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February 6, 1987

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Mr. Gordon Waring
National Marine Fisheries Service
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Dear Gordon:

Enclosed is a draft of the gillnet section of our final report under contract NA-84-EA-C-00070. We are in the process of preparing a draft for the other fisheries we investigated, but wanted to forward this section to you because no significant additional work was done with the other fisheries since our April 1986 draft annual report, and because interactions between Phocoena and the groundfish gillnetting are of the most concern.

I want to emphasize the hazards of extrapolation of the reported take in our sample to the entire population of harbor porpoise. First, incidental take rates are not constant along the coast, and our permit holders were individuals who wanted the legal protection because they were experiencing significant incidental take. Second, not all groundfish gillnet effort overlaps porpoise abundance in either time or space. Third, the total reported by each fisherman represents a minimal estimate of his take. Fourth, fishermen having no marine mammal entanglements are not likely to report this zero take. Finally, there is a great annual variability in the effort, the local abundance of marine mammals, and the incidental capture rates.

We can say that Phocoena are the most frequently killed species in the groundfish gillnet fishery, and this take is the most common of any of the fisheries we have examined. We believe there is the potential in some years for exceeding the current quota of 180 listed in the small take exemption for this fishery.

We are not able to determine the impact of the incidental take of Phocoena on the population status because we do not know recruitment or mortality, and population estimates have wide confidence intervals. If the estimates are all correct, then the population would be able to withstand the take of most years. However, if the population estimates are high, the recruitment is lower than assumed, or if gillnet effort increases drastically, then the fishery will significantly impact the harbor porpoise population.

We look forward to your evaluation of the draft.

Best regards,

James R. Gilbert
Assoc. Prof. Wildlife

MARINE MAMMAL INTERACTIONS WITH NEW ENGLAND GILLNET FISHERIES

Introduction

Worldwide, gillnet fisheries are among those most frequently involved in direct conflicts with marine mammals. Several pinniped species are known to scavenge gilled fish from surface gillnets, often becoming ensnared in the process and damaging the gear (Miller 1981, DeMaster et al. 1982, Fowler 1982, Everitt and Beach 1982, Beach et al. 1985, Montgomery 1986).

Large numbers of cetaceans and pinnipeds are incidentally captured in gillnets annually. Salmon driftnet fisheries were reportedly responsible for the annual entanglement of 10,000 porpoises (*Phocoenoides dalli* and others) in the North Pacific (Ohsumi 1975) and 1500 harbor porpoises (*Phocoena phocoena*) off Greenland (Lear and Christensen 1975). Anchored (set) gillnets are also known to entangle cetaceans (Matkin and Fay 1980, Lien 1981, Mead 1981, Smith et al. 1983, Montgomery 1986). An estimated 40,000 small cetaceans in Sri Lanka (Ailling 1985) and half the marketed cetaceans observed in Peru by Read et al. (1985) were reportedly taken incidental to other gillnet fisheries.

In New England, drift and anchored gillnets are used in fisheries for demersal and pelagic finfish. Here, as elsewhere, gillnetting effort often coincides with areas of marine mammal abundance due to the overlapping foraging patterns of the mammals and target commercial fish species (Gaskin et al. 1984). Under these conditions, incidental marine mammal captures are inevitable and often unavoidable. Observations of Endangered cetaceans towing net fragments in New England waters (MMEP unpub rept. 1986) have generated concerns that local marine mammal populations may be threatened by both active and derelict gillnet gear. Gillnet fisheries therefore, were among the New England fisheries most thoroughly investigated during the survey of marine mammal-fishery interactions in New England conducted by the University of Maine (UMO) between 1981 and 1986 with funding from the Northeast Fisheries Center, NMFS/NOAA, Woods Hole, MA.

This report summarizes results from the investigation of marine mammal interactions with three New England's gillnet fisheries.

Among the objectives of this research were to:

1. describe New England's gillnet fisheries
2. identify the marine mammals currently or potentially involved in direct conflicts with these fisheries
3. determine spatial and temporal patterns associated with these interactions
4. identify potential mitigation measures where applicable

DRIFT GILLNETS

Driftnets have been used as an effective means of harvesting swordfish in portions of Georges Bank and the Gulf of Maine since the early 1980's. Since then, fewer than 8 vessels have used driftnets in any year. Most of these boats use gillnets as a secondary technique, complimenting their primary harvest techniques, longlining and harpooning (P. Gerritor, NMFS, pers. commun.)

Swordfish gillnets are typically constructed of 18 in (46cm) mesh polyfilament twine and are strung together to form nets approximately 1.4 mi long (2.3 km) and 60 ft (18.2m) deep. The nets are attached to the vessel, suspended at a depth of approximately 24 ft (7.3m), and left to fish overnight. Nets are set near the surface in waters with depths of between 600 and 3600 ft (183-1098 m) and are most effective from June to October.

The potential exists in this fishery for incidental capture of several "offshore" odontocete species. Informal reports from swordfishermen suggest that occasional pilot whales (Globicephala melaena) and "large dolphins" become entangled in these nets. Although the species of dolphins involved is uncertain, those which could be expected in these waters include: the Atlantic white-sided dolphin (Lagenorhynchus acutus), common dolphin (Delphinus delphis), and white-beaked dolphin (L. albirostris) (CeTAP 1981, Katona et al.1983). There is currently no means by which to determine the species or number of marine mammals which are caught incidental to swordfish gillnet activities.

