ocean and off the coast of Sri Lanka (13 February-17 March 1982, 20 January-24 April 1983, and 22 February-25 May 1984). Although the principal purpose was to locate and track sperm whales, *Physeter macrocephalus*, observations of other cetaceans were recorded. Odontocetes were observed during the three years in the following relative frequencies (number of observations/number of individuals): spinner dolphin, *Stenella longirostris* (48/1, 804), striped dolphin, *Stenella coeruleoalba* (12/531), spotted dolphin, *Stenella* cf. *Stenella attenuata* (14/656), common dolphin, *Delphinus delphis* (14/711), Risso's dolphin, *Grampus griseus* (37/321), bottlenose dolphins, *Tursiops* sp. (39/477), humpback dolphin, *Sousa* sp. (4/10), false killer whale, *Pseudorca crassidens* (6/43), Fraser's dolphin, *Lagenodelphis hosei* (1/12), pygmy killer whale, *Feresa attenuata* (5/10), Cuvier's beaked whale *Ziphius cavirostris* (1/2), Pilot whale, *Globicephala* cf. *Globicephala macrorhynchus* (3/78), Southern bottlenose whale, *Hyperoodon planifrons* (2/42), and unidentified dolphins (85/664). Behavioural observations and habitat preferences are discussed.

INTRODUCTION

In 1979 members of the International Whaling Commission (IWC) voted to declare the northern portion of the Indian Ocean (20° E-130° E longitude, above 55° S latitude) a marine mammal sanctuary. This international commitment was accompanied with an urgent request that "benign research" of the living whales in the sanctuary be commenced. In response to this request, the World Wildlife Fund-Netherlands (WWF) raised funds for a three year (1982-84) study of sperm whales to be carried out from a 9 m research vessel, s/rv *Tulip*. By agreement with the IWC, the study was also designed to obtain information about the identity, distribution, and relative abundance of all cetaceans sighted. This paper reports on the observations of free ranging odontocetes, other than sperm whales, in the northern portion of the sanctuary from November 1981 through 25 May 1984.

MATERIALS AND METHODS

On 29 November 1981, s/rv *Tulip* sailed from the Suez Canal to begin a survey of cetaceans in the Red Sea and northern Indian Ocean. The vessel arrived in Sri Lanka on 14 February 1982 after stops in Djibouti, Oman, and India (Fig. 1). From 14 February to 17 March 1982, s/rv *Tulip* was used to follow

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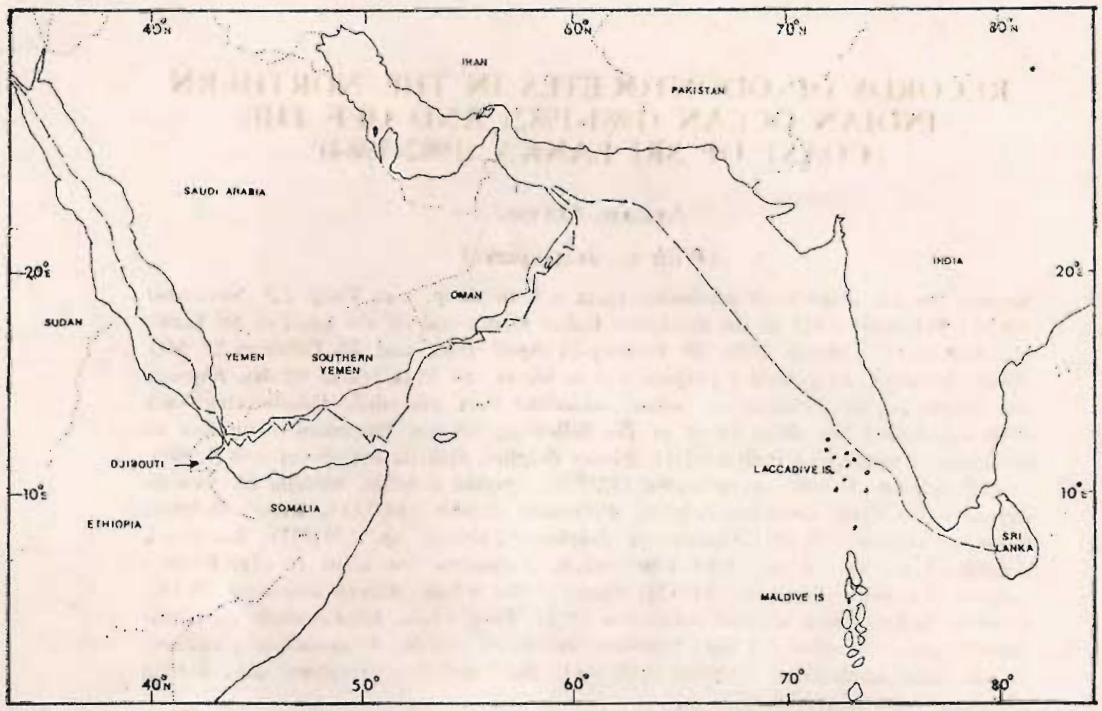

Fig. 1. The route sailed by sr/v *Tulip* 29 November, 1981 through 12 February, 1982.

sperm whales off the west coast of Sri Lanka. During the following two field seasons (20 January-24 April 1983 and 22 February-25 April 1984) the vessel was based at Trincomalee, a harbor on the northeast coast of Sri Lanka, and used to study cetaceans within approximately 100 nm of that port. The research was on sperm, *Physeter macrocephalus* and blue, *Balaenoptera musculus* sp., whales. However, during all field seasons the crew recorded information on all cetaceans sighted.

A constant watch was kept during daylight hours. At least one of five crew members was positioned in the stern of the boat, approximately 3 m above sea level for a maximum three hour watch. When cetaceans were seen the vessel's course was altered to determine species and numbers, but the engine was only used when the speed of the vessel dropped below two knots. Oceanographic variables (e.g. surface water temperature, wind speed, wind direction, etc.) were measured and recorded for each sighting to examine such effects on cetacean distribution and abundance. Surface water temperature was recorded in degrees celsius and depth was monitored up to 1,100 m, the operational limits of the Simrad Skipper 603 depth sounder. Local time, date, and position were obtained from a Tracor Transtar Satellite Navigator.

For this research, a "herd" was defined as a group of cetaceans seen moving in the same direction and at similar speeds. A "sighting" was considered to be an event which began when the first individual became visible and ended when the last was no longer visible.

TABLE 1

INCIDENTAL SIGHTINGS OF SMALL CETACEANS RECORDED IN THE NORTHERN INDIAN OCEAN DURING THE SPRING 1982-1984 FIELD SEASONS. RATING IS RECORDED AS 1=POSITIVE, 2=PROBABLE, AND 3=POSSIBLE IDENTIFICATION

