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Proceedings of the Workshop on Precision and Timeliness Issues in Recreational Fisheries Management

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Proceedings of the Workshop on Precision and Timeliness Issues in Recreational Fisheries Management

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Preface

Funding for this project was provided by a cooperative grant between the Atlantic States Marine Fisheries Commission and the U.S. Fish and Wildlife Service through the Federal Aid in Sport Fish Restoration Program (Grant No. 14-48-0009-94-1256).

Acknowledgements

This proceeding document is the result of a workshop convened by the Atlantic States Marine Fisheries Commission on July 13, 1994 in Annapolis, Maryland. The initial workshop agenda was developed by the members of the Commission's Marine Recreational Fisheries Statistics Committee. The Commission would like to acknowledge the members of the precision/timeliness steering committee for providing essential input into the development of this workshop: Mr. Ronald Essig, Mr. Nick Nicholson, and Dr. Lisa Kline. The Commission would like to extend its appreciation to workshop presenters for making this workshop a success. Species reports on stock status and management were prepared by the species Plan Review Teams of the Commission and by Richard Christian.

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Executive Summary

The Workshop on Precision and Timeliness Issues in Recreational Fisheries Management was convened by the Atlantic States Marine Fisheries Commission on July 13, 1994 in Annapolis, Maryland. This workshop was designed to evaluate the use of target precision levels in fisheries management, and to provide a consensus on recommended target precision levels and timeliness of data availability for five priority species. Summer flounder, winter flounder, red drum, weakfish, and bluefish were chosen for evaluation by the Commission's Marine Recreational Fisheries Statistics Committee. These species were chosen on the basis of their importance as recreational species and on the basis of stock decline.

Current levels of precision and sampling effort in the National Marine Fisheries Service's Marine Recreational Fishery Statistics Survey (MRFSS) were evaluated for each species. The focus of the workshop discussions was on geographic range and natural history of each species, evaluation of recent trends in state harvest ratios, and evaluation of the management regime for each species.

The management unit for summer flounder is from Maine through North Carolina. Current levels of precision for summer flounder are less than 15 percent on a coastal and sub-regional basis. In 1992 and 1993 the majority of states harvesting more than one percent of the total coastwide harvest has proportional standard errors (PSE) of less than 20 percent. Based on this information, workshop participants and the MRF Statistics Committee recommended that: 1) the coastwide PSE should not exceed 20 percent, 2) for states that harvest more than 10 percent of the total coastwide harvest, PSEs should range between 10-20 percent, and 3) for states that harvest between one percent and 10 percent of the total coastwide harvest, PSEs should range between 20-30 percent. It was recommended that data should be available by April 1 for stock assessment purposes and February 15 for management purposes.

The management unit for winter flounder is from Maine through Delaware. Current levels of precision for winter flounder are less than 13 percent on a coastal and sub-regional basis. In 1992 and 1993 the majority of states had PSEs of greater than 20 percent. Based on this information, workshop participants and the MRF Statistics Committee recommended that: 1) for states that harvest more than 10 percent of the total coastwide harvest, PSEs should range between 10-20 percent, and 2) for states that harvest between one percent and 10 percent of the total coastwide harvest, PSEs should range between 20-30 percent. It was recommended that data should be available by March 1 for stock assessment purposes and April 15 for management purposes.

The management unit for red drum is from the New Jersey/New York state line through Florida. Current level of precision for red drum are less than 9 percent for the Atlantic Coast and the South Atlantic region. PSEs for the Mid-Atlantic region are greater than 35 percent, however, sample size are extremely low due to red drum being harvested

at the extremes of its range. In 1992 and 1993 PSEs for the states of North Carolina through Florida were less than 20 percent. Based on this information, workshop participants and the MRF Statistics Committee recommended that: 1) for all South Atlantic states, PSEs should range between 10-20 percent. It was recommended that data should be available by March 1 for stock assessment purposes and April 15 for management purposes.

The management unit for weakfish is from Massachusetts through Florida. Current levels of precision for weakfish are less than 15 percent for the Atlantic Coast, the Mid-Atlantic region, and the South Atlantic region. PSEs for the New England region are greater than 40 percent, however, sample sizes are extremely low due to weakfish being harvested at the extremes of its range. Based on this information, workshop participants and the MRF Statistics Committee recommended that: 1) for states that harvest more than 10 percent of the total coastwide harvest, PSEs should range between 10-20 percent, and 2) for states that harvest between one percent and 10 percent of the total coastwide harvest, PSEs should range between 20-30 percent. It was recommended that data should be available by March 1 for stock assessment purposes and April 15 for management purposes.

The management unit for bluefish is from Maine through Florida. Current levels of precision for bluefish are less than 10 percent on a coastal and sub-regional basis. In 1992 and 1993 the majority of states harvesting more than one percent of the total coastwide harvest has proportional standard errors (PSE) of less than 20 percent. Based on this information, workshop participants and the MRF Statistics Committee recommended that: 1) for states that harvest more than 10 percent of the total coastwide harvest, PSEs should range between 10-20 percent, and 2) for states that harvest between one percent and 10 percent of the total coastwide harvest, PSEs should range between 20-30 percent. It was recommended that data should be available by March 1 for stock assessment purposes and April 15 for management purposes.

The Commission's Marine Recreational Fisheries Statistics Committee recommended that the technical committees of the five identifies priority species (red drum, winter flounder, summer flounder, weakfish, and bluefish) examine the historical MRFSS database after completion of the MRFSS re-estimation procedure to determine the time-series to be used in the calculation of the specific state harvest proportions and evaluate the effects of individual state target proportional standard errors (PSE) on coastal PSE's.

Introduction

The National Marine Fisheries Service (NMFS) has conducted the Marine Recreational Fishery Statistics Survey (MRFSS) for collection of catch, effort, and participation data on recreational species annually since 1979. The published literature, as reviewed during this workshop, includes many references to precision requirements of recreational statistics necessary to support fishery management decision making and monitoring of recreational fisheries. The majority of publications cite a target level of precision of 15-20 percent. This target level of precision is relatively arbitrary and may vary depending on the manner in which the fishery is managed. There is only one case on the Atlantic Coast where a precision level has been required for compliance to the fishery management plan. Under striped bass adaptive management as described in Amendment 4, key producer states are required to supplement the MRFSS to achieve a 20 percent coefficient of variation (proportional standard error).

Use of target precision levels for recreational statistics would benefit interjurisdictional fisheries management by encouraging states to monitor recreational fisheries at a consistent and comparable level along the Atlantic Coast. An issue of equal importance to precision levels is the timeliness of data dissemination and finalization to support stock assessments and fishery management decisions. This workshop was designed to address issues concerning both precision and timeliness of recreational fisheries statistics.

The Commission's Marine Recreational Fisheries Statistics Committee developed the Workshop on Precision and Timeliness Issues in Recreational Fisheries Management to provide consensus on recommended target precision levels and dates for data dissemination for both stock assessment and fisheries management. The committee focused these activities on five priority species: summer flounder, winter flounder, red drum, weakfish, and bluefish. These species were chosen for their importance as recreational species and on the basis of stock decline and need for management. Current levels of sampling effort and precision were evaluated for each species. Based on discussions by workshop participants on the natural history, recent state harvest ratios, and geographic range of each species, target levels of precision were recommended. The recommendations for precision levels and time deadlines for availability of preliminary data will be forwarded to the Commission's Statistics Policy Committee and to each of the Commission's species technical committees for implementation.

This workshop also evaluated the use of optimization techniques to allocate add-ons to the MRFSS telephone and intercept surveys as a method of increasing precision. Details of this method are included in the MRFSS User's Manual, Atlantic States Marine Fisheries Commission Special Report No. 37.

Risk and Uncertainty Versus Precision

Joseph Powers, Ph.D.
National Marine Fisheries Service
Southeast Region

This report provides background information on a study conducted by Joseph Powers and Victor Ostreco on the balance between risk and uncertainty versus precision, and summarizes experiences in the Southeast Region in relation to use of recreational statistics in fisheries management. In the Southeast Region, the recreational component is a large part of fisheries management for king and Spanish mackerel, red drum, and red snapper. The history of recreational statistics began in 1979 with the National Marine Fisheries Service's initiation of the Marine Recreational Fisheries Statistics Survey (MRFSS). The commercial data time series in much longer than the recreational time series and can provide some conjectures concerning the recreational component. Stock assessment biologists and fisheries managers must deal with the uncertainty in recreational statistics due to the short time series of data.

Management of Gulf of Mexico king mackerel involves three fishery components: recreational, commercial, and bycatch. The recreational component of the fishery, measured in catch in numbers, is larger than the commercial component over the history of the fishery. The bycatch in weight of fish is mainly due to the shrimp trawl fishery and is relatively small. The management process for king mackerel in the Gulf of Mexico involves an annual stock assessment which began in 1985. Recommendations are made by a panel of scientists about the allowable biological catch, with uncertainty expressed as a range in values. The fishery management councils choose a total allowable catch within that range for management purposes. King mackerel is a recovering stock with the overall management goal being to increase spawning biomass and spawning potential ratio (SPR) to an acceptable level.

The allowable biological catch (ABC) is an estimate with an associated variance, which provides an estimate of the biological risk. The associated socio-economic factors are dealt with by the Councils in setting the total allowable catch (TAC). The assessment attempts to directly evaluate the variability within the estimates. Six factors account for the variability of the ABC: 1) variability in the total catch, 2) variability in the bycatch, 3) variability in catch at age, 4) variability in natural mortality, 5) variability in the indices of abundance used as tuning indices in the model (mainly catch-per-unit effort indices), and 6) variability in projections of recruitment.

The purpose of the study conducted by Powers and Ostreco was to evaluate the differences in precision and how they affect the precision of the estimate of ABC (the decision point). A distribution of ABC estimates was calculated based on a Monte Carlo simulation of existing levels of precision. Fisheries managers can choose within this

distribution when setting the TAC. A value above the 50 percent level is beneficial to the fishermen, but detrimental to the fish stock. A value below the 50 percent level (risk adverse) is beneficial to the fish stock, but has a detrimental effect on the fishermen.

This study also evaluated the effects of research programs and precision of the individual components affecting the distribution of ABC and the choices managers would make in the TAC categories. The status quo level of research was evaluated against a research program designed to reduce the proportional standard error by 50 percent, produce a 50 percent reduction in indices and a 50 percent reduction in catch-at-age proportions. The relative research costs on a relative basis were also included in the analysis. The results indicated that a research program would reduce the uncertainty in the overall ABC estimate. A 50 percent reduction in overall catch would significantly affect the overall distribution and affect the range of ABC and TAC. A 50 percent reduction in catch estimates reduced the variation in ABC from 40 percent to 24 percent. In general, the dominant portion of the variability in catch estimates for king mackerel on an annual basis from the MRFSS was about 25-30 percent in the early years of the survey. A 50 percent reduction in catch estimates would provide for a proportional standard error of 15-20 percent. The expected yield varies little, except for a skewed distribution, since we are dealing with issues of precision not accuracy. A benefit of collecting more data is that bias will be reduced.

For a given probability of overfishing, research can allow for an increase in expected yield due to an increase in the tails of the distribution. For a given probability of expected yield, research will decrease the probability that fisheries managers will exceed that TAC. If funding levels increase, the error bars (variability) about the estimates will narrow. When data collection procedures change, things react in predictable ways. From a management perspective, research limits the variability in terms of the tails of the distribution. Given that management is based on a risk adverse manner, there is a great benefit to increased funding for research. If managers manage in a risk adverse manner, the narrower distribution allows for greater precision. However, if managers manage in a risk prone manner, surplus is lost and recovery time will increase.

Overall precision of the decision point is of interest to fisheries managers and not the precision of the catch statistic. Acceptance of precision of overall catch statistics is dependent on the management measures being considered. Annual quota and quota monitoring implies a different level of precision. When monthly quota monitoring was implemented for king mackerel, there was a high cost associated with it. Cost of monitoring needs to be considered in conjunction with the need for increased levels of precision.

Review of Target Precision Levels
Used in Fisheries Management

Nick Nicholson
Coastal Resources Division
Georgia Department of Natural Resources

and

Ron Essig
U.S. Fish and Wildlife Service

Atlantic States Marine Fisheries Commission. May 1992. Addendum II - Required Monitoring Programs: Changes to Required Monitoring Programs, Supplement to the Striped Bass FMP - Amendment #4.

> "Under adaptive management as described in Amendment 4, monitoring programs provide the information to continuously tailor management regulations to stock status. As the information base grows, so does knowledge of information needs. The tables in this addendum outline the current information needs, and designate monitoring programs which will fill these needs...."
>
> From Table 1, "Study Category: Catch and Effort; Needs and General Guidelines: track mortality in a general way, VPA; states named should supplement NMFS MRFSS to achieve 20% CV, or may propose specialized striped bass surveys to better assess harvest. MRFSS without supplementation may be used by other states with a recreational fishery; Responsible Agencies: NMFS, MA, RI, CT, NY, NJ, MD, VA, PRFC."

Bayley, Peter B., Stephen T. Sobaski, Michael J. Halter, and Douglas J. Austen. 1991. Comparisons of Illinois creel surveys and the precision of their estimates. In Creel and Angler Surveys in Fisheries Management. Am. Fish. Soc. Sym. 12:206-211.

> "A major goal of creel surveys is to obtain acceptable precision in angling effort and harvest estimates at minimal cost... The required precision for estimates depends on the program's goals. Analyses of trends for long-term series do not require as high a precision as do short-term management decision. The relative precision values for effort are about twice as good as those for harvest. If values within $\pm$ 20% are deemed satisfactory for management purposes, this will include 31 of 33 creel surveys reported here. In contrast, the relative precision values for harvest estimates need improvement, especially because values for individual species tend to be higher. If values within $\pm$ 20% are regarded as acceptable for management, then the sampling percentage for the current design needs to be about 60-70% when combined with a stratification percentage of at least 60%."

Connecticut Department of Environmental Protection. 1988. A study of marine recreational fisheries in Connecticut, 1984-1988. Federal Aid Project F-54-R final report.

> "The MRFSS telephone survey estimates total recreational fishing trips with good precision (CV < 20%)...From 1979 through 1988, annual marine recreational fishing trips have been estimated from the telephone survey data with adequate precision (CV < 20%)...Population estimates of marine anglers are derived from the telephone survey, however, the relative precision of these estimates was generally poor (CV > 30%)...Unlike the mean number of saltwater anglers, the estimates of total trips were computed with good precision (CV < 20%)...Estimated directed trips provided trends in angler effort for blackfish, bluefish, scup, summer flounder and winter flounder with very good precision (CV < 12%)"

Essig, Ronald J. and Mark C. Holliday. 1991. Development of a recreational fishing survey: The Marine Recreational Fishery Statistics Survey case study. In Creel and Angler Surveys in Fisheries Management. Am. Fish. Soc. Sym. 12:245-254.

> "The 1973 Moshman study surveyed NMFS headquarters and management staff, NMFS fisheries centers and laboratories, state government personnel, nongovernment marine biologists, industry personnel, and members of the Interstate Marine Fisheries Commissions. ...A sampling error of about 15% was acceptable to most of the respondents. "
> Moshman Associates. 1973. User needs for marine sport fishing data and statistical collection plans. Final Report to National Marine Fisheries Service, Washington, DC.

Everhart, W. Harry and William D. Youngs. 1981. Principles of Fishery Science, Second Edition. Cornell U. Press, London, UK. 349 p.

> "...some prior knowledge of population is necessary ... The 50 percent level of precision is suggested for surveys while the 25 percent level is recommended for management studies." This is in reference to estimating population size.

Gulland, J. A., ed. 1988. Fish Population Dynamics, 2nd Edition. John Wiley & Sons, London, G.B. 422 p.

> "...compared to most ecological questions, fisheries assessment questions often need answers which are quite precise: $\pm$ 20% rather than order of magnitude answers. However, it is not always realized that a higher degree of precision (e.g. $\pm$ 5%) is seldom needed. The result can be either that excessive efforts are used to get unnecessary precision, or, more frequently, data are not collected because it is felt that 'precise' information cannot be obtained."

Gunderson, Donald R. 1993. Surveys of Fisheries Resources. John Wiley & Sons, Inc. New York, NY. 248 p.

> "A more reasonable alternative to setting a rigid variance requirement, then determining the sample sized required, is to calculate the precision attainable with a number of different sample sizes given appropriate estimates of variance. The goal here is to gain some idea of the sensitivity of precision to alternative sample sizes that may be used. A common finding is that above a certain threshold, increases in sample size result in only marginal increases in precision."

Laevastu, Taivo, and Herbert A. Larkins. 1981. Marine Fisheries Ecosystem: Its quantitative evaluation and management. Fishing News Books, Ltd., Surrey, Great Briton. 162 p.

> "Grosslein (1976) has shown that, in general, the accuracy of estimates based on trawling survey results is at best $\pm$ 50%."
> Grosslein, M. D., 1976. Some results of fish surveys in the mid-Atlantic Bight, important for assessing environmental impacts. Am. Soc. Limnol. and Oceanogr. Spec. Symp. 2:312-328.

Lester, N. P., M. M. Petzold, and W.I. Dunlop. 1991. Sample size determination in roving creel surveys. In Creel and Angler Surveys in Fisheries Management. Am. Fish. Soc. Sym. 12:25-39.

> "... To develop meaningful indices, a standard level of precision is necessary. An arbitrary precision level of 20% has been recommended for monitoring Ontario FAU lakes."
> OMNR (Ontario Ministry of Natural Resources). 1978. Designation of assessment units. Report of Strategic Plan for Ontario Fisheries Working Group 1. OMNR, Toronto.

Malvestuto, Stephen P. 1993. Sampling the recreational fishery. In Fisheries Techniques. Amer. Fish. Soc., Southern Printing Co., Inc., Blacksburg, VA 468 p.

> "Keep in mind that even if catch and effort information collected is accurate, it will be of little value for documenting change in the fishery unless it is also precise. Strive to keep relative standard errors as small as possible; values in excess of 20% are not desirable."

Nielsen, Larry A., and David L. Johnson, eds. 1983. Fisheries Techniques. Am. Fish. Soc., Southern Printing Co., Inc., Blacksburg, VA. 468 p.

> "Two characteristics of sampling data - accuracy and precision - describe the value of the data. Accuracy refers to how well the sample represents the whole. ....

Precision of sampling data refers to repeatability. Statistics like standard deviations and quartile ranges are measures of precision. In general, the narrower the "confidence interval" around an estimate made from a sample, the more likely you are to get a similar result if you take another sample in the same way. Collecting highly precise data usually requires extensive sampling effort as well as a careful design.
...Formulas for calculating the optimum size and number of sampling units can be found in statistical design texts.
...The number and size of sampling units, ..., will be a compromise between the precision and cost of the data. Generally, more sampling units mean lower variance in the data and, therefore, higher precision.
...Pope (1981), for example, argues that for important fisheries, managers would like to have absolute population estimates with coefficients of variation of 10-20%. It is conceivable that for fishes which are very highly exploited and have very tight coupling between recruitment and population size, such precision might be needed. Most fisheries, however, do not warrant the cost of such precision even if achievable because of natural variation in the production process."
Pope, J.G. 1981. Practical guidelines for the precision of assessment data. International Council for the Exploration of the Sea CM 1981/G:13.

Osborn, Hal R. 1986. State of Texas Marine Recreational Fishing Survey -- Design, implementation, and use of the data. In: Lazauski, Henry G., ed. 1986. Proceedings of the statistical symposium: "Design, collection, and assessment of angler volunteered information programs". Gulf States Marine Fisheries Commission. Mobile, AL. Number 14:10-15.

"The number of days that we survey (marine recreational harvest monitoring) each season is the result of a sample size estimation based on data from past years. The variances from original survey landings estimates were used to calculate a sample size which would provide annual landings estimates for each bay system with coefficients of variation of no more than $\pm$ 10 percent."

Osborn, Maury, ed. 1992. Proceedings: Workshop on marine "for-hire" recreational fisheries survey methodology. Report of the Data Mgmt. Sub., GSMFC. 30 p.

"The actual attainable level of monitoring depends on various factors, including the importance of the fishery, the level of cooperation among Federal and State fishery management agencies, and budgetary constraints. Different levels of coverage and precision engender different levels of risk when making management decisions. A desirable level of precision is defined as a 15% to 20% proportional standard error (the standard error of an estimate divided by the estimate and multiplied by 100) with an α of 0.05."

Shepherd, J. G. 1984. The availability and information content of fisheries data. pp 95-109. IN: May, R. M., editor. 1984. Exploitation of Marine Communities. Springer-Verlag, Berlin, West Germany. 366 p.

> "... not all the data (from fishing surveys) is likely to be of uniformly high quality. Coefficients of variation on the order of 10% on catch-at-age or abundance indices would be considered excellent. Thirty percent would be more usual, and coefficients of variation exceeding 50% are not uncommon. Not all of this variability is due to inadequate sampling - a substantial part may be due to natural variability."

Sigler, William F. and John W. Sigler. 1990. Recreational Fisheries: Management, Theory, and Application. U. Nevada Press, Reno, Nevada. p 418.

> "In creel survey work the terms accuracy and precision are often incorrectly used interchangeably. Precision is a measure of the repeatability of an estimator; in other words, if the precision is high, the values determined are spread closely around the expected value of the parameter being determined. Accuracy is a measure of the closeness of an estimate to the true population parameter. It is possible to have high precision but low accuracy. Inaccuracy may be due to chance variation and/or bias.... Because precision is so important to creel sample surveys, any mechanism to increase it is valuable."

Issues Affecting Precision

Maury Osborn
National Marine Fisheries Service

1. Sample Size Considerations

Within the telephone and intercept portions of the MRFSS there are dual sources of variability, related to the total sample size and the sample size of "hits". Within the telephone survey total sample size is measured as the number of coastal households contacted, while the number of "hits" is the total number of households that actually have saltwater fishing activity. The total number of households with fishing activity affects the variance, especially when there are very few "hits" in a stratum. Within the telephone survey, 10 percent or less of the households contacted have saltwater fishermen. Within the intercept survey, the total sample size is the total number of anglers intercepted, while the sample size of "hits" is the total number of anglers that actually caught a species.

Sample size is a major factor affecting variance. Several states add sample size to the MRFSS, which results in an increase in precision. States in the Southeast have been sampled at a rate of 2.5 times the original MRFSS base since 1992, resulting in improvements in precision. For example, Florida has a total telephone survey sample size of approximately 50,000 households, and a sample size of "hits" of approximately 3-4,000 per year. The majority of Atlantic coastal states have total sample sizes of less than 10,000 households. Sample sizes in the Southeast Region have been increased to 2.5-times the base level, as compared to the Northeast Region.

2. Charter/Party boat Fishing

The number of fishing trips is expanded to total trips through the use of coastal/noncoastal ratios. In the charter/party boat mode, often there are very high ratios of non-resident anglers. This may have a major effect on the variance about the estimates in certain cells. The high variances are dampened by pooling resident ratios for a five-year period.

3. Life History Characteristics

When evaluating precision levels it is important to consider the life history of the species. For example, rare species or pulse fisheries will have higher variances than common species and fisheries. Seasonality and migratory behavior will also affect precision levels, since catches will not be evenly distributed among all states and/or waves of fishing. The range of the species must also be considered when evaluating precision levels. An increase in sample sizes in states or areas at the extreme ranges of a species distribution may not provide a compensatory increase in precision levels.

4. Management Regulations

Bag and size limits may tend to improve precision by narrowing the range of catch and size distributions. A quota management regime may increase variances by narrowing the temporal distribution of catches, similar to a pulse fishery.

5. Fishing Activity

Waves 1 and 6 will typically have higher variances due to a decrease in the level of fishing activity as compared to waves 3-5. In some states in the Northeast region, wave 2 also has very low fishing pressure and thus higher variances.

Summer Flounder

Summer Flounder Stock Status and Management

Family: Bothidae

Genus and Species: *Paralichthys dentatus*

Description: The summer flounder is a left-eyed flatfish. The eyed side always blends in perfectly with the sea bed. There is usually a scattering of 10 to 14 eye-like spots on the body. As in other flatfish, the blind side is white and relatively featureless. The teeth are well developed on both sides of the jaws.