With the resettlement of the U.S./Canada boundary on Georges Bank, swordfishermen lost the right to fish in areas that were suited to the use of gillnets. Although gillnets were used there by as many as 8 New England swordfishermen in 1985, closure of this area appears to have reduced swordfish gillnetting effort in New England significantly in 1986 (P. Gerritor, NMFS, pers. commun.). Although there are currently no means available by which to document gillnetting effort by New England's swordfishermen, it appears to be both limited and of decreasing intensity.

ANCHORED GILLNETS

A. Mackerel gillnets

Description

Surface gillnets are used in a winter fishery for mackerel in Cape Cod Bay. Mackerel gillnets are typically constructed of 2" (5.1cm) mesh monofilament twine and are 100-

200 feet (30.5-61m) long and 15 feet (4.6m) deep. In Cape Cod Bay, each boat sets 5- 20 nets which are left to fish untended overnight.

Because they fish the waters frequented by wintering aggregations of harbor seals (*Phoca vitulina* and odontocetes (*Phocoena phocoena*, *L. acutus*, *G. melanus*), these gillnetters were reported to experience gear damage, fish loss, and incidental marine mammal captures. In order to document the nature and extent of marine mammal interactions with this fishery, project personnel interviewed a small fleet of mackerel gillnetters on Cape Cod in the winter of 1981/82.

Survey Methods

Our sample included five mackerel gillnetters that fished from November 1981 to early January 1982. The number of boats actively fishing varied daily depending on the abundance of mackerel, their market value, and sea conditions. Though a small fleet, the gillnetters sampled accounted for approximately 20% of the 1980 Massachusetts mackerel landings (R. Schultz, NMFS, pers. commun.)

Interviews were conducted as mackerel were landed (dockside sample) and at-sea while working aboard active boats (at-sea sample). At-sea sampling provided a means for directly observing fishing activities, collecting data from entangled animals, and developing open communication with the fishermen. Several fishermen agreed to maintain a daily record of fishing effort, gear and fish damage, and marine mammal sightings and entanglements.

Results

The mackerel landed by these fishermen were marketable only when intact and unmarred (i.e. damage = loss). Several of these gillnetters attributed loss of netted fish to scavenging by gulls, seals, and squid. Two fishermen reported negligible loss of fish to seals. The remaining three reported an estimated loss of 0.3% of the total season's landings. The proportion of seal-damaged fish harvested was greatest in the week when landings were lowest. Gillnetters also reported net damage due to marine mammal collision or entanglement. The maximum financial loss to each boat reporting gear damage was estimated to be \$525, not including lost fishing time.

Four fishermen reported the entanglement of 24 marine mammals (3 species), representing one entanglement per 62.5 net-days (net-day = each day a net was left in the water, tended or not). Of these, seven were dead when removed; the remainder were reportedly released unharmed. The remaining gillnetter reported no incidental marine mammal take. Atlantic white-sided dolphins, harbor porpoise, and harbor

seals accounted for 14, 9, and 1 of the entanglements, respectively (Table A).

One entanglement was observed during 8 at-sea samples representing one entanglement per 70 observed net-days. The animal, a male harbor porpoise was caught near the floatline in a net approximately 1.5 miles (2.4km) from shore.

The frequency of marine mammal mortality in mackerel gillnets (avg. 1.4/boat/season) documented here was far less than perceived by local biologists prior to the study (4-10/boat/season, S. Mayo, pers. commun.). The number of entanglements per net-day reported by the gillnetters (1:62.5) was 11 % lower than the take rate estimated during at-sea observations (1:70).

Assuming proper species identification, the number of Atlantic white-sided dolphins incidentally taken (10 alive, 4 dead) by this sample of gillnetters is the highest documented to date for a New England fishery.

B. Groundfish gillnets

Description

Gear:

Anchored gillnets are used in New England to fish for groundfish species, including cod, hake, pollock, haddock, etc. Nets are anchored to set just off the bottom in water depths of 35-100 fathoms (64 - 183m). They are constructed of monofilament twine with a stretched mesh length of 5 1/2 " - 6 1/2" (14 cm -16.5cm). As many as 20 individual nets, each measuring 15 ft x 300 ft (4.6m x91.5m), are linked together to form "strings" approximately 1 mile (1.6 km) long.

The majority of New England groundfish gillnetters are "day boats" that travel up to 25 miles (15.5km) offshore daily to haul and reset their gear. These boats are typically 34 ft to 50 ft (10m to 15m) in length and can be refitted for use in other fisheries (Acheson et al. 1980). Some larger vessels from Portland, Gloucester, and Cape Cod fish for 3 - 5 days at a time offshore on Cashes and Fippinies Ledges (Fig. A). Both tonnage and undertonnage vessels are involved in groundfish gillnetting in New England; NMFS port agents record their landings and effort separately. Vessels are classified as tonnage if they exceed 5 gross tons capacity or are federally documented.

