さけ・ます流し網漁業に関連した海産哺乳動物、特にイシイルカに関する1984年調査の概要

Outline of 1984 Research on Marine Mammals, especially Dall's Porpoise relating to Salmon Gillnet Fishery.

１９８４年　９月

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水　　産　　庁

Fisheries Agency of Japan

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水産庁　遠洋水産研究所

1984年の海産哺乳動物に関する調査研究は、1978年に改訂された〝北太平洋の公海漁業に関する国際条約〟の第10条、同付属書第1節c項及び1984年に改訂された日本と米合衆国政府間の了解覚書に従って実施された。なお、具体的な調査計画については、1984年2月東京で行われた海産哺乳動物特別小委員会科学分科会において検討された。1984年9月までに行われた調査研究の項目は、次のとおりであり、これらの概要について報告する。内容の分析は、現在進行中であり、結果については後日発表される予定である。

本年は、条約及び日米了解覚書の下で、さけ・ます流し網漁業で混獲される海産哺乳動物に関する調査が行われてから、7年目にあたる。日本は、1984年においても、これら海産哺乳動物主としてイシイルカの混獲統計の収集及び生物学的調査研究に多くの努力を払った。また、さけ・ます母船及び独航船に乗船した米国視察員について、可能な限り援助と協力を行った。科学調査船に乗船した米国科学視察員についても同様であった。

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注：この文書を引用する場合は下記による。
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1. 混獲された海産哺乳動物の統計資料

1984 年漁期に北太平洋で操業された日本のさけ・ます流し網漁業及び科学調査船の試験操業の際に混獲された海産哺乳動物の資料は、今まで行われてきた様に、夫々所定の方式に従って収集整理された。即ち、母船式漁業では、所属独航船からの混獲資料を各母船において集計し、水産庁へ報告されたものである。基地式漁業では、各漁船に義務づけられている漁獲成績報告書と共に提出される混獲実績表を、水産庁において集計した。

科学調査船による各種調査及び母船上における生物調査は、「さけ・ます及び海産哺乳動物等、調査の手引き」に定められた調査要領に従って行われた。

1) 母船式さけ・ます流し網漁業

母船式漁業では、4母船に所属する合計 172 隻の独航船が、さけ・ますを漁獲する流し網に混獲される海産哺乳動物に関する資料を収集した。1984 年の結果は、1978 年以降の関連データと共に、表－1 に示してある。

本年は、6月と7月の漁期間中に、米国 200 海里漁業水域を含む定められた漁場において、合計 194 回の船団操業と、延べ 8,333 回の独航船の操業が行われた。その際に混獲された海産哺乳動物は合計 2,675 頭であり、このうちイシイルカは 2,670 頭、オットセイ 5 頭であった。

米国海産哺乳動物視察員は、1母船 3 名づつ合計 12 名であったが（Doc．2801 表 3 参照）、6月中旬から 7 月下旬にかけて、夫々 87 ～ 89 日間、母船に滞在した。但し、その間、交替で独航船に便

乗し、海産哺乳動物の混獲状況を視察した。他に、各船団1名づつの日本人視察員も同様の調査を実施した。日本と米国視察員の観察した1操業当り平均混獲頭数及び一般漁船の報告に基づく平均混獲頭数は近似した値であった。

2) 基地式さけ・ます流し網漁業

基地式さけ・ます流し網に混獲された海産哺乳動物に関する資料は、1984年5月～7月の漁期間に収集された。これらの資料は、1978年以降のデータと共に、表－2に示してある。本年は、812頭のイシイルカが混獲された。

3) さけ・ます科学調査船

1984年4月～8月の期間、沖合水域において9隻のさけ・ます調査船が活動した。調査水域は168°W以西の北太平洋及び175°W以西のベーリング海であり、このうち1隻の調査船は、北東太平洋で調査を行った。これら調査の規模は、ほぼ前年並のものであった。

これらの調査船は、4月23日から8月6日までの間に、351回（総使用反数44,579反）の試験操業を行い、53頭の海産哺乳動物が混獲された。このうちイシルカは32回、41頭が羅網した。
資料は1978年以降のデータと共に表－3に示してある。

2. イシイルカ豊度推定のための調査

イシイルカは、北太平洋の沖合水域に広く分布回遊する冷水性のイルカである。さけ・ます漁業を通じての資料は整備されつつあるが、水域が限定されるため、北太平洋全域をカバーしきれない。近年は、これらを補充するため多くの努力を続けている。

1) さけ・ます科学調査船等による目視調査

さけ・ます科学調査船は、漁場への往復航路及び操業点間の移動に際し、可能な限りイシイルカの目視調査を行っている。これらの資料は所定の様式で記載され、提出された報告は、遠洋水研で解析している。

1984年は、4月20日から8月21日の期間、9隻のさけ・ます調査船、1隻のいるか専門調査船及び若潮丸が、延べ588日、50,614海里に亘って目視調査を行った。調査水域は、前述したとおり、主として168°W以西の北太平洋であるが、一部東太平洋及びベーリング海が含まれる。これらの資料は、1978年以降のデータと共に表－4に示してある。

一方、さけ・ます調査船いわき丸の第2次航海（6月3日～7月6日）及び熊本丸の第2次航海（6月18日～7月27日）には、米国科学視察員各1名が便乗し、イシイルカの目視調査と混獲されたイシイルカの標本採取を行った。また、おしょろ丸には、延べ4名の米国研究者が分かれて乗船し、函館～