Largest Recorded: The maximum length reported is almost 4 feet, with a weight of 26 pounds.

Range: The geographic range of summer flounder encompasses the estuarine and coastal waters from Nova Scotia to Florida. The center of its abundance lies within the Mid-Atlantic region. The southern and gulf flounders occur from North Carolina southward and often are not distinguished from summer flounder, especially in the commercial fishery.

Natural History: Summer flounder normally inhabit coastal and estuarine waters during the warmer months of the year and move offshore to depths of 120 to 600 feet during the fall and winter. Spawning begins at about age 2 or 3 and occurs during the fall and winter while fish are moving offshore or on their wintering grounds. Larvae and post-larvae drift and migrate inshore, entering coastal and estuarine nursery areas from October to May. The fry seek the bottom on reaching the coast, and the first year or two are spent in estuaries over the entire range of the species. Summer flounder grow to about 9 inches during their first year, reach 13 inches at the end of their second year, and 16 inches at the end of their third year.

I. Status of the Fishery Management Plan

The original Summer Flounder Fishery Management Plan (FMP) was adopted by the Commission in 1982 and by the Mid-Atlantic Fishery Management Council in 1988. Since then, five amendments have been developed. The objectives of the summer flounder fishery management plan as amended are:

1. Reduce fishing mortality in the summer flounder fishery to assure that overfishing does not occur.

2. Reduce fishing mortality on immature summer flounder to increase spawning stock biomass.
3. Improve the yield from the fishery.
4. Promote compatible management regulations between State and Federal jurisdictions.
5. Promote uniform effective enforcement of regulations.
6. Minimize regulations to achieve the management objectives stated above.

States participating in the summer flounder management program include the states from North Carolina through Maine except Pennsylvania.

II. Status of the Stock

Based upon NMFS Northeast Fisheries Science Center spring survey indices, stock biomass is currently at the lowest average level since the late 1960's early 1970's, and is about one-third of the level observed in the mid 1970's. Spring survey indices (mean weight/tow) rose from a low point in 1970 to a peak in 1976, was at an average level during the late 1970's and early 1980's, and then declined drastically from 1985 to 1989 before increasing from 1990 to 1992. Fishing mortality rates are currently about 1.1 (NMFS 1992), well in excess of the Fmax of .23.

The survey indices and VPA results indicate that stock abundance, and hence the catches, are currently being sustained primarily by fish at age 2 and younger. At present, as a direct result of the high rate of fishing mortality, both recreational and commercial catches of summer flounder reflect this age class composition. Individuals of this species have previously been known to live up to 20 years, yet older and larger fish are now rare in the landings. This situation indicates a severely compressed age composition of the stock, which poses a great risk to recruitment because the older, more fecund spawning adults are being removed too rapidly from the population.

The current Fmax of 0.23 corresponds to a spawning stock biomass per recruit level of 12%. Current F levels (about 1.1) equate to a spawning stock biomass per recruit level of about 2-3%.

III. Status of the Fishery

Commercial landings in 1992 were 7,302 metric tons (MT), an increase of 18% relative to the 1991 level (6,200 MT), and 74% greater than the low 1990 level (4,200 MT) (Figure 1). These values are well below the average landings of 11,300 MT during 1982 - 1990. The greatest landings during that period occurred during 1984 (17,000 MT).

The recreational fishery for summer flounder harvests a significant proportion of the total nominal catch of this species, and in some years, recreational landings have exceeded

the commercial landings (Figure 1). Recreational landings in 1992 were 3,400 MT about the same as in 1991, but a 50% increase over the low 1990 landings. During the period of 1982-1990, recreational landings averaged 8,200 MT, with highest reported landings occurring in 1983 (16,400 MT). Recreational harvest in number of fish occurs from Massachusetts through Florida, with the majority of recreational harvest occurring in New York, New Jersey and Virginia in 1992 and 1993 (Table 1). In 1992 and 1993, New Jersey accounted for over 51 percent of the coastwide harvest.

Table 1. Recreational harvest of summer flounder by state from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS), 1992-1993. Harvest is measured as the number of Type A + B1 fish.

State	1992 Harvest	Percent 1992 Harvest	1993 Harvest	Percent 1993 Harvest
ME			120	0.003
NH			230	0.005
MA	50,533	1.14	85,488	1.85
RI	77,817	1.75	75,291	1.63
CT	104,084	2.34	45,366	0.98
NY	464,929	10.46	898,640	19.50
NJ	2,345,084	52.77	2,361,840	51.24
DE	247,634	5.57	265,197	5.75
MD	293,723	6.61	134,131	2.91
VA	704,255	15.85	490,182	10.63
NC	149,894	3.37	238,008	5.16
SC	5,759	0.13	11,789	0.26
GA	519	0.01		
FL			3,301	< 1.00
Total	4,444,230		4,609,583	

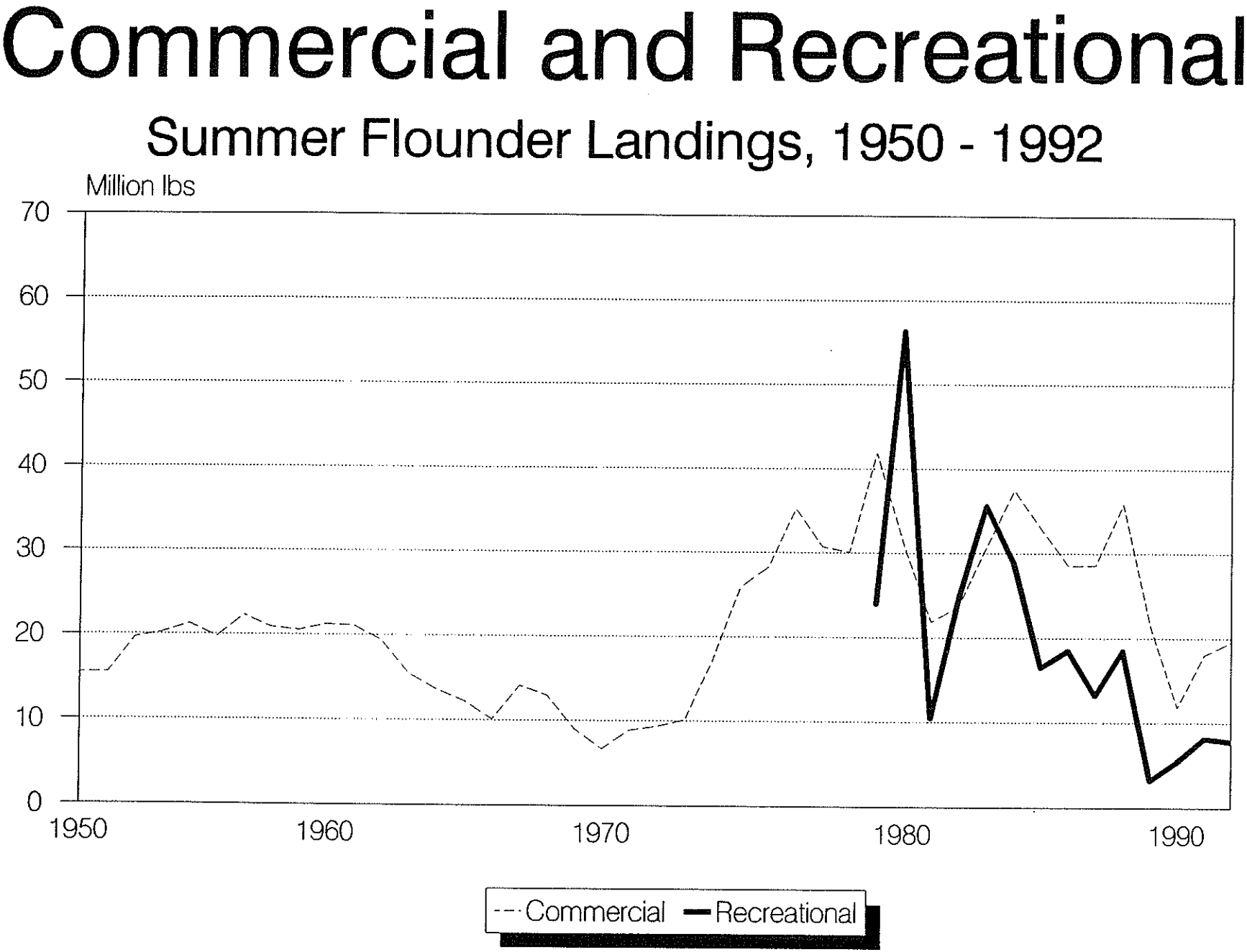

Figure 1. Recreational and commercial landings of summer flounder, 1950-1992.

IV. Status of Management Measures

Management measures imposed upon harvesters of summer flounder include annual quotas, minimum sizes, minimum mesh requirements, permits and administrative costs for dealers and vessels, a moratorium on entry into the fishery, mandated use of sea samplers, monitoring of sea turtles in the southern part of the management unit, and collection of data and record keeping by dealers and processors.

Annual commercial quotas were implemented in all states beginning on January 1, 1993. Minimum sizes which comply with the FMP are in effect in all states within the management unit, and cod end restrictions are in effect in Maine, New Hampshire, Massachusetts, New Jersey, and North Carolina. Total closures are imposed on mobile gear in New Hampshire and Delaware. As of May 28, 1993, Maine had attained its commercial quota and harvesting ceased. New Hampshire prohibited the landing of summer flounder. Due to a significant bycatch of sea turtles in the winter trawl fishery, a sea turtle conservation requirement has been added to Amendment 2.

A minimum size limit of 14 inches with a six-fish possession limit has been established for the recreational fisheries. In addition, an annual, coastwide recreational fishing season has been established for the period of May 15 to September 30.

V. Commission FMP Recommendations

1. 14" recreational size limit
2. 13" commercial size limit
3. Commercial quota
4. Recreational season (May 15-September 30)
5. Six (6) fish bag limit
6. 5 1/2" mesh size

Sample Sizes and Precision for Summer Flounder

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and

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The overall MRFSS coastwide sample size for summer flounder is approximately 3,000 intercept interviews. Current proportional standard errors for the Atlantic Coast and by subregion are below 13 percent (Table 2).

Table 2. Current levels of precision and sample sizes for summer flounder for the Atlantic Coast and by subregion, 1992 and 1993 MRFSS data.

Region	1992		1993	
	PSE	N	PSE	N
Coastal	4.0	2800	4.5	2850
New England	12.2	250	11.0	250
Mid-Atlantic	4.5	2200	5.0	2300
South Atlantic	8.1	200	6.7	500

In 1992, states that harvested more than one percent of the total coastwide recreational harvest of summer flounder (Table 1) had PSE's of less than 20 percent, with the exception of Massachusetts (Figure 2). Massachusetts harvested 1.14 percent of the coastwide harvest and had a PSE of 21.2 percent. South Carolina and Georgia harvested only 0.13 and 0.01 percent of the coastwide harvest for summer flounder, resulting in much higher PSE's (36.1 and 72.1 percent, respectively). Intercepts where anglers caught summer flounder for South Carolina and Georgia were extremely low, at 10 and less than 5 interviews, respectively.

In 1993, states that harvested more than one percent of the total coastwide harvest for summer flounder (Table 1) had PSE's less than 20 percent (Figure 3). Maine, New Hampshire, South Carolina, and Florida harvested less than one percent of the coastwide harvest and had PSE's greater than 39 percent. Samples with summer flounder for these states were less than 10 interviews.

Summer Flounder 1992

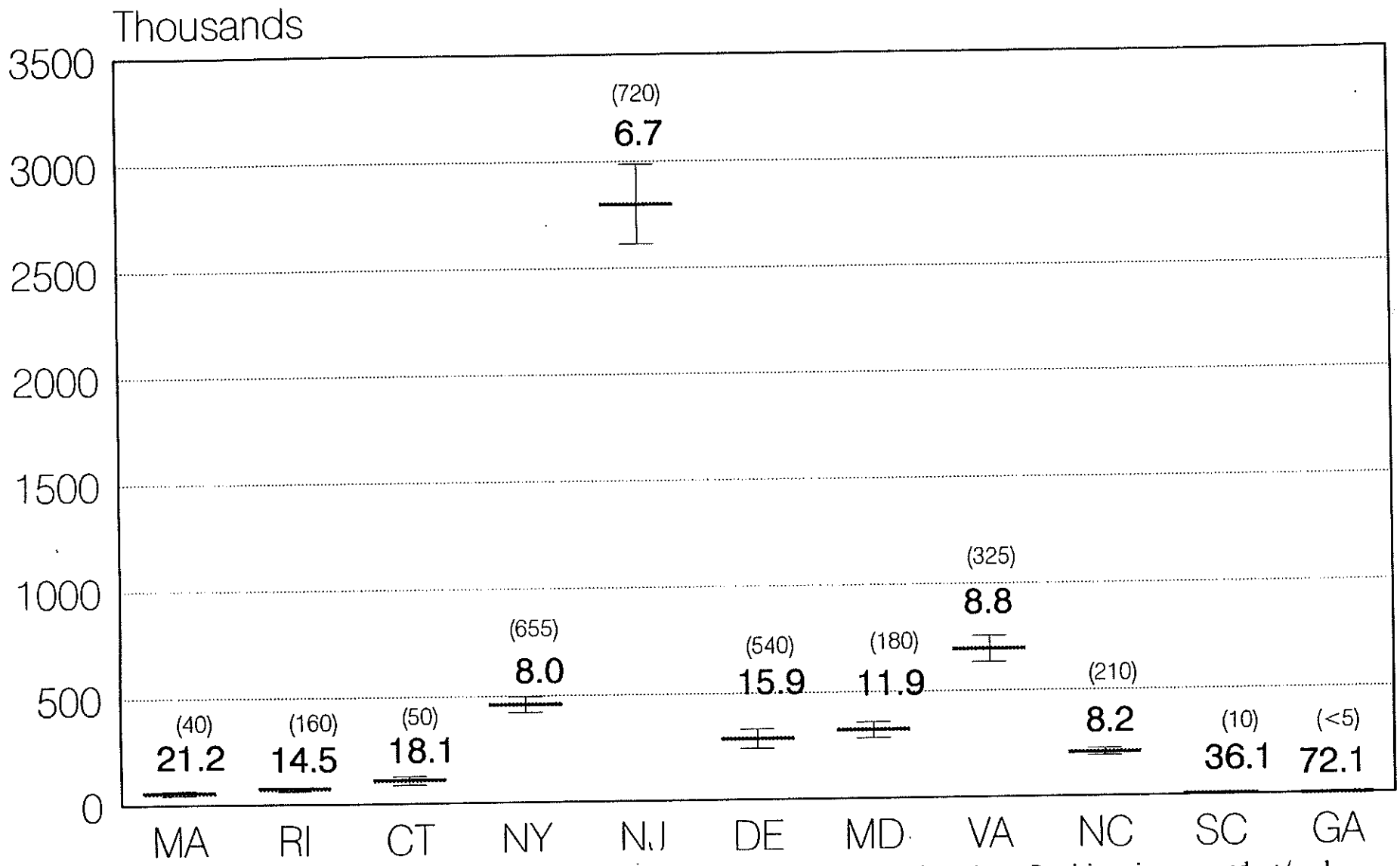

Figure 2. Current levels of sampling effort and precision by state for summer flounder. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1992.

Summer Flounder 1993

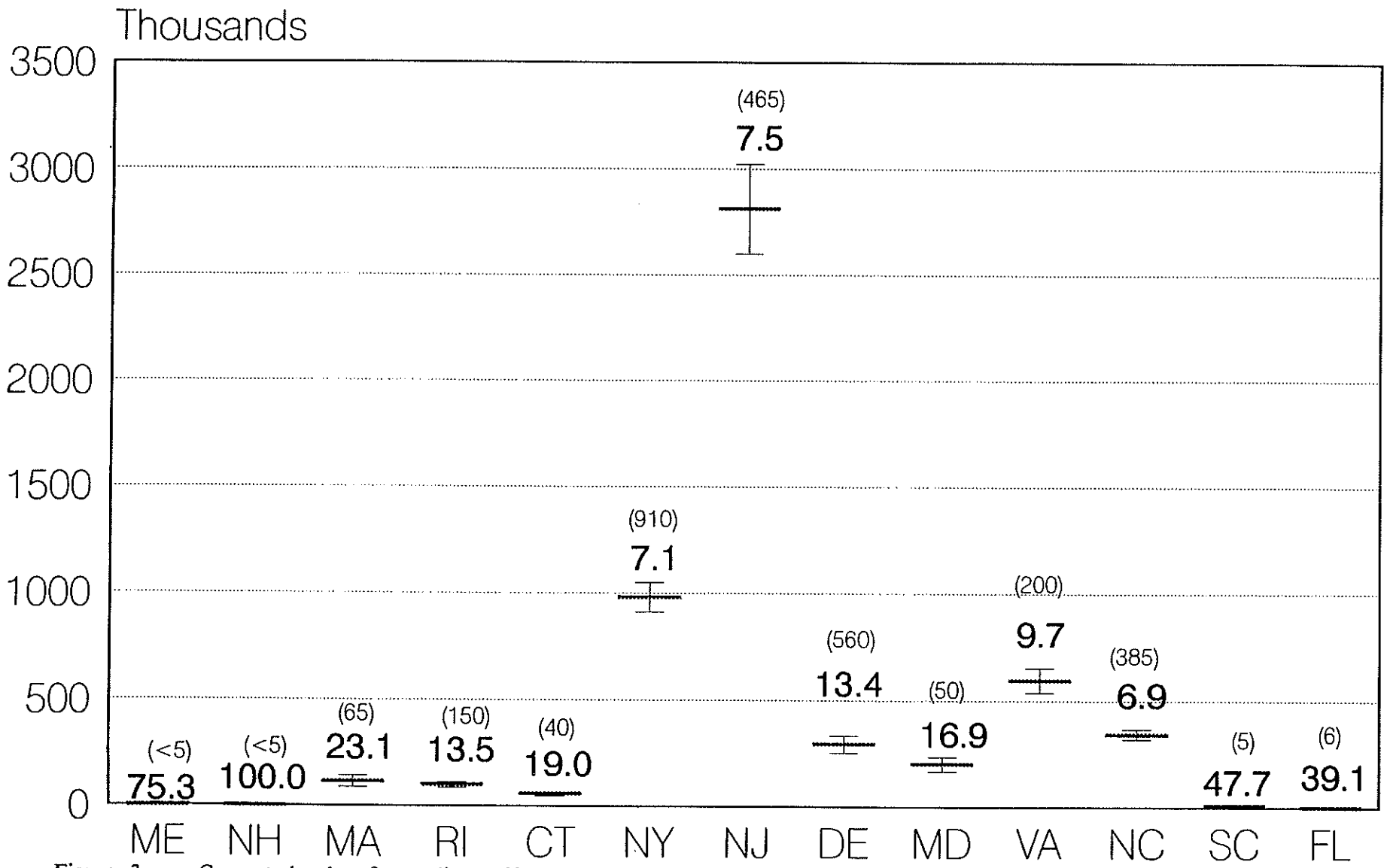

Figure 3. Current levels of sampling effort and precision by state for summer flounder. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1993.

Recommendations For Target Levels of Precision and Timeliness for Summer Flounder

Precision Targets

The coastwide PSE should not exceed 20 percent.

For states that harvest more than 10 percent of the total coastwide harvest of summer flounder, PSE's should range between 10-20 percent.

For states that harvest between 1 percent and 10 percent of the total coastwide harvest of summer flounder, PSE's should range between 20-30 percent.

Timeliness Targets

For stock assessment purposes, MRFSS data should be available by April 1.

For management purposes, MRFSS data should be available by February 15.

Winter Flounder

Winter Flounder Stock Status and Management

Family: Pleuronectidae

Genus and Species: *Pleuronectes americanus*

Description: Eyes and color pattern are on the right side of the fish. The caudal fin is separate and the lateral line is straight. The eyes are large, with a scaled area between the eyes. The mouth is small. The color and pattern of winter flounder are variable, usually dark gray, gray-brown, or olive green.

Largest Recorded: Winter flounder grow to 25 inches and 8 pounds, with the average about 1/2 to 2 1/2 pounds.

Range: The geographic distribution of winter flounder, also known as the blackback flounder, includes estuaries, coastal waters, and offshore fishing banks along the Atlantic coast of North American from Labrador to Georgia. It is one of the most common demersal fishes in inshore regions from southern Newfoundland to Chesapeake Bay.

Natural History: Habitat requirements for winter flounder are based on life history stage. The species is a winter spawner, with demersal eggs, contributing to peak abundances of larvae in late winter and early spring in estuarine systems. Juvenile flounder seen to prefer sand or sand-silt bottom and tolerate a wide range of salinity and temperature (4-30 ppt salinity and 32-77 degrees F). Evidence from tagging experiments has demonstrated that adult spawners return to the same spawning grounds year after year.

Maturity varies with size and age. Flounder mature at an earlier age in the southern part of their range. In the middle Atlantic states, females mature at ages 2 or 3; in more northern areas, maturity is not achieved until age 6 for males and 7 for females. Generally, females produce from 0.5 to 1.5 million eggs, but as many as 3.3 million eggs may be produced by exceptionally large fish. temperature and salinity appear to control survival and viability of eggs. Larval development occupies 2-3 months and is regulated by temperature. Larvae change to juveniles approximately 6-10 weeks after hatching. Young-of-the-year and some one-year old flounder remain in natal estuaries year round. Predatory fish such as striped bass and bluefish, birds, invertebrates (jellyfish) and marine mammals prey on the larvae and juveniles.

Winter flounder may live to twenty years of age. Several authors have calculated growth rates for winter flounder and have demonstrated substantial variability in length at age. The fastest growth occurs on George's Bank, followed by the area south and east of Cape Cod; slowest growth occurs north of Cape Cod into Newfoundland and south from Long Island Sound to New Jersey. A generalized seasonal migration can be described for winter flounder. Adults leave the nearshore zone during summer months when water temperature rises above 58 degrees F. Movement to cooler, deeper water is restricted to areas where the temperature is about 54 degrees F. Flounder move back into shoal waters with declining autumn temperatures. Winter flounder north of Cape Cod appear to make localized migrations and remain nearshore, while south of Cape Cod, winter flounder disperse a considerable distance offshore.

I. Status of Fishery Management Plan

The Interstate Fishery Management Plan for Inshore Stocks of Winter Flounder was adopted by the Commission in May 1992. The major plan goals as adopted are:

1. To maintain winter flounder stocks in sufficient abundance to support stable, productive commercial and recreational fisheries.
2. To preserve, maintain, and enhance habitat and environmental quality necessary for optimal growth and reproduction.
3. To the extent possible, minimize incompatibility in management practices between this and other northwest Atlantic management plans, recognizing that winter flounder stocks vary biologically and may justify differing strategies.
4. To the extent possible, minimize conflicts between competing uses of the winter flounder resource.

The designated management unit for the plan includes the state waters of Maine through Delaware. States with a declared interest include Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Delaware.

II. Status of the Stocks

Three inshore Management Units are identified: **Gulf of Maine** (GOM) - waters north of Cape Cod; **Southern New England** (SNE) - Massachusetts waters east and south of the Cape, Rhode Island waters and Long Island Sound (LIS) east of the Connecticut River including Fishers Island Sound; and **Mid-Atlantic** (MA) - waters west of the Connecticut River through Orient Pt to Montauk, NY including western LIS, Gardiners and Peconic Bays and the waters south and west of Montauk Pt to the Delaware-Maryland border.

Exploitation is high in all three areas, with recent fishing rates (median values through 1991) of F=0.99, 1.06 and 1.07 for SNE, MA and GOM, respectively. Initial estimates of F in 1992 range between F=0.95-1.25 in SNE (Mass, RI, CT surveys), from F=0.6-1.25 in MA (CT, NY, NJ surveys), and are estimated to be F=1.25 for the GOM stock unit (Mass survey). A single natural mortality rate (M=0.35) is used for the three stocks.

