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Incidental Catch of Small Cetaceans in the Offshore Gillnet Fishery in Northern Australian Waters: 1981-1985

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ABSTRACT

Several species of small cetaceans are taken incidentally in the offshore gillnet fishery off northern Australia. *Tursiops truncatus* and *Stenella longirostris* form the majority of the by-catch. Other species recorded to date are *Stenella attenuata*, *Sousa chinensis* and *Pseudorca crassidens*. Data on the incidental catch collected through the Australian Fishing Zone Observer Program are presented. For the period June 1981 to December 1985 the total cetacean by-catch is estimated to be in the order of 14,000 animals, based on observation of 2.33% of 17,467 sets. Changes to the fishery, including methods used and areas fished and their possible effects on cetacean catch rate are discussed.

INTRODUCTION

Several species of small cetaceans are captured incidentally in a pelagic gillnet fishery which operates in northern waters of the Australian Fishing Zone (AFZ). Gillnet fishing vessels from Taiwan operate in Australian waters under an agreement between commercial interests from Taiwan and the Australian Government. A review of the general characteristics of the fishery and an initial assessment of the level of the cetacean by-catch for the period June 1981 to March 1983 is given in Harwood, McNamara, Anderson and Walter (1984).

Gillnet vessels operating in waters adjacent to northern Australia have been under Australian jurisdiction since declaration of the AFZ in November 1979. The area in which vessels from Taiwan are permitted to operate has been reduced on several occasions since 1979 to avoid gear and operational conflicts with Australian fishing activities. The authorised gillnetting area for vessels from Taiwan during the period June 1981 to December 1985 is shown in Fig. 1. Catch and effort data for the fishery, which is reported by Walter (1981) to have commenced in 1974, are presented in Table 1.

Table 1

Catch and effort in the Taiwanese gillnet fishery in northern Australian waters from January 1974 to December 1985. Data relating to the operation of vessels from Taiwan for the period January 1974 to June 1979 were taken from Walter (1981) and data from July 1979 to December 1985 were supplied by the Australian Department of Primary Industry. The figures in brackets are alternative figures supplied in an unpublished paper (Walter, 1981). Notes: a. Operating days (usually one set per day); b. The maximum number of gillnetters from Taiwan licensed to fish in the AFZ since November 1979 has varied with different access agreements. From August 1985 the maximum number of gillnetters licensed to operate in the AFZ was 18

Year	Total fish catch (tonnes)	Fishing effort (no. of set nets)	Max. no. of vessels
1974	618	—	—
1975	17,303	—	—
1976	16,414	—	67
1977	19,174 (26,847)	10,174 (10,325)[a]	—
1978	20,475 (30,523)	12,352 (12,352)[a]	—
1979 (Jan-Oct)	16,490	10,959	—
1979 (Nov-Dec)	716	566	30[b]
1980	5,611	3,971	30
1981	7,080	4,591	30
1982	6,911	4,642	30
1983	7,873	3,261	30
1984	6,193	3,695	38
1985	3,078	1,461	37

METHODS

Information on the geographical distribution and level of gillnet fishing effort and fish catch by Taiwanese vessels operating in the AFZ was obtained through the radio-reporting system administered by the Australian Fisheries Service (AFS) of the Department of Primary Industry. Data on the location and cetacean catch of observed sets was provided by the AFZ Observer Program and through a joint research program involving the Australian National Parks and Wildlife Service (ANPWS), AFS and fishing interests from Taiwan. A summary report of the joint program of gear modification trials to investigate possible methods of reducing the level of the cetacean by-catch is presented in Hembree and Harwood (1987). Data from the 1984 and 1985 trials, for which no significant change in cetacean by-catch was shown, were included for the purpose of this analysis as a major proportion of the AFZ observer effort for those years was devoted to the trials.