Juneau～Honolulu～函館の航海中、調査にあたった。

2）行動生態に関する日米共同調査

北太平洋におけるさけ・ます流し網漁業で混獲されるイシイルカの資源・生物学的研究は機会ある毎に日米共同調査が行われてきた。本年は懸案となっていた米国のヘリコプターによる行動生態観察に、日本の研究者が参加し、共同調査を実施した。

この調査は、イシイルカの豊度推定の基礎となる目視観測にあたって、イシイルカがどの様な状態で調査船上から発見されるかを、船以外の視点から明らかにしようとするものである。調査はヘリコプターと調査船が同時に協力して行われた。概要は次のとおりであった。

調　査　期　間　　1984年6月12日～7月3日

調　査　海　域　　47°～60°N、125°～153°Wの北東太平洋

調　　査　　船　　Surveyor　8,150トン　NOAA所属

ヘリコプター　　Bell　205A

調　　査　　員　　米国4名　日本1名

調査船Surveyorは6月12日にSeattleを出港し、22日までの期間はアラスカ湾に至る水域、6月23～26日はPrince William Sound湾内、6月27日～7月2日はKodiak島の南東水域で調査を行い、7月3日にKodiakに入港し、終了した。

この間、調査船上からの目視調査は、延べ21日間、1,600海里に亘って行われた。またヘリコプターによる空中からの目視調査は、26フライト行われた。これらの調査によって、イシイルカを主体に数種の海産哺乳動物を発見し、夫々の目的に従って資料の解析がなされている。

3．イシイルカの生物学的研究のための標本収集

1）母船式さけ・ます流し網漁業

イシイルカの生物学的研究は、母船式さけ・ます流し網漁業で混獲される標本について米国側が担当し、多くの成果をあげてきた。

1984年も前年に引続き、各母船に乗船した米国視察員が日本側の協力を得て、独航船が持ち帰ったイシイルカを計測し、解剖して歯や臓器の標本を採取した。6月～7月の漁期中に母船へ持ち帰ったイシイルカは、1,103頭であった（表－5）。

一般に母船式漁業で混獲されるイシイルカのうち、約半数は独航船の甲板上に引揚げられ、母船へ持帰るが、長期間調査操業を行う独航船では、母船へ持帰れない場合もある。一方、船団が米国200海里漁業水域外南公海で操業する場合には、母船の冷蔵庫のスペースが可能な限り、保存しておき、標本として提供した。ベーリング公海では日本人調査員が米国オブザーバーと同様な作業を行った。

2) 基地式さけ・ます流し網漁業

基地式さけ・ます流し網漁船は、出港後1ケ月に及ぶ長期航海を行うため、船艙のスペース、冷凍能力が少ないので、イシイルカを保蔵して持帰ることは極めて困難であった。しかし、基地式漁場水域内におけるイシイルカの生物学的情報が重要であるので、引続き標本収集の努力を払ってきた。

1984年は、漁期間中に31頭のイシイルカと1頭のセミイルカが、漁船によって持帰られ、釧路魚市場の冷蔵庫に凍結保管された。これらの標本は、8月下旬に現地で解凍し、生物学的測定及び歯・臓器等の標本採取を行った。現在、国立科学博物館において、整理と解析が進められている。

3) さけ・ます科学調査船

さけ・ます調査船の操業する流し網で混獲されたイシイルカは、船上において生物学的計測を行っている。しかし、専門調査員が乗船していない場合には、貴重な標本を有効に活用するため、可能な限り基地である釧路港へ持帰ることとした。

1984年は4月～8月の調査期間中、3隻の調査船が合計10頭のイシイルカと、ネズミイルカ1頭を持ち帰り、釧路魚市場冷蔵庫に保管した。これらの標本は、基地式の標本と共に8月下旬に解剖処理し、目下検討中である。

調査船熊本丸の2次航海で混獲されたイシイルカについては、乗船していた米国研究者が、計測に立会い、胃・生殖腺・脊椎等の標本を採取し、詳細な研究用にNMMLに持帰った。

4) 専門調査船による北洋いるか資源調査

さけ・ます漁業で混獲されるイシイルカについては、1978年以降調査が継続され、生物学的、生態学的知見が蓄積されつつある。しかし、標本収集に当って多くの努力が払われたにも拘わらず、短期間の限定された漁業を通じての情報では、イシイルカの全生活史を解明する上で、時空間的に偏りが生ずることが指摘されてきた。そこで1982、1983年には、沖合さけ・ます漁期終了後の8～9月に、北西北太平洋海域において、専門調査船を出動させ調査を行ってきた。この結果、雌雄・親子連れ等による棲み分け、再生産率、年齢構成等について新たな知見が得られた。

本年は、「北洋いるか資源調査」として、175°以西の北西北太平洋海域において、専門調査船が、電気銛突きん棒により標本収集を実施した。これらの結果は、中型さけ・ます漁場水域におけるイシイルカの補完資料となろう。

調査の概要は次のとおりであった。

調査期間　1984年5月10日～6月20日

調査海域　175°E以西、36°N以北、米国及びソ連200海里水域外の北西太平洋

調査船　第58宝洋丸　224トン（水産庁用船）

調査航海中、目視観察によって1,871頭のイシイルカを認め、187頭（イシイルカ型148、リクゼンイルカ型39）を捕獲した。この他カマイルカ21頭、セミイルカ10頭が得られた。これらについて船上で体長・体重を計測し、解剖を行い、生殖器官、臓器、脂皮、骨格、歯等の標本を採取した。夫々について研究分担に従って分析が進められている。