Obs.	Species	Date (Month/Day/Year)	Rating	Lat.	Long.
1	*Delphinus delphis*	120181	3	35 05	23 24
2	*Delphinus delphis*	120381	3	33 14	27 48
3	*Tursiops* sp.	120581	3	31 19	32 21
4	Unidentified Dolphin	121281	3	25 04	35 44
5	Unidentified Dolphin	121281	3	23 46	36 43
6	Unidentified Dolphin	121281	–	23 27	36 49
7	Unidentified Dolphin	121381	–	23 20	36 54
8	*Tursiops* sp.	121381	2	22 18	37 40
9	Unidentified Dolphin	121381	–	22 08	37 48
10	*Tursiops* sp.	121481	2	21 28	37 54
11	*Tursiops* sp.	121481	2	20 21	38 25
12	*Tursiops* sp.	121581	2	19 58	38 38
13	*Pseudorca crassidens*	121581	1	19 31	38 53
14	*Tursiops* sp.	121681	1	17 53	39 07
15	Unidentified Dolphin	121681	–	17 53	39 07
16	Unidentified Dolphin	121681	–	17 38	39 14
17	Unidentified Dolphin	121681	–	17 42	39 17
18	*Tursiops* sp.	121781	2	17 23	39 54
19	*Tursiops* sp.	121781	3	16 44	40 25
20	Unidentified Dolphin	121781	–	16 43	40 28
21	*Tursiops* sp.	121881	2	16 20	41 04
22	*Tursiops* sp.	121881	2	16 06	41 45
23	*Sousa* sp.	122281	3	13 09	43 14
24	*Tursiops* sp.	122381	3	12 12	43 27
25	*Delphinus delphis*	122381	3	12 05	43 25
26	*Delphinus delphis*	122381	3	12 01	43 27
27	*Sousa* sp.	122581	1	11 39	43 08
28	*Pseudorca crassidens*	123081	3	12 11	44 09
29	*Feresa attenuata*	123081	3	12 13	44 15
30	*Grampus griseus*	123081	2	12 13	44 15
31	*Grampus griseus*	123081	1	12 13	44 16
32	*Stenella attenuata*	123081	1	12 24	44 33
33	Unidentified Dolphin	123081	–	12 28	44 40
34	Unidentified Dolphin	123181	–	12 22	45 02
35	Unidentified Dolphin	123181	–	12 39	45 16
36	Unidentified Dolphin	123181	–	12 59	45 44
37	Unidentified Dolphin	10182	–	13 05	46 06
38	*Tursiops* sp.	10182	1	13 14	46 28
39	Unidentified Dolphin	10382	–	13 19	48 24
40	*Delphinus delphis*	10382	3	13 07	49 01
41	*Tursiops* sp.	10382	2	12 25	51 07

TABLE 1 (contd.)

42	*Tursiops* sp.	10582	2	12	29	51 11
43	*Stenella longirostris*	10682	2	13	35	51 50
44	Unidentified Dolphin	10882	–	15	59	52 47
45	*Grampus griseus*	10882	2	16	05	52 48
46	Unidentified Dolphin	10882	–	16	05	52 48
47	Unidentified Dolphin	10882	–	16	08	52 52
48	*Grampus griseus*	10882	2	16	14	52 58
49	*Grampus griseus*	10882	2	16	16	52 57
50	*Tursiops* sp.	10982	3	16	42	53 41
51	*Stenella longirostris*	10982	1	16	45	54 11
52	*Grampus griseus*	10982	1	16	48	54 26
53	Unidentified Dolphin	10982	–	16	57	54 47
54	*Sousa* sp.	11082	1	16	56	54 00
55	*Sousa* sp.	11182	1	16	56	54 00
56	*Delphinus delphis*	11382	1	16	58	54 29
57	*Stenella longirostris*	11382	2	16	53	54 12
58	*Delphinus delphis*	11382	3	16	58	54 29
59	*Delphinus delphis*	11482	1	17	18	55 24
60	*Delphinus delphis*	11482	1	17	19	55 27
61	*Delphinus delphus*	11482	3	17	19	55 27
62	*Delphinus delphis*	11582	1	17	18	55 28
63	*Delphinus delphis*	11582	1	17	21	55 27
64	Unidentified Dolphin	11582	–	17	20	55 27
65	Unidentified Dolphin	11782	–	17	23	55 42
66	Unidentified Dolphin	11982	–	18	13	57 42
67	*Stenella longirostris*	11982	3	18	49	57 47
68	*Feresa attenuata*	12082	2	19	17	58 11
69	Unidentified Dolphin	12082	–	19	21	58 16
70	Unidentified Dolphin	12082	–	19	46	58 27
71	*Ziphius cavirostris*	12382	1	22	15	59 55
72	*Grampus griseus*	12482	1	23	15	59 11
73	*Tursiops* sp.	12482	1	23	15	59 10
74	*Feresa attenuata*	12482	3	23	24	58 59
75	Unidentified Dolphin	12882	–	22	47	60 41
76	*Tursiops* sp.	12982	2	22	37	62 47
77	*Tursiops* sp.	12982	2	22	37	62 29
78	*Tursiops* sp.	12982	3	22	34	62 31
79	Unidentified Dolphin	13082	–	22	29	62 46
80	Unidentified Dolphin	20482	–	16	32	68 27
81	Unidentified Dolphin	20482	–	16	20	68 42
82	*Stenella coeruleoalba*	20582	3	15	50	69 12
83	Unidentified Dolphin	20782	–	13	37	72 30
84	*Pseudorca crassidens*	20882	3	11	51	72 56
85	*Stenella longirostris*	20982	1	10	53	75 12
86	*Grampus griseus*	20982	3	10	41	75 17
87	Unidentified Dolphin	20982	–	10	41	75 17
88	Unidentified Dolphin	20982	–	10	25	75 25
89	Unidentified Dolphin	21082	–	10	25	75 27
90	*Pseudorca crassidens*	21082	3	10	25	75 27

TABLE 1 (contd.)

91	Unidentified Dolphin	21082	–	10 15	75 28
92	Unidentified Dolphin	21082	–	10 23	75 29
93	*Stenella longirostris*	21082	2	10 23	75 30
94	*Stenella attenuata*	21082	1	10 12	75 34
95	Unidentified Dolphin	21082	–	08 22	76 28
96	Unidentified Dolphin	21082	–	08 21	76 30
97	*Tursiops* sp.	21282	3	07 39	77 38
98	Unidentified Dolphin	21282	–	07 29	77 52
99	Unidentified Dolphin	21282	–	07 23	77 59
100	Unidentified Dolphin	21282	–	07 29	77 56
101	Unidentified Dolphin	21282	–	07 20	77 59
102	*Stenella attenuata*	21982	2	06 21	79 40
103	*Stenella coeruleoalba*	21982	1	06 21	79 40
104	Unidentified Dolphin	22082	–	05 47	80 14
105	Unidentified Dolphin	22082	–	05 47	80 14
106	Unidentified Dolphin	22282	–	05 51	80 13
107	*Stenella longirostris*	22282	2	05 47	80 07
108	Unidentified Dolphin	22282	–	05 54	79 54
109	*Stenella coeruleoalba*	22382	1	06 23	79 38
110	*Stenella coeruleoalba*	22382	1	06 30	79 38
111	*Delphinus delphis*	22382	1	06 30	79 38
112	*Delphinus delphis*	22482	1	07 42	79 29
113	Unidentified Dolphin	22582	–	08 14	79 34
114	*Stenella longirostris*	22782	1	07 58	79 00
115	*Grampus griseus*	30182	1	07 17	79 40
116	*Stenella longirostris*	30182	1	07 32	79 34
117	*Stenella longirostris*	30182	1	07 32	79 37
118	*Stenella coeruleoalba*	30782	1	07 36	79 24
119	*Stenella longirostris*	30782	1	07 34	79 21
120	*Stenella coeruleoalba*	30782	1	07 38	79 22
121	Unidentified Dolphin	30882	–	08 03	79 17
122	Unidentified Dolphin	30882	–	08 00	79 32
123	Unidentified Dolphin	30982	–	08 03	79 33
124	Unidentified Dolphin	30982	–	08 06	79 26
125	*Stenella coeruleoalba*	30982	1	08 06	79 20
126	*Grampus griseus*	31082	1	08 04	79 34
127	*Grampus griseus*	31182	1	08 17	79 36
128	Unidentified Dolphin	31182	–	07 53	79 36
129	*Stenella longirostris*	31182	3	07 50	79 36
130	Unidentified Dolphin	31282	–	07 16	76 38
131	*Tursiops* sp.	31282	1	07 01	79 47
132	*Tursiops* sp.	31382	1	07 00	79 45
133	*Stenella longirostris*	31382	1	06 59	79 44
134	*Stenella longirostris*	31382	1	07 00	79 41
135	Unidentified Dolphin	31482	–	07 30	78 00
136	Unidentified Dolphin	12183	–	08 39	79 24
137	*Tursiops* sp.	12283	1	08 49	78 38
138	Unidentified Dolphin	12283	–	08 49	78 35
139	*Tursiops* sp.	12483	3	07 40	78 00

TABLE 1 (contd.)