Gillnet vessels from Taiwan are regularly boarded by government observers under the AFZ Observer Program. Whilst on board, observers monitor fishing operations and provide assistance in the fulfilment of reporting and data collection requirements. As well as analysing the composition of the fish catch, observers record details of cetaceans captured during gillnetting operations. Since

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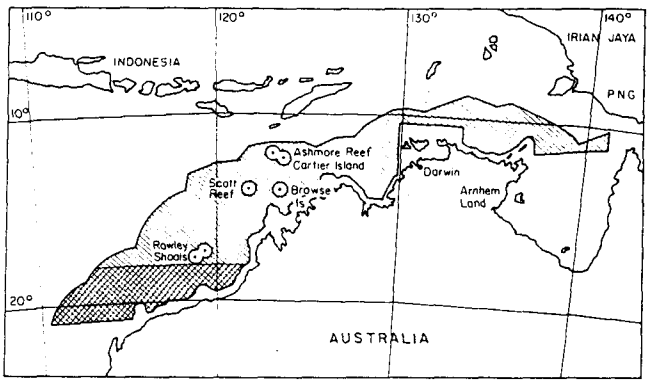

Fig. 1. Authorised foreign gillnetting area from June 1981 to December 1985. The only foreign gillnet vessels operating in the area were from Taiwan. From August 1983 the vessels from Taiwan were excluded from the area south of 18°S shown by heavier shading (adapted from Millington and Walter, 1981).

July 1983, ANPWS has funded a research consultancy carried out by the Western Australian Museum to investigate the incidental catch of cetaceans in the gillnet fishery.

RESULTS

A monthly summary of observed cetacean catches, observer effort and total fishing effort for the 54 month period June 1981 to December 1985 is presented in Table 2. Over that period 17,467 gillnet sets were made. Of these, 407 (2.33%) were attended by Australian observers who recorded the capture of 319 cetaceans in 145 net sets. All but three of the cetaceans whose capture was recorded by observers were dead. The analysis does not include animals which were returned to the sea alive.

The geographical distributions, by 1° blocks, of total fishing effort, observer effort and observed cetacean catch rate are shown in Figs 2, 3 and 4 respectively. Boardings of gillnet vessels during observer cruises, apart from those during the gillnet modification trials, were made at random; however, cruises gave greater coverage to areas nearer to Darwin (the embarkation point for most observer cruises). A chi-square analysis carried out on observer data partitioned into 1° blocks, with frequencies pooled for blocks where expected observer effort (based on the distribution of total fishing effort) was less than three sets, showed a significant difference between the distributions of actual and expected observer effort during the study period.

$$(\text{chi}^2 = 256.62;\ 27\ \text{df};\ p<0.01).$$

It was assumed that the difference between the distributions of observer and total fishing effort had no major effect on the analysis of cetacean catch rates for the whole fishery. Unless observer effort has sampled areas of low or high cetacean catch rate disproportionately then estimates of overall catch rates for the fishery should be unaffected by the different distributions of observer and total fishing effort.

An estimate of total cetacean by-catch during the period June 1981 to December 1985 may be made using cetacean catch rates observed in the fishery. The average cetacean catch rate (cetaceans per gillnet set) for the 54 months to December 1985 was 0.8010 cetaceans per net set (SE=0.0956). Applying that catch rate to the total fishing effort gives a total estimated by-catch of 13,991 cetaceans (SE=1669).

Table 2

Observed catch by vessels from Taiwan of small cetaceans of all species in the gillnet fishery in northern Australian waters for the period June 1981 to December 1985 * Includes one cetacean returned to the sea alive; all others were dead