Fishery independent surveys show no apparent trend in abundance for the GOM (Mass Survey). Abundance has generally declined in SNE since the late 1970's (RI and Mass surveys), however, the NMFS inshore index of age 3+ abundance showed no clear trend. Abundance indices in the mid-Atlantic also show a general decline. The CT Survey (LIS) index of adults (age 3+) declined during 1984-86, then gradually increased to a time series high in 1990 before declining rapidly to a record low in 1992. Periodic surveys in Delaware estuaries show winter flounder abundance declined between the 1966-70 period and the 1980-81 surveys, and no winter flounder were taken in recent Delaware trawl surveys.

III. Status of the Fishery

Coastwide commercial landings declined from 31 million lb in 1981 to a recent historic low level of 13 million lb in 1989 before increasing slightly to 15 million lb in 1991 (Figure 4). Commercial landings are dominated by the EEZ, comprising on average (1979-91) 77% of the total even with Georges Bank (GB) excluded. During the most recent three years, the proportion of landings coming from the EEZ (excluding GB) has increased to 82%.

Recreational catches (ME-DE) account for 36% of total landings (excluding GB), however, proportions vary among stock units. The majority of landings in the mid-Atlantic unit are attributed to recreational fishermen, whereas Southern New England unit landings are dominated by the commercial fishery. Recreational landings in the three areas have declined in recent years from 18.6 million lb (1984) to 3.4 million lb in 1989 (Figure 4). Recreational harvest in 1992 and 1993 occurred from Maine through New Jersey, with extremely low harvest in Virginia in 1993 (Table 3). Massachusetts, New York, and New Jersey accounted for the majority of recreational harvest in 1992 and 1993. New York accounted for 53 and 41 percent of the total coastwide landings for these years, while New Jersey accounted for 36 percent of the coastwide landings in 1993.

Commercial and Recreational

Winter Flounder Landings, 1950 - 1992

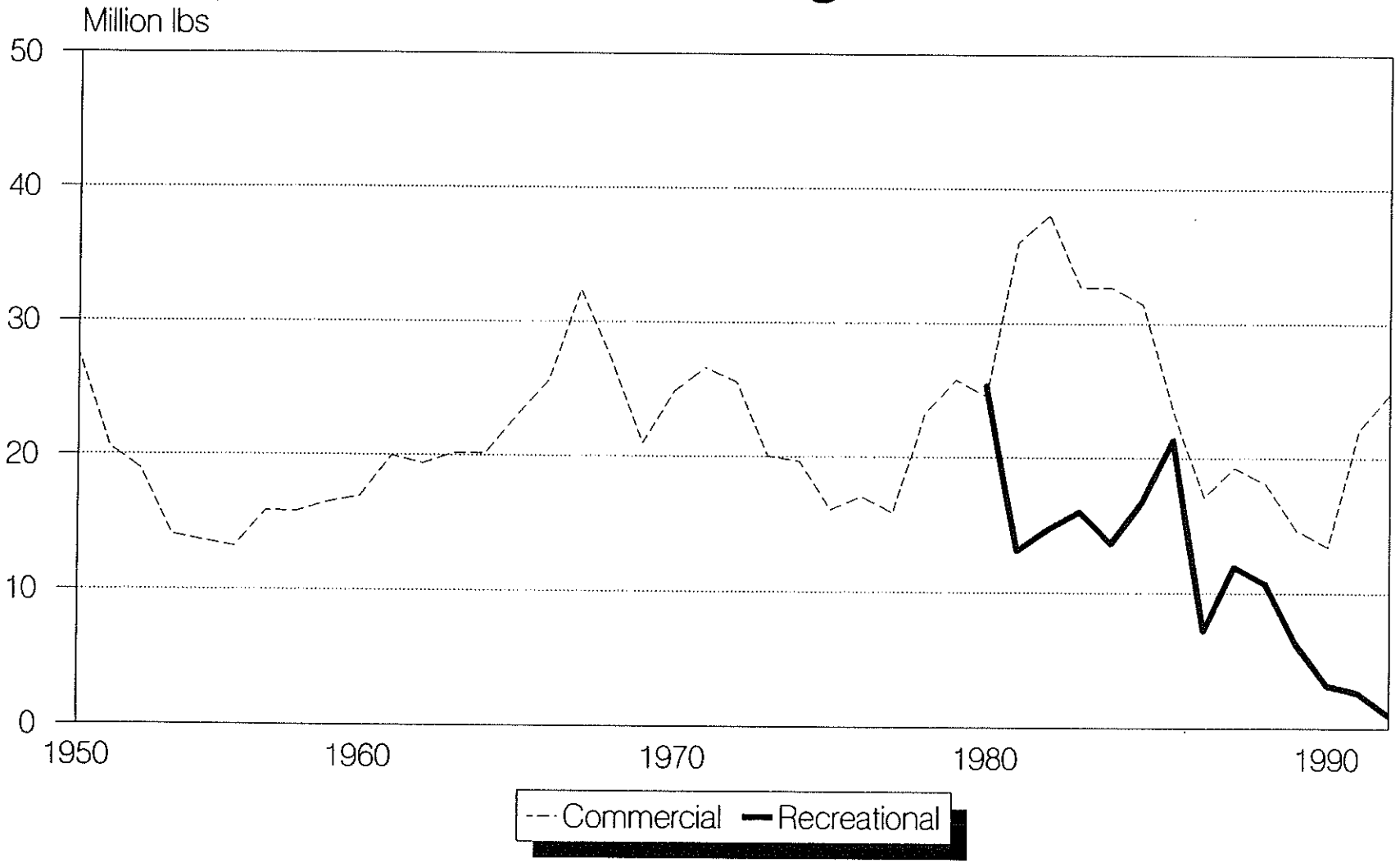

Figure 4. Recreational and commercial landings of winter flounder, 1950-1992.

Table 3. Recreational harvest of winter flounder by state from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS), 1992-1993. Harvest is measured as the number of Type A + B1 fish.

State	1992 Harvest	Percent 1992 Harvest	1993 Harvest	Percent 1993 Harvest
ME	25,151	2.78	52,315	3.94
NH	16,898	1.87	13.766	1.04
MA	134,808	14.92	178,569	13.45
RI	7,681	0.85	10,164	0.77
CT	107,116	11.86	48,599	3.66
NY	481,243	53.28	543,048	40.89
NJ	130,385	14.43	480,961	36.22
DE				
MD				
VA			531	0.04
NC				
SC				
GA				
FL				
Total	903,282		1,327,953	

IV. Status of Management Measures

The Plan calls for harvest control strategies which will achieve the target management reference point (F_{40}) in three steps. Currently all states are required to have implemented measures to achieve F_{25}. By January 1, 1995 measures to achieve F_{30} are to be in place, and by January 1, 1999, the Plan requires that F_{40} be achieved. With current regulations including minimum fish and mesh sizes and season/area closures most states meet the F_{25} level.

V. Commission FMP Recommendations

Harvest Control Strategies include:

1. 10-12" FL size limit
2. 3 1/2" - 5 1/2" mesh size

Sample Sizes and Precision for Winter Flounder

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and

Maury Osborn
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The overall MRFSS coastwide sample size for winter flounder is approximately 823 intercept interviews. Current proportional standard errors for the Atlantic Coast and by subregion are below 13 percent (Table 4).

Table 4. Current levels of precision and sample sizes for winter flounder for the Atlantic Coast and by subregion, 1992 and 1993 MRFSS data.

Region	1992		1993	
	PSE	N	PSE	N
Coastal	8.7	900	9.6	800
New England	11.6	250	10.6	250
Mid-Atlantic	11.7	500	12.1	600
South Atlantic	---	---	---	---

In 1992, only Massachusetts and New York had PSE's less than 20 percent for winter flounder (Figure 5). Samples where winter flounder were encountered for Massachusetts and New York were 145 and 515, respectively. New York accounted for over 53 percent of the total coastwide harvest for winter flounder, while Massachusetts accounted for about 15 percent (Table 3). Connecticut and New Jersey had PSE's ranging from 20 to 30 percent, with samples with winter flounder of 60 and 80 interviews, respectively. Maine, New Hampshire, and Rhode Island had PSE's greater than 30 percent and corresponding samples with winter flounder of less than 15 interviews. Maine, New Hampshire, and Rhode Island accounted for 2.78, 1.87, and 0.85 percent of the total coastwide harvest of winter flounder.

In 1993, only Massachusetts and New York had PSE's less than 20 percent for winter flounder (Figure 6). Samples with winter flounder were 170 interviews for Massachusetts and 620 interviews for New York (Figure 6). Connecticut and New Jersey had PSE's ranging from 20 to 30 percent, with corresponding samples of 52 and 80 interviews, respectively. Maine, New Hampshire, Rhode Island, and Virginia had PSE's greater than

30 percent and less than 15 samples with winter flounder. New York and New Jersey accounted for 40.9 and 36.2 percent of the total coastwide harvest for winter flounder, while Rhode Island and Virginia each accounted for less than one percent of the coastwide harvest (Table 3).

Winter Flounder 1992

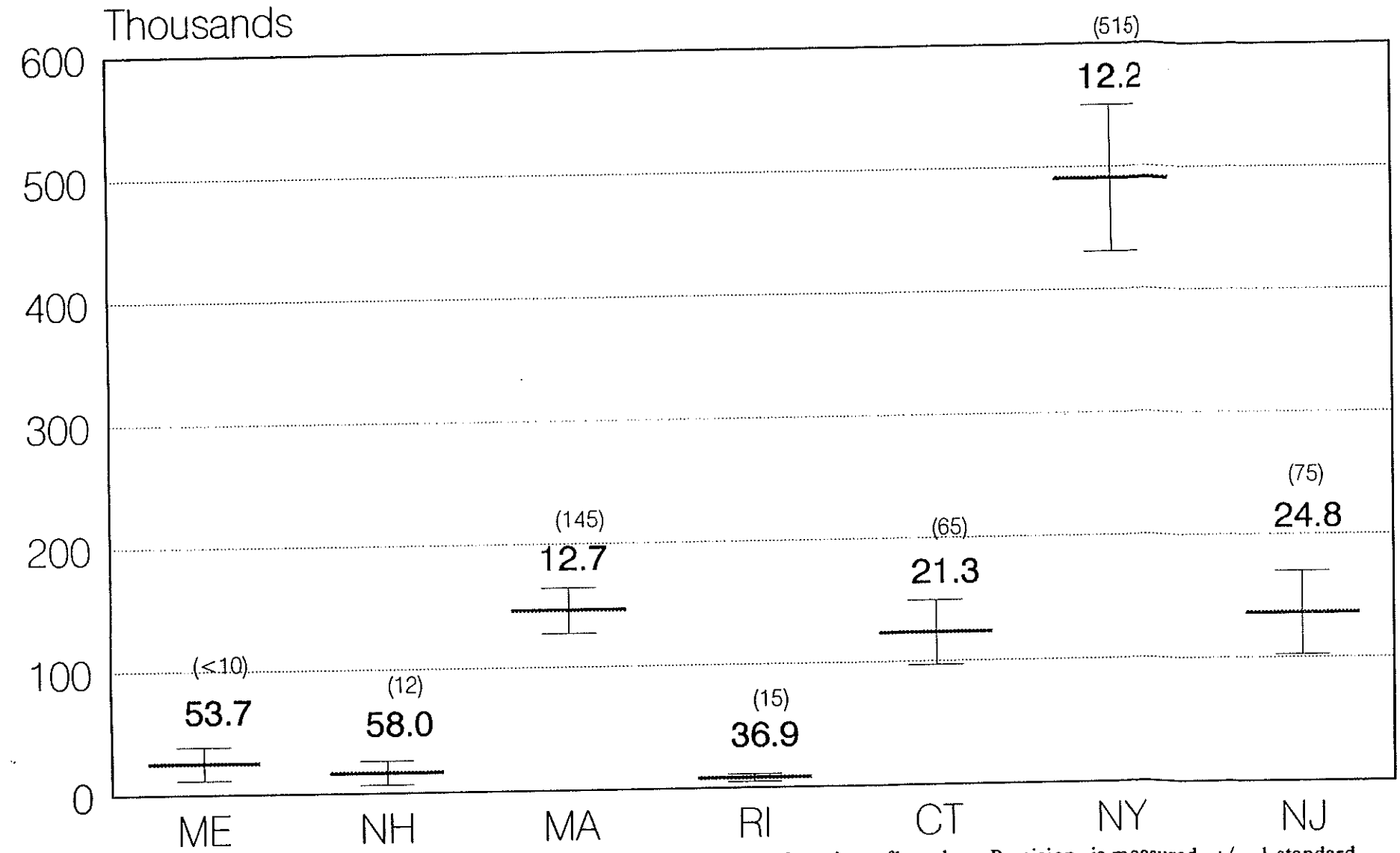

Figure 5. Current levels of sampling effort and precision by state for winter flounder. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1992.

Winter Flounder 1993

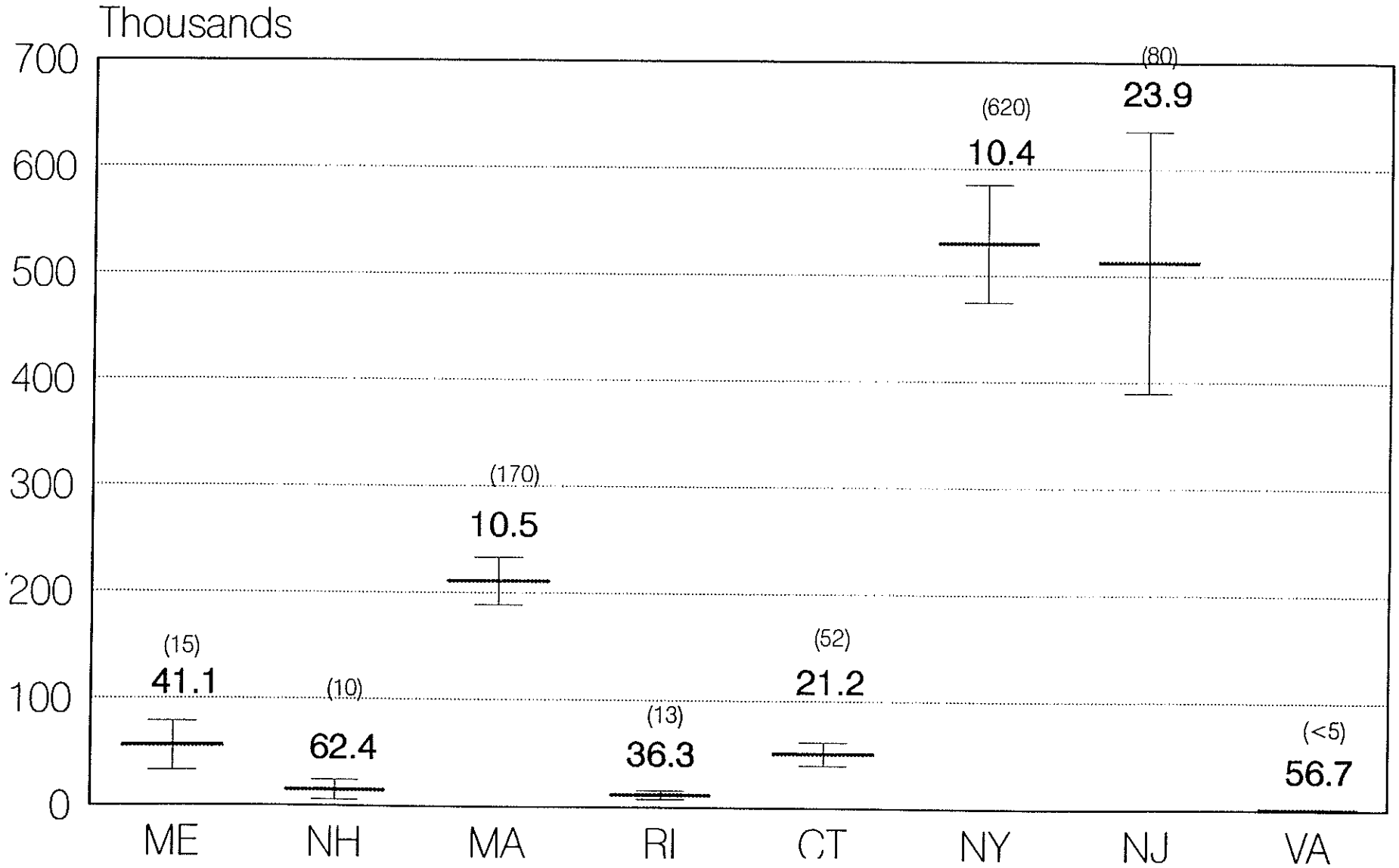

Figure 6. Current levels of sampling effort and precision by state for winter flounder. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1993.

Recommendations For Target Levels of Precision and Timeliness for Winter Flounder

Precision Targets

For states that harvest more than 10 percent of the total coastwide harvest of winter flounder, PSE's should range between 10-20 percent.

For states that harvest between 1 percent and 10 percent of the total coastwide harvest of winter flounder, PSE's should range between 20-30 percent.

Timeliness Targets

For stock assessment purposes, MRFSS data should be available by March 1.

For management purposes, MRFSS data should be available by April 15.

Red Drum

Red Drum Stock Status and Management

Family: Sciaenidae

Genus and Species: *Sciaenops ocellatus*

Description: Red drum body is elongate with coppery red overtones on a silvery gray background. A large black spot occurs on either side of the caudal peduncle, and at times two or more spots may be present. The red drum lack chin barbles found on many other drums.

Largest Recorded: The largest recorded red drum was 94 pounds 2 ounces and caught in Avon, North Carolina on November 7, 1984.

Range: Red drum are found worldwide in tropical, subtropical, and temperate coastal waters. Red drum on the Atlantic coast range from Massachusetts to Key West, Florida, but are found primarily from New Jersey southward.

Natural History: The red drum belongs to the family Sciaenidae, commonly known as drums since many of its members make drumming sounds by vibrating their swim bladders with special muscles. Size and age at sexual maturity varies over the range. In Florida males begin maturing at age 1 and females between ages 2 and 3. In North Carolina females mature at ages 4 or 5. Spawning on the Atlantic coast is believed to occur from July through December. Spawning takes place inshore near ocean passes or inlets to estuaries and possibly in some large estuaries. Eggs spawned in the ocean are carried by tidal currents into estuaries where they hatch. Larvae are further transported by subsurface tidal currents into shallow, less saline waters. Red drum juveniles in these inshore nursery areas have a varied diet, ranging from zooplankton to small invertebrates, and, finally small crabs and shrimp.

Sub-adult red drum exhibit a high growth rate (about 12-14 inches at age 1) and are estuarine-dependent. Juvenile red drum seek deeper estuarine areas or move offshore in response to declining winter temperatures. Adults form schools and move southward and offshore during winter and return northward during summer months. Red drum usually reach Cape Hatteras in March or April and are found in Chesapeake Bay and along the New Jersey coast from May to October. Sub-adults are very limited in their coastal movements, generally staying within estuarine systems or in nearshore coastal waters.

I. Status of the Fishery Management Plan

The Red Drum Fishery Management Plan (FMP) was adopted by the Commission in 1984 and by the South Atlantic Fishery Management Council in 1990. Amendment #1 was approved by the Commission in October 1991. The goal of the management plan is to attain optimum yield from the red drum fishery over time. Optimum yield in the Atlantic coast red drum fishery is the amount of harvest that can be taken by U.S. fishermen while maintaining the spawning stock biomass per recruit level at or above 30% of the level that would result at a fishing mortality rate of F=0. Three major objectives have been adopted:

1. Assure escapement of juveniles to the spawning stock by controlling fishing mortality.
2. Address incompatibility and inconsistency among state and federal regulations by establishing a system which can adapt to change in resource abundance, new scientific information and changes in fishing patterns among user groups or by area.
3. Promote cooperative collection, analysis, and utilization of biologic and socio-economic data.

The management unit of Amendment #1 extends from Florida north to the New Jersey/New York state line. However, the intent of the 1988 Policy Board action requesting complementary regulations in all states from Florida through Maine remains the same.

II. Status of the Stock

A 1992 stock assessment using virtual population analysis (VPA) used recreational and commercial data from 1986 through 1991. An analysis of state (GA, SC, and NC) information on application of the VPA, young-of-year, and bag limits also was conducted. These analyses indicate that the question of when offshore emigration or reduced availability begins (during or after age 3) continues to be a source of bias that tends to result in overestimates of fishing mortality. However, the continued assumptions of no fishing mortality on adults (ages 6 and older), causes a bias that tends to underestimate fishing mortality. Estimates of escapement range from 0.7 to 0.9% for M=0.23 and about 1.0% for M=0.46. Similarly, estimates of maximum spawning potential range from 0.6 to 1.1% for M=0.23 and 1.4 to 1.5% for M=0.46. These estimates are similar to those obtained in the 1991 stock assessment.

III. Status of the Fishery

Recreational catches of red drum during the 1980's increased from a low of 632,500 lb in 1981 to a peak of 2,719,000 lb in 1984, then declined to 511,800 lb in 1990 (Figure 7). Recreational landings in 1991 approximately doubled from the previous year to just over 1 million lb. Recreational harvest ranges from Virginia to Florida, with the majority of

harvest occurring in South Carolina, Georgia, and Florida (Table 5). These three states account for 91 and 86 percent of the total coastwide landings in 1992 and 1993, respectively.

Commercial landings ranged between 127,800 lb in 1991 and 439,900 lb in 1980 (Figure 7). In numbers of fish caught, Atlantic red drum constitute predominantly a recreational fishery (approximately 87-94% in recent years). Commercially, red drum continue to be harvested as part of mixed species fisheries in North Carolina. Both commercial and recreational fisheries appear to be supported primarily by catches of sub-adult red drum (ages 0-5).

Table 5. Recreational harvest of red drum by state from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS), 1992-1993. Harvest is measured as the number of Type A + B1 fish.

State	1992 Harvest	Percent 1992 Harvest	1993 Harvest	Percent 1993 Harvest
ME				
NH				
MA				
RI				
CT				
NY				
NJ				
DE				
MD				
VA	13,299	3.83	11,815	3.70
NC	17,771	5.11	32,432	10.14
SC	126,430	36.37	119,534	37.39
GA	81,046	23.32	96,367	30.14
FL	109,057	31.37	59,574	18.63
Total	347,602		319,722	

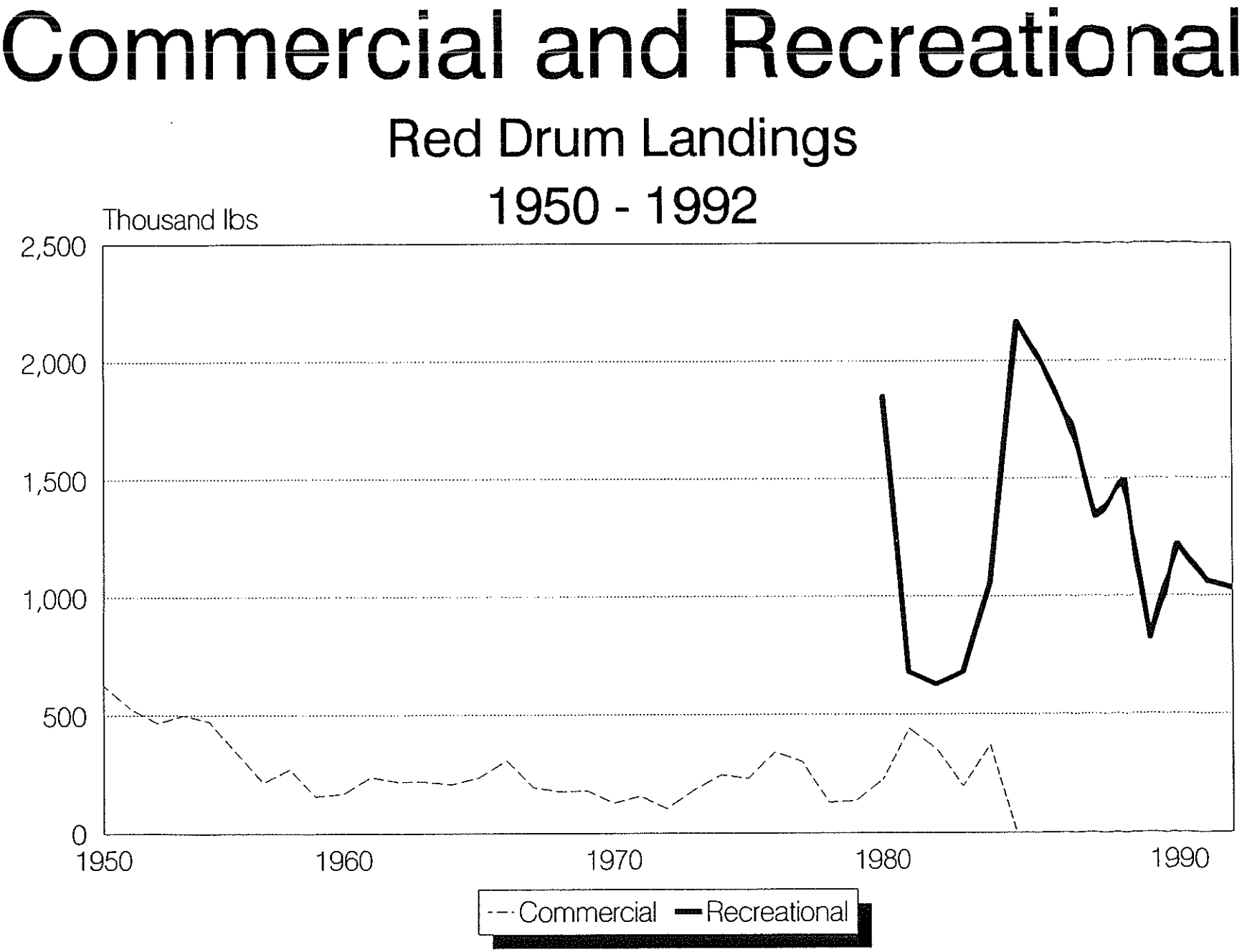

Figure 7. Recreational and commercial landings of red drum, 1950-1992.