91	Unidentified Dolphin	21082	–	10 15	75 28
92	Unidentified Dolphin	21082	–	10 23	75 29
93	*Stenella longirostris*	21082	2	10 23	75 30
94	*Stenella attenuata*	21082	1	10 12	75 34
95	Unidentified Dolphin	21082	–	08 22	76 28
96	Unidentified Dolphin	21082	–	08 21	76 30
97	*Tursiops* sp.	21282	3	07 39	77 38
98	Unidentified Dolphin	21282	–	07 29	77 52
99	Unidentified Dolphin	21282	–	07 23	77 59
100	Unidentified Dolphin	21282	–	07 29	77 56
101	Unidentified Dolphin	21282	–	07 20	77 59
102	*Stenella attenuata*	21982	2	06 21	79 40
103	*Stenella coeruleoalba*	21982	1	06 21	79 40
104	Unidentified Dolphin	22082	–	05 47	80 14
105	Unidentified Dolphin	22082	–	05 47	80 14
106	Unidentified Dolphin	22282	–	05 51	80 13
107	*Stenella longirostris*	22282	2	05 47	80 07
108	Unidentified Dolphin	22282	–	05 54	79 54
109	*Stenella coeruleoalba*	22382	1	06 23	79 38
110	*Stenella coeruleoalba*	22382	1	06 30	79 38
111	*Delphinus delphis*	22382	1	06 30	79 38
112	*Delphinus delphis*	22482	1	07 42	79 29
113	Unidentified Dolphin	22582	–	08 14	79 34
114	*Stenella longirostris*	22782	1	07 58	79 00
115	*Grampus griseus*	30182	1	07 17	79 40
116	*Stenella longirostris*	30182	1	07 32	79 34
117	*Stenella longirostris*	30182	1	07 32	79 37
118	*Stenella coeruleoalba*	30782	1	07 36	79 24
119	*Stenella longirostris*	30782	1	07 34	79 21
120	*Stenella coeruleoalba*	30782	1	07 38	79 22
121	Unidentified Dolphin	30882	–	08 03	79 17
122	Unidentified Dolphin	30882	–	08 00	79 32
123	Unidentified Dolphin	30982	–	08 03	79 33
124	Unidentified Dolphin	30982	–	08 06	79 26
125	*Stenella coeruleoalba*	30982	1	08 06	79 20
126	*Grampus griseus*	31082	1	08 04	79 34
127	*Grampus griseus*	31182	1	08 17	79 36
128	Unidentified Dolphin	31182	–	07 53	79 36
129	*Stenella longirostris*	31182	3	07 50	79 36
130	Unidentified Dolphin	31282	–	07 16	76 38
131	*Tursiops* sp.	31282	1	07 01	79 47
132	*Tursiops* sp.	31382	1	07 00	79 45
133	*Stenella longirostris*	31382	1	06 59	79 44
134	*Stenella longirostris*	31382	1	07 00	79 41
135	Unidentified Dolphin	31482	–	07 30	78 00
136	Unidentified Dolphin	12183	–	08 39	79 24
137	*Tursiops* sp.	12283	1	08 49	78 38
138	Unidentified Dolphin	12283	–	08 49	78 35
139	*Tursiops* sp.	12483	3	07 40	78 00

TABLE 1 (contd.)

140	*Tursiops* sp.	12883	1	06 15	79 50
141	*Stenella attenuata*	12883	1	06 07	79 50
142	*Tursiops* sp.	12883	1	06 00	79 53
143	*Stenella longirostris*	12883	1	06 00	79 53
144	*Stenella longirostris*	12983	1	05 52	80 18
145	*Tursiops* sp.	12983	3	05 52	80 20
146	*Stenella longirostris*	12983	1	05 33	80 22
147	*Stenella longirostris*	13083	3	06 16	82 02
148	*Tursiops* sp.	13083	1	06 16	82 07
149	*Tursiops* sp.	13183	1	06 33	81 57
150	Unidentified Dolphin	13183	–	06 44	82 06
151	Unidentified Dolphin	20183	–	06 37	82 05
152	*Tursiops* sp.	20183	2	06 38	82 02
153	*Lagenodelphis hosei*	20283	3	06 26	81 53
154	Unidentified Dolphin	20283	–	06 19	81 48
155	*Grampus griseus*	20383	1	06 23	81 49
156	Unidentified Dolphin	20383	–	06 22	81 50
157	*Tursiops* sp.	20583	3	07 00	82 04
158	*Pseudorca crassidens*	20683	2	07 38	82 01
159	*Grampus griseus*	20683	1	07 54	82 01
160	*Feresa attenuata*	20683	3	07 53	81 54
161	*Grampus griseus*	21583	1	08 42	81 23
162	*Stenella coeruleoalba*	21683	1	08 43	81 20
163	*Grampus griseus*	21883	1	08 36	81 28
164	*Stenella longirostris*	21983	1	08 35	81 22
165	*Stenella longirostris*	30283	1	08 39	81 19
166	Unidentified Dolphin	30783	–	08 26	81 42
167	*Grampus griseus*	30783	1	08 28	81 46
168	Unidentified Dolphin	30783	–	08 33	81 41
169	*Stenella longirostris*	30883	1	08 21	81 51
170	*Stenella coeruleoalba*	30983	1	08 12	82 02
171	Unidentified Dolphin	30983	–	08 07	82 06
172	*Stenella attenuata*	31083	2	08 08	82 08
173	Unidentified Dolphin	31083	–	08 09	82 12
174	*Tursiops* sp.	31183	2	08 29	82 16
175	Unidentified Dolphin	31183	–	08 31	82 08
176	Unidentified Dolphin	31283	–	08 36	81 54
177	*Stenella longirostris*	31283	1	08 34	81 39
178	*Stenella attenuata*	31283	1	08 34	81 39
179	Unidentified Dolphin	31883	–	08 54	81 57
180	Unidentified Dolphin	32083	–	07 53	82 12
181	Unidentified Dolphin	32083	–	07 53	82 21
182	*Globicephala macorhynchus*	40583	1	09 22	81 03
183	Unidentified Dolphin	40683	–	09 54	80 58
184	*Stenella longirostris*	40983	3	09 46	80 58
185	*Stenella longirostris*	41083	1	09 46	80 52
186	*Stenella longirostris*	41083	1	09 46	80 54
187	Unidentified Dolphin	41083	–	09 39	80 59
188	Unidentified Dolphin	41183	–	09 28	81 34

TABLE 1 (contd.)