4. イシイルカの音響学的生態調査

1) 水 槽 実 験

イシイルカは外洋性であるため、水槽内の生態実験用に生捕り、飼育することは極めて困難であった。本年は、北洋いるか対策調査グループ（日本大学、鴨川シーワールド水族館、水産庁水産工学研究所）が、さば2そう旋網漁船金毘羅丸（14トン）の協力により、実験標本を得ることができた。

即ち同船は、5月7日朝9時、茨城県日立市会瀬沖10海里、水温7℃で、イシイルカ20頭の群を発見し、旋網で3頭を捕獲した。その後健康管理と実験準備のため、5月9日夜鴨川シーワールドの水槽（8×12×3m、水量230トン）へ移送した。

水槽内では、①鳴音の録音、②水面に張ったロープと吊り下げた糸に対する反応、③超音波に対する反応の観察を行った。擬似エコーロケーションの超音波パルスに対しては、嫌悪する行動が見受けられた。

カマイルカ1頭を同水槽に入れる等の配慮をしたが、餌付けが十分でなく、5月18日に死亡し、実験は中止となった。

2) 野 外 実 験

① 北海道オホーツク沿岸

北海道知床半島沿岸のオホーツク海には、夏季イシイルカが来遊することが知られており、この時期の海況は平穏であるため、各種野外実験に好適である。北洋いるか対策調査グループは、前年に引き続き斜里町ウトロ地先水域において、イシイルカの超音波に対する反応実験を行った。実験は、6月1日～4日、8月14～16日の2回、24、50KHz及び擬似エコーロケーションの3種類の超音波パルスをイシイルカに放射し、その反応行動を観察した。

② いるか専門調査船

イシイルカは、飼育による水槽実験が困難であるところから、あらゆる機会をとらえて、野外実験を試みる努力が払われた。この実験は、前記「北洋いるか資源調査」として活動した、いるか専門調査船第53宝洋丸の航海に便乗して行われた。調査は北西北太平洋の広範な海域に及んだ。

第53宝洋丸の5月10日～6月20日に至る航海期間中、水中マイクロホンによるイシイルカ及び他のイルカ類に対する鳴音録音は、5月12日～6月18日に実施した。また、水中スピーカーによるシャチ鳴音の放声実験を試みた。

③ さけ・ます及び海産哺乳動物調査船

前年に引き続き、ベーリング海域で行われた「さけ　動物調査」の調査船若竹丸（新船 424 トン）に便乗して、各種実験を行った。若　6月25日～8月8日であったが、実験はさけ・ます流し網の試験操業と関連して

先づ、調査船が漂泊中に、船の周囲を遊泳するイシ　エコーロケーション発生装置から超音波を発し、反応行動を観察した。周波数範囲は　波モードは、パルス波とFM波を1秒毎に交互に発信するものであった。

次に、流し網にカーバイトガンを取付けて試験操業　の防除効果及びさけ・ますの漁獲率について検討した。また遊泳中のイシイルカに　ンを爆発させ、その反応行動を観察した。

流し網に誤網したイシイルカについては、詳細にそ　航走中は目視観察により、行動生態の解明に努めた。

5. イシイルカ混獲防止のための改良漁具試験

北太平洋の米国200海里漁業水域内で操業する母船　漁業は、海産哺乳動物の混獲について、北太平洋漁業国際条約に依拠する日米了解　する米国国内法に規制されている。具体的には 1984 年に改訂された日米了解覚書　決められている。

この趣旨に従って、海産哺乳動物の混獲を防止する　を払ってきた。即ち、イシイルカに関する基礎的研究として、音響学的手法による　生物学的特徴の把握である。これらの研究と併行して、さけ・ます独航船による改　がプロジェクトチームを中心に行われてきた。1984 年漁期からは、全独航船の 25　漁具を使用することが義務づけられた。本年はこの条件を充足しつつ、前年まで行　によるイシイルカの混獲防除試験も継続した。

1）中空糸付き改良流し網

海中に敷設した流し網に対し、イルカのエコーロケ　るために、網中央部分のナイロン糸3本を、中空糸に取替えた改良漁具である。これ　試験操業において、イルカの混獲を減少させるのに一定の効果が認められてきた。

1984年は、この改良流し網を、各船団11隻づつの独　44隻がこれを使用して、漁期間中操業を行った（Test 1－1）。これは、全独航　に相当する。改良流し網使用船と一般漁船のイシイルカの混獲頭数は、表－6に示し

改良漁具を使用した独航船は、船団操業に当っては、　くランダムに配置した。Test 1及び2の改良漁具使用船（56隻）と先航独航船　2隻の一般漁船について、1操

隻当りの混獲率を比較すると、Test 1の場合は8%程度低下するものと試算された。

2) 超音波発生器による防除試験

イルカは様々な音波を発射して遊泳行動をしているので、適当な周波数の超音波を利用すれば、流し網の存在を予知させることができると考えられる。これについて4節で述べた音響学的基礎実験の実用化を図るために、Test 1とは別の独航船でTest 2を実施した。これは、次の3種類の音波発生器を、流し網の各部に等間隔になる様に取付けたものである。