IV. Status of Management Measures

All states (except Pennsylvania which does not have a fishery for red drum) within the designated management unit have implemented management measures with at least the minimum requirements of the 1984 plan. Current regulations in other states are being amended to come into compliance with Amendment #1.

Recommendations of Amendment #1 are to be accomplished through a series of steps in reaching the target SSBR level of 30%. Management measures that will attain an SSBR level above 10% should be implemented as a first step. Given variations in State red drum fisheries along the Atlantic coast, either of two scenarios for the first step is recommended: a) 18-in. TL min., 27-in TL max., and a 5-fish bag limit with one fish exceeding 27 in. TL; or b) 14-in. TL min., 27-in. TL max., and 5-fish bag limit, with no fish exceeding 27 in. TL. The states of New Hampshire, Virginia, North Carolina, South Carolina, Georgia, and Florida have implemented regulations in compliance with these recommendations.

V. Commission FMP Recommendations

1. Either scenario: 18" min. size, 27" max. size, one fish greater than 27";
   14" min. size, 27" max. size, no fish greater than 27"

2. Five fish possession limit

Sample Sizes and Precision for Red Drum

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and

Maury Osborn
National Marine Fisheries Service

The overall MRFSS coastwide sample size for red drum is approximately 320 intercept interviews. Current proportional standard errors for the Atlantic Coast and the New England and South Atlantic subregions are below 9 percent (Table 6). PSE's for the Mid-Atlantic subregion were 37.7 and 52.5 percent in 1992 and 1993, respectively.

Table 6. Current levels of precision and sample sizes for red drum for the Atlantic Coast and by subregion, 1992 and 1993 MRFSS data.

Region	1992		1993	
	PSE	N	PSE	N
Coastal	8.2	320	8.5	320
New England	---	---	---	---
Mid-Atlantic	37.7	20	52.5	20
South Atlantic	8.4	300	8.6	300

Harvest of red drum occurred from Virginia to Florida, with the majority of landings in the South Atlantic Region (Table 5). PSE's for the states from North Carolina to Florida were less than 20 percent in 1992 and 1993 (Figures 8 and 9). The PSE for Virginia was 38.3 percent in 1992 and 50.3 percent in 1993, with samples with red drum of 8 and 7 interviews. Recreational harvest of red drum in Virginia was less than 4 percent of the total coastwide harvest in 1992 and 1993 (Table 5).

Red Drum 1992

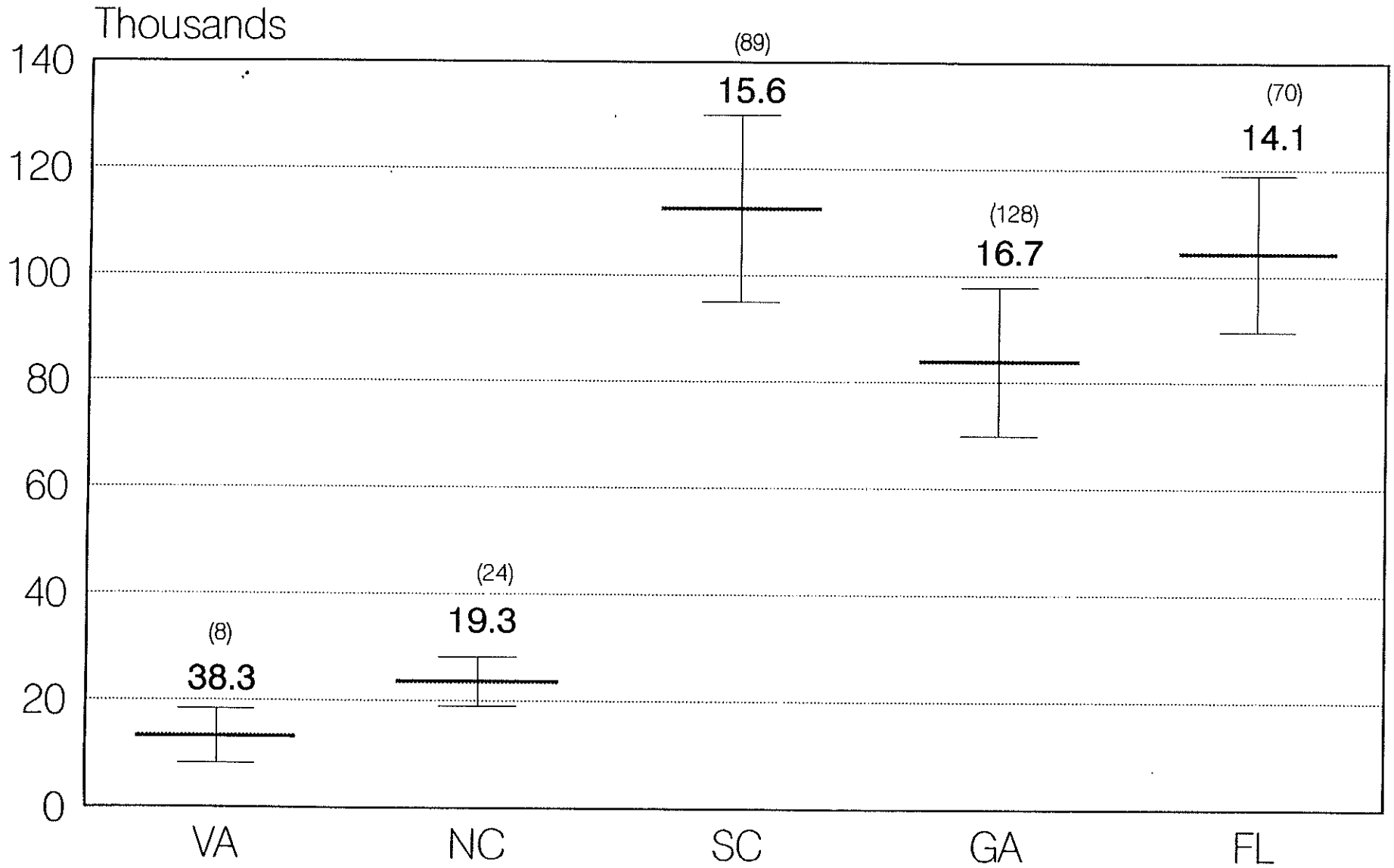

Figure 8. Current levels of sampling effort and precision by state for red drum. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1992.

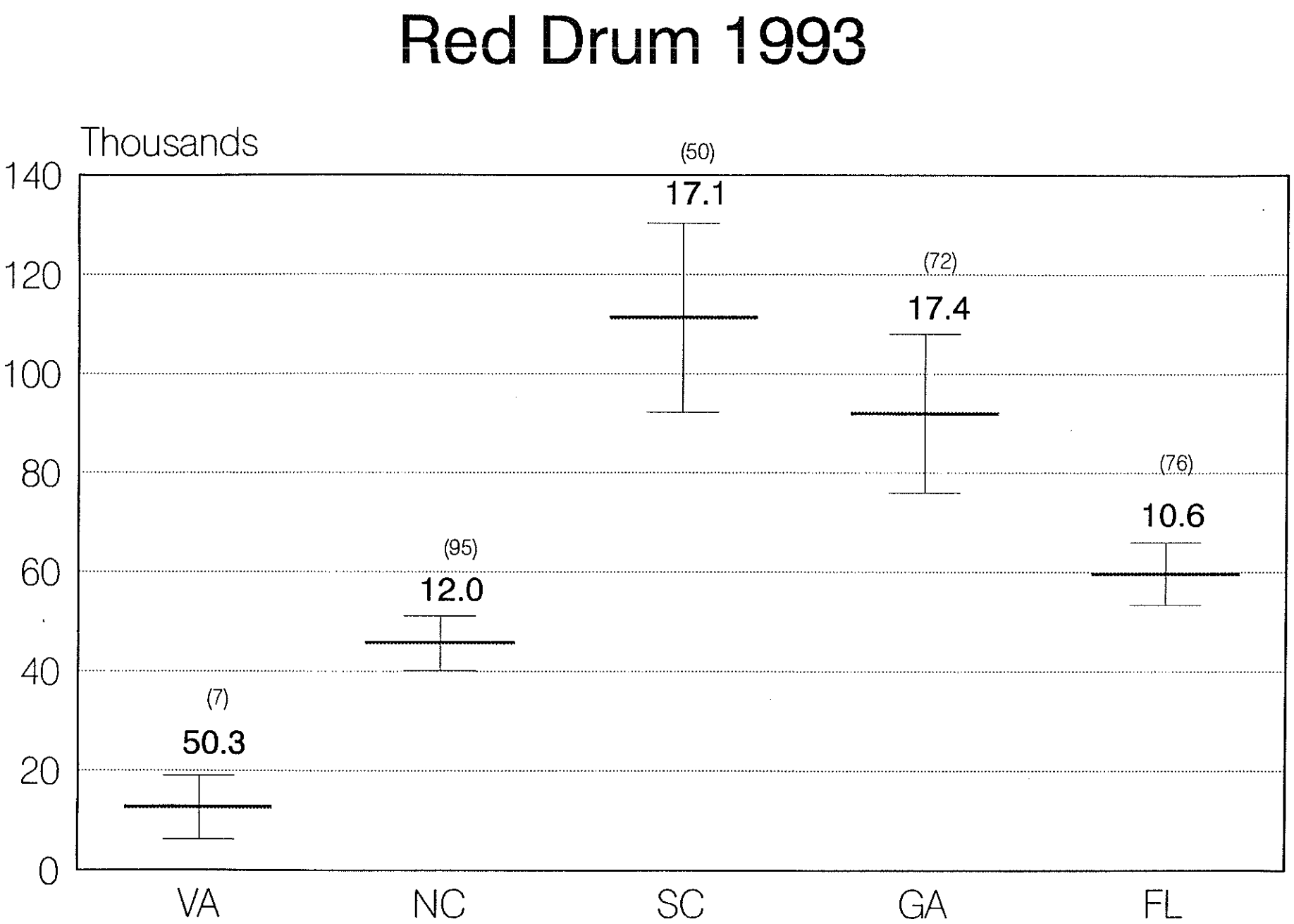

Figure 9. Current levels of sampling effort and precision by state for red drum. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1993.

Recommendations For Target Levels of Precision and Timeliness for Red Drum

Precision Targets

For all South Atlantic states, PSE's should range between 10-20 percent.

Timeliness Targets

MRFSS preliminary estimates should be available by March 1.

MRFSS final estimates should be available by April 15.

Weakfish

Weakfish Stock Status and Management

Family: Sciaenidae

Genus and Species: *Cynoscion regalis*

Description: Weakfish are dark olive to blueish above, with many small dark spots. These spots are not well defined and are various shades, sometimes arranged in diagonal rows. Weakfish are paler below, with various metallic reflections along their sides. The name refers to the tender, easily-torn membrane of the fish's mouth, rather than its fighting ability.

Largest Recorded: The largest weakfish recorded was 19 pounds, 2 ounces and caught in Delaware Bay, Delaware on May 20, 1989.

Range: Weakfish range along the Atlantic coast from Massachusetts to Florida, occasionally straying north of Nova Scotia. The area of greatest abundance extends from New Jersey to North Carolina during the warm season, while the stock retreats to the North Carolina area during winter.

Natural History: Spawning and early development occur in the nearshore ocean waters and estuaries from March to October. Juveniles spend their first summer in the estuaries. With declining water temperatures in the fall, both juveniles and adults move southward and spend the winter in the ocean. Weakfish reach maturity at ages varying from 1-3 years. Weakfish are 10-12 inches in length at age 2, while 30-inch fish may be as old as 12 years. Weakfish range to at least three feet and 17.5 pounds, however, in recent years weakfish are rarely caught at sizes larger than 28 inches and 6 pounds. There is some evidence that two major stocks exist, one in the north and a second larger one in the south, although recent genetic work on population structure indicates that there is only one stock. Young weakfish feed on planktonic organisms, changing their diet to worms, crustaceans, mollusks, and fish as they grow. Weakfish are consumed by bluefish, flounders, striped bass, and sharks.

I. Status of the Fishery Management Plan

The Weakfish Fishery Management Plan (FMP) was adopted by the Commission in 1985. Following a precipitous decline in landings of weakfish along the Atlantic Coast Amendment #1 to the Weakfish FMP was approved in 1991. The goal of the Weakfish

FMP is to perpetuate the weakfish resource in fishable abundance throughout its range and generate the greatest economic and social benefits from its commercial and recreational harvest and utilization over time. The major objectives as adopted in Amendment #1 are:

1. A requirement for states to institute a phased reduction in weakfish harvest rates of 15% in 1992 reaching 50% in 1995, with a gradual imposition of higher minimum size limits (10, 11 and 12 inches) during each year.
2. A recommendation that states reduce the bycatch of weakfish in southern shrimp fisheries by 50% and the use of mesh size in commercial fisheries that allow 75% of undersized weakfish to escape.

States with a declared interest include the states of Massachusetts through Florida.

II. Status of the Stock

The 1993 weakfish stock assessment indicated a current average (1990-92) annual exploitation rate of 62%, with F = 1.18 (Crecco 1993). A target exploitation rate of 17% is necessary to achieve the biological reference point, F_{20} = 0.22, equivalent to a maximum spawning potential (MSP) of 20% of an unfished spawning stock. Recent levels of MSP have been estimated at 2-5% (Vaughan 1993). The current average exploitation rate must be lowered by 73% to reach F_{20}.

In recent years weakfish recruitment has been stable, but harvests and stock and spawning biomass have declined markedly, as the stock continues its juvenescence (Gibson 1993). Roughly 91% of the combined 1991 landings or estimates of weakfish in food-grade, scrap, or shrimp bycatch categories were age 1 or younger (Vaughan 1993).

III. Status of the Fishery

Landings in recent years are about 60% below the levels of the 1980's when weakfish supported important commercial and sport fisheries from North Carolina to southern New England (Figure 10). Recreational harvest (17.5% of total harvest) was 1.8 million lbs in 1990, 2.4 million lbs in 1991, and 1.8 million lbs in 1992. Recreational harvest in 1992 and 1993 ranged from Rhode Island to Florida, with extremely low harvest in Rhode Island, Connecticut, New York, South Carolina, and Georgia (Table 7).

Commercial harvest was dominated by trawl (34.1%) and gill net (36.1%) in 1990-1992. Total commercial harvest declined from 11.8 million lbs in 1990, to 8.8 million lbs in 1991, and 7.4 million lbs in 1992.

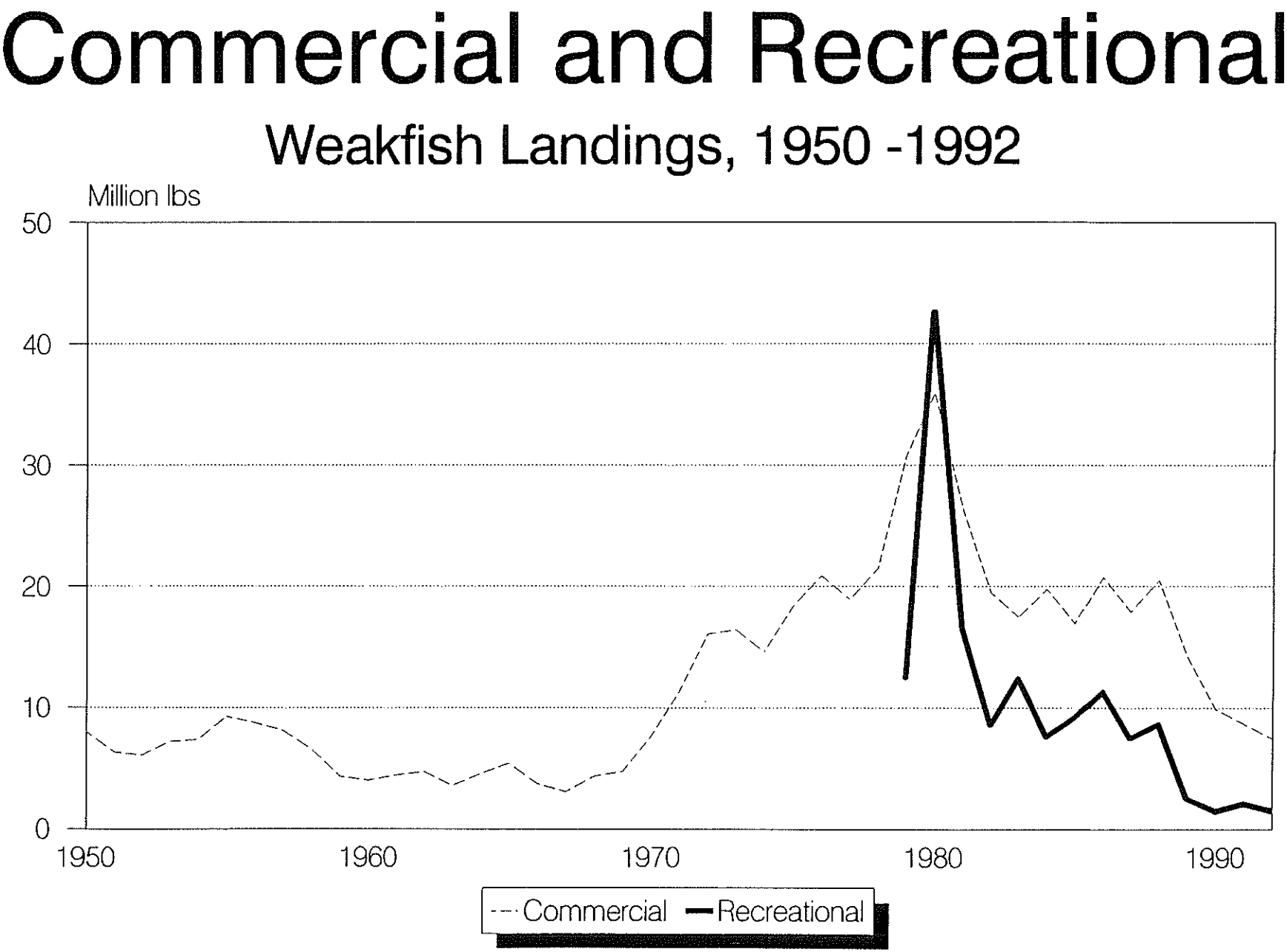

Figure 10. Recreational and commercial landings of weakfish, 1950-1992.

Table 7. Recreational harvest of weakfish by state from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS), 1992-1993. Harvest is measured as the number of Type A + B1 fish.

State	1992 Harvest	Percent 1992 Harvest	1993 Harvest	Percent 1993 Harvest
ME				
NH				
MA				
RI	10,251	1.15		
CT	432	0.05	1,380	0.18
NY	5,289	0.59	9,500	1.23
NJ	261,165	29.18	146,921	18.99
DE	91,627	10.24	165,853	21.43
MD	120,061	13.41	144,112	18.62
VA	276,658	30.91	73,489	9.50
NC	28,475	3.18	73,774	9.53
SC	25,856	2.89	7,047	0.91
GA	1,961	0.22	12,323	1.59
FL	73,369	8.20	139,405	18.02
Total	895,144		773,803	

IV. Status of Management Measures

Under revised guidelines developed by the Technical Committee in 1993 to evaluate states' plans for implementing management measures to reduce the annual exploitation of weakfish by 25% in 1993, no state was in compliance.

V. Commission FMP Recommendations

1. 12" recreational size limit
2. 12" commercial size limit
3. Strategy to control fishing mortality

Sample Sizes and Precision for Weakfish

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and

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National Marine Fisheries Service

The overall MRFSS coastwide sample size for weakfish is approximately 550 intercept interviews. Current proportional standard errors for the Atlantic Coast are below 8 percent (Table 8). PSE's for the Mid-Atlantic and South Atlantic subregions are below 10 and 15 percent, respectively. PSE's for the New England subregion were 65.1 and 43.2 percent in 1992 and 1993, respectively.

Table 8. Current levels of precision and sample sizes for weakfish for the Atlantic Coast and by subregion, 1992 and 1993 MRFSS data.

Region	1992		1993	
	PSE	N	PSE	N
Coastal	7.7	550	7.5	550
New England	65.1	<10	43.2	<10
Mid-Atlantic	8.7	450	9.1	450
South Atlantic	13.5	100	13.4	100

In 1992, New Jersey, Delaware, Maryland, Virginia, and North Carolina had PSE's of less than 20 percent for weakfish (Figure 11). Samples with weakfish for these states were greater than 40 interviews (Figure 11), and each state harvested more than one percent of the total coastwide harvest (Table 7). Rhode Island, South Carolina, and Florida also harvested greater than one percent of the total coastwide harvest for weakfish; however, PSE's ranged from 20.2 to 68.1 percent. Samples with weakfish were 33 interviews in Florida, 17 interviews in South Carolina, and less than 10 interviews in Rhode Island. States that harvested less than one percent of the total coastwide harvest had PSE's ranging from 34.2 to 61.5 percent, with samples of less than 13 interviews per state.

In 1993, Delaware, Maryland, Virginia, and North Carolina had PSE's of less than 20 percent for weakfish (Figure 12). Samples with weakfish for these states were greater than 37 interviews (Figure 12), and each state harvested greater than one percent of the

total coastwide harvest (Table 7). New York, New Jersey, Georgia, and Florida harvested greater than one percent of the total coastwide harvest; however, PSE's ranged from 20.1 to 72.4 percent. Samples in New York and New Jersey were 13 and 36 interviews, respectively. Samples in Georgia were less than 10 interviews in 1993, with a PSE of 72.4 percent. Connecticut and South Carolina accounted for less than one percent of the total coastwide harvest and had associated samples with weakfish of less than 10 interviews, with PSE's of 42.4 and 45.7 percent, respectively.