189	*Hyperoodon planifrons*	41183	2	09 28	81 34
190	*Pseudorca crassidens*	41183	1	09 28	81 34
191	*Grampus griseus*	41283	1	08 45	81 18
192	Unidentified Dolphin	41283	–	08 28	81 12
193	*Stenella longirostris*	41883	1	08 35	81 22
194	Unidentified Dolphin	42083	–	07 41	82 17
195	*Tursiops* sp.	42183	1	07 47	82 25
196	Unidentified Dolphin	42183	–	07 47	82 25
197	*Tursiops* sp.	42183	1	07 48	82 25
198	*Stenella coeruleoalba*	42283	1	08 05	81 59
199	Unidentified Dolphin	42283	–	08 02	81 55
200	*Stenella longirostris*	21884	1	05 51	81 02
201	*Stenella coeruleoalba*	21984	3	06 15	81 45
202	*Stenella longirostris*	22084	1	07 12	82 11
203	*Feresa attenuata*	30384	3	08 36	81 21
204	*Stenella attenuata*	30684	1	08 38	81 30
205	*Stenella longirostris*	30684	1	08 38	81 30
206	*Stenella attenuata*	30784	2	08 35	81 25
207	*Stenella longirostris*	30784	1	08 36	81 27
208	*Stenella longirostris*	30884	1	08 36	81 25
209	Unidentified Dolphin	30884	–	08 36	81 26
210	*Stenella longirostris*	31184	2	08 33	81 16
211	*Globicephala macrorhynchus*	31184	2	08 35	81 31
212	*Tursiops* sp.	31184	1	08 35	81 30
213	*Grampus griseus*	31284	2	09 12	81 12
214	*Grampus griseus*	31384	1	09 32	81 10
215	*Grampus griseus*	31384	1	09 38	81 08
216	*Grampus griseus*	31384	1	09 40	81 05
217	*Grampus griseus*	31384	1	09 41	81 07
218	*Stenella longirostris*	31384	1	09 40	81 06
219	*Stenella longirostris*	31384	3	09 35	81 06
220	*Stenella longirostris*	31484	2	09 28	80 55
221	Unidentified Dolphin	31484	–	09 29	80 56
222	*Grampus griseus*	31484	1	09 35	80 58
223	*Stenella longirostris*	31484	2	09 31	80 56
224	Unidentified Dolphin	31484	–	09 28	80 57
225	*Grampus griseus*	31584	1	09 33	81 04
226	*Grampus griseus*	31584	1	09 32	81 04
227	*Grampus griseus*	31584	1	09 32	81 04
228	*Grampus griseus*	31684	1	09 02	81 08
229	*Grampus griseus*	31684	1	09 04	81 07
230	*Grampus griseus*	31684	1	09 03	81 09
231	*Grampus griseus*	31684	1	09 04	81 10
232	*Grampus griseus*	31684	1	09 08	81 11
233	*Grampus griseus*	31684	1	09 08	81 12
234	*Stenella longirostris*	31684	1	09 10	81 12
235	*Stenella attenuata*	31684	1	09 10	81 12
236	Unidentified Dolphin	31784	–	08 57	81 19
237	*Stenella longirostris*	31784	1	08 42	81 19

TABLE 1 (contd.)

238	Unidentified Dolphin	31784	–	08 40	81 18
239	*Stenella longirostris*	31784	1	08 38	81 21
240	*Grampus griseus*	31784	3	08 36	81 23
241	*Stenella longirostris*	31984	1	08 36	81 22
242	*Grampus griseus*	32484	1	08 01	81 59
243	Unidentified Dolphin	32584	–	08 27	81 34
244	*Stenella longirostris*	32584	2	08 35	81 23
245	*Stenella coeruleoalba*	32584	2	08 35	81 23
246	*Grampus griseus*	32884	1	08 54	81 16
247	*Grampus griseus*	32884	1	08 53	81 15
248	*Grampus griseus*	32884	1	08 55	81 15
249	Unidentified Dolphin	33084	–	09 28	80 55
250	Unidentified Dolphin	33184	–	09 25	81 00
251	*Stenella longirostris*	40184	2	09 05	81 06
252	*Stenella attenuata*	40184	1	08 54	81 13
253	*Stenella longirostris*	40884	1	09 27	80 58
254	*Stenella attenuata*	40884	2	09 27	80 58
255	Unidentified Dolphin	40884	–	09 27	80 51
256	*Stenella longirostris*	40884	1	09 28	80 57
257	*Stenella attenuata*	40984	1	09 24	80 59
258	*Stenella longirostris*	41084	1	09 28	80 58
259	*Stenella attenuata*	41084	3	09 33	80 59
260	*Tursiops* sp.	41184	1	08 33	81 16
261	*Tursiops* sp.	41684	1	.. ..	.. ..
262	*Stenella longirostris*	41684	3	.. ..	.. ..
263	*Tursiops* sp.	41684	1	.. ..	.. ..
264	*Stenella longirostris*	41784	1	.. ..	.. ..
265	*Tursiops* sp.	41784	1	08 35	81 23
266	*Stenella longirostris*	41784	1	08 35	81 22
267	*Hyperoodon planifrons*	42384	3	09 43	80 52
268	Unidentified Dolphin	42484	–	09 33	80 57
269	Unidentified Dolphin	42484	–	09 31	80 56
270	*Globicephala macrorhynchus*	42584	1	09 10	81 07
271	*Stenella attenuata*	42584	1	09 10	81 07

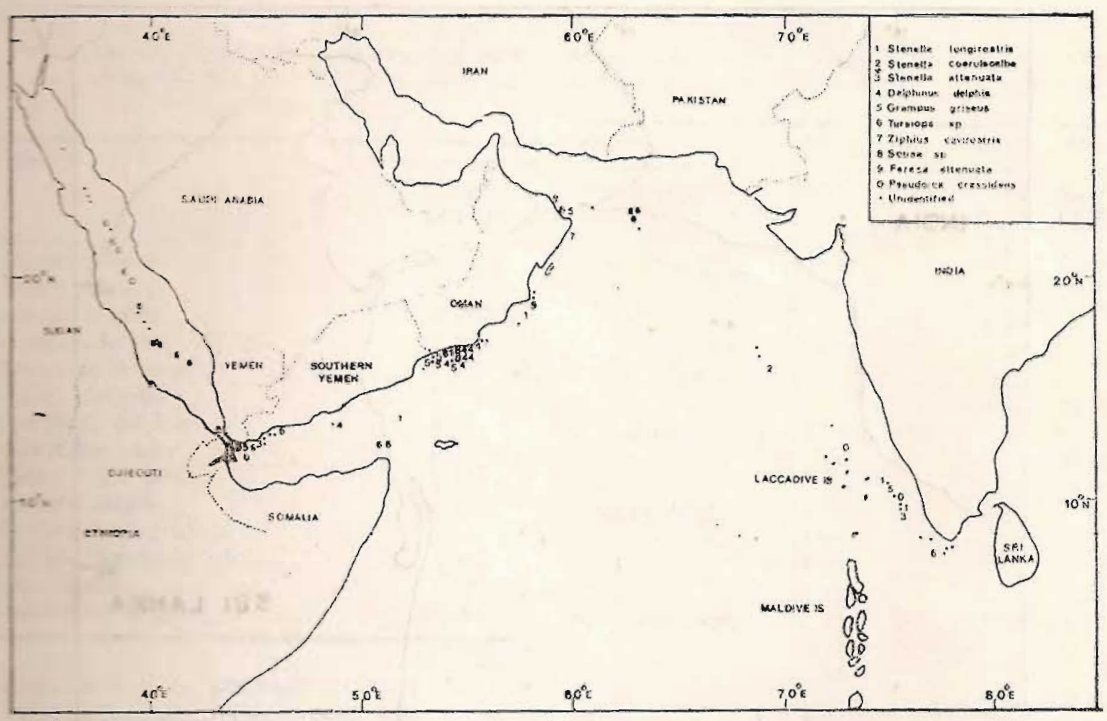

Fig. 2. Sightings of odontocetes in the northern Indian Ocean, 29 November, 1981 through 12 February, 1982.

Each sighting was comprised of a herd. Some herds contained smaller sub-sets called "groups." Groups could be distinguished because animals in them moved in close coordination with one another and were often in clusters, spatially distinct from one another.

Observations of herd or individual behaviour are summarized by species. Informal estimates were made of the number of animals in a herd and their speed of movement. Animals were photographed with 35 mm Canon cameras and photographs were analysed later to confirm species identity. A flash was used at night to photograph individuals riding-the-bow. Sightings are listed in Table 1, along with codes indicating confidence in identification (1 = positive, 2 = probable, and 3 = possible identification).