Month	Fishing effort (no. of sets)	Observer effort (no. of sets)	Observed net set with cetaceans	Observed cetacean catch	Month	Fishing effort (no. of sets)	Observer effort (no. of sets)	Observed net set with cetaceans	Observed cetacean catch
1981					**1984**				
Jun	312	10	4	8	Jan	642	7	2	3
Jul	338	0	-	-	Feb	561	5	2	2
Aug	364	0	-	-	Mar	353	0	-	-
Sep	488	4	0	0	Apr	73	0	-	-
Oct	397	16	6	17	May	134	0	-	-
Nov	324	0	-	-	Jun	139	0	-	-
Dec	185	12	4	13	Jul	82	0	-	-
1982					Aug	207	0	-	-
Jan	328	0	-	-	Sep	403	41	15	28
Feb	605	12	4	10	Oct	475	36	11	20
Mar	618	18	3	3	Nov	409	5	2	2
Apr	302	10	2	4	Dec	217	3	2	3
May	199	0	-	-	**1985**				
Jun	390	15	6	12	Jan	284	3	2	11
Jul	467	16	6	7	Feb	417	15	7	20
Aug	387	3	0	0	Mar	331	0	-	-
Sep	367	0	-	-	Apr	16	0	-	-
Oct	90	0	-	-	May	0	-	-	-
Nov	380	21	7	10	Jun	0	-	-	-
Dec	509	0	-	-	Jul	0	-	-	-
1983					Aug	47	13	5	14*
Jan	422	15	1	2	Sep	98	18	11	37*
Feb	455	8	3	3	Oct	41	26	10	29
Mar	443	12	2	2	Nov	48	18	9	17
Apr	416	0	-	-	Dec	179	1	0	0
May	524	0	-	-					
Jun	564	5	1	1	Total	17,467	407	145	319
Jul	276	1	0	0					
Aug	211	6	2	4					
Sep	437	6	1	1					
Oct	554	9	4	12					
Nov	451	10	8	18*					
Dec	508	7	3	6					

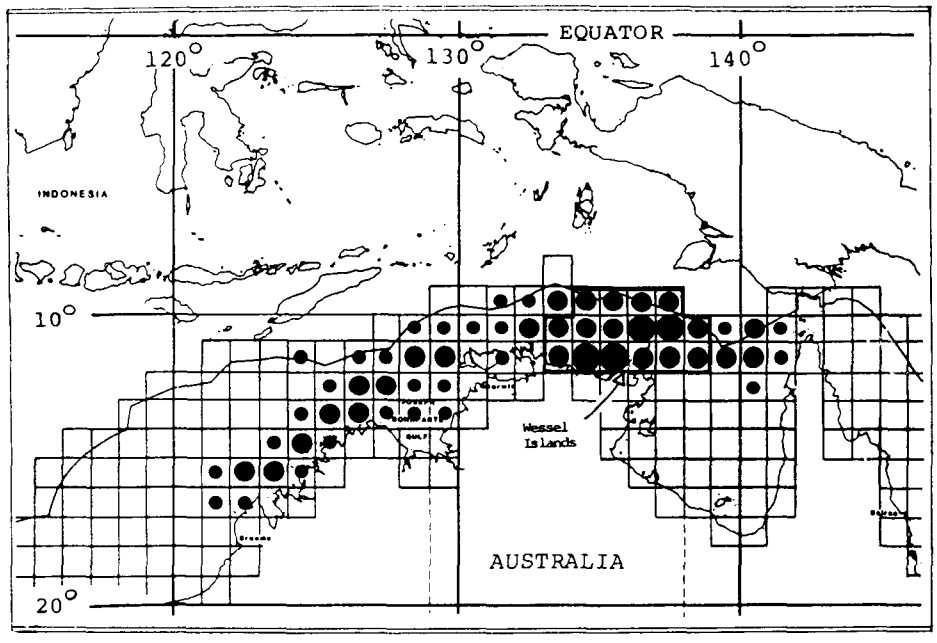

Fig. 2. Geographical distribution of total fishing effort for the period June 1981 to December 1985. The perimeter of the sixteen 1° blocks near the Wessel Islands where 72% of the total fishing effort occurred is outlined. Total fishing effort (no. of sets): ■ 1,000+; ◙ 100-999; ◘ 1-99; □ 0.