Weakfish 1992

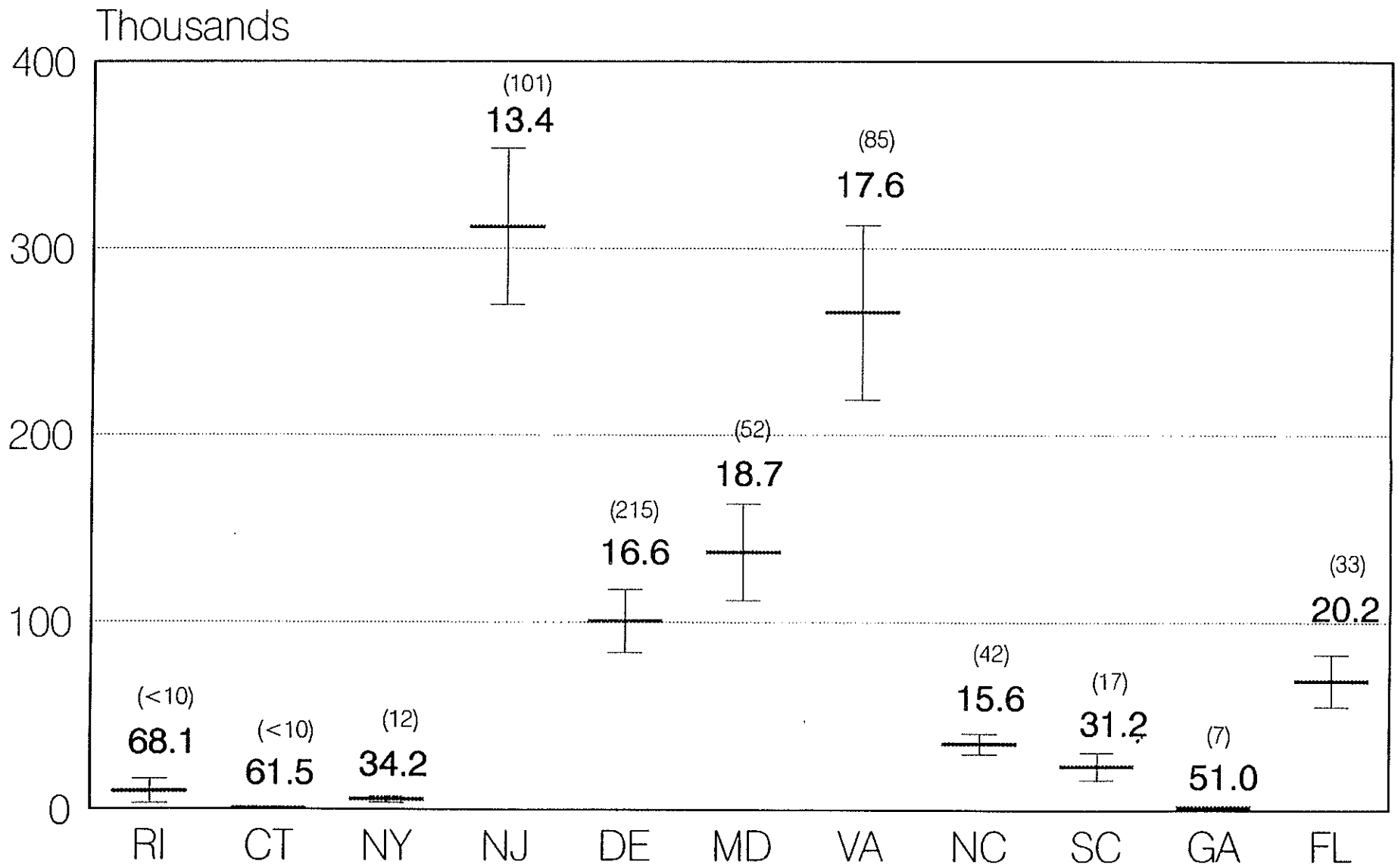


Figure 11. Current levels of sampling effort and precision by state for weakfish. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1992.

Weakfish 1993

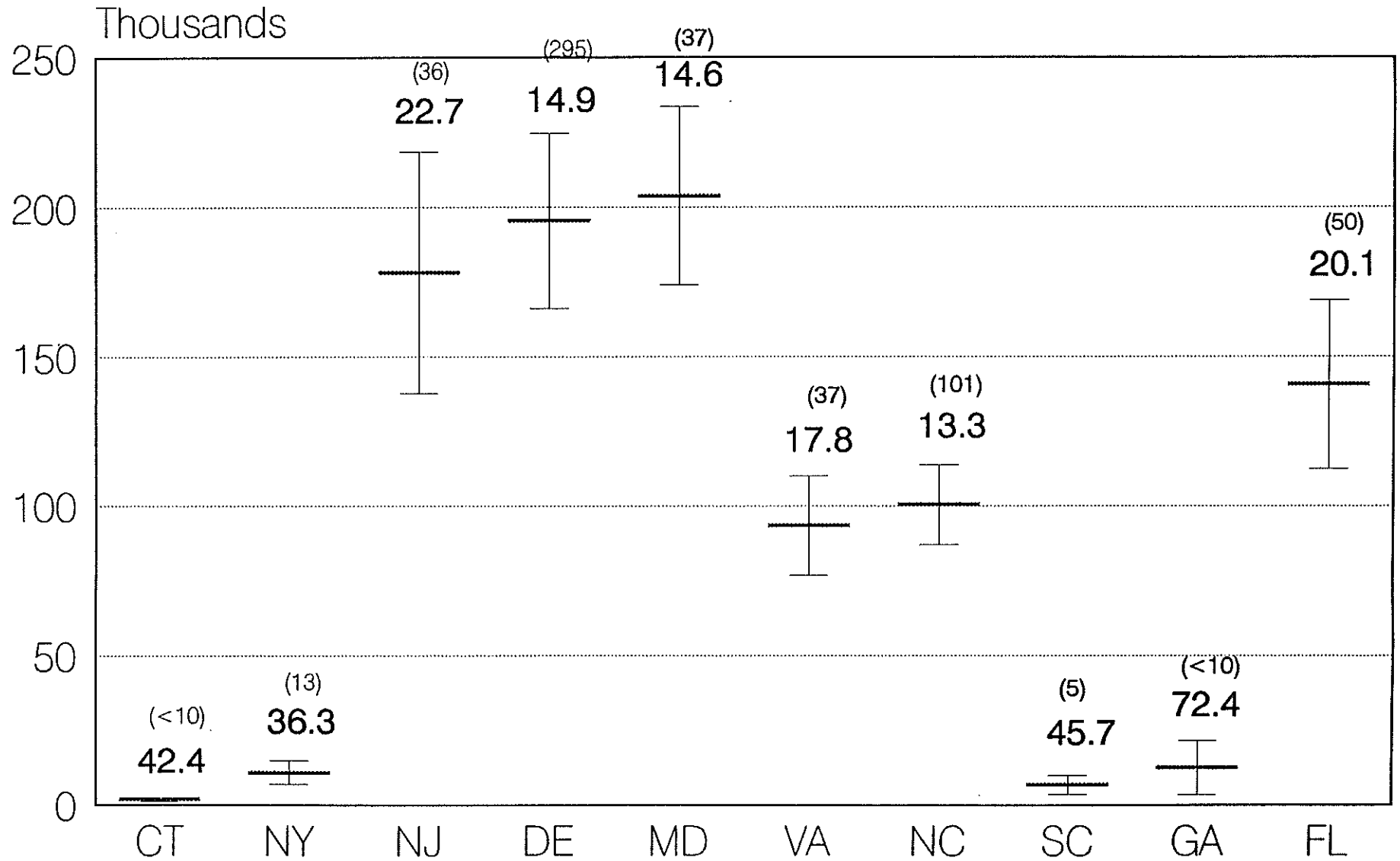


Figure 12. Current levels of sampling effort and precision by state for weakfish. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1993.

Recommendations For Target Levels of Precision and Timeliness for Weakfish

Precision Targets

For states that harvest more than 10 percent of the coastwide harvest for weakfish, PSE's should range between 10-20 percent.

For states that harvest between 1 percent and 10 percent of the coastwide harvest for weakfish, PSE's should range between 20-30 percent.

Timeliness Targets

MRFSS preliminary estimates should be available by March 1.

MRFSS final estimates should be available by April 15.

Bluefish

Bluefish Stock Status and Management

Family: Pomatomidae

Genus and Species: *Pomatomus saltatrix*

Description: Bluefish are greenish or bluish above and silvery on the sides, with a blackish blotch on the pectoral fin base. The caudal fin is dusky and the cheeks and gill cover are scaly. The second dorsal fin and the anal fin are long, with about 23-26 and 25-27 rays, respectively. Both fins are densely covered with small scales. The lateral line is straight, with a strong arch toward the front. The mouth is large, with prominent flattened and triangular teeth.

Largest Recorded: The largest recorded bluefish was 31 pounds, 12 ounces and caught at Hatteras, North Carolina on January 20, 1993.

Range: Bluefish are a migratory, pelagic species generally found in continental shelf water in temperate and semi-tropical oceans around the world with the exception of the northern, central and eastern Pacific Ocean. Off the eastern United States and Canada, bluefish range from Nova Scotia to Florida and in the Gulf of Mexico from Florida to Texas. Tagging studies and other information indicate a significant degree of separation between bluefish in the northeastern Atlantic and those in the Gulf of Mexico, although some intermingling may occur. For management purposes, a unit stock of bluefish has been assumed along the Atlantic coast.

Natural History: Bluefish is the only member of the family Pomatomidae. The voracious bluefish richly deserves the nick names "marine piranha" and "chopper" because it swims in large schools through shoals of bait fish, slashing and destroying everything in its path, including small individuals of its own species. Adult bluefish travel northward in spring and summer, and southward in fall and winter. Both migration periods are characterized by some offshore-inshore movement. Migrations appear to be triggered by water temperatures between 54 and 59 degrees F on the low side and around 80 degrees F on the high. During summer, bluefish stocks are centered between Cape Cod and Cape Hatteras, with larger fish being further north. During winter bluefish tend to be offshore on the outer continental shelf and south, between Cape Hatteras and Florida. Bluefish spawn in two principal areas along the Atlantic coast, one in the South Atlantic bight and the other in the Mid-Atlantic bight. Spawning in the South Atlantic occurs

on the shoreward edge of the Gulf Stream, principally during spring and to a lesser extent in the fall and winter. Larvae from the spring spawning drift north of Cape Hatteras in the Gulf Stream and spread out along the continental slope of the Mid-Atlantic Bight. These young bluefish enter shelf water and estuaries in mid-June as waters warm. They remain in the estuaries during the summer, and migrate south along the coast in early fall. Larvae from fall-winter spawning in the South Atlantic move to inshore water south of Cape Hatteras. In the mid-Atlantic Bight, spawning begins in continental shelf water in June, peaks in July and continues into August with these young-of-the-year inhabiting estuaries or near shore waters before migrating south in the fall.

Bluefish display rapid growth in their early years. Studies indicate that mean lengths more than double between ages 1 and 4. Lengths at age 1 range from 9 to 11 inches and at age 2 have already increased to 15-20 inches. Growth rates of older (above age 5) fish decline with age. Bluefish over age 8 are uncommon. The maximum age is currently believed to be about 12 years, equivalent to about 40 inches in length.

I. Status of the Fishery Management Plan

The Bluefish Fishery Management Plan (FMP) was adopted by the Commission in October 1989 and approved by the Secretary of Commerce in March 1990. This FMP is unique in that it represents the first management plan to be jointly developed by an interstate commission and the Fishery Management Councils. The major goal of the FMP is to conserve the bluefish resource along the Atlantic coast. Five major objectives have been adopted:

1. Increase understanding of stock and fishery.
2. Provide highest availability to U.S. fishers; maintain, within limits, traditional uses (commercial fishery not exceeding 20% of total catch).
3. Enhance management throughout the range.
4. Prevent recruitment overfishing.
5. Reduce waste.

States with a declared interest in the bluefish FMP include all member states except Pennsylvania.

II. Status of the Stock

Bluefish recreational landings, catch per unit effort and relative spawning stock biomass have steadily declined during the last five years. In 1993, the Bluefish Stock Assessment Subcommittee re-estimated the biological reference points (F_{01}, F_{msy}, F_{coll}) for

Atlantic coast bluefish. Under current conditions in the fishery, i.e. no length limits and Y-O-Y bluefish F estimated at 0.25, the F01 for Atlantic coast bluefish is 0.20. Under current conditions F_{msy} is 0.25 and F_{coll} is calculated at 0.55.

The Bluefish Stock Assessment Subcommittee estimated the changes in bluefish spawning stock biomass (SSB) and fishing mortality (F) between 1982 and 1991 using the ADAPT virtual population analysis (VPA) and the CAGEAN separable virtual population analysis (SVPA) models applied to the bluefish catch at age matrix (ages 0 to 8+). These model runs suggest that coastwide bluefish SSB dropped from about 300 million pounds in 1982 to below 81 million pounds in 1989. The steady drop in bluefish SSB is consistent with the declining trend in mean CPUE for bluefish from the recreational fishery and with the decline in relative SSB from the NMFS fall survey.

From 1982 to 1985 F ranged from 0.23 to 0.42 and varied without trend. Between 1986 and 1988 F generally rose beyond current F_{msy} and F_{coll} levels of 0.25 and 0.55, respectively (F range: 0.33 to 0.87). The current F is sufficiently high to have caused the observed decline in bluefish recreational landings and SSB.

III. Status of the Fishery

Commercial bluefish landings, which had declined by over 33% to 10.4 million pounds in 1989, increased to 13.8 million pounds in 1990 (Figure 13). Landings then declined to 13.6 million pounds in 1991 and to 10.7 million pounds in 1992. The recreational catch dropped steadily from a 1986 value of 130.9 million pounds to 37.3 million pounds in 1992, the lowest value in the time series. Both the 1992 commercial landings and recreational catch were below the 1979 to 1992 average of 13.9 and 98.2 million pounds, respectively.

Recreational catch by number declined by over 45% in the Mid-Atlantic subregion from 1991 to 1992 and decreased by almost 2 million fish in the North Atlantic (Figure 13). However, from 1991 to 1992 the recreational catch in the South Atlantic was relatively stable. Recreational harvest in 1992 and 1993 ranged from Maine to Florida, with the majority of harvest occurring between Connecticut and New Jersey, and in North Carolina and Florida (Table 9).

In 1992, most of the coastal commercial landings were attributed to fishers using gill nets (37%) and otter trawls (28%). Gears most likely to cause a rapid increase in commercial landings of bluefish, i.e., purse seines, runaround gill nets and pair trawls, caught relatively few bluefish.

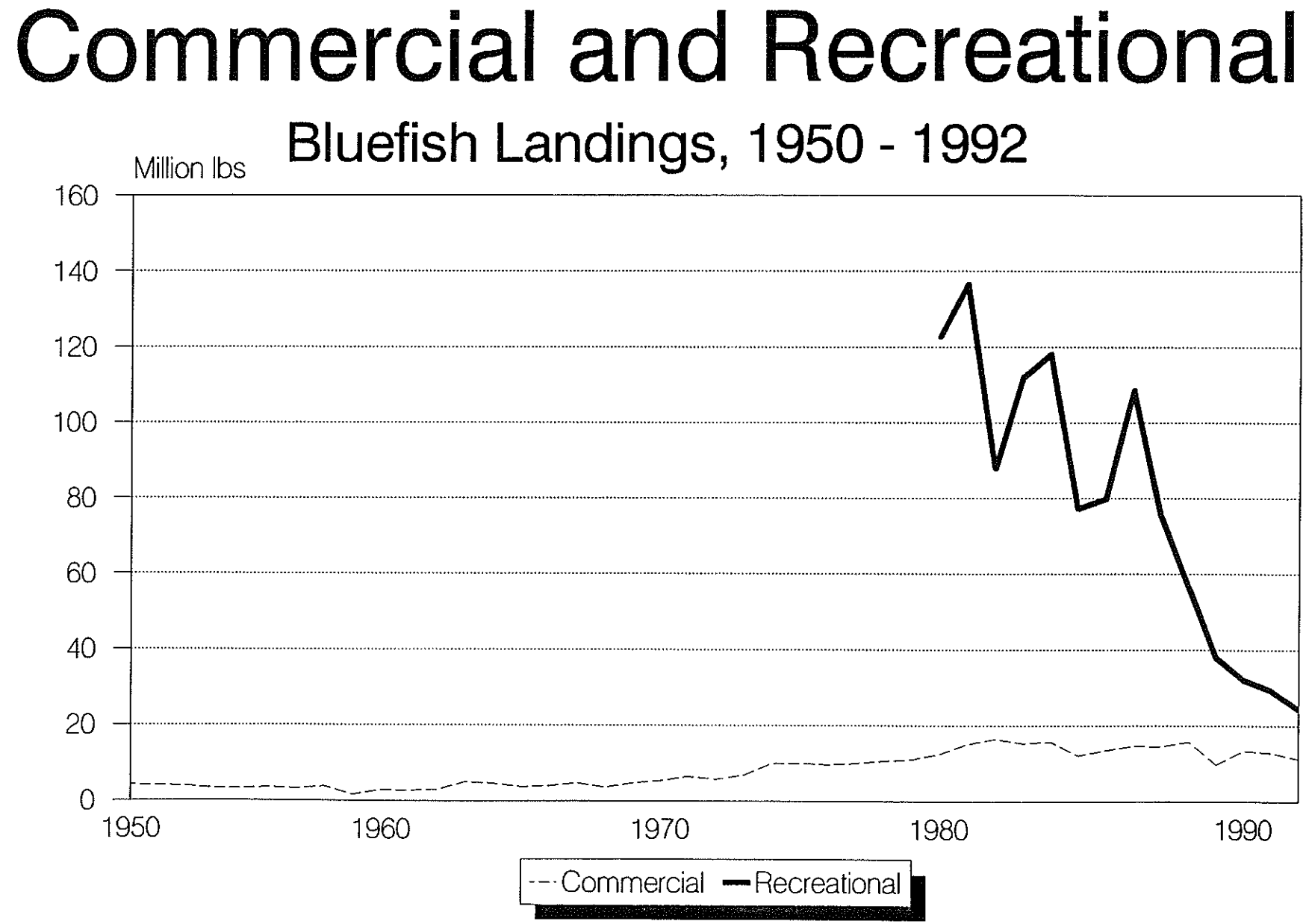


Figure 13. Recreational and commercial landings of bluefish, 1950-1992.

Table 9. Recreational harvest of bluefish by state from the National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey (MRFSS), 1992-1993. Harvest is measured as the number of Type A + B1 fish.

State	1992 Harvest	Percent 1992 Harvest	1993 Harvest	Percent 1993 Harvest
ME	93,743	1.42	21,788	0.52
NH	26,192	0.40	21,388	0.51
MA	312,444	4.75	321,535	7.69
RI	294,316	4.47	113,717	2.72
CT	1,045,368	15.88	392,708	9.39
NY	1,202,575	18.27	1,125,801	26.92
NJ	1,648,004	25.04	513,561	12.28
DE	172,871	2.63	103,730	2.48
MD	295,730	4.49	127,874	3.06
VA	168,175	2.55	44,134	1.06
NC	522,349	7.94	532,074	12.72
SC	33,144	0.50	89,584	2.14
GA	7,634	0.12	6,770	0.16
FL	759,987	11.55	767,171	18.35
Total	6,582,531		4,181,836	

IV. Status of Management Measures

As of November 14, 1993, eleven states have either implemented the ten fish possession limit for recreational anglers advocated in the FMP or a measure determined to have conservation equivalency. These include Maine, New Hampshire, Massachusetts, Rhode Island, New York, Delaware, Maryland, Virginia, South Carolina, Georgia and Florida.

As of November 14, 1993, twelve states have implemented licensing of fishermen who take bluefish for commercial purposes.

V. Commission FMP Recommendations

1. Ten (10) fish bag limit or equivalent conservation
2. Commercial quota, if commercial fishery exceeds 20%.

Sample Sizes and Precision for Bluefish

Lisa L. Kline, Ph.D.
Atlantic States Marine Fisheries Commission

and

Maury Osborn
National Marine Fisheries Service

The overall MRFSS coastwide sample size for bluefish is approximately 4,000 intercept interviews. Current proportional standard errors for the Atlantic Coast and all subregions are below 10 percent (Table 10).

Table 10. Current levels of precision and sample sizes for bluefish for the Atlantic Coast and by subregion, 1992 and 1993 MRFSS data.

Region	1992		1993	
	PSE	N	PSE	N
Coastal	4.1	4300	3.5	3050
New England	9.8	1500	6.2	1250
Mid-Atlantic	4.9	2000	5.7	1100
South Atlantic	8.2	800	5.9	700

With the exception of Maine, all states greater than one percent of the total coastwide harvest for bluefish had PSE's less than 20 percent in 1992 (Table 9, Figure 14). In 1992, Maine accounted for only 1.4 percent of the total coastwide harvest and had a PSE of 34.5 percent. There were only 35 interviews with bluefish in Maine in 1992. New Hampshire, South Carolina, and Georgia accounted for less than one percent of the total coastwide harvest for bluefish and had PSE's of 42.9, 20.3, and 39.4 percent, respectively. Samples for these states were less than 30 interviews with bluefish.

In 1993 all states with harvest less than one percent of the total coastwide harvest for bluefish had PSE's less than 20 percent (Table 9, Figure 15). In 1993, Maine, New Hampshire, and Georgia accounted for less than one percent of the total coastwide harvest and had PSE's of 26.6, 39.8, and 30.7 percent, respectively. Samples with bluefish for these states were less than 40 interviews.

Bluefish 1992

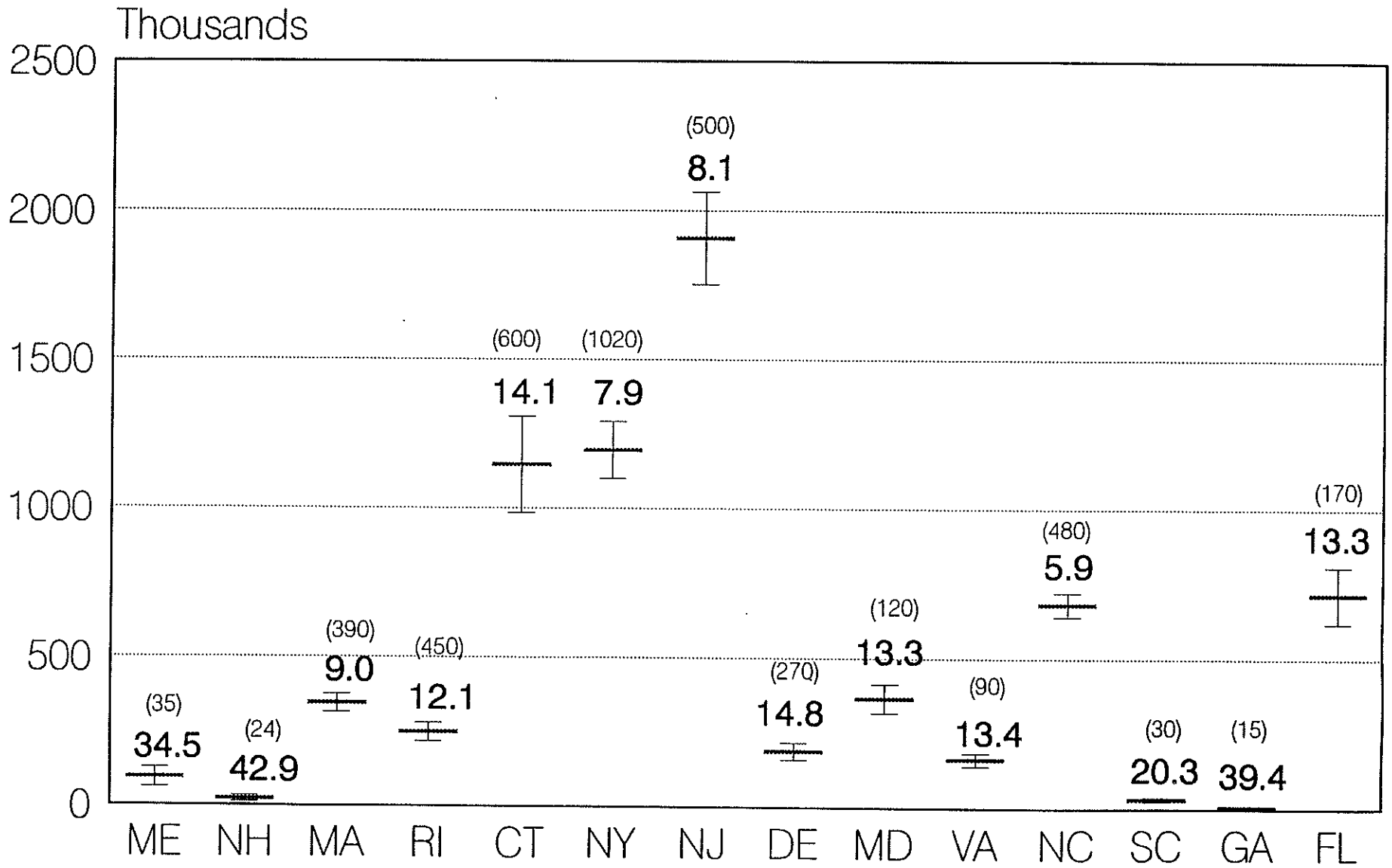


Figure 14. Current levels of sampling effort and precision by state for bluefish. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1992.