① 9KHz音波発生器（Test 2－1）

これは、この試験の初期に開発されたものであり、各船団1隻づつ、計4隻の独航船が、1隻当り、10台、合計40台（ほかに予備1隻当り2台、計8台）を使用した。

② 145KHz単純型音波発生器（Test 2－2）

これは、イシイルカのクリックの145KHzを、1,000倍のパルス幅（50ms）で何回も発生させ、そのエネルギー量で刺激を与え、エコーロケーションを混乱させ、注意力を換起するものである。各船団1隻が5台づつ流し網に取付け(計4隻、20台、ほかに予備1隻当り1台、計4台)、通常の操業を行った。

③ 145KHzイルカ型音波発生器（Test 2－3）

イシイルカが使っているエコーロケーションに近い超音波パルスを発生させ、警報を与える方式である。これは、各船団1隻が夫々5台を取付け（計4隻、20台、ほかに予備1隻当り1台、計4台)、操業を行った。

以上の3種の音波発生器を取付けた改良漁具使用船は、合計12隻であり、中空糸網を使用した独航船を加えると56隻となり、これは全独航船の33%に相当する。

3種の音波発生器を取付けた独航船数は、各4隻づつで少ないが、一般漁船に対してTest 2－3が羅網頭数の頻度分布に差があった。

3) そ の 他

イシイルカが流し網に羅網するメカニズムを把握するため、前年度に引き続き、①水平方向区分別てん絡頭数、②てん絡の状態、③海況によるてん絡頭数の相異、④さけ・ますの漁獲に対する影響等の調査を行った。

これらイシイルカ羅網の実態を解明することにより、より効果的な混獲防止機器の開発、漁具の改良が図られることとなろう。

Table 1. Number of incidental take of marine mammals, catcher boat operations and gillnet used by mothership salmon driftnet fishery during 1978 to 1984

Year	Total number of catcher boat operation	Total number of gillnet used (in tans)	Total number of incidental take	Break down by species				
				Dall's porpoise	PP	OO	CU	EJ
1978	8,284	2,721,113	505	497	1	1	6	-
1979	8,611	2,798,022	688	682	3	-	3	-
1980	9,551	3,145,913	1,004	1,000	4	-	-	-
1981	8,811	2,902,231	1,370	1,361	-	-	9	-
1982	8,957	2,942,443	3,199	3,190	-	-	8	1
1983	8,967	2,954,989	2,990	2,986	-	-	4	-
1984[a]	8,333	2,739,857	2,675	2,670	-	-	5	-

a: Preliminary
PP: Harbour porpoise
OO: Killer whale
CU: Northern fur seal
EJ: Steller sea lion

Table 2. Number of incidental take of marine mammals and gillnet used by land-based salmon driftnet fishery during 1978 to 1984

Year	Total number of gillnet used (in tans)	Dall's porpoise	Northern right whale dorphin
1978	3,371,736	303	-
1979	3,218,490	127	-
1980	3,144,187	139	-
1981	3,233,925	696	-
1982	2,961,730	1,641	-
1983	3,113,681	1,291	-
1984[a]	—	812	1

a: Preliminary

Table 3. Number of incidental take of marine mammals, gillnet operations and gillnet used by salmon research vessels during 1978 to 1984

Year	Number of total operations	Number of gillnet used (in tans)	Marine mammals incidental taken							
			Dall's porpoise	PT	PP	LO	LB	UD	CU	US	~~EL~~ RS
1978	355	44,622	27(22)[b]	-	-	-	-	-	1(1)	2(2)	-
1979	268	34,615	20(16)	-	-	1(1)	-	-	17(12)	-	-
1980	276	38,080	56(27)	1(1)	1(1)	-	3(1)	3(2)	19(10)	-	-
1981	287	40,739	21(15)	1(1)	-	-	3(2)	-	15(13)	-	-
1982	317	40,262	48(37)	2(2)	-	-	-	-	15(11)	-	-
1983	321	39,730	31(26)	-	-	-	-	-	2(2)	-	-
1984[a]	351	44,579	41(32)	-	1(1)	1(1)	3(1)	-	6(6)	-	1(1)

a: Preliminary
b: The figures in parentheses indicate the number of operations when marine mammals were taken.
PT: Dall's porpoise, truei type
PP: Horbour porpoise
LO: Pacific whiteside dorphin
LB: Northern right whale dorphin
UD: Unidentified porpoise
CU: Northern fur seal
US: Unidentified seal
~~EL: Sea otter~~
RS: Ringed Seal

Table 4. Sighting survey of marine mammals conducted by salmon research vessels during 1978 to 1984

Year	Number of research vessels	Period of survey	Accumulated days sighted	Accumulated distance sighted (N.M)
1978	9	May 10 - Sept.14	563	36,505
1979	9	May 10 - Aug. 11	533	42,969
1980	9	Apr.21 - Aug. 13	548	44,744
1981	9	Apr.23 - Aug. 16	639	46,232
1982	10[b]	Apr.24 - Sept.19	653	49,830
1983	10[b]	Apr.20 - Sept.10	608	43,116
1984[a]	11[c]	Apr.20 - Aug. 21	588	50,614

a: Preliminary
b: Including dedicated vessel for Dall's porpoise research
c: b + Wakashio Maru

Table 5. Number of marine mammals brought back to motherships for biological samplings and periods during U.S. scientific observers on board in 1984