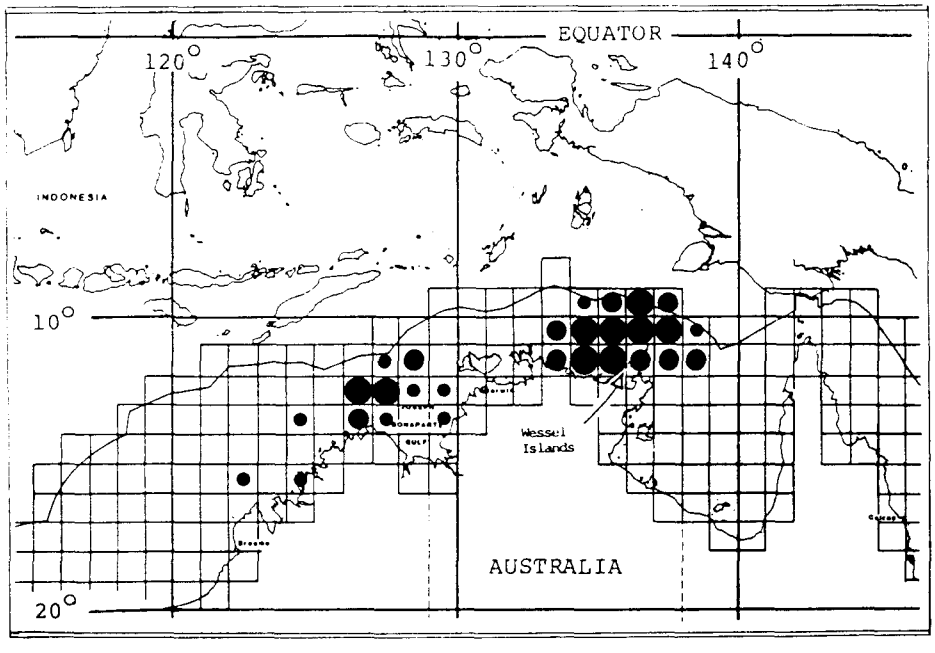

Fig. 3. Geographical distribution of observer effort for the period June 1981 to December 1985, scaled for comparison with the distribution of total fishing effort (Fig. 2). Observer effort (No. of sets): ■ 23+; ◙ 3–22; ◘ 1-2; □ 0.

Changes in cetacean catch rate

Significant declines in cetacean catch rate with both time and increasing cumulative fishing effort were shown in a weighted linear regression analysis carried out on cetacean catch data for the period June 1981 to March 1983 (Harwood *et al.*, 1984). Quantitative assessment of trends in cetacean catch rate for the extended period June 1981 to December 1985 was not attempted because substantial changes to the fishing method and the areas of operation of the gillnet fleet took place during the later years. Also, observer effort represented a biased sample of fishing effort in that the proportion of monthly fishing effort sampled varied markedly during the study period. Average observed cetacean catch rates and total fishing effort by calendar year are shown in Table 3. The average catch rate for 1985 was more than twice that observed during any of the three previous years.

Changes to the fishery

Several significant changes have been observed in the northern gillnet fishery since observations began in 1980. The average length of net deployed per vessel per set has