Bluefish 1993

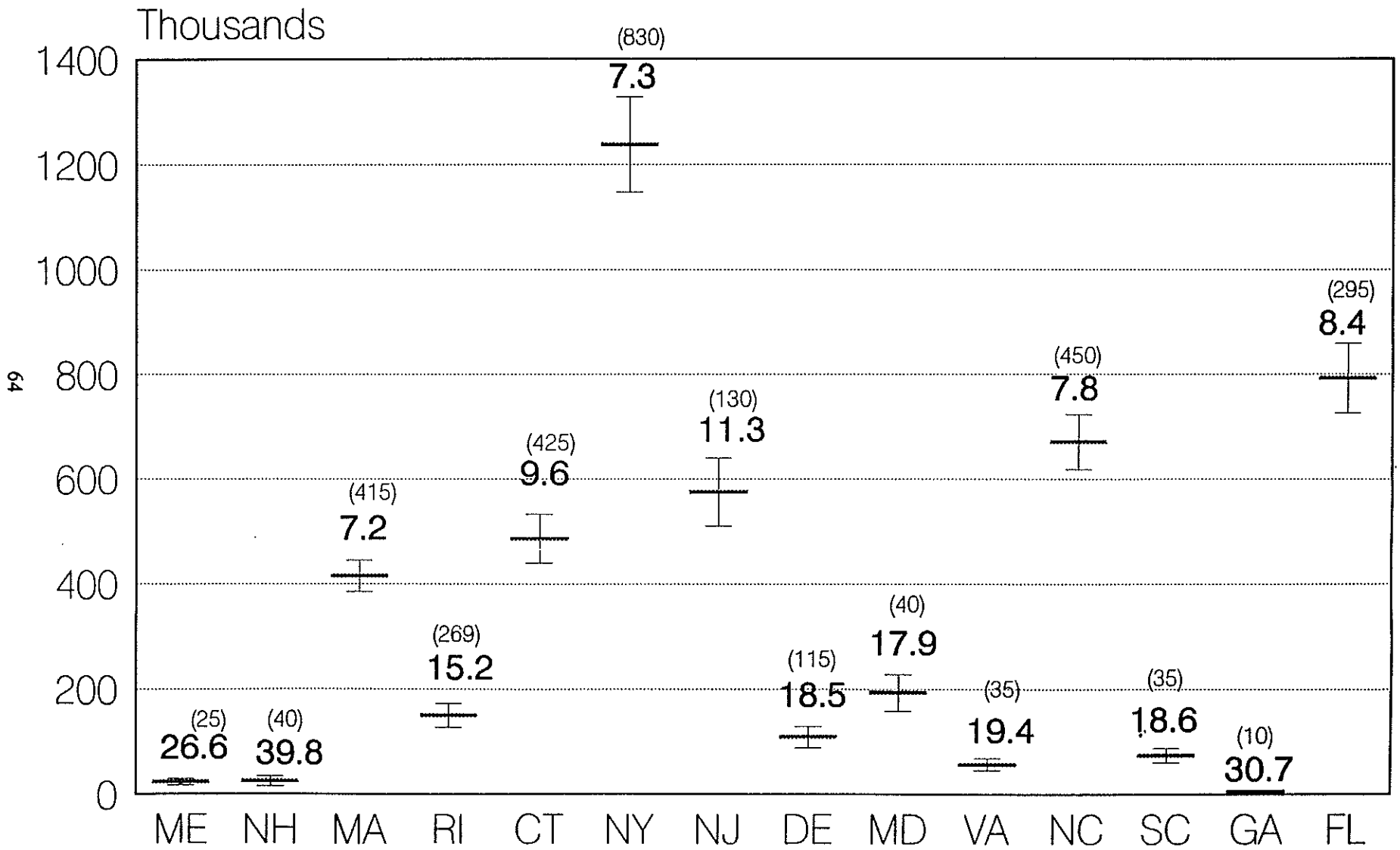


Figure 15. Current levels of sampling effort and precision by state for bluefish. Precision is measured +/- 1 standard error about the mean number of fish, and as the proportional standard error. Sample size by state is shown as the value in parentheses.

Source: Marine Recreational Fisheries Statistics Survey (MRFSS) Type A + B1 data, 1993.

Recommendations For Target Levels of Precision and Timeliness for Bluefish

Precision Targets

For states that harvest more than 10 percent of the coastwide harvest for bluefish, PSE's should range between 10-20 percent.

For states that harvest between 1 percent and 10 percent of the coastwide harvest for bluefish, PSE's should range between 20-30 percent.

Timeliness Targets

MRFSS preliminary estimates should be available by March 1.

MRFSS final estimates should be available by April 15.

Overall Recommendation

The Commission's Marine Recreational Fisheries Statistics Committee recommended that the technical committees of the five identifies priority species (red drum, winter flounder, summer flounder, weakfish, and bluefish) examine the historical MRFSS database after completion of the MRFSS re-estimation procedure to determine the time-series to be used in the calculation of the specific state harvest proportions and evaluate the effects of individual state target proportional standard errors (PSE) on coastal PSE's.

Appendix A.

Proportional Standard Errors on

Effort Estimates

PSE's on Effort Estimates

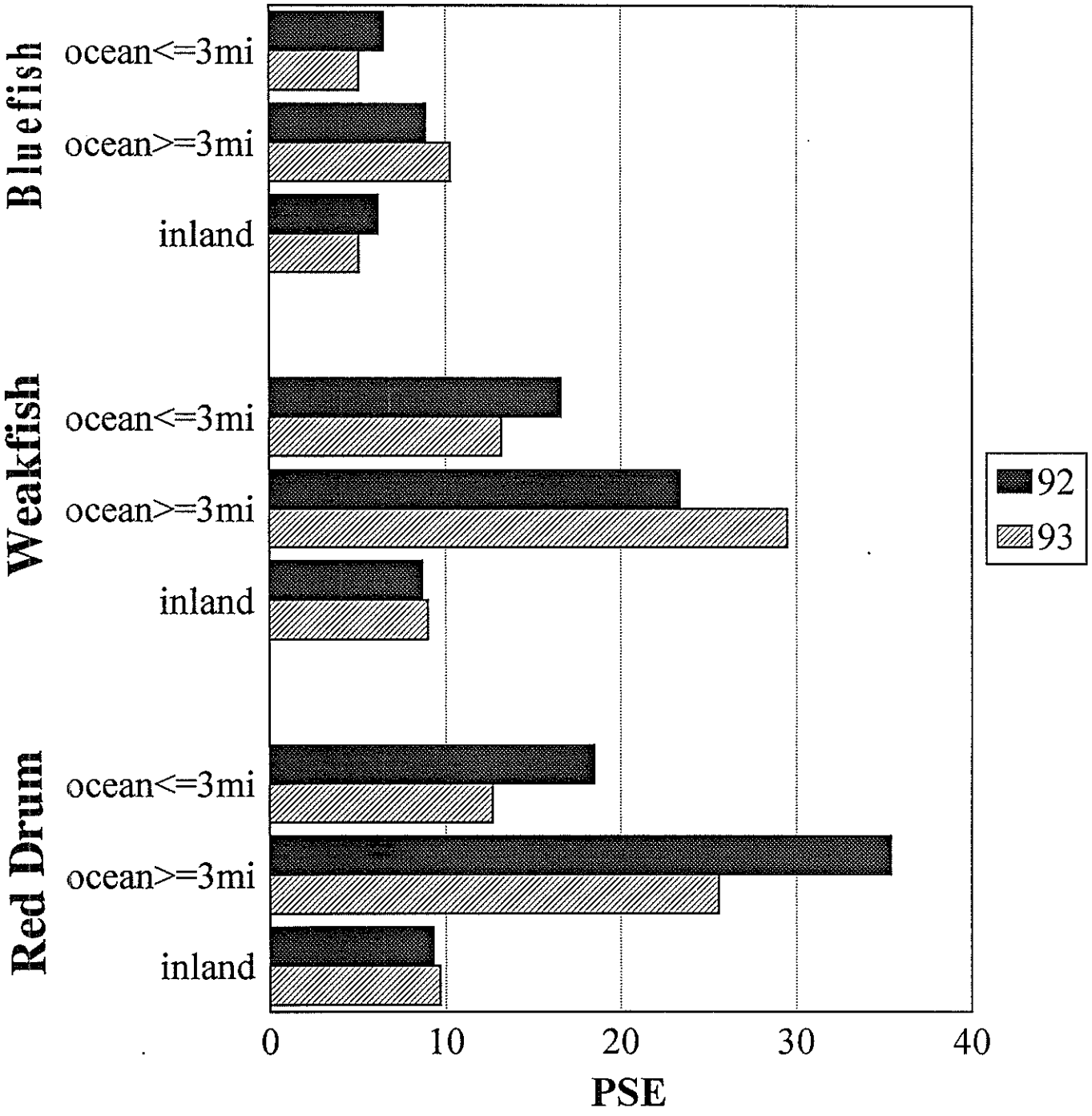
The PSE's on effort estimates from the MRFSS telephone survey are less than 10 percent on a coastal, regional, wave, and mode level. State effort estimates are less than 20 percent. PSE's on the state/wave level vary between 5 and 110 percent when all waves are included. PSE ranges decline to 5-43 percent for waves 3-5. Ranges for the New England and Mid-Atlantic regions are higher than the South Atlantic, probably due to increased sampling in the South Atlantic region. PSE's at a state/mode level are less than 20 percent for the shore mode in all states except Maine and New Hampshire. PSE's on the charter/party boat mode of fishing are greater than 20 percent in all states, except New York and New Jersey. Increases in PSE's for the charter/party boat mode is due to the difficulty in sampling this mode of fishing. PSE's for the private/rental boat mode are less than 20 percent, except for the state of New Hampshire.

Appendix B.

Proportional Standard Errors by Species and Area

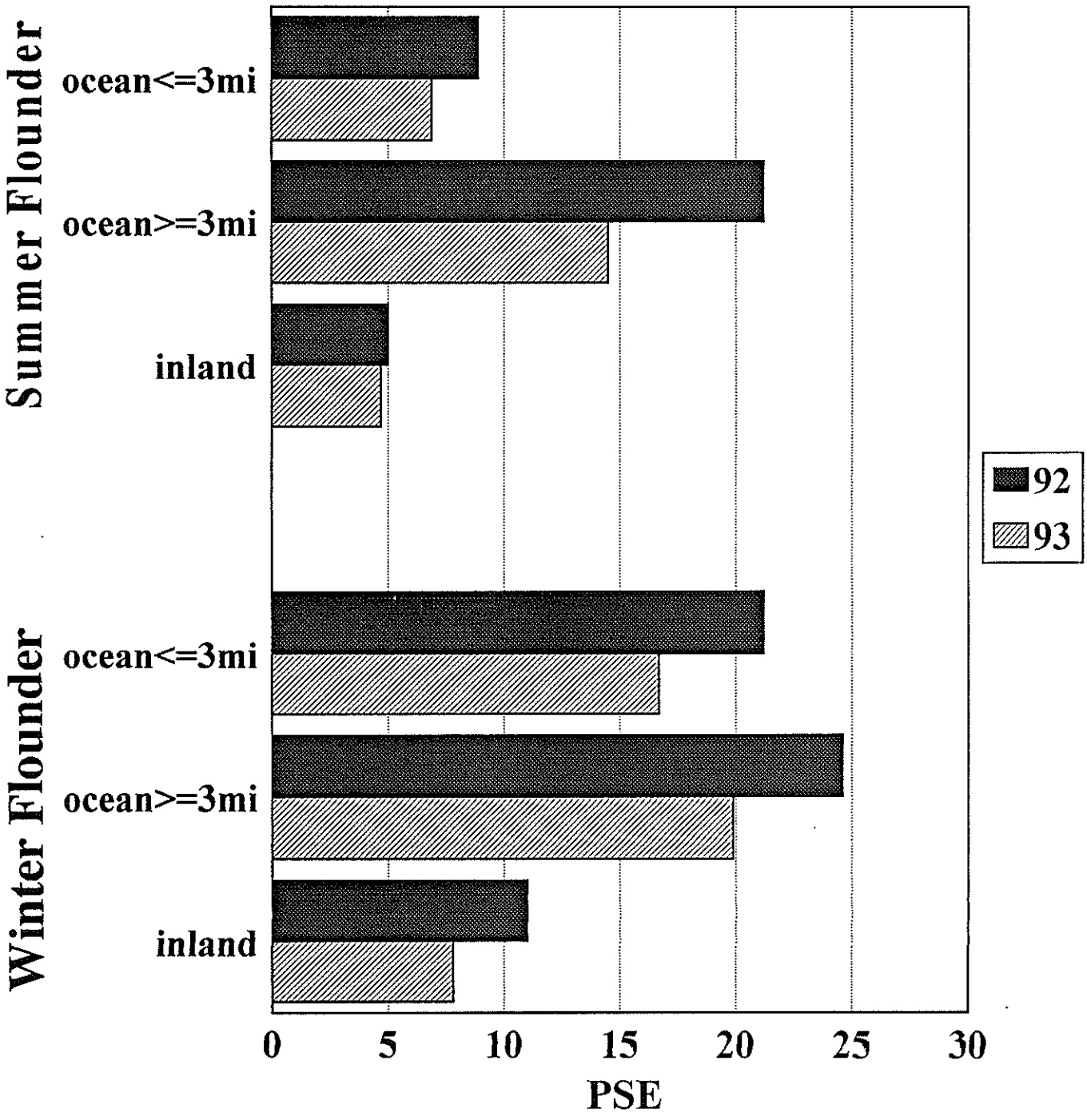
Harvest PSE's By Area

Bluefish, Weakfish, & Red Drum



Harvest PSE's by Area

Summer & Winter Flounder

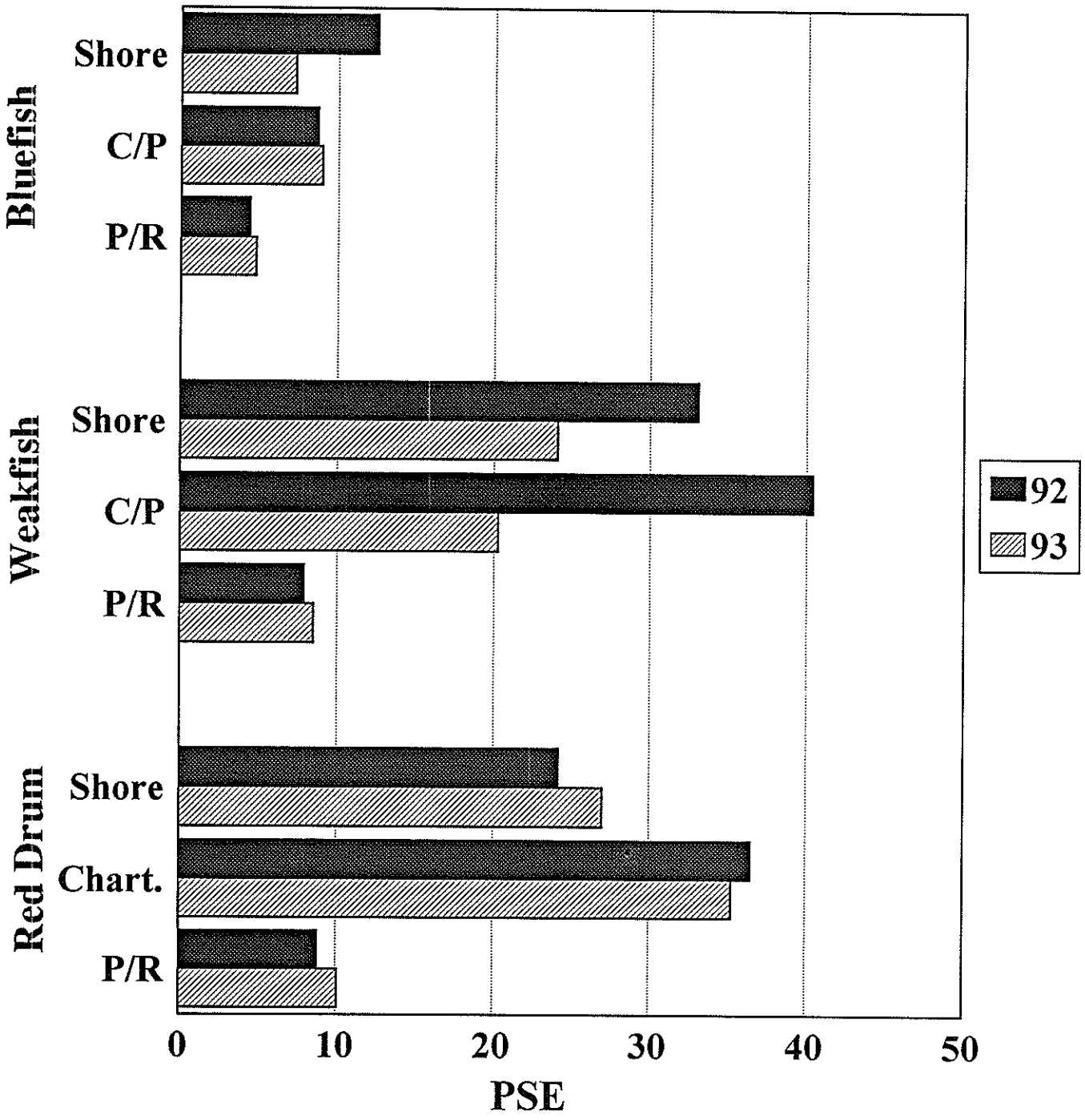


Appendix C.

Proportional Standard Errors by Species and Mode

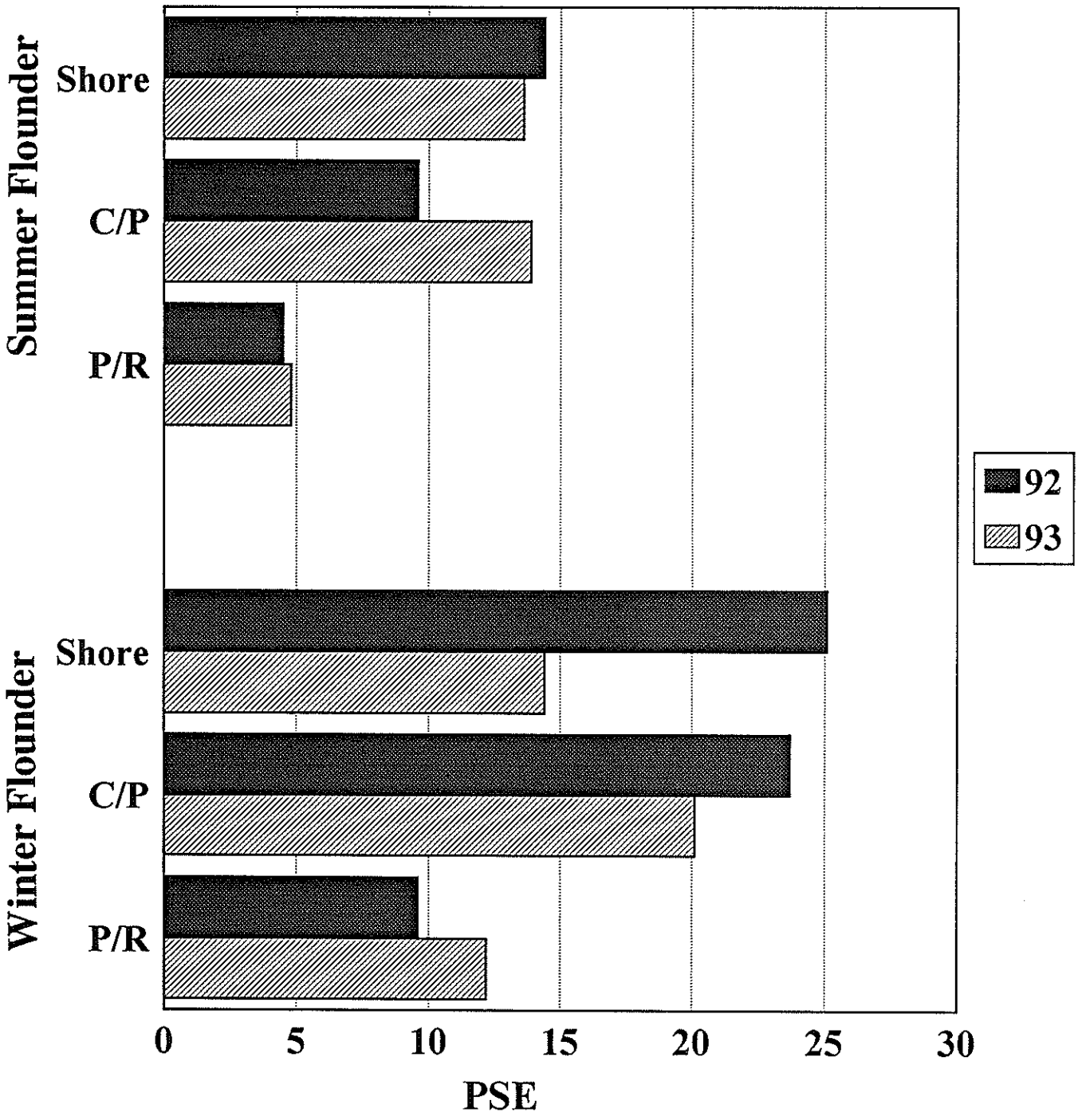
Harvest PSE's by Mode

Bluefish, Weakfish, & Red Drum



Harvest PSE's by Mode

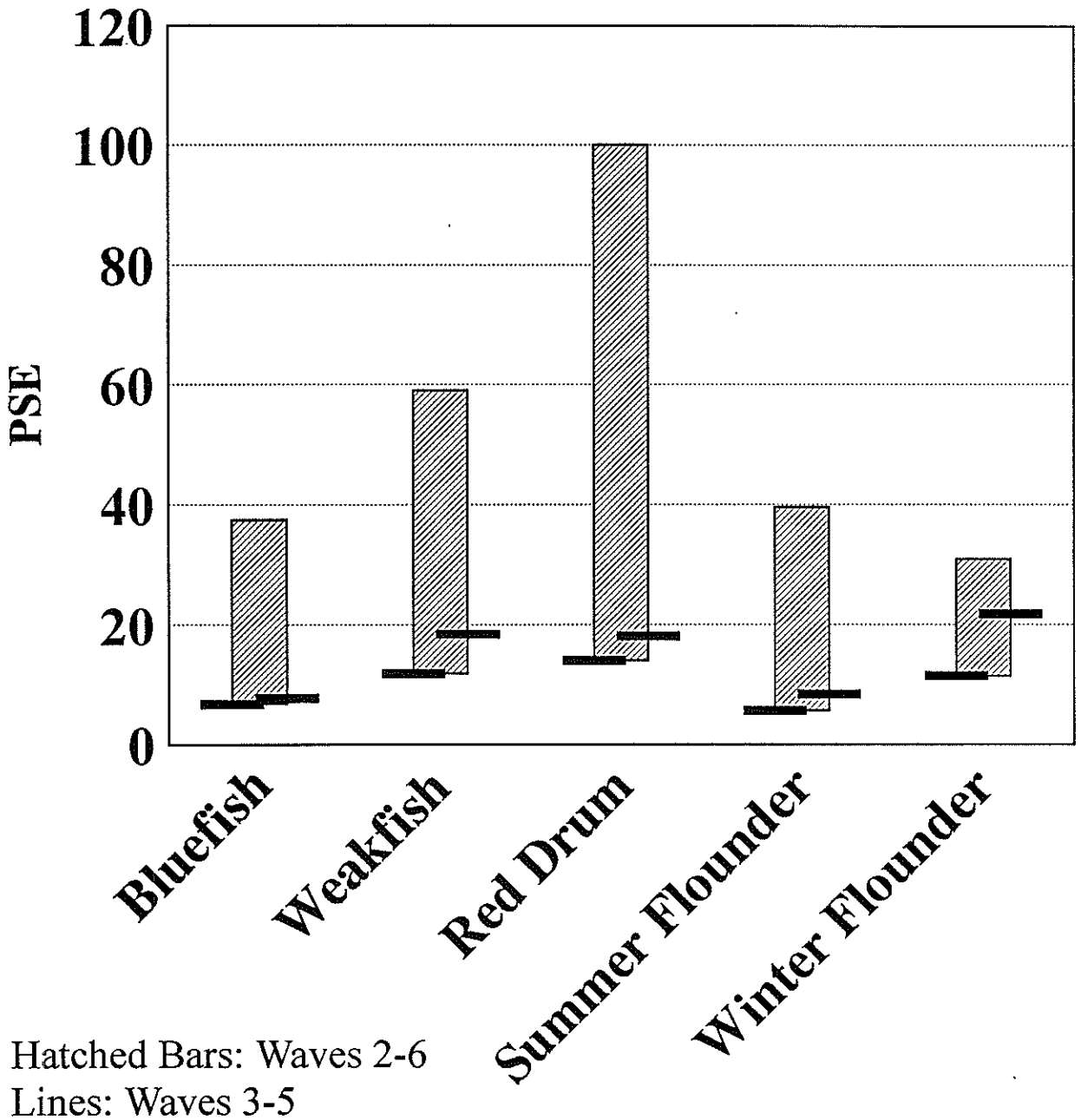
Summer & Winter Flounder



Appendix D.