Results and Discussion

There were 135 sightings in 1982 (Figs. 2 & 3), 64 in 1983 (Fig. 4) and 72 in 1984 (Fig. 5). The frequency (number of observations/number of individuals) with which each species was seen is shown in the three year period is listed in Table 2. In six sightings, multi-species herds were involved. As there were no means to assess the degree of interaction between such species or to determine how long they were actually in contact, each species was recorded separately. A total of 3,818 minutes was spent observing animals, but

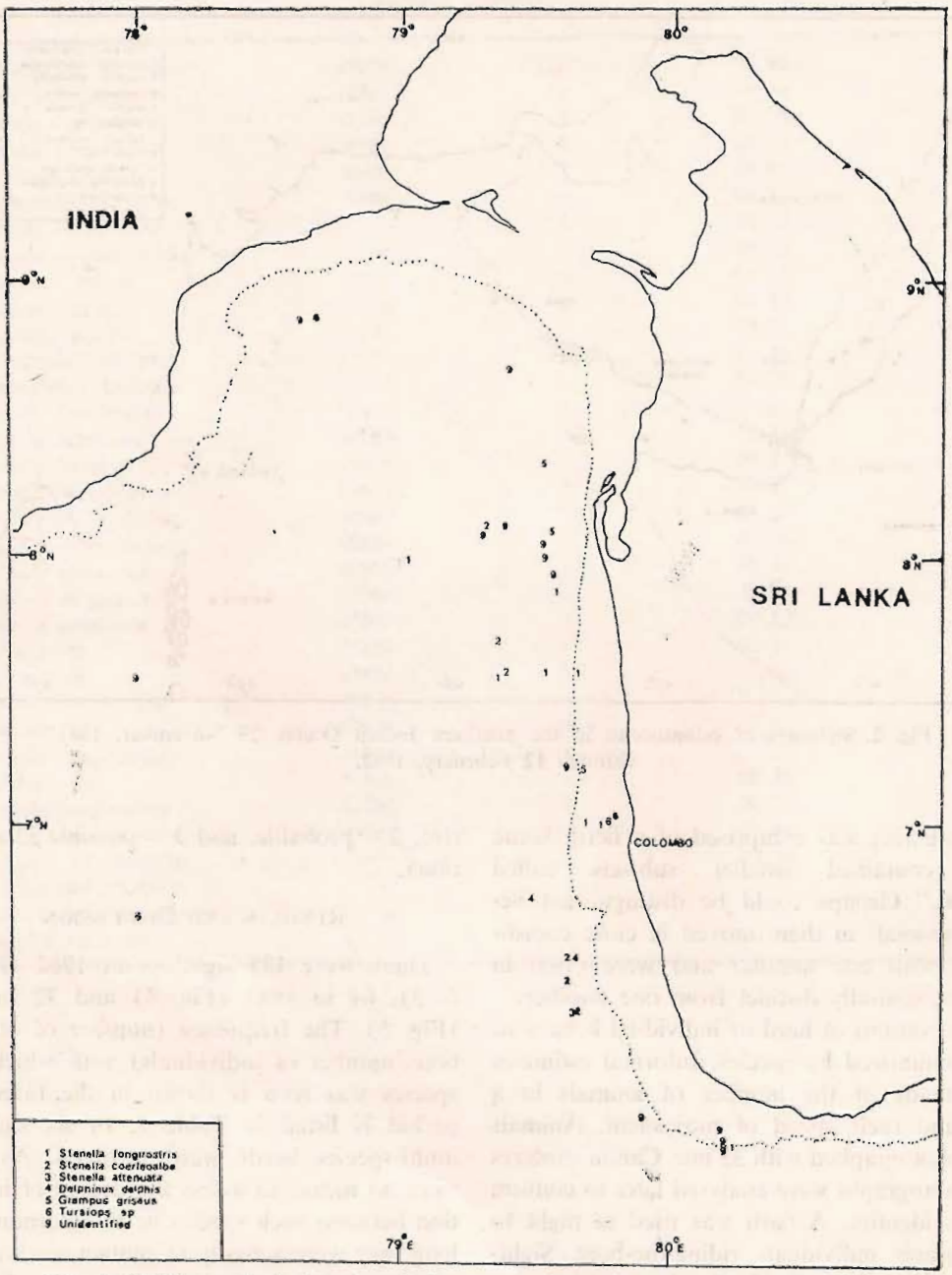

Fig. 3. Sightings of odontocetes off the west and southwest coasts of Sri Lanka, 13 February through 17 March, 1982. The dotted line represents the 1,000 m depth contour.

TABLE 2

THE FREQUENCY WITH WHICH ODONTOCETES WERE OBSERVED DURING THE 1982, 1983 AND 1984 FIELD SEASONS

Species	number of observations/number of individuals
spinner dolphin	48/1804
striped dolphin	12/531
spotted dolphin	14/656
common dolphin	14/711
bottlenose dolphin	39/477
Risso's dolphin	37/321
humpback dolphin	4/10
false killer whale	6/43
pygmy killer whale	5/10
Fraser's dolphin	1/12
Cuvier's beaked whale	1/2
Southern bottlenose whale	2/42
pilot whale	3/78
unidentified dolphin	85/664

encounters were generally brief. There were 33 occasions when the animals were followed for at least 30 minutes. Forty-eight observations occurred at night when animals rode-the-bow. Cetacean distribution has been linked to water temperatures and currents in the Indian Ocean (Nishiwaki 1983), but the temperature of the surface water proved too homogeneous to be used in this manner. All sightings occurred within 21°7'C and 31°2'C. Depth was not recorded for all sightings in 1984 because the depth sounder was broken. Calves were seen various times and places (Table 3). Animals were considered a "calf" if they were accompanied by an individual which appeared to be at least twice its size.

Following Keller *et al.* (1982), two indices of abundance were calculated for cetaceans seen on December 25 1981 to February 12 1982 from s/rv *Tulip* (Table 4). The transects covered an estimated 3,300 nm (6,111 km)

TABLE 3

OBSERVATIONS IN WHICH A HERD WAS OBSERVED WITH ONE OR MORE CALVES DURING THE THREE YEAR STUDY

Species	Jan.	Feb.	March	April
spinner dolphin	29/83	09/84	01/82	01/84
		11/84	07/82	08/84
		18/84	13/82	
			02/83	
			06/84	
			08/84	
			16/84	
striped dolphin		23/82	07/82	
			09/83	22/83
spotted dolphin	28/83	10/82	12/83	01/84
				06/84
				16/84
common dolphin	14/82			
	14/82			
	15/82			
	15/82			
bottlenose dolphin	01/82		13/83	21/83
	05/82			11/84
	29/82			16/84
				17/84
Risso's dolphin	09/82	15/82		
	24/82			
Pilot whale				11/84
				25/84

between Djibouti and Sri Lanka. Indices of abundance were not calculated for the time spent in the Red Sea because a constant watch was not kept due to rough weather.