Number/effort:

The number and effort of each tonnage vessel gillnetting in

New England is recorded in the NEFC/NMFS data base. The statistics for all undertonnage vessels, however, are combined and not individually recorded. We were able to determine the number of undertonnage vessels gillnetting in Maine and New Hampshire only by examining monthly landings data by port.

The number of groundfishermen actively gillnetting varies regionally, seasonally, and annually. The maximum number of tonnage gillnetters landing groundfish in MA, NH, and ME during a single month of 1984 was 64 (Fig. B). The concentration of these boats was greatest in Gloucester, Portland, and New Hampshire ports, accounting for 32.8, 21.9, and 20.3 % of the effort, respectively.

Groundfish gillnet effort varies seasonally in New England depending on the local abundance of groundfish, market value of alternative fish species, and weather conditions. Although a few gillnetters fish throughout the year, monthly effort differs markedly from Massachusetts to eastern Maine (Fig. C). Groundfish gillnetting effort in MA and NH follows a bimodal pattern, with peaks in spring and fall. In Maine, gillnet effort is spread throughout the year in southern ports but becomes an increasingly summer-based fishery east of Portland.

Effort also varies annually throughout New England. Because most vessels can be easily refitted for other fishing activities, gillnetting is often a transitional or interim fishery for many fishermen. Acheson et al. (1980) reported that only 65.5 % of Maine gillnetters relied on gillnetting as their primary source of income. Many of these fishermen engage in scalloping, lobstering, or trawling on a seasonal or annual basis when groundfish are scarce or of little value. Between 1982 and 1986, for instance, a total of ten different gillnetters fished from one sampled port in Maine, ranging from 2 to 8 in each year. Of these, however, only one boat (10%) had netted in each of the five years, two (20%) had netted in only one of the five years, and the remaining 7 (70%) had netted in two or three of these years. Switching from gillnetting to other fisheries is less common in southern New England (NH and MA) ports (Acheson et al. 1980).

In Maine and New Hampshire, the total number of tonnage and undertonnage gillnetters decreased between 1984 and 1986.)) NMFS data to come {{{

Marine mammal interactions:

Potential marine mammal interactions with this fishery include entanglement of cetaceans and seals and the resulting damage to nets (Gilbert and Stein 1981). Predation on netted fish has not been reported as a significant loss.

As a preliminary survey of marine mammal interactions with this fishery, phone interviews were conducted with 17 Maine

groundfish gillnetters (Fig. A) in 1982 . Four gillnetters contacted through these interviews were interviewed regularly while unloading their catch. A total of 4 at-sea samples were made aboard their vessels in 1982.

Marine mammals were reported as an insignificant source of fish loss and gear damage by 13 of the 17 gillnetters interviewed. Three gillnetters fishing on Jefferies Ledge and near Matinicus Is. (Fig. A) reported occasional damage to nets from whale and "dolphin" collisions. Six reported that shark damage was a greater problem and that entangled dolphins rarely ruined a net.

Entanglement of cetaceans or seals was reported by all but two gillnetters interviewed by telephone. Their combined response suggested an average of 118 "dolphins" and 22 seals are entangled annually by these 17 gillnetters. Averaged by coastal region, the reported incidental take of marine mammals was lowest in the south-coastal and greatest in the mid-coastal regions (Fig. A). The average entanglement rate reported by the 3 east-coastal gillnetters contacted was intermediate.

The cetaceans reported entrapped in nets were termed, by fishermen, either "whales" or "dolphins"; few attempted to identify small cetacean species. All entrapped mammals were reportedly dead when recovered from the nets. The number of entanglements was reported to vary between years, with particularly high incidental take rates in certain years (S. Mercer, pers. commun.). One gillnetter noted a positive correlation between inshore bluefish abundance and marine mammal entanglement rates, speculating that both resulted from atypical local prey abundance.

Quantifying Incidental Take

From these preliminary surveys, it became evident that at least two species of marine mammals (harbor seals and harbor porpoise) had the potential to become entangled in groundfish gillnets in New England. The species involved and the level of take could not be legally ascertained, however, because no legal exemption to the Marine Mammal Protection Act of 1972 (MMPA) existed for this fishery.

Until 1979, East coast fishermen were covered under General Take permits to the MMPA granted to West coast fishing associations (Gilbert and Stein 1981). Since then, East coast fisheries had applied for their own Permits and amendments to the MMPA incidental take exemptions had been enacted (Fed. Reg. FR 48(240): 55493-55496). As a result, groundfish gillnetters bore no legal exemption from the MMPA and could not, therefore, legally report their incidental

marine mammal captures.

In order to quantify incidental take levels and identify the species involved, we applied for a small take exemption to the MMPA on behalf of this fishery. This permit, effective February 1984, originally set annual incidental take quotas for harbor seals and harbor porpoise of 50 and 180, respectively. These quotas represent 0.3-0.4% of the estimated 10,500-15,000 harbor seals (Gilbert and Stein 1981, Katona et al. 1983) and 1.0-2.6% of the estimated 7,000-18,000 harbor porpoise (Kraus et al. 1983) present in New England. This exemption was amended in August 1984 to allow the cumulative take of 50 individuals of five additional species (*Halichoerus grypus*, *L. acutus*, *L. albirostris*, *D. delphis*, *G. maleana*).