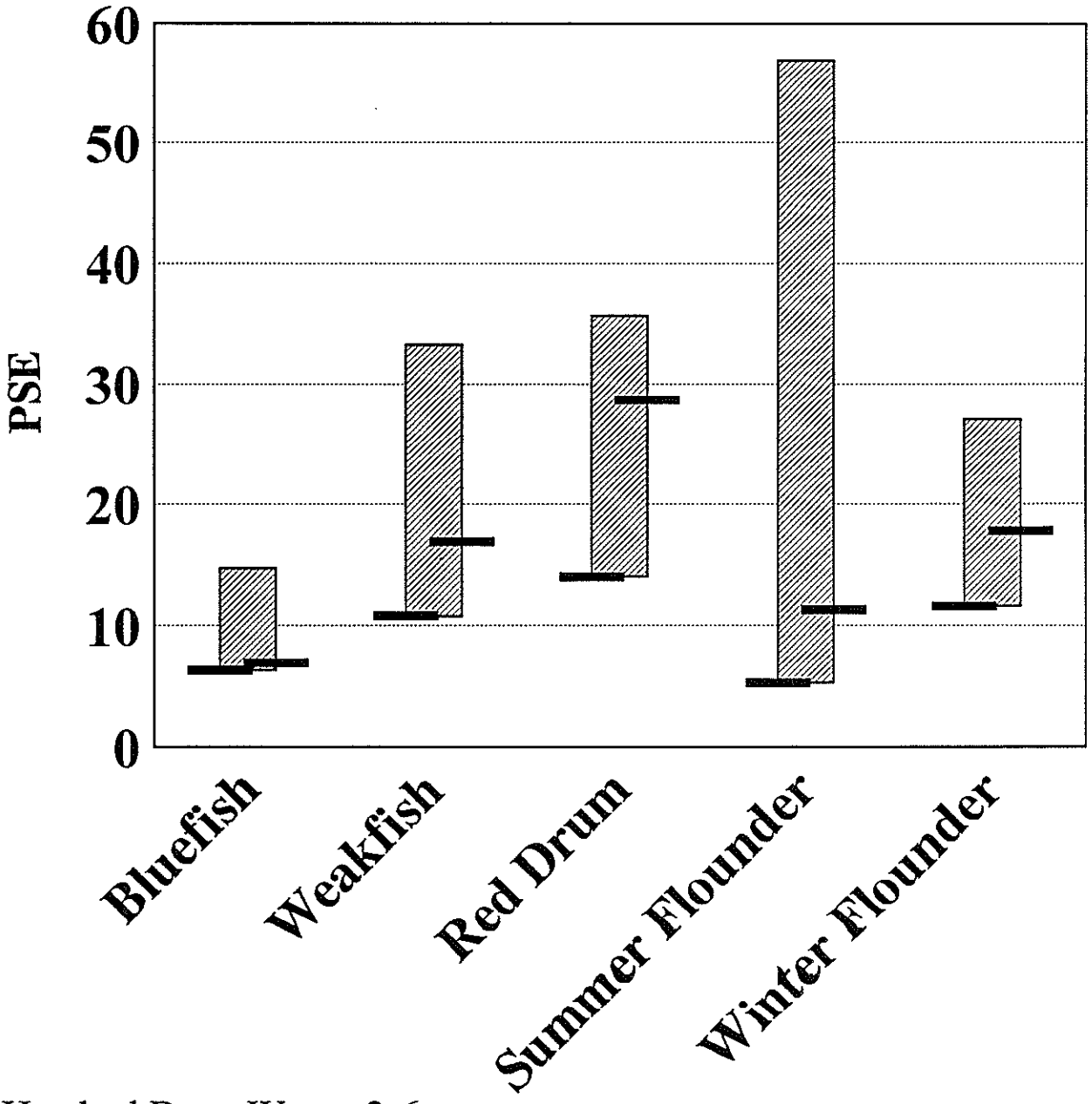
Proportional Standard Errors and Sample Sizes by Species and Wave

Harvest PSE's By Wave 1992



Hatched Bars: Waves 2-6
Lines: Waves 3-5

Harvest PSE's By Wave 1993



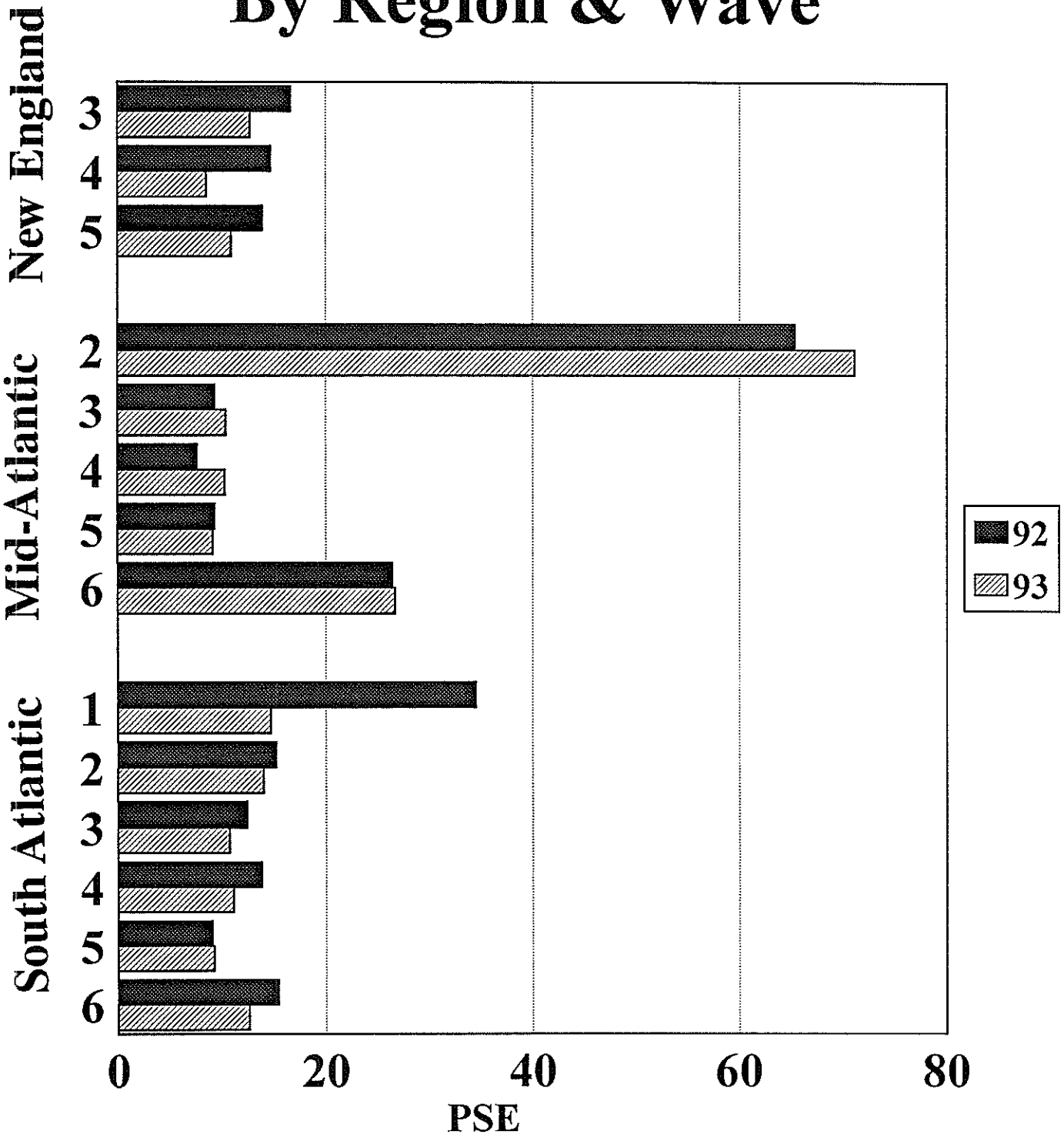
Hatched Bars: Waves 2-6
Lines: Waves 3-5

Appendix E.

Proportional Standard Errors and Sample Sizes by Species/Region/Wave and Species/State/Wave