SYSTEMATIC ACCOUNTS

Striped dolphins

Striped dolphins, *Stenella coeruleoalba*, were seen 12 times off the coasts of Oman, India, and Sri Lanka in waters greater than 1,100 m deep. During 33% of the sightings animals came to the bow, but overall they seemed uninterested in our presence. For all sightings, individuals within a herd appeared to be

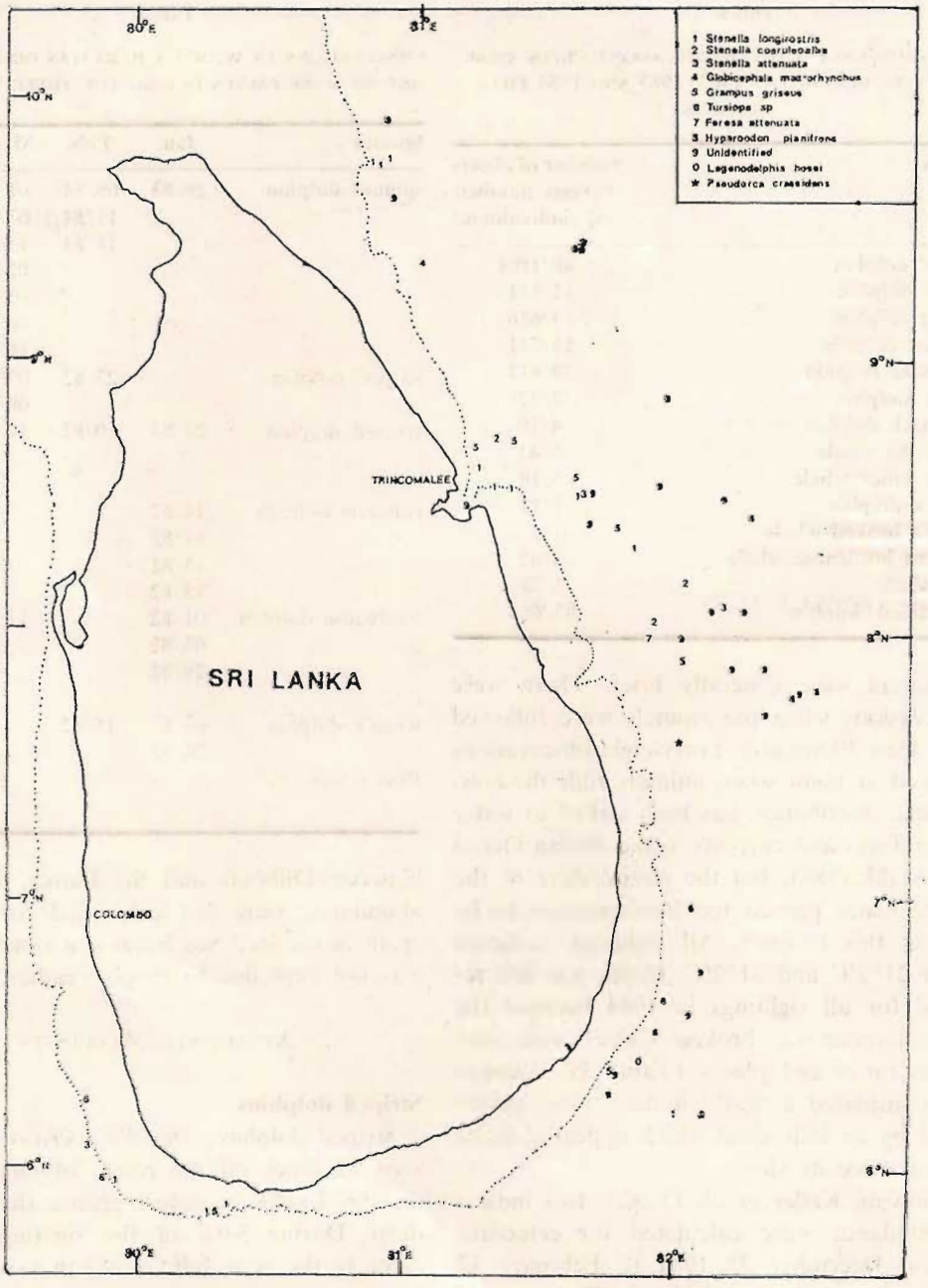

Fig. 4. Sightings of odontocetes off the east and south coasts of Sri Lanka, 20 January through 24 April, 1983. The dotted line represents the 1,000 m depth contour.

TABLE 4

INDICES OF ABUNDANCE OF ODONTOCETES IN THE NORTHERN INDIAN OCEAN, DECEMBER 25, 1981 THROUGH FEBRUARY 12, 1982

Species	number of sightings	I_1	number of individuals	I_2
spinner dolphin	6	0.18	427	13.0
striped dolphin	1	0.03	3	0.09
spotted dolphin	2	0.06	100	3.0
common dolphin	8	0.24	573	17.4
Risso's dolphin	8	0.24	101	3.1
bottlenose dolphin	11	0.34	82	2.43
humpback dolphin	3	0.09	9	0.3
false killer whale	3	0.09	5	0.03
pygmy killer whale	2	0.06	9	0.3
Cuvier's beaked whale	1	0.03	2	0.06
unidentified dolphins	33	1.0	327	9.9
TOTAL	78	2.4	1,638	49.7

I_1 = number of sightings/100 nm.
I_2 = number of individuals/100 nm.

dispersed often as distances as great as a mile. Herd size varied, but 48% of the herds contained 6 to 50 animals (Fig. 6). Aerial activity included "humping", a jump where the dolphin's nose and fluke remain in the water and a "head-first-reentry" jump in which the dolphin leaves the water returning nose first (Wursig and Wursig 1980). "Head-slaps", "back-slaps", "leaps", and "tail-over-head" leaps were also seen (Norris and Dohl 1980a). The first three such jumps are self explanatory. The last named jump is one in which the animal leaves the water and then brings its tail over its head and returns to the water tail first. While off Sri Lanka in February, March, and April, calves were occasionally seen.

Spinner dolphins

Forty-eight herds of spinner dolphins, *Stenella longirostris*, were sighted along the coasts of Oman, India and Sri Lanka. Of these herds, 62% contained fewer than 50 animals (Fig. 6), 62% occurred at depths which were less than 1,000 m, and 32% contained animals which rode-the-bow. Calves were seen 13 times between January and March.

We had little success in observing or filming animals underwater. Once, however, a herd of 15 spinner dolphins approached s/rv *Tulip* while some of the crew were in the water. Initially the dolphins were engaged in aerial activity, but by the time they reached us, they had slowed down or remained motionless. Three of the animals seemed to be interacting. Two of the animals (escorts) alternately stroked the body of the third (focal animal) with their beaks. Periodically one of the two escorts would turn its belly towards the focal animal. During the seven minutes that dolphins were observed, the hydrophones were monitored on a Uher recording system. Initially as the animals swam towards s/rv *Tulip* squeals were heard, but by the end of the observation period the herd appeared to be silent.

Generally, spinner dolphins seemed to avoid our boat or to be uninterested in its presence. Aerial activity included the "spin" (Norris and Dohl 1980a), leap, back-slap, tail-over-head leap, humping, head-first-re-entry jump, and a somersault in which the animals flipped several times about a horizontal axis. During one sighting off the coast of Sri Lanka when Little terns, *Sterna albifrons*, were with a herd of dolphins, one dolphin leapt out of the water to snatch a flying fish from the beak of a tern. On another occasion, a large fish, possibly tuna, *Thunnus* sp., was jumping out of the water in the middle of a school of spinners.