Name of motherships	Period during U.S. scientific observers on board motherships		Number of marine mammals brought back to motherships	
Kizan maru	June 9 - June 29 July 8 - July 24	(38 days)	Dall's porpoise	311
Meiyo maru	June 9 - July 4 July 15 - July 25	(37 days)	Dall's porpoise	236
Nojima maru	June 9 - July 8 July 17 - July 25	(39 days)	Dall's porpoise	259
Jinyo maru	June 9 - June 25 July 6 - July 26	(38 days)	Dall's porpoise	297
Total		152 days		1,103

Table 6. Number of Dall's porpoise incidentally taken by experimental boats and ordinary catcher boats in 1984 fishing season

Catcher boats	Gear	Number of set	Incidental take
Experimental boats	Test 1 - 1	2,134	647
	Test 2 - 1	194	62
	Test 2 - 2	194	61
	Test 2 - 3	194	60
Catcher boats	Ordinary net	4,462	1,479
Scout boats	Ordinary net	1,155	361
Total		8,333	2,670

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TRANSLATION

OUTLINE OF 1984 RESEARCH ON MARINE MAMMALS, ESPECIALLY DALL'S PORPOISE RELATING TO THE SALMON GILLNET FISHERY

Far Seas Fisheries Research Laboratory

Fisheries Agency of Japan

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Introduction

Research on marine mammals was conducted in 1984 in accordance with Article 10 of the International Convention for the High Seas Fisheries of the North Pacific Ocean as amended in 1978, paragraph 1(c) of the Annex to the Convention and the Memorandum of Understanding between the Governments of Japan and the United States as amended in 1984. In addition, the research plan was considered at the meeting of the Scientific Sub-Committee of the Ad Hoc Committee on Marine Mammals, INPFC, held in Tokyo in 1984 February. The outline of research conducted up to 1984 September is described. Some analyses are still under way and detailed results will be reported later. This year (1984) is the seventh year of research under the Convention and Memorandum of Understanding on marine mammals taken incidentally by the salmon driftnet fishery. Japan exerted effort to collect statistics on incidental catch of marine mammals, particularly Dall's porpoise, and to conduct biological surveys on the species. Japan also provided in 1984 every possible assistance and cooperation to the scientific activities by U.S. marine mammal observers on board salmon motherships and catcher boats and scientific observers on board the research vessels.

Outline of research

1. Collection of statistical data on the incidentally taken marine mammals in the following operations

    (1) Mothership salmon driftnet fishery
    (2) Landbased salmon driftnet fishery
    (3) Salmon research vessels

2. Survey for estimating abundance of Dall's porpoise

    (1) Sighting survey by the salmon research vessels
    (2) Japan-U.S. joint survey on behavior of Dall's porpoise

3. Sampling for biological studies of Dall's porpoise

(1) Mothership salmon driftnet fishery
(2) Landbased salmon driftnet fishery
(3) Salmon research vessels
(4) Survey on porpoise stocks in the North Pacific by the dedicated research vessel

4. Acoustic studies on Dall's porpoise

(1) Experiments in water tank
(2) Field experiments

(i) The Sea of Okhotsk coast of Hokkaido
(ii) The dedicated research vessel for Dall's porpoise research
(iii) The salmon and marine mammal research vessels

5. Gear modification experiments in order to reduce or eliminate the incidental take of Dall's porpoise

(1) Modified driftnets with air tube threads
(2) Experiments using the supersonic sound generators
(3) Others

Statistics on incidentally taken marine mammals

Data on marine mammals incidentally taken by the Japanese salmon driftnet fishery operated in the North Pacific Ocean in the 1984 fishing season and by research vessels conducting experimental operations were collected and compiled in the same manner as in previous years. That is, for the mothership salmon driftnet fishery, data on marine mammals incidentally taken obtained from the catcher boats were summed by each mothership and reported to the Fisheries

Agency of Japan. For the landbased fishery, statistics were compiled by the Fisheries Agency of Japan based on the "Report on incidental take" which is submitted by each vessel to the Agency together with the report on salmon catch which each vessel is obliged to submit.

Various surveys by the research vessels and biological surveys on board motherships were conducted in compliance with the methods provided in the "Guide of surveys on salmon and marine mammals, etc.".

(1) Mothership salmon driftnet fishery

In the mothership salmon driftnet fishery, a total of 172 catcher boats attached to four motherships collected data on marine mammals incidentally taken by salmon driftnets. The results obtained in 1984 are shown, together with those from 1978, in Table 1.

In 1984, a total of 194 fleet operations and 8,333 gillnet operations by catcher boats were conducted in the designated fishing grounds, including the U.S. 200 mile fishing zones, during June to July. A total of 2,675 marine mammals (2,670 Dall's porpoise and 5 northern fur seals) were incidentally taken.

A total of 12 U.S. marine mammal observers (three for each mothership--see Table 3, INPFC Doc. 2801) were on board the motherships for 37 to 39 days from mid-June to late July. During the period, they were on board the catcher boats alternately and monitored the incidental take of marine mammals. In addition, one Japanese observer for each fleet conducted a similar survey. The average numbers of marine mammals incidentally taken per operation, obtained by the U.S. and Japanese observers and from the catch reports submitted by catcher boats, were nearly similar.

(2) Landbased salmon driftnet fishery

Data on marine mammals incidentally taken by the landbased salmon driftnets were collected during the period from May to July in 1984. These data, together with data since 1978, are shown in Table 2. In 1984, a total of 812 Dall's porpoise were incidentally taken by this fishery (Table 2).