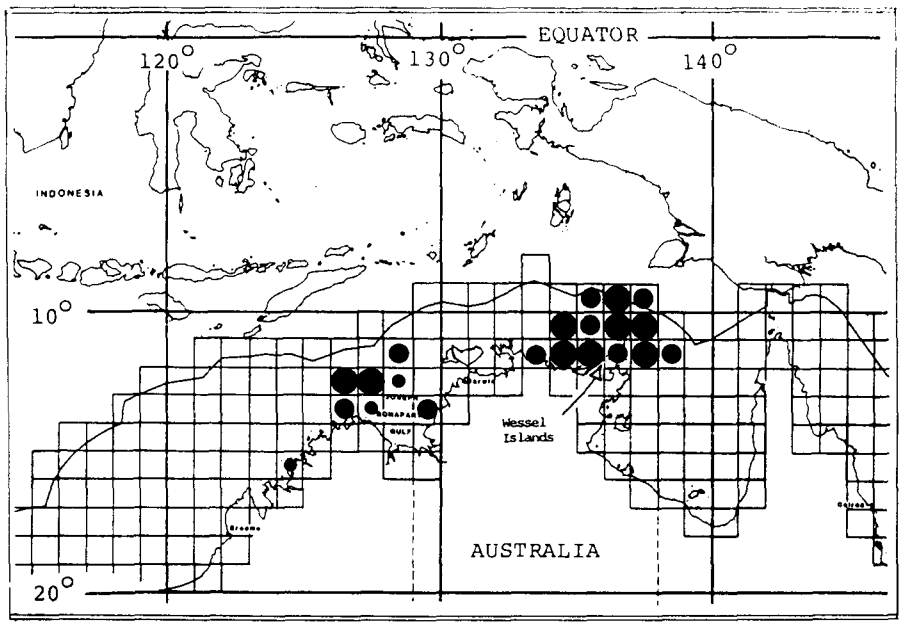

Fig. 4. Geographical distribution of observed cetacean catch for the period June 1981 to December 1985, scaled for comparison with the distribution of total fishing effort (Fig. 2). Observed cetacean catch (No. of cetaceans): ■ 18+; ◙ 2–17; ◘ 1; □ 0.

Table 3

Total fishing effort and average cetacean catch rate in the gillnet fishery in northern Australian waters by calendar year for the period June 1981 to December 1985

Year	Months	Total fishing effort (no. of sets)	Average cetacean catch rate (cetaceans per set)
1981	Jun-Dec	2,408	0.90
1982	Jan-Dec	4,642	0.48
1983	Jan-Dec	5,261	0.61
1984	Jan-Dec	3,695	0.59
1985	Jan-Dec	1,461	1.34

Table 4

Estimated average net length deployed by gillnet vessels from Taiwan in the Australian Fishing Zone. Data supplied by the Department of Primary Industry. The estimates of average net length were calculated using data from 20 vessels, each of which fished for at least two years during the period 1979-1985. In any one year net lengths varied through the fleet, eg. in 1985 from approximately 10 to 20km. Accurate data are not available on net length for all vessels operating each year

Period	Average length of gillnet (km)	Period	Average length of gillnet (km)
Nov 1979–Oct 1980	8.2	Nov 1982–Oct 1983	13.0
Nov 1980–Oct 1981	8.8	Nov 1983–Oct 1984	13.5
Nov 1981–Oct 1982	10.3	Nov 1984–Oct 1985	16.0

almost doubled. Estimates of the average net length by calendar year are shown in Table 4. It was not possible to assess trends in catch rate per unit length of net (e.g. per kilometer) because accurate data on net length were available for only part of the gillnet fleet in any year. Another major change in the fishery has been the rapid introduction of nets with surface set headlines from late 1984. Prior to that time the majority of vessels fished nets set 2-3m below the water surface.

Analysis of the geographical distribution of fishing effort during the study period showed a shift in effort eastwards since 1984. The percentages of total fishing effort fished east of 136°E for the periods 1981-83 and 1984-85 were 35% and 53% respectively. Vessels operated in some 800,000 km² of the AFZ since 1981; however fishing effort was markedly concentrated in particular sections of the authorised gillnetting area. An area of about 200,000 km² around and to the north of the Wessel Islands occupied approximately only 13% of the authorised area, but accounted for 73% of the total fishing effort, 87% of the observer effort and 82% of the observed cetacean catch.