Four races of *Stenella longirostris* are found in the Pacific Ocean : 1) Costa-Rican spinner, 2) eastern spinner, 3) white-belly spinner, and

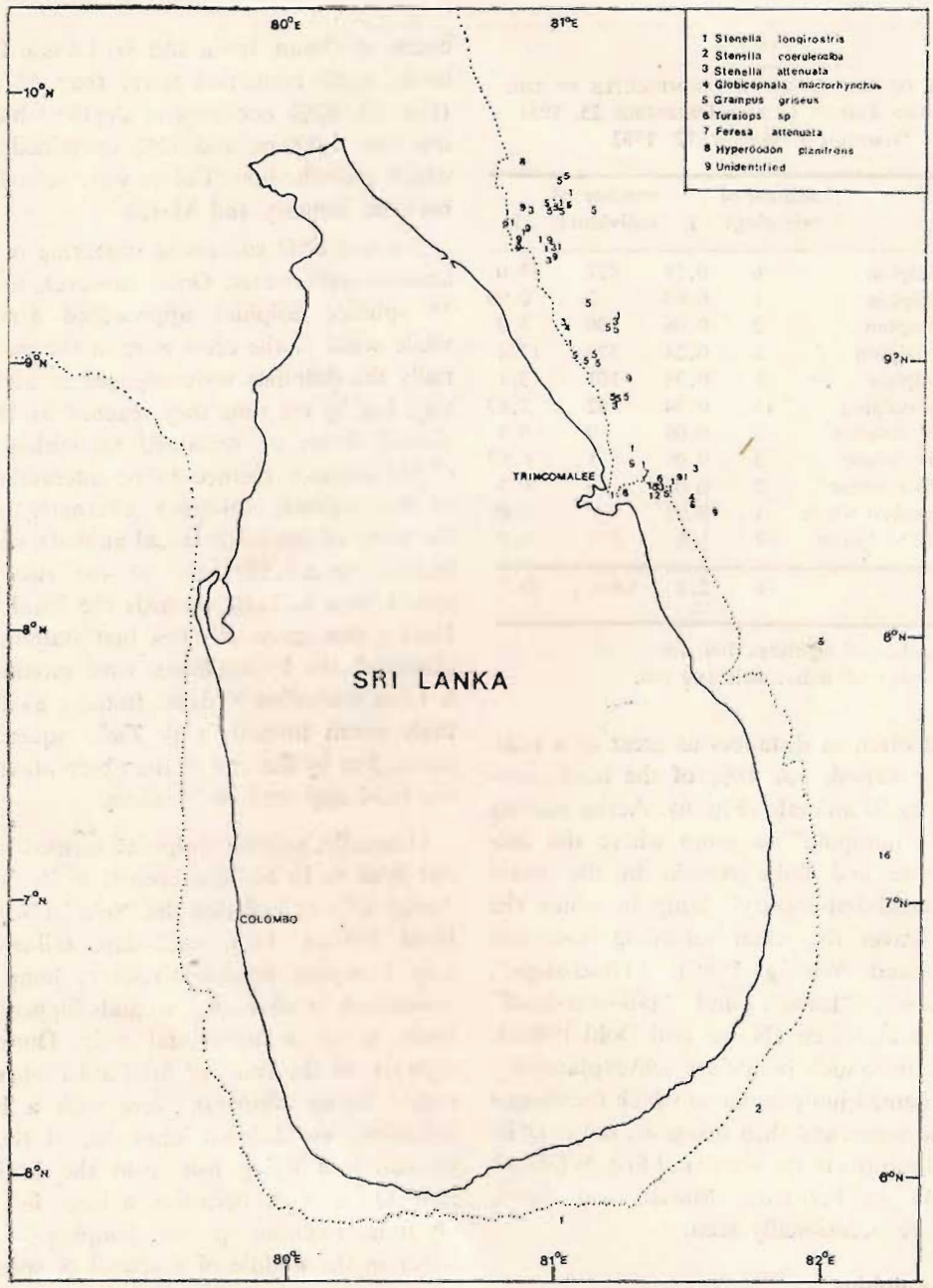

Fig. 5. Sightings of odontocetes off the east coast of Sri Lanka, 22 February through 25 May, 1984. The dotted line represents the 1,000 m depth contour.

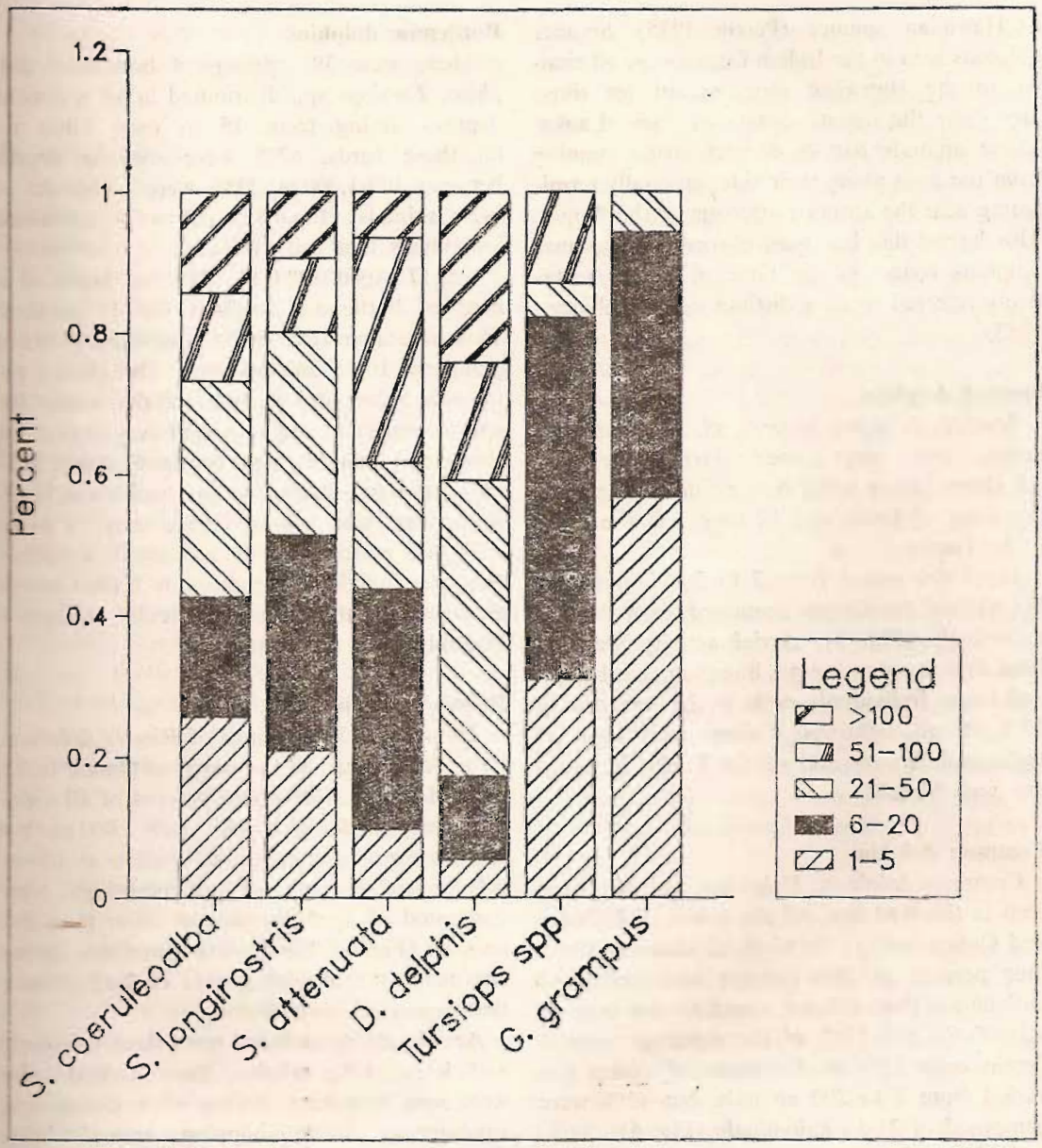

Fig. 6. Proportions of herds by herd, size for all species.

4) Hawaiian spinner (Perrin 1975). Spinner dolphins seen in the Indian Ocean were all similar to the Hawaiian race, except for those seen of the west coast of Sri Lanka. These animals had a distinct stripe running from the anus along their side, gradually terminating near the anterior insertion of the flipper. This lateral line has been observed on spinner dolphins found in the Gulf of Aden, tentatively referred to as a distinct race (Robineau 1983).