(3) Salmon research vessels

Nine salmon research vessels were engaged in the survey in high sea areas during 1984 April to August. The main areas surveyed were the North Pacific Ocean west of 168°W and the Bering Sea west of 175°W. One of those research vessels conducted operations in the northeastern Pacific Ocean. The scale of the surveys was almost the same as in the previous year.

These research vessels conducted a total of 351 experimental operations (the total number of driftnets used was 44,579 tans) during April 23 to August 6 and took 53 marine mammals incidentally. Of those, 41 Dall's porpoise were taken in 32 operations. These data are shown with those obtained since 1978 in Table 3.

Survey for estimating abundance of Dall's porpoise

Dall's porpoise are a cold water resident distributed widely in offshore areas of the North Pacific Ocean. Although the data obtained by the salmon fisheries are being accumulated, it is difficult to monitor the entire North Pacific Ocean because the areas of operation are limited. Much effort has been exerted in recent years in order to cover unsurveyed areas.

(1) Sighting survey by salmon research vessels

Salmon research vessels have conducted sighting surveys as much as possible on their way to and from the fishing grounds and during the time of navigation from one station to another. These data were recorded in a format and the reports submitted are being analyzed at the Far Seas Fisheries Research Laboratory.

Nine salmon research vessels, one dedicated porpoise research vessel, and the Wakashio maru conducted sighting surveys for a total of 588 days (50,614 miles) from April 20 to August 22 in 1984. The areas surveyed were mainly the North Pacific Ocean west of 168°W and effort was also expended in the northeastern Pacific and Bering Sea, as described earlier. Data obtained are shown with those collected since 1978 in Table 4.

In the second cruise of the salmon research vessel Iwaki maru (June 3 to July 6) and the second cruise of the Kumamoto maru (June 18 to July 27), one U.S. observer for each was on board and conducted the sighting survey and collected samples from Dall's porpoise incidentally taken. Also, a total of four U.S. scientists were on board the Oshoro maru in different periods and conducted surveys during the cruise from Hakodate to Juneau to Honolulu to Hakodate.

(2) Japan-U.S. joint survey on behavior of Dall's porpoise

A Japan-U.S. joint survey on population and biological studies of Dall's porpoise incidentally taken by the salmon driftnet fishery in the North Pacific Ocean has been conducted at every opportunity. In 1984, as had been desired for several years, a Japanese scientist participated in the U.S. helicopter survey for observations on behavior of Dall's porpoise. The objectives of this survey were to clarify, through sightings from a place other than a vessel, the behavior of Dall's porpoise when they are sighted by research

vessels. This survey was conducted simultaneously and jointly by a helicopter and a research vessel. The outline of the survey was as follows--

Period	1984 June 12 to July 3
Survey area	the northeastern Pacific between 47° to 60°N and 125° to 153°W
Research vessel	NOAA vessel Surveyor, 3,150 GRT
Helicopter	Bell 205-A
Research personnel	4 U.S. scientists and 1 Japanese scientist

The research vessel Surveyor sailed from Seattle on June 12 and conducted observations on the way to the Gulf of Alaska up to June 22, in Prince William Sound during June 23 to 26, in areas southeast of Kodiak Island from June 27 to July 2, and entered Kodiak on July 3 on completion of the survey.

During these periods, sightings from the research vessel were conducted for a total of 21 days and 1,600 miles. A total of 26 flights were conducted by the helicopter for sighting from the air. In these surveys, several species of marine mammals, mainly Dall's porpoise, were found and analyses of data are under way in accordance with each purpose during the research.

Sampling for biological studies of Dall's porpoise

(1) Mothership salmon driftnet fishery

The U.S. side has been in charge of examination of samples of Dall's porpoise incidentally taken by the mothership salmon driftnet fishery for biological study of Dall's porpoise and has obtained excellent results.

In 1984, as in the previous year, the U.S. observers who were on board each mothership conducted biological measurements, dissected specimens, and collected samples of teeth and internal organs of Dall's porpoise brought by the catcher boats in cooperation with Japan. During the fishing periods in June and July 1,103 Dall's porpoise were brought to the motherships (Table 5).

In the mothership fishery, in general, about one-half of the Dall's porpoise entangled in the nets were taken on board the catcher boats and brought back to the motherships. Scout boats, however, which usually conducted operations for a lengthy period, occasionally could not bring back specimens caught.

During operations in the open sea south of the U.S. 200 mile fishing zone, the porpoises caught were kept under refrigeration as much as space allowed and were subsequently provided for measurements and sampling to the scientists. During mothership operations in the open sea in the Bering Sea, Japanese research personnel conducted measurements and sampling similar to that done by U.S. observers.

(2) Landbased salmon driftnet fishery

It is quite difficult for the landbased salmon fishing vessels to bring refrigerated Dall's porpoise back to port because the period of their voyage is as long as one month and space in a vessel's hold and power for refrigeration are also limited. However, because biological information on Dall's porpoise in the landbased salmon fishing grounds is important, sampling efforts have been continuously made.

The landbased fishing vessels brought back 31 Dall's porpoise and one northern right whale dolphin during the 1984 fishing season which were kept frozen at Kushiro Fish Market. Those samples were thawed and biological measurements and collection of samples, such as teeth and internal organs, were subsequently made at Kushiro in late August. Cataloging and analyses of those samples are under way at the National Museum of Science.