The small-take exemption was made available to New England groundfisherman free of charge. Those receiving a permit were supplied with a logbook in which to record their marine mammal interactions and a description of the species covered by the permit (Fig. D). Logbooks were collected from participating gillnetters at the end of their fishing season.

Results

Permits were distributed to 11 gillnetters in 1984, 22 in 1985, and 11 in 1986. Permit distribution focused on ports where incidental captures were reported to be most frequent from phone and dock-side interviews. Gillnetters were personally contacted and the terms of the incidental take exemption and logbooks were explained. During initial dockside contact, four gillnetters reported that their incidental captures were so infrequent that they did not feel the need for the legal coverage provided by the permit, and declined to take a permit. Many of these were "trip" boats which fish offshore 4-5 days at a time. Logbooks were returned anonymously to UMO at the end of each year. Log return rates were 63.6, 59.1, and -- % for the years 1984-1986, respectively.

All marine mammals captured in groundfish gillnets were reported to be dead when retrieved from the gear. In 1984, 39 captures were reported, including 30 harbor porpoise (15F:14M:1?), 5 harbor seals (2F:2M:1?), and 4 grey seals (2F:1M:1?). In 1985, 117 marine mammal captures were logged by 13 fishermen, including 107 harbor porpoise (28F:28M:41?), 6 white-sided dolphins (2F:2M:2?), and 4 harbor seals (2F:1M:1?). An additional 50-60 cetacean captures were verbally reported for 3 fishermen. Although the species' identities were uncertain, many were believed to be harbor porpoise. The compilation of 1986 returns is incomplete; at the time of this writing 11 marine mammal captures had been reported by 5 gillnetters. Individual variability in gillnetter effort precludes the determination of net-days of effort for the fishery and, consequently, a

calculation of marine mammal capture rates in terms of net-days of effort.

Based on log returns, incidental captures occurred in water depths ranging from 28 to 58 fathoms (51.2 - 106.1 m) and up to approximately 25 miles (40.2 km) offshore. Captures were most frequently reported from gillnetters fishing on Jefferies Ledge, around Matinicus Island, and near Mt. Desert Rock (Fig. A). These areas are seasonally important sites of both groundfish and marine mammal concentrations. The apparent preponderance of incidental captures in these areas may be biased by the distribution of gillnet activity and our sampling strategy.

Carcass necropsy

The benefits of legal exemption of these fishermen from the MMPA extended beyond the acquisition of their incidental marine mammal capture reports. With this permit, gillnetters were also able to voluntarily transport marine mammal carcasses to shore for necropsy by University personnel, as authorized under Scientific Collection Permit No. 431. This allowed the collection of biological data from specimens legally taken incidental to commercial gillnetting operations. Examination of carcasses provided information on the age, sex, health, food habits, and reproductive condition of the animals being entangled. From this we were able to identify the portion of each population being affected by net-related mortality.

As a result of gillnetter cooperation, 57 of the 146 (39%) marine mammals reported in logs in 1984 and 1985 were collected for necropsy. In 1984, 25 of the 39 (64%) mammals retrieved from nets were necropsied, including 21 harbor porpoise (11F:10M) and 4 harbor seals (2F:2M). In 1985, 32 of the 107 (29.9%) marine mammals reported in logs were available for necropsy, including 28 harbor porpoise (14F:14M), 2 Atlantic white-sided dolphins (1F:1M), and 2 harbor seals (1F:1M). Thirteen carcasses were necropsied in 1986, including 12 harbor porpoise (4F:8M) and 1 harbor seal (1F:0M) (Table C).

The sexual maturity of each specimen was estimated based on total body length, gonadal examination, and tooth eruption. Individuals were identified as mature, immature, or uncertain without additional data (Table D). All 7 harbor seals (4F:3M) recovered from these nets and necropsied were pups. Both of the white-sided dolphins collected in 1985 were sexually immature but apparently greater than 1 year old. Of the 29 female porpoises examined between 1984 and 1986, 16 (55.2%) were immature, 11 (37.9%) were mature, and 2 (6.9%) were of questioned maturity (Table D). Of the 32 male porpoises examined, 17 (53.1%) were immature, 11 (34.4%) were mature, and 4 (12.5%) were of undetermined maturity (Table D). Teeth were extracted from each animal for later sectioning

and counting of incremental growth layers (Gaskin and Blair 1977).

At-sea observations

An additional benefit resulting from the gillnetters acquisition of a legal exemption to the MMPA was our ability to observe gillnet activities while accompanying them at sea. This enabled us to observe specific conditions of mammal entanglements, verify species' identification and estimate incidental take rates based on observed rates. Although all gillnetters possessing a small-take permit volunteered to allow UMO personnel onboard to observe their fishing activities, vessel size and scheduling conflicts limited our sampling to 4 vessels each year in 1984 and 1985. All boats sampled fished with 3 or 4 strings of up to 20 nets each. We observed the retrieval of 601 and 474 nets on these boats in 1984 and 1985, respectively.

No marine mammals were recovered from nets observed in 1985; 6 (4 *P. phocaena* and 2 *H. grypus*) were observed in 1984. Combined, the observed capture rate was 6 marine mammal captures per 1175 net-days, or an average of 1 per 195.8 net-days.