Cetacean species caught in the gillnet fishery

Data collected by fisheries observers indicated that cetaceans have been captured accidentally in all areas of the Arafura and Timor Seas where gillnetters operate in the AFZ. Sufficient information was recorded to allow the identification of 265 of the 319 cetaceans captured during the observed sets. The identified cetacean catch comprised 159 (60%) *Tursiops truncatus*, 93 (35%) *Stenella longirostris*, 12 *Stenella attenuata*, one *Pseudorca crassidens* and one *Sousa chinensis*. While these species probably account for most of the unidentified specimens, it is possible that the incidental catch involves other cetacean species. Although several other cetacean species are known, from strandings, to occur in the area of the fishery, species identified reliably at sea during observer operations have included only those found to date in the by-catch.

DISCUSSION

Gillnet vessels from Taiwan have been operating in waters off northern Australia for approximately twelve years. The incidental capture of small cetaceans in the fishery was first recorded in 1980 by fisheries observers monitoring gillnet operations in the newly declared AFZ. There are no data available on the cetacean by-catch for the first seven years

of the fishery and uncertainty regarding areas and level of effort in the fishery for that period would make estimates based on current cetacean catch rates unreliable.

The cetacean catch for the period June 1981 to December 1985 is estimated to be in the order of 14,000 animals. The estimate is based on an analysis in which data on all cetacean species and all areas of the fishery are pooled to calculate an overall catch rate.

The effect of the pelagic gillnet fishery on particular species or stocks of cetaceans is difficult to assess given the low number of sets observed in the fishery. The level of removals from the area near the Wessel Islands in which a high proportion of the fishing effort has been recorded, is estimated to have been as high as 580 cetaceans per 1° block per year (5 cetaceans per year per 10km square) based on observed catch rates.

Little is known of the population biology or distribution of the small cetacean species which occur in the area of the gillnet fishery. *Tursiops truncatus* comprises 60% of the identified cetacean catch, with the remainder made up of *Stenella longirostris*, *S. attenuata*, *Pseudorca crassidens* and *Sousa chinensis*. To assess the impact of the incidental catch, information on the population sizes, distributions and recruitment rates of the cetacean species involved would be required.

Although changes to the fishing method, biases in observer sampling and the low number of sets observed preclude accurate assessment of trends in cetacean catch rate per unit length of net, it appears that the catch rate per uncalibrated set was notably higher in 1985 than in previous years during the study period. The introduction of surface set headlines in late 1984, and substantial increases in net length in recent years have probably contributed to higher catch rates[1]. Sea trials conducted in early 1986 under the joint research program investigating possible methods for reducing the level of the by-catch showed that the cetacean catch rate in a surface set was significantly higher than in an otherwise identical sub-surface net.

Since 1984, total fishing effort per year has declined and the fishery has shifted eastwards, with a significant increase in effort east of 136°E. Both these factors may have influenced cetacean catch rates, particularly if a reduction and shift in fishing effort has relieved pressure on cetacean populations which may have been depleted by heavy fishing effort in previous years. Insufficient data are available to assess the relative contributions of these and other factors discussed above to any changes in cetacean catch rate.

Cetacean catch rates observed on gillnetters in northern Australian waters are comparable with those recorded in the Japanese driftnet (gillnet) fisheries for salmon in the western North Pacific. Vessels operating in the salmon fishery deploy nets approximately 17km in length. In 1982, catch rates of 0.29 to 0.96 cetaceans per set were observed (Jones, 1984).

The by-catch of small cetaceans in the gillnet fishery off northern Australia is much higher than that reported for any other Australian commercial fishery. Concern about the level and possible impacts of the incidental catch led to the establishment in April 1984 of a co-operative research program to investigate modifications to gillnets which might reduce the level of the by-catch. The results of sea trials conducted under the joint program are reported in Hembree and Harwood (1987).

[1]Since December 1986, the use of pelagic gillnets in the northwestern AFZ has been limited to a maximum of 2.5km per vessel. Foreign gillnet activity in the AFZ has ceased.

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