(3) Salmon research vessels

Dall's porpoise incidentally taken in the research operations are usually measured biologically on board the research vessels. However, where no marine mammal observers were on board, the bodies were brought back to Kushiro as circumstances allowed so that the valuable samples could be obtained.

During the survey period, 1984 April to August, three research vessels brought back a total of 10 Dall's porpoise and one Harbor porpoise to refrigerator storage at the Kushiro Fish Market. Those samples were dissected together with the samples obtained from the landbased salmon driftnet fishery in late August and analysis of the samples are being made.

For Dall's porpoise incidentally taken during the second cruise of the research vessel the Kumamoto maru, a U.S. scientist on board the vessel was present at measurement and dissection and collected samples of stomachs, reproductive organs, and vertebrae, etc. for detailed study at the National Marine Mammal Laboratory.

(4) Survey on porpoise stocks in the North Pacific by the dedicated research vessel

Studies on Dall's porpoise incidentally taken by the salmon fisheries have been conducted since 1978 and biological and ecological findings have been accumulated. However, notwithstanding the much effort being exerted for sampling, it has been pointed out that the use of information only from fisheries which operate in limited areas and periods would result in some spatio-temporal biases in clarifying the whole life history of Dall's porpoise. Therefore, in 1982 and 1983, during the period August and September, after the high seas salmon fishing season, the dedicated research vessel conducted surveys in the northwestern North Pacific Ocean. As a result, new findings were

obtained such as the separate distribution by sex, mother-calf pairs and others, the reproduction ratio, and the age structure, etc.

In 1984, the dedicated vessel sampled Dall's porpoise with electric harpoons in the northwestern North Pacific Ocean west of 175°E during the "Survey on porpoise stocks in the North Pacific Ocean". The results provide supplementary data on Dall's porpoise on the fishing grounds for the landbased salmon fishery. An outline of the survey is as follows--

Period	1984 May 10 to June 20
Area	the northwestern North Pacific Ocean west of 175°E, north of 36°N, and ouside of the U.S. and U.S.S.R. 200 mile fishing zones
Research vessel	Hoyo maru No. 53, 224 GRT (chartered by Fisheries Agency of Japan)

During the survey cruise 1,871 Dall's porpoise were sighted and 187 Dall's porpoise (148 dalli-type and 39 truei-type) were captured. In addition, 21 Pacific whiteside dolphin and 10 northern right whale dolphins were obtained. For those porpoise, measurements of body lengths and body weights were made and during dissection, reproductive organs, internal organs, subcutaneous fat, skeletal structures, and teeth, etc. were sampled. Analyses are under way by different personnel for each aspect of the study.

Acoustic studies of Dall's porpoise

(1) Experiments in the water tank

Because Dall's porpoise is an oceanic animal, it was extremely difficult to catch Dall's porpoise and to keep them in water tanks for behavioral experiments. In 1984, the research group, which consisted of members from Nihon University, Kamogawa Sea World (aquarium), and

the National Research Institute of Fishery Engineering, succeeded in obtaining Dall's porpoise alive for the experiments in cooperation with the Konpira maru, pair purse seiners for mackerel (14 GRT each). At 0900 on May 7 the seiners discovered a group of 20 Dall's porpoise in an area 10 miles off Ose, Hitachi city, Ibaragi Prefecture (water temperature 7°C) and caught three Dall's porpoise with the purse seine. One of those (male, 158 cm in body length and 76.5 kg in body weight) was transported to the Oarai Aquarium nearby and accommodated there temporarily. It was subsequently transported to a water tank (8x12x3 m, water volume 230 t) in the Kamogawa Sea World during the night of May 9 for the purposes of health management and preparation for the experiments.

The experiments conducted in the water tank were: (1) recording of vocalization, (2) observation of responses to a rope set on the surface of the water and to suspended threads, and (3) observation of response to supersonic sound waves. Behavior to attempt to avoid the supersonic waves was observed in the experiment using supersonic pulses resembling those used in echo location (artificial echo location pulses). In spite of various attempts, for example placing one Pacific whiteside dolphin together with the porpoise in the tank, the porpoise did not become adjusted to feeding and died on May 18. Subsequent experiments were cancelled.

(2) Field experiments

(i) Sea of Okhotsk coast of Hokkaido

Dall's porpoise are known to migrate to the Sea of Okhotsk coast around the Shiretoko Peninsula in Hokkaido during summer. The oceanographic conditions are good in this season. Therefore, these areas at this season are suitable for various field experiments on Dall's porpoise. The research group conducted a survey on reactions of Dall's porpoise to supersonic sound waves in the foreshore of

Utoro, Shari town, as a continuation of experiments in the previous year. The experiments were conducted in two separated periods, during June 1 to 4 and August 14 to 16, in which three types of supersonic waves (24 kHz, 50 kHz, and artificial echo location pulses) were emitted towards the porpoise to observe their response.

(ii) Dedicated vessel for porpoise research

Since it is difficult to conduct experiments on Dall's porpoise in water tanks, every possible effort was exerted to attempt field experiments. The following experiments were conducted, taking advantage of the cruise of the Hoyo maru No. 53, the dedicated vessel for Dall's porpoise research, conducting the "Survey on porpoise stocks in the North Pacific Ocean" as mentioned earlier. The survey covered broad areas in the northwestern Pacific Ocean.

During the cruise of the Hoyo maru No. 53 from May 10 to June 20, recordings of vocalizations of Dall's porpoise and other porpoises, using underwater microphones, were made from May 12 to June 18. Emission of vocalizations of clicks of killer whales from an underwater speaker was also conducted.