The characteristics of each gillnet string, including depth, location, predominant fish species caught, and haul/set times were recorded along with marine mammal observations recorded at sea. Characteristics of nets which did and did not capture marine mammals were compared; non-capture data for 1984 and 1985 are grouped (Table E). Physical characteristics of the strings involved in marine mammal by-catch are not obviously different from those which did not capture marine mammals.

Potential mitigation measures were identified based on at-sea observations of gillnet activities. The capture of marine mammals in this gear appears to occur as the nets are set. This hypothesis is supported by the fact that all mammals retrieved from the gear were dead and that fishermen reported having set nets while large "schools of dolphins" were swimming/feeding at the surface. If this is true, several mitigation measures may effectively reduce the frequency of entrapment in the descending nets, including modification of gear deployment and use of acoustical deterrents. The use of heavier end-anchors would sink the net quicker, reducing the amount of time the net is in the water column. Delaying net deployment until the surface is free of cetaceans would hamper fishing activities but likely decrease the potential for entangling mammals at the surface. While acoustic deterrents have met with limited success in may be enhanced here by their infrequent deployment on mammals that are not being directly attracted to the fishing

gear. The effectiveness of electronic deterrents, broadcast from the fishing vessel as it sets nets, should be tested in New England.

CONCLUSION/DISCUSSION

Net damage and fish robbing were not reported to be a major economic concern to gillnetters interviewed in this survey. Gillnets, however, were found to entangle both pinnipeds and cetaceans in New England waters. Although occasional collisions of large cetaceans with gillnets were reported, their direct mortality is apparently low in this gear. Pinniped and small odontocetes were found to entangle in both surface and bottom gillnets.

The gillnet fisheries vary in their potential effect on marine mammal populations in New England. Because of their length and location, swordfish surface gillnets would be expected to take large numbers of offshore odontocete species. Because effort is relatively limited and apparently decreasing, this fishery is not currently considered a major source of marine mammal mortality in New England. Surface mackerel gillnets were found to incidentally capture Atlantic white-sided dolphins when set coincident with areas of inshore winter abundance. Because many of the animals could be released unharmed and the fishery is limited in both size and duration, the incidental mortality of white-sided dolphins in this fishery is likely insignificant to the population [CeTAP (1982) estimate = 36,281 +/- 19,027, 95%CI]. The observed rate of marine mammal entanglement in groundfish gillnets (per net-day) was nearly one third that observed for mackerel nets. Effort in this fishery, however, is yearround in areas and seasonally coincident with marine mammal abundance. Harbor porpoise are reportedly the most frequently captured and killed mammals in this gear. For these reasons, the incidental capture of harbor porpoise in groundfish gillnets was identified as the greatest potential conflict between marine mammals and New England's gillnet fisheries.

This investigation represents a preliminary attempt at quantifying incidental marine mammal captures in New England. The potential incidental mortality of Phocoena in bottom gillnets may range from 30 - 600 per year in New England, based on interpretation of fishermen's reports. This minimum figure was derived by assuming that the lowest annual take of Phocoena reported by sampled gillnetters (30) was the total for the fishery. This is obviously underestimated by a limited sample size and reporter bias. The maximum figure, on the other hand, was derived by averaging take per-gillnetter sampled over 3 years (5.1 porpoise/gillnetter) and assuming a constant take for each of New England's 90 - 120 gillnetters. The estimate of

per-gillnetter take rates are biased upward by our sampling strategy. Offshore boats with no marine mammal bycatch were under-represented and gillnetters with high take were over-represented in our sample, since those experiencing problems were more likely to seek legal coverage and report their take. For these reasons, we believe neither extreme is realistic and that annual take rates fall somewhere between these figures. These extremes, however, serve to illuminate the potential extent of this conflict and need for further investigation.

Neither our incidental take estimates nor current population estimates are adequate to determine the impact of gillnet-related mortality on the harbor porpoise population. Incidental take is difficult to assess in this fishery because both gillnet effort and incidental take vary annually, regionally, and seasonally. Gillnetters are scattered along the coast making individual contact logistically improbable and the NMFS data base does not currently allow the determination of effort by undertonnage gillnet vessels. Although capture rates reported voluntarily in logbooks are subject to reporter bias, it is important to maintain a monitoring system for this fishery despite its statistical shortcomings.

Even given an accurate estimate of incidental mortality, its effect on the porpoise population in New England cannot be determined without more reliable census and population data. Although studied extensively in the Bay of Fundy since the 1970's, definitive information on the distribution, abundance, and population discreteness of harbor porpoise in the Gulf of Maine and Bay of Fundy is lacking. Abundance estimates for Phocoena in New England waters are based on a single ship survey (Kraus et al. 1983), the interpretation of which has been debated (D. Gaskin, Univ. of Guelph, pers. commun.). In addition, the discreteness of stocks from the Bay of Fundy and Gulf of Maine remains undetermined. Comparable porpoise mortality reported in the Bay of Fundy gillnets (Smith et al. 1983, A. Read, Univ. of Guelph, pers. commun.) would represent additional mortality in this population if these stocks are inseparable.