Spotted dolphins

Spotted dolphins *Stenella* cf. *Stenella attenuata*, were seen once during the day off Oman, once while bow-riding at night off the coast of India and 12 times off the coast of Sri Lanka.

Herd size varied from 7 to 200 individuals, but 44% of the schools contained fewer than 20 individuals (Fig. 6). Aerial activity included head-first-re-entry jumps, humping, head-slaps, and leaps. Individuals came to the bow during 57% of all sightings. Calves were seen off India in February and off Sri Lanka in January and March.

Common dolphins

Common dolphins, *Delphinus delphis*, were seen in the Red Sea, off the coasts of Djibouti and Oman, and in the Gulf of Mannar. Sixty-four percent of these groups seen contained individuals that did not come to the bow of s/rv *Tulip* and 57% of the sightings were at depths over 1,000 m. Estimates of group size varied from 3 to 200 animals, but 42% were composed of 21-50 individuals (Fig. 6).

Aerial activity was not as varied as that observed in *Stenella* species, but animals frequently would leap over 2.8 m high or jump out of the water, landing on their backs. Calves were seen in January.

Bottlenose dolphins

There were 39 sightings of bottlenose dolphins, *Tursiops* sp., distributed in all waters at depths varying from 15 to over 1,100 m. Of these herds, 62% were seen at depths between 100-1,000 m, 51% were composed of 6-20 animals (Fig. 6), and 64% contained individuals that rode-the-bow.

On 17 April 1984 at 1415, we followed a herd of bottlenose dolphins for 45 minutes. This herd appeared to be composed of three groups of 10-15 animals each. The groups remained below the surface of the water for approximately two minutes and then surface for about two minutes with continual aerial activity. Head-first-re-entry jumps, back-slaps, head-slaps, leaps and tail-slaps were seen. In particular, we noticed that three animals (possibly the same individuals) repeatedly leaped out of the water together in a high circular arc approximately every 25 seconds.

Risso's dolphins

There were 37 sightings of Risso's dolphins, *Grampus griseus*, off the coasts of Oman, India, and Sri Lanka. Fifty-three percent of all sightings were made in depths over 1,000 m, but herds were seen at depths as shallow as 100 m. Fifty-seven percent of all sightings were composed of herds containing fewer than five animals (Fig. 6). Herds were sometimes spread out over 1,000 m with groups of 2-15 animals that remained coordinated.

Aerial activity included head-slaps, tail-slaps, and leaps. Like whales, these animals also were seen breaching, fluking when diving, and spy-hopping. In spy-hopping, animals bring their head entirely or partially out of the water. Three times animals spy-hopped facing s/rv *Tulip*, suggesting that they were curious about our vessel, but they generally did not show interest in our boat. Once while diving with

them, we saw approximately 50 animals appear about 6-9 m below us in groups of two or three.

Fraser's dolphins

Fraser's dolphins, *Lagenodelphis hosei*, were possibly seen once off the east coast of Sri Lanka in February. The depth was greater than 1,100 m and they were travelling at approximately 2-4 knots. The group of 12 animals did not seem interested in our boat and animals were only seen humping except for an occasional head-first-reentry jump.

Humpback dolphins

Humpback dolphins, *Sousa* sp., were seen four times outside Djibouti Harbor and in Salalah Harbor, Oman. One of the crew (Hal Whitehead) watched three animals herd fish schools into a shallow shoreline in the harbor. Similar behavior has been observed with bottlenose dolphins (Leatherwood 1975, Norris and Dohl 1980b, Hoese 1971).

Medium sized whales

Two Cuvier's beaked whales, *Ziphius cavirostris*, were seen off the coast of Oman at a depth of about 850 m. Animals appeared to have white backs with scars on the dorsal surface. Animals did not fluke while diving.

Two unidentified beaked whales were seen off the coast of Oman in waters deeper than 1,000 m. They did not fluke, but backs were arched when diving. From the distance their color appeared black and they averaged about 5.4 m in overall length.

Hyperoodon planifrons, southern bottlenose whales were tentatively identified off the east coast of Sri Lanka on 11 April 1983 and possibly again on 23 April 1984. In the first sighting, the whales were spread out over approximately 800 m, and 40 animals were arranged in groups of ten while travelling at a speed of 4-7 knots. Estimated lengths were from 5.6 m to 7.8 m, and animals appeared cream colored, with a pronounced bulbous head. The groups travelled in horizontal formations and no flukes were seen when the animals dove.

Pygmy killer whales, *Feresa attenuata* were seen once off the coast of Oman and five times off Sri Lanka in waters 120 m to 1,000 m deep. All animals sighted were seen in groups of less than six individuals and animals generally travelled slowly, avoiding s/rv *Tulip*.

False killer whales, *Pseudorca crassidens*, were seen on six occasions off Oman, India, and Sri Lanka and in the Red Sea in depths greater than 300 m. Animals in the Red Sea rode-the-bow, but during all other sightings, groups seemed to take no interest in our vessel.

Pilot whales, *Globicephala* cf. *Globicephala macrorhynchus*, were seen three times off the east coast of Sri Lanka. On 5 April 1983, members of s/v *Tulip* were in the water with sperm whales when eight pilot whales swam under 12 sperm whales. During the other two sightings, pilot whales were seen in herds of 50 and 20 animals while moving at about two to four knots.

Mixed herds

Herds containing mixed species were rarely recorded, but it is likely that the crew of s/rv *Tulip* simply did not notice both species when individuals were travelling rapidly in large herds. Different herds of dolphins which were seen in close proximity to one-another occurred more frequently. Risso's dolphins were seen in close proximity to sperm whales, bottlenose dolphins, pygmy killer whales, and false killer whales. Southern bottlenose whales, unidentified dolphins, and false killer whales were seen in the same vicinity on 6 February 1983 and

pilot whales were seen with sperm whales on 5 April 1983. The extent that herds associate spatially or temporally is not known.

Mixed herds of dolphins included spinner and spotted dolphins, spinner and common dolphins, spinner and striped dolphins, and striped and common dolphins. These sightings are described below:

1. A mixed herd of over 200 spinner dolphins and spotted dolphins was followed for 40 minutes (0815-0855) on 12 March 1983. Spinners were bunched into tight groups, with little aerial activity. The spotted dolphins were organized into looser groups and much aerial activity was seen including leaps, head-slaps, head-first-re-entry jumps, and head-over-tail leaps. Tuna were seen jumping out of the water among these animals.

2. On 6 March 1984 a mixed herd of about 35 animals were encountered at (0815-0830). There was little aerial activity except for Head-first-re-entry jumps and occasional tail-slaps and leaps.

3. On 16 March 1984, a group of 75 animals was followed from 1625 to 1705. Among the entire herd, head-first-re-entry jumps, back-slaps, head-slaps, leaps and spins were seen. The spotted dolphins rode the bow, but the spinner dolphins did not. In addition, 175 birds were seen surrounding the school. Species which were identified by one of the crew (N. Davies) included *Sterna bergii*, Crested terns, *Anous stolidus*, Brown noddy terns, *Sterna anaethetus*, Bridled terns, and possibly *Sterna bengalensis*, Lesser crested terns and *Sterna dougallii*, Roseate tern.

4. At 1252 on 13 January 1982, more than 100 common dolphins were seen with spinner dolphins. There was little aerial activity and the herd, which was initially travelling in a long line, seemed to spread out forming small groups.

5. Striped and common dolphins were seen together on 23 February 1982, at 0950. The herd was divided into sub-groups of about six animals spread out over a distance of approximately one mile. The groups travelled at speeds as great as 15 knots.

6. Striped and spinner dolphins were seen in a mixed herd on 25 March 1984 at 1730. All animals were moving at about 10 knots in a horizontal line.

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