(iii) Salmon and marine mammal research vessels

As a continuation from the previous year, various experiments on marine mammals were conducted on board the new Wakatake maru (424 GRT), a research vessel which was engaged in surveys on salmon and marine mammals in the Bering Sea. The survey of the Wakatake maru was from June 25 to August 8 and the experiments were conducted in conjunction with the experimental operations of salmon driftnets.

While the research vessel was stationary, supersonic sound waves were emitted towards Dall's porpoise swimming around the vessel from the artificial echo location generator and the reactions observed. The

frequencies used ranged from 20 to 50 kHz and the transmission mode was such that a pulse wave and an FM wave were emitted alternately every second.

Subsequently, experiments included the use of carbide guns. The influence of their use in deterring Dall's porpoise and on the catch rate of salmon was examined as was the reaction of Dall's porpoise to the carbide gun explosions. Detailed recordings were made on state of entanglements of Dall's porpoise in the salmon gillnets. During the cruise, sighting surveys were also conducted in order to clarify their ecology and behavior.

Gear modification experiments to avoid the incidental take of Dall's porpoise

The incidental take of marine mammals by the mothership salmon driftnet fishery in the U.S. 200 mile fishing zone in the North Pacific Ocean has been regulated by the Memorandum of Understanding between the Governments of Japan and the United States and related U.S. domestic regulations. In essence, the revised MOU in 1984 describes an action plan.

To comply with the plan much effort has been exerted to avoid incidental take of marine mammals and conduct basic studies on behavior and biological characteristics of Dall's porpoise using hydro-acoustic methods. Gear modification experiments have also been conducted in a practical application by the project team using actual catcher boats attached to the motherships. Twenty-five percent of all catcher boats were obliged to use the modified gears in the 1984 fishing season. In 1984, this condition was fulfilled. Experiments to avoid the incidental take of marine mammals by using sound generators were also continued.

(1) Gillnets modified with air tube threads

Three nylon threads in the central part of the salmon gillnet were replaced with three nylon air tube threads which were woven into the net so that the porpoise could easier detect existence of the net. This type of modified gear has been used experimentally since 1981 with some effects.

In 1984, a total of 44 catcher boats of four mothership fleets (11 catcher boats of each fleet) used these modified gillnets and operated throughout the fishing season (Test 1-1). This number is equivalent to 26% of all catcher boats. The numbers of incidentally caught Dall's porpoise by catcher boats which used the modified gillnets and those which used ordinary gillnets are shown in Table 6.

The catcher boats which used the modified gillnets operated randomly without distinction from ordinary boats in the fleet operations. Preliminary comparison showed that take rate per operation of Test 1 experimental vessels was about 8% less than the catch rate of ordinary vessels, which numbered 92[1].

(2) Experiments to avoid the incidental catch using supersonic generator

Because porpoises emit various sound waves while swimming, it is considered that if we generate supersonic waves with proper frequencies we can let porpoises detect the existence of salmon gillnets.

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[1] Total vessels in four fleets 172

Test 1 vessels	44
Test 2 vessels (described below)	12
Scout vessels	24
Ordinary vessels	92

Towards the practial use of the results which were obtained in the study described earlier in the section "Acoustic study on behavior of Dall's porpoise" three groups of catcher boats, different from those used in Test 1, were equipped with gillnets with three types of sound generators (one type of generator for each group) and catches were compared. The generators were attached to the gillnets at the same intervals.

Test 2-1; sound generators with 9 kHz frequency

This type of generator was developed at the early stage of the experiments. A total of four catcher boats (one from each fleet) used a total of 40 generators and carried a total of eight spare generators (two spares for each catcher boat).

Test 2-2; simple mode sound generators (145 kHz)

This type generates supersonic pulses with a frequency of 145 kHz and 1,000 times greater pulse width (50 milliseconds) than clicks of the Dall's porpoise. The pulses emitted from the generator stimulate the porpoises' auditory senses and the energy of the pulses interferes with their echo location and makes them cautious. One catcher boat of each fleet conducted fishing operations after attaching five generators to each set of salmon gillnets (a total of 20 generators for the four vessels) and each vessel carried one spare generator.

Test 2-3; dolphin mode sound generators (145 kHz)

Generators which emit supersonic waves similar to those used in echo location by Dall's porpoise were used. One catcher boat from each fleet used five generators (a total of 20) and carried one spare generator.

The fishing vessels using gillnets with one of the three types of sound generators totalled 12 in all. A total of 44 catcher boats used the air tube thread nets and thus 56 or 33% of the total fishing vessels participated in the gear modification experiments.

Although the number of the catcher boats which used the above three types of sound generators is small (four catcher boats for each type), some differences in frequency distribution of Dall's porpoise entangled were observed for vessels in Test 2-3 from those in ordinary gillnets.

(3) Others

As a continuation of studies in the previous year, the following observations were made to study the mechanism of entanglement of Dall's porpoise in the salmon gillnets; (a) the horizontal distribution of numbers of Dall's porpoise entangled in the nets, (b) states of entanglement, (c) changes in the numbers entangled by oceanographic conditions, (d) influence of entanglement on the catch of salmon.

Clarification of the mechanism of entanglement of Dall's porpoise enables development of more effective devices and better nets to avoid the incidental catch of Dall's porpoise.

TABLES 1 TO 6 ARE IN ENGLISH IN THE JAPANESE DOCUMENT