The incidental take reports suggest that in certain years, the groundfish gillnet fishery has the potential to exceed the annual quota of 180 porpoise allowed in the MMPA exemption. This quota was based on conservative estimates of recruitment rate (1.0 -2.6%) in a population estimated at 7000 -18,000. An allowable incidental take level should be reassessed using updated estimates of population recruitment and abundance.

The effects of fishing-related mortality on Phocoena in the northwest Atlantic warrant further investigation. This is a fairly short-lived species whose population dynamics are poorly understood. Incidental mortality could become a significant

burden on this population if 1) gillnet effort and take increase substantially, 2) current estimates of reproductive potential are unrealistically low, or 3) the current population level has been overestimated. All three elements should be investigated and potential, practicable mitigation measures should be sought to reduce existing take levels.

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Table A. Fishing effort, and marine mammal interactions reported during the 1981-82 mackerel season by 5 Cape Cod gillnetters.

Gillnetters Interviewed	Fishing Effort		Marine Mammal Interactions				
	Number of Fishing-days	Net-days	Number of mm Holes	No. (%) of landed Fish	Loss \$ Value ²	Entanglements Dead	Entanglements Alive
'A'	27	582	7	125 (0.3)	38	3	5
'B'	20	389	1	340 (0.8)	102	1	4
'C'	11	200	0	0	0	0	0
'D'	9	136	0	Negligible	0	3	0
'E'	10	193	7	90 (0.3)	27	0	8
	77	1,500	15	555 (0.3)	167	7	17

¹ Measure of gear damage attributed to marine mammals.

² Based on average dock price of 20 cents/pound mackerel and average fish weight of 1.5 pounds.

Table C. Summary of the marine mammal species reported by New England groundfish gillnetters and necropsied by UMO personnel, 1984-1986.

Year	Species	No. Reported	No. Necropsied (sex ratio)
1984	<u>Phocoena phocoena</u>	30	21 (11F:10M)
	<u>Phoca vitulina</u>	5	4 (2F:2M)
	<u>Halichoerus grypus</u>	4	0
1985	<u>Phocoena phocoena</u>	97	28 (14F:14M)
	<u>Phoca vitulina</u>	6	4 (2F:2M)
	<u>Lagenorhynchus acutus</u>	4	2 (1F:1M)
1986*	<u>Phocoena phocoena</u>	12+	(4F:8M)+
	<u>Phoca vitulina</u>	1+	(1F)

* Incomplete returns.

Table D. Approximated sexual maturity of *Phocoena* specimens collected from 1984 to 1986 based on macroscopic gonadal examination, body length, and tooth eruption.

	1984	1985	1986	Total
	-----	-----	-----	-----
FEMALES N =	11	14	4	29
Immature	7 (63.6%)	6 (42.9%)	3 (75%)	16 (55.2%)
Mature	3 (27.3%)	7 (50%)	1 (25%)	11 (37.9%)
Uncertain	1 (9.1%)	1 (7.1%)	0	2 (6.9%)
collection dates	20 June- 19 Sep	7 June- 9 Oct	11 June- 9 Sept	
MALES N =	10	14	8	32
Immature	5 (50%)	6 (42.9%)	6 (75%)	17 (53.1%)
Mature	4 (40%)	6 (42.9%)	1 (12.5%)	11 (34.4%)
Uncertain	1 (10%)	2 (14.3%)	1 (12.5%)	4 (12.5%)
collection dates	22 June- 19 Sept	22 June- 10 Nov	11 June- 9 Sept	

Table E. Characteristics of gillnet strings observed with and without marine mammal (mm) bycatch during at-sea sampling of the groundfish gillnet fishery, 1984 and 1985. All nets were constructed of 6"-6 1/2" monofilament webbing.

Characteristic		Strings with mm bycatch (N = 5)	Strings without mm bycatch (N = 54)
Mesh Depth	range	47-55 fathoms	40-78 fathoms
	mean	52.3 fathoms	58.2 fathoms
# days since tended	range	1 - 3 days	1 - 2 days
	mean	1.67 days	1.08 days
Species Composition ^a of fish caught in string			
	Cod	4 (80%)	26 (48.1%)
	Flatfish	1 (20%)	3 (5.6%)
	Dogfish	1 (20%)	8 (14.8%)
	Hake	2 (40%)	10 (18.5%)
	Mackerel	0	2 (3.7%)
	Pollock	0	7 (13.0%)
	Misc. ^b	0	1 (1.9%)

^aNumber and (%) of strings in which these fish species represented at least 40% of the haul, as determined by visual estimate of the number of fish landed.

^bMisc. = sea ravens, sculpins, goosefish, etc.

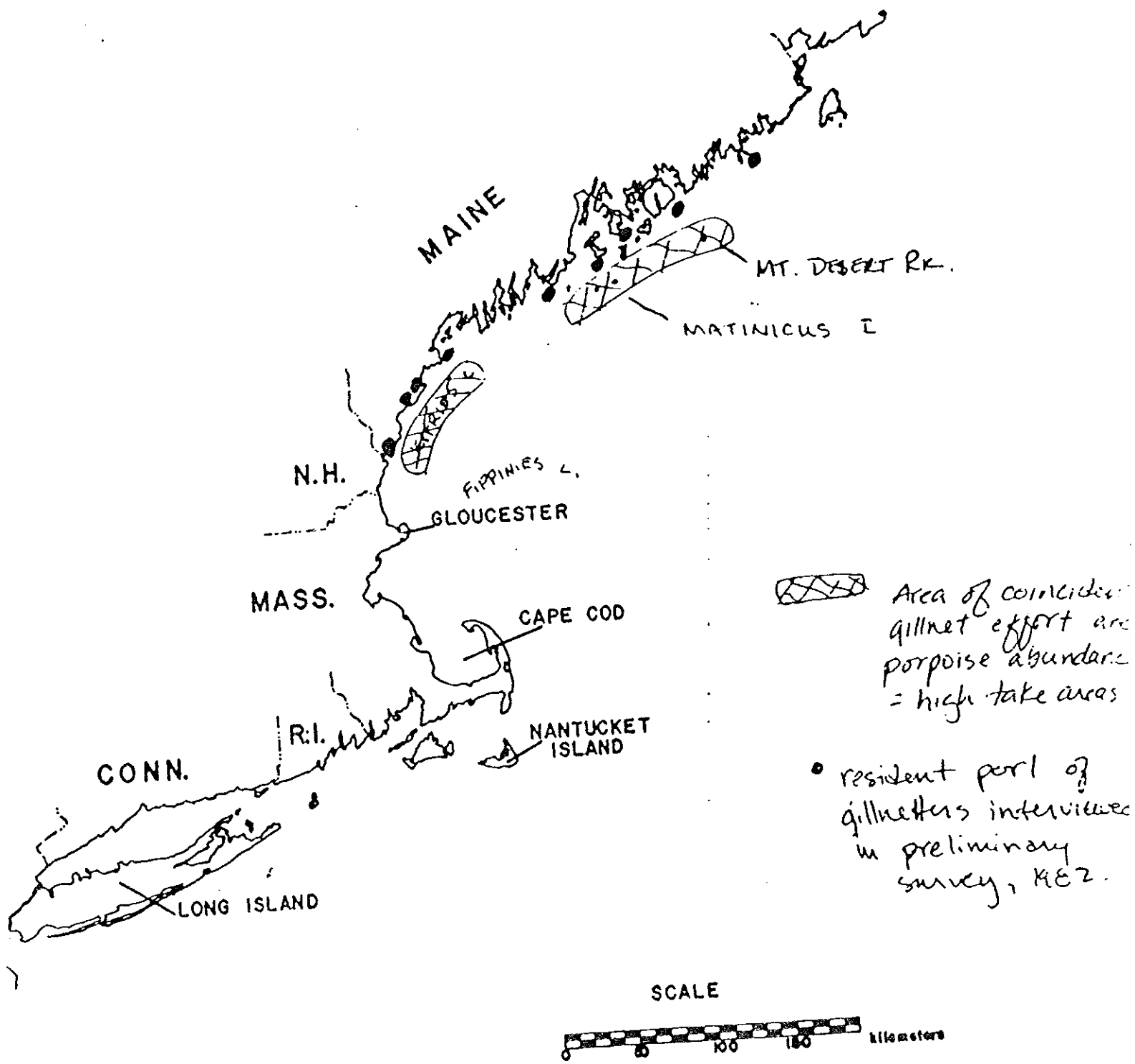


Figure A. Distribution of Maine gillnetters interviewed in 1982 and locations of gillnet effort. Areas where significant conflicts with porpoise occur are cross-hatched.

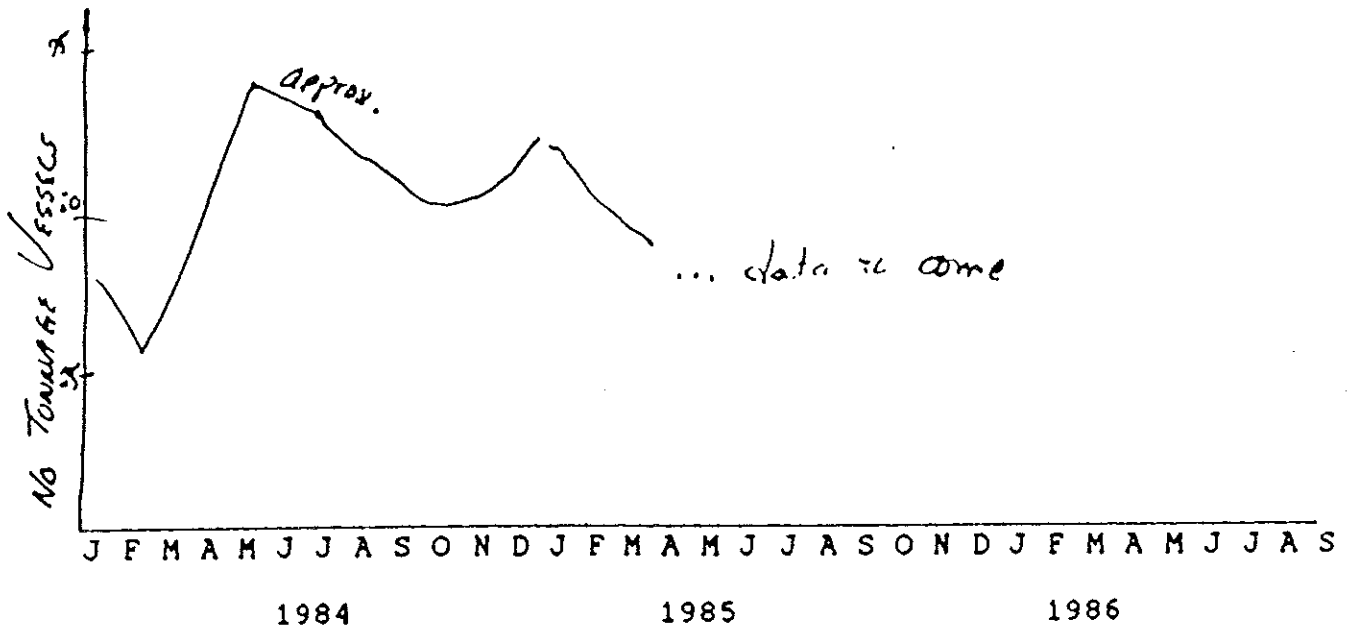


Figure B. Total number of tonnage groundfish gillnetters fishing in Maine, New Hampshire, and Massachusetts.

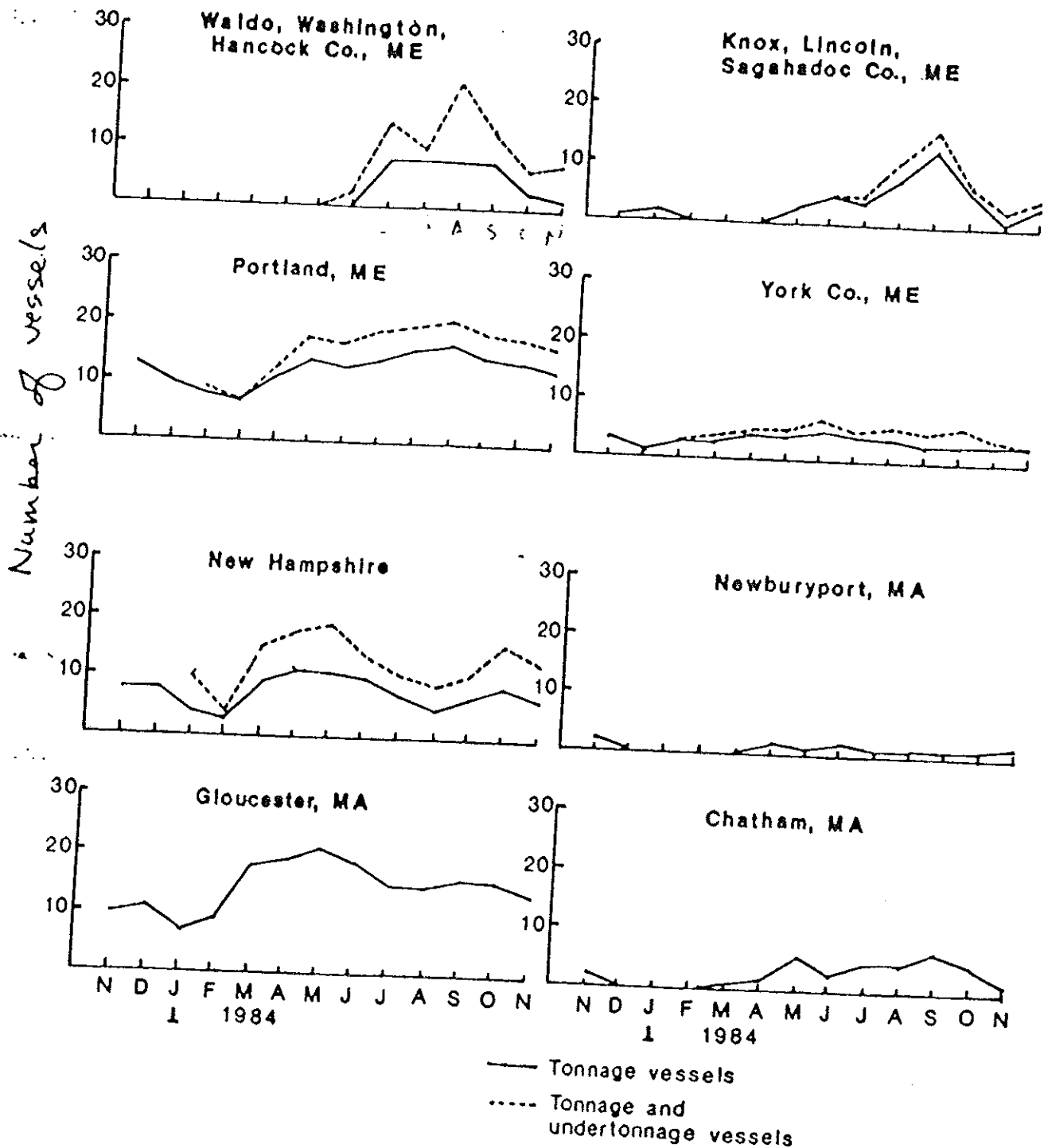


Figure C. Seasonal Variation in gillnet effort in New England Ports, 1984. (1985 and 1986 data to be data when current (1986) effort data is available from NMES)