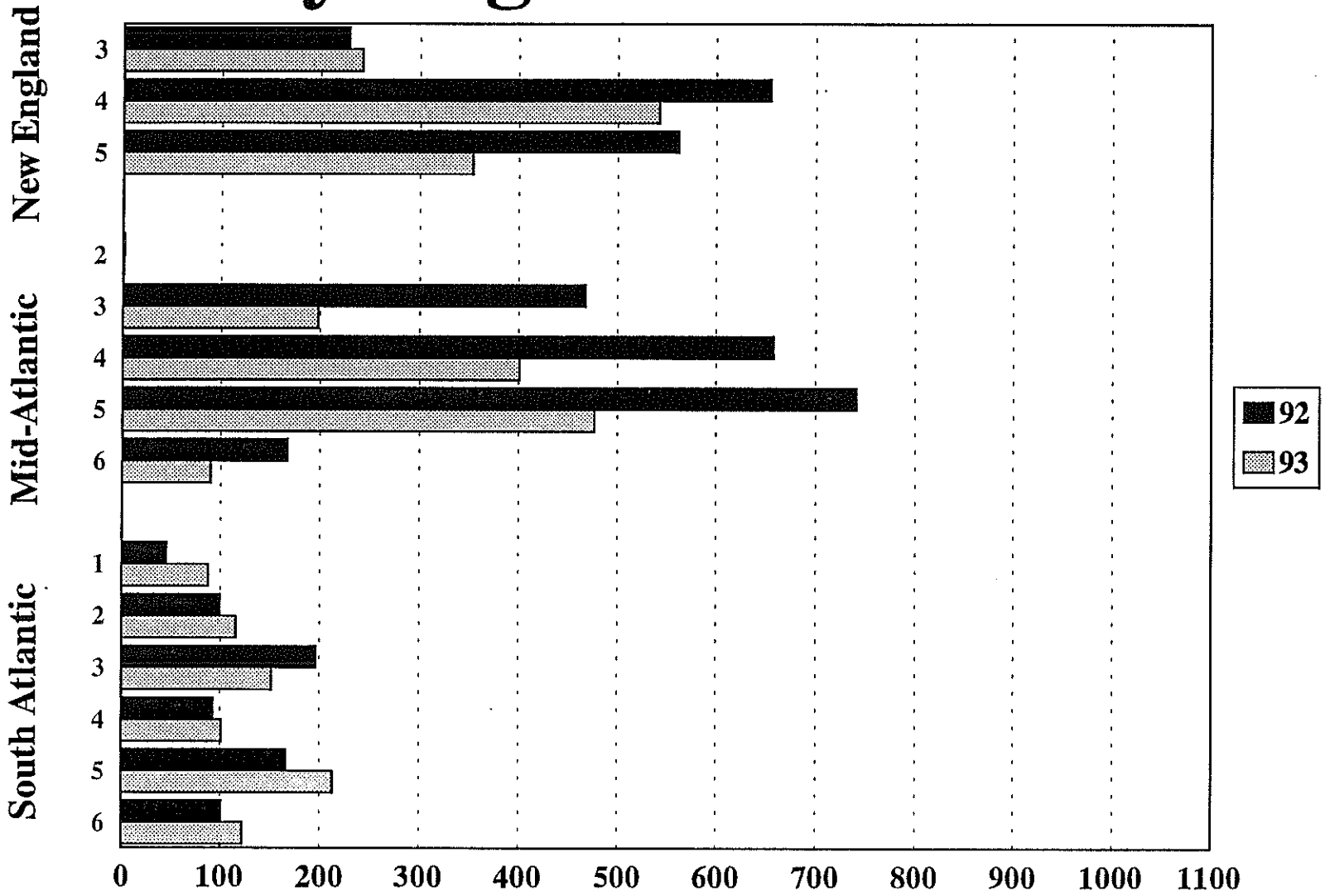
Bluefish Harvest PSE's

By Region & Wave



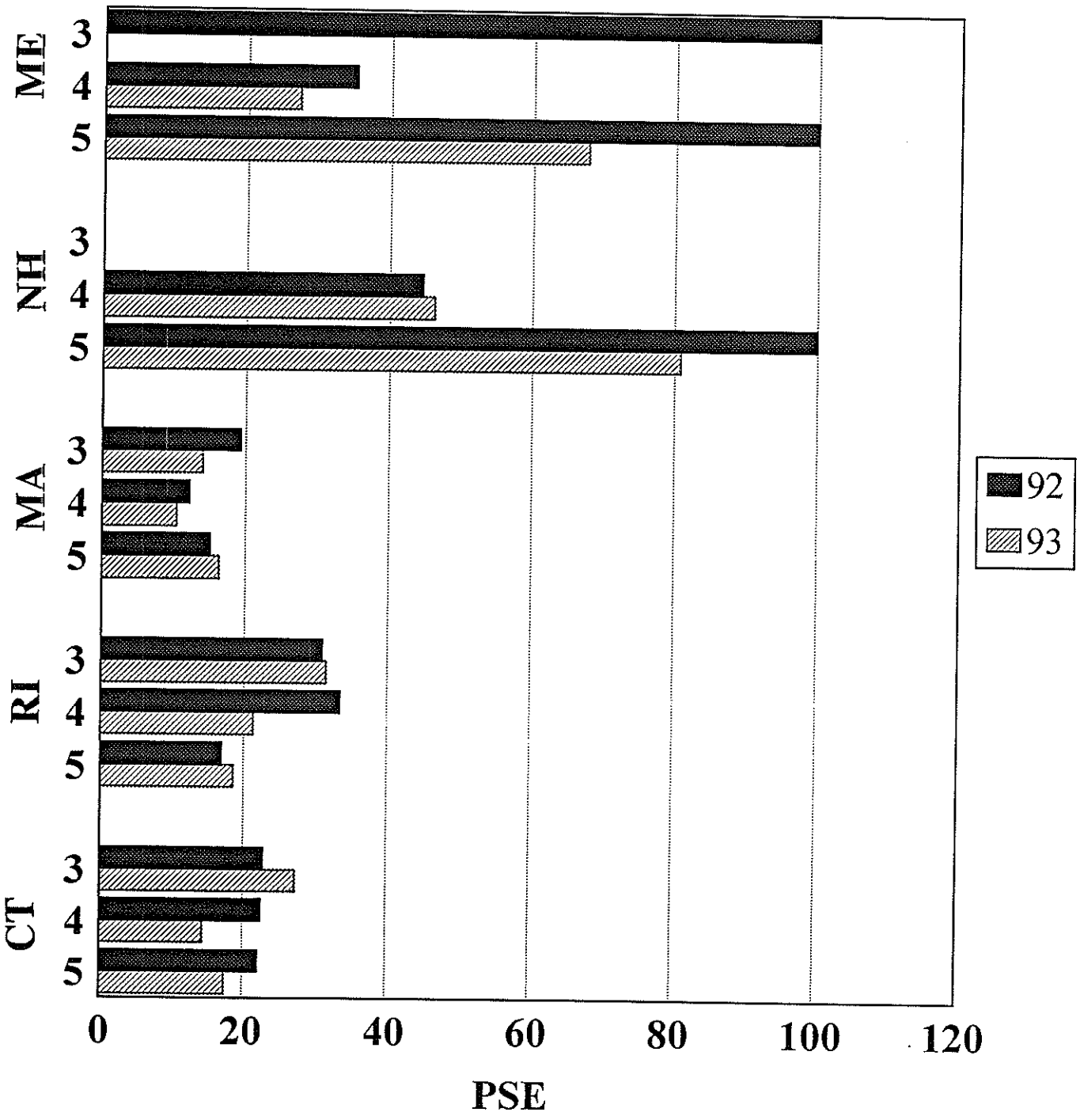
Bluefish N

by Region and Wave



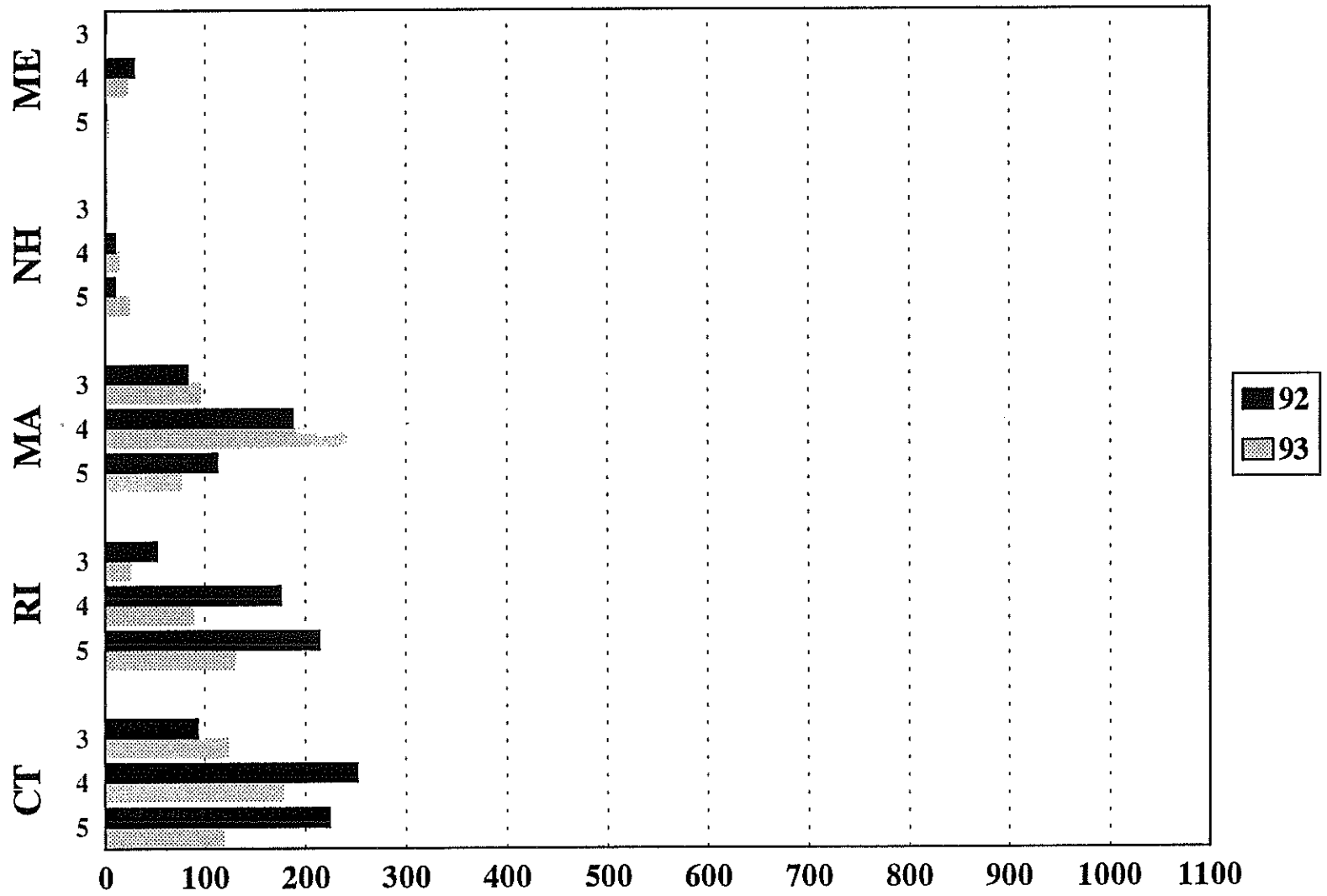
Bluefish Harvest PSE's

New England States



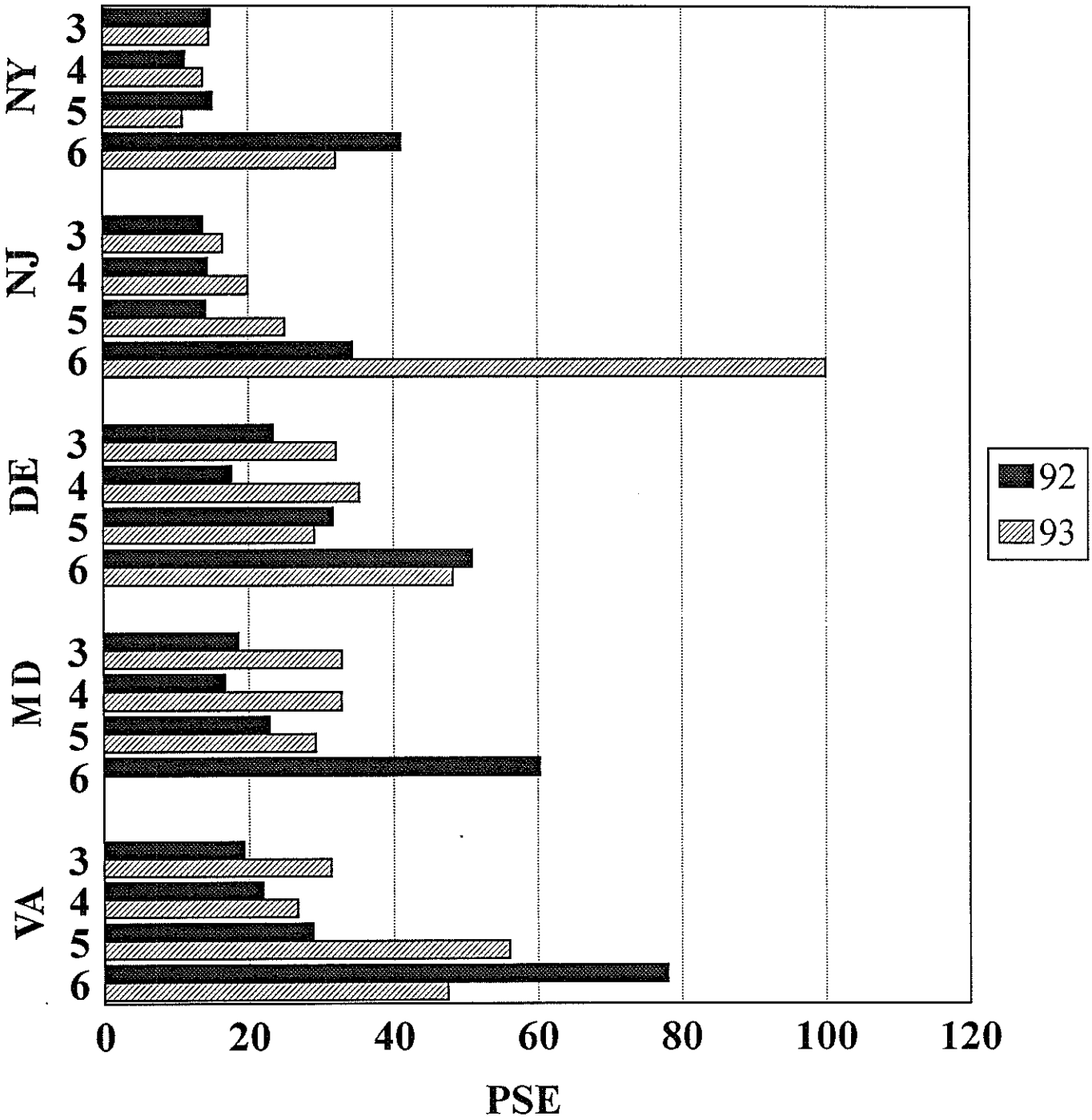
Bluefish N

New England



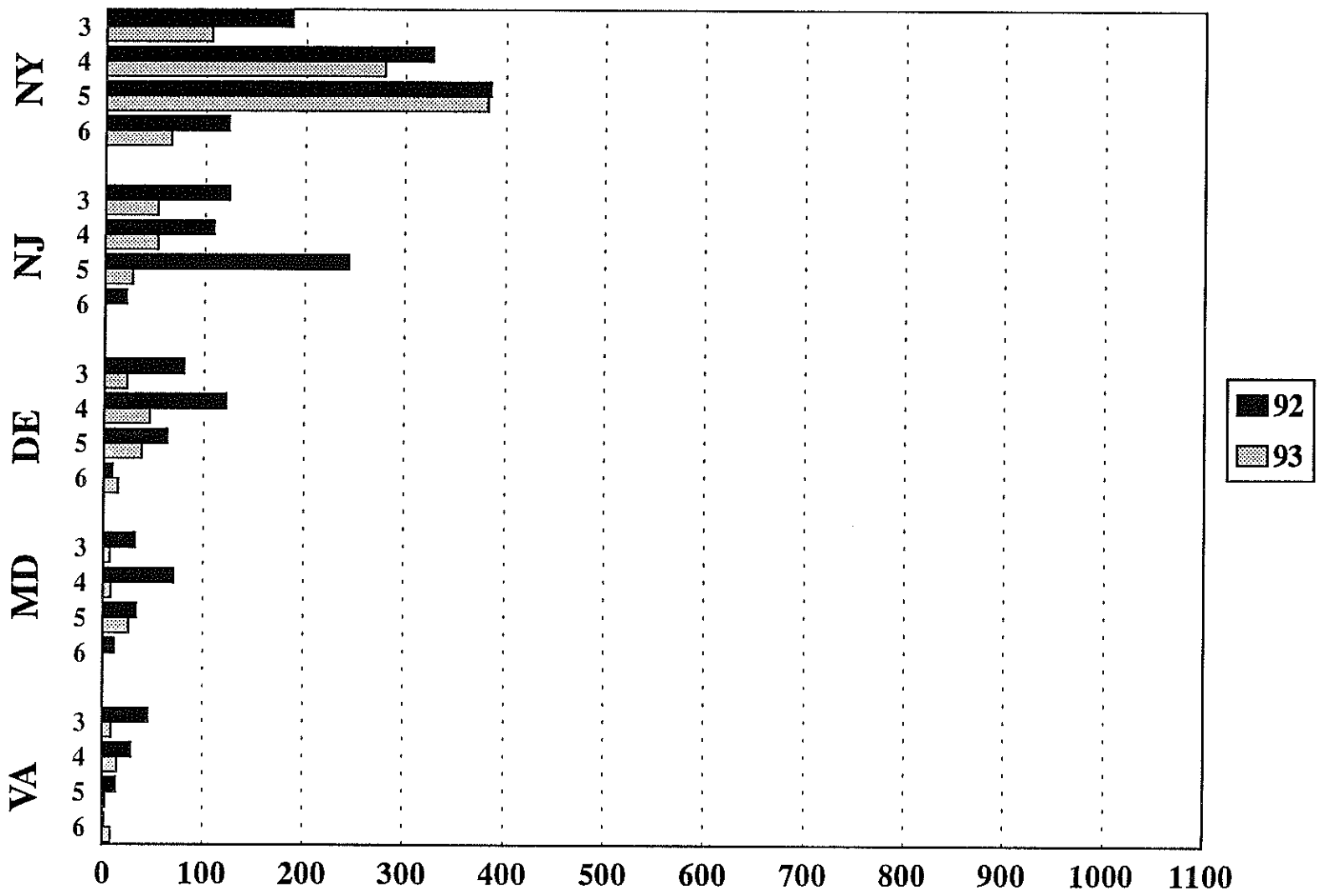
Bluefish Harvest PSE's

Mid-Atlantic States



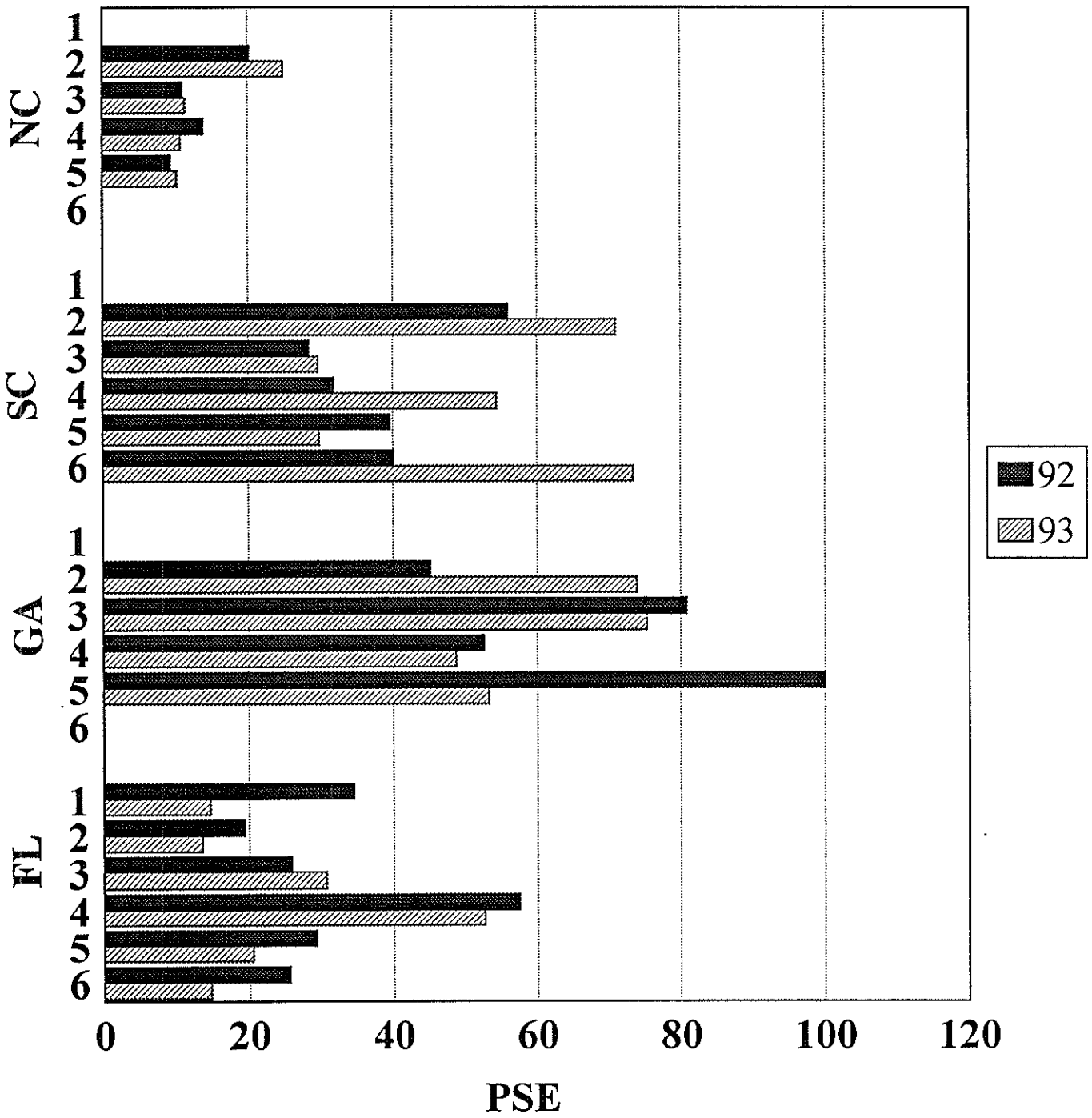
Bluefish N

Mid-Atlantic



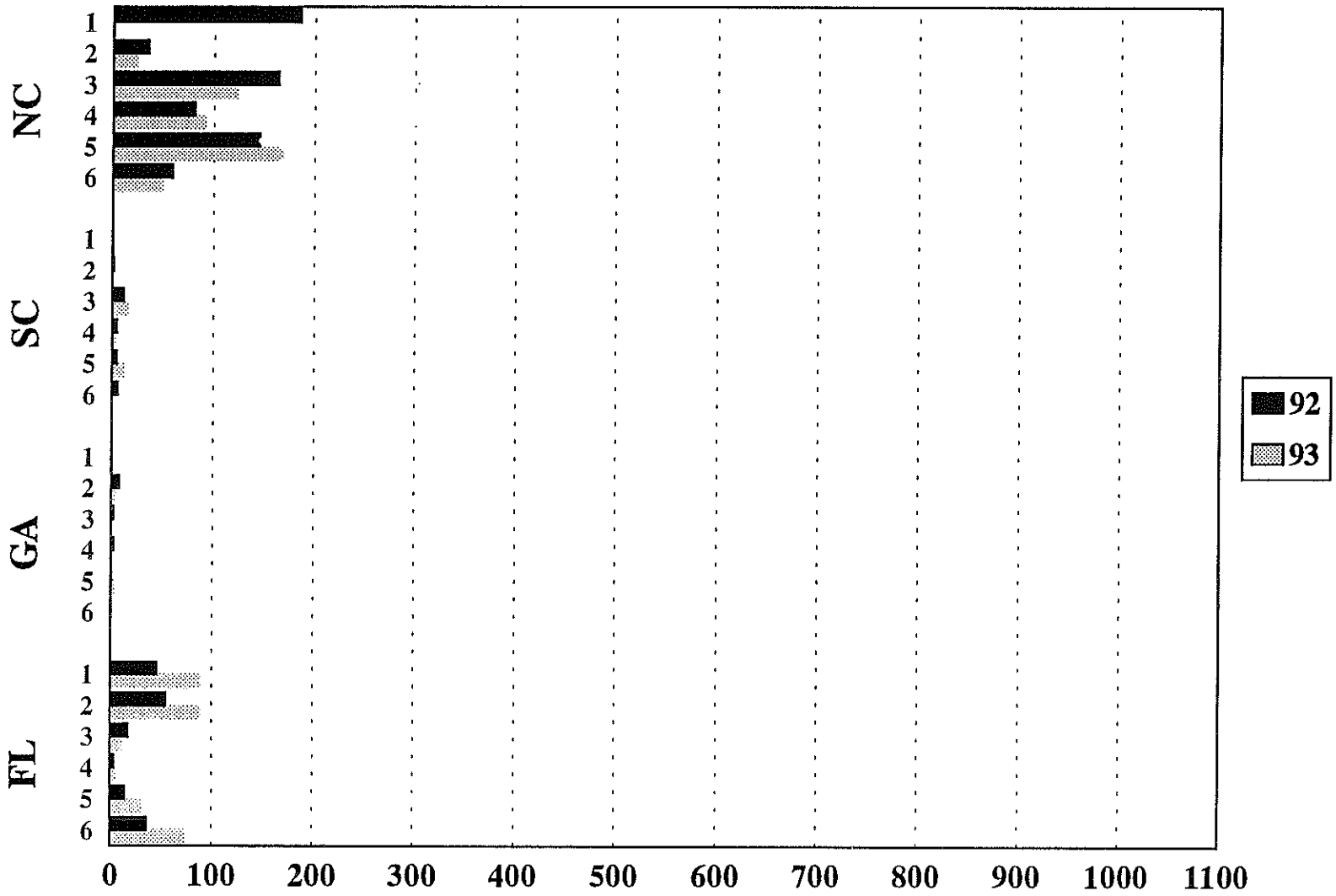
Bluefish Harvest PSE's

South Atlantic States



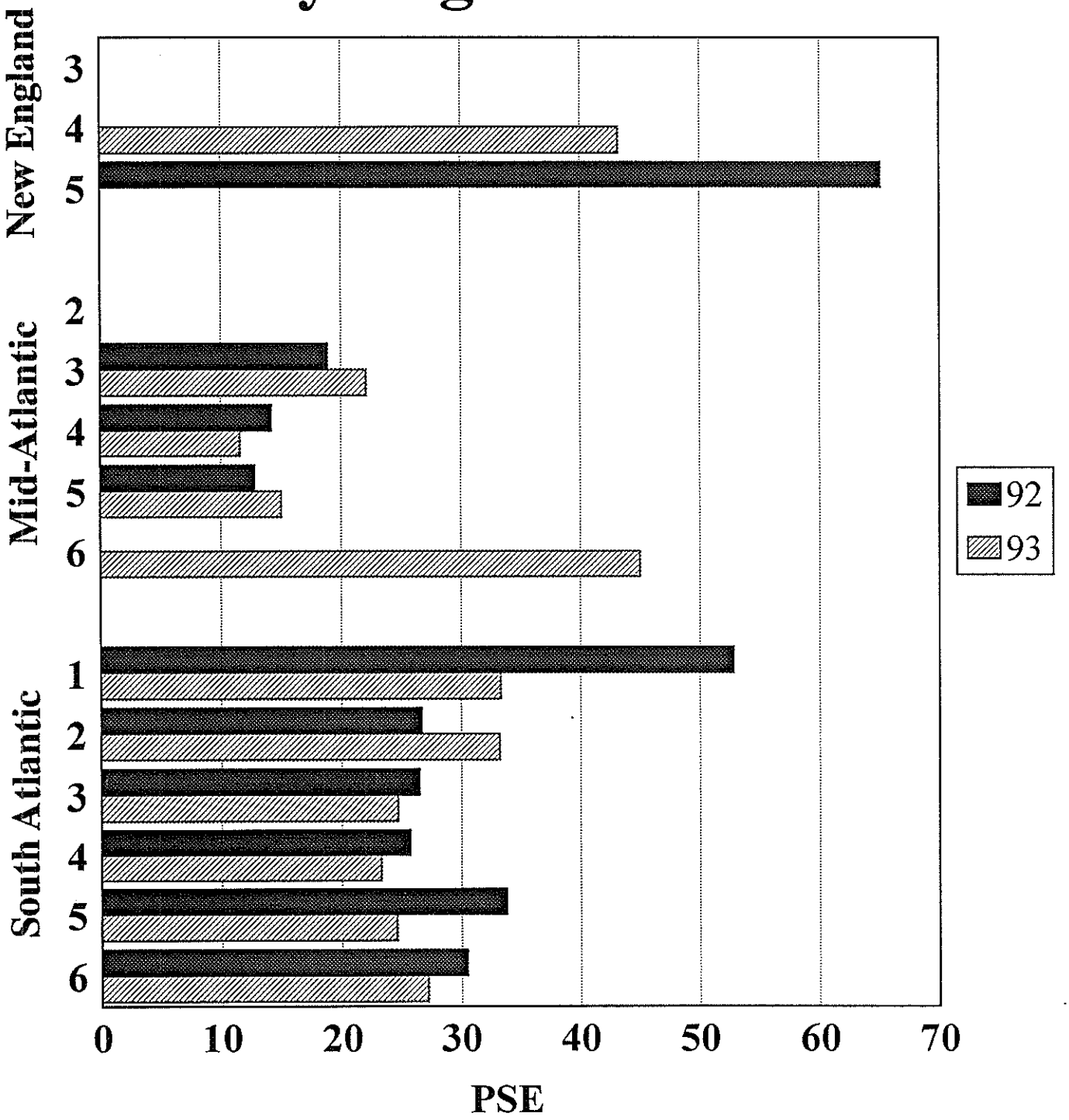
Bluefish N

South Atlantic

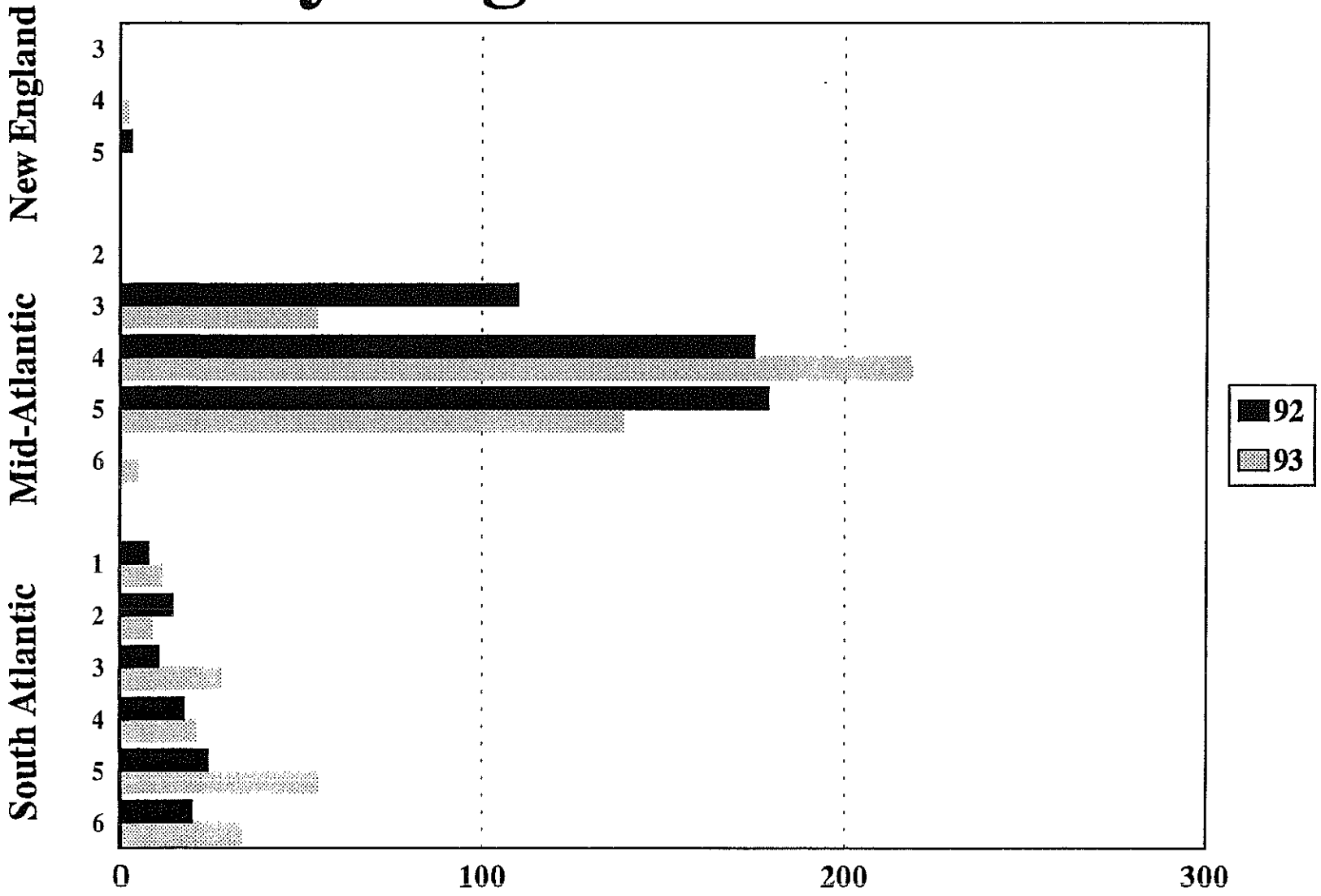


Weakfish Harvest PSE's

By Region & Wave

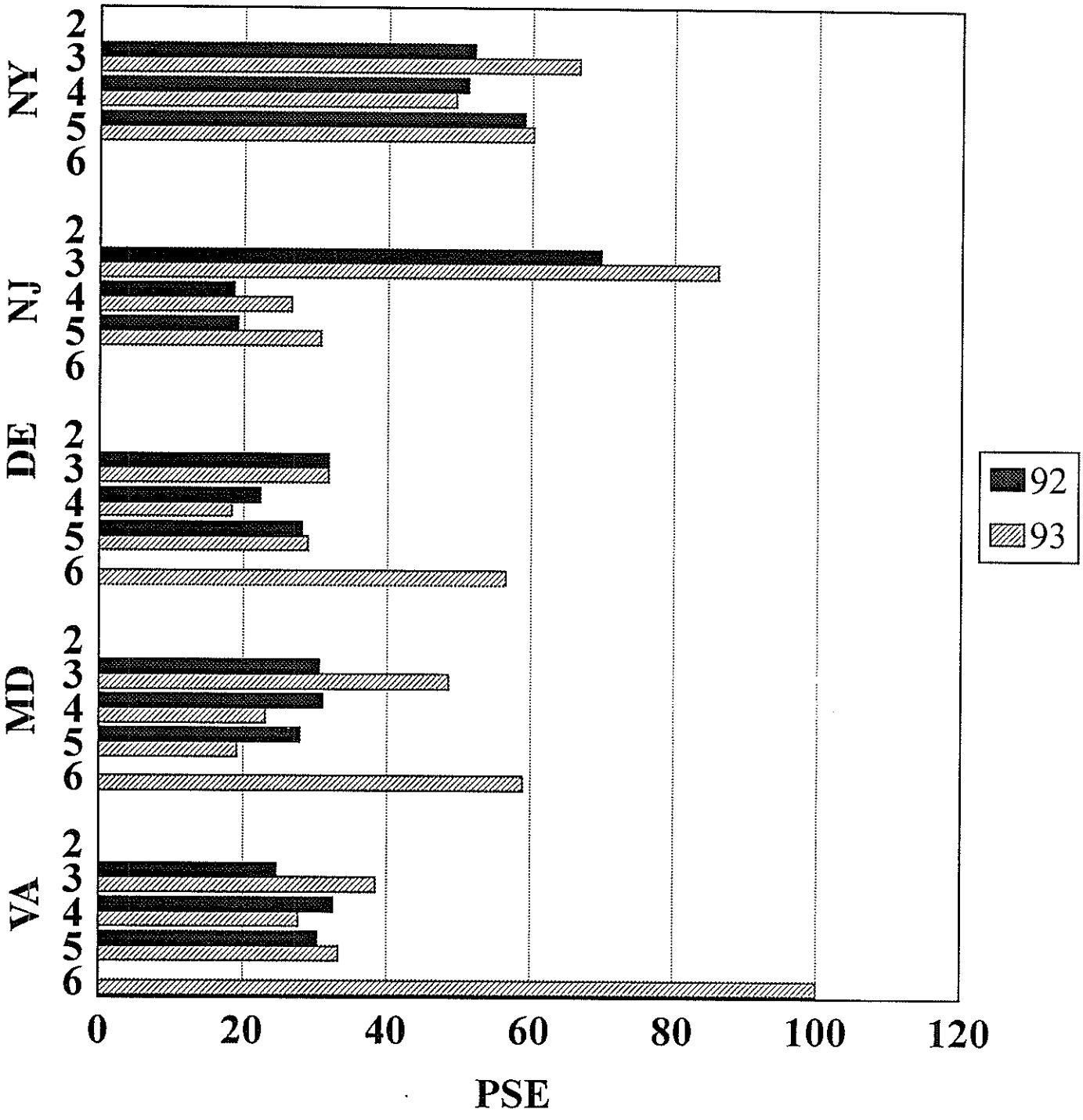


Weakfish N
by Region and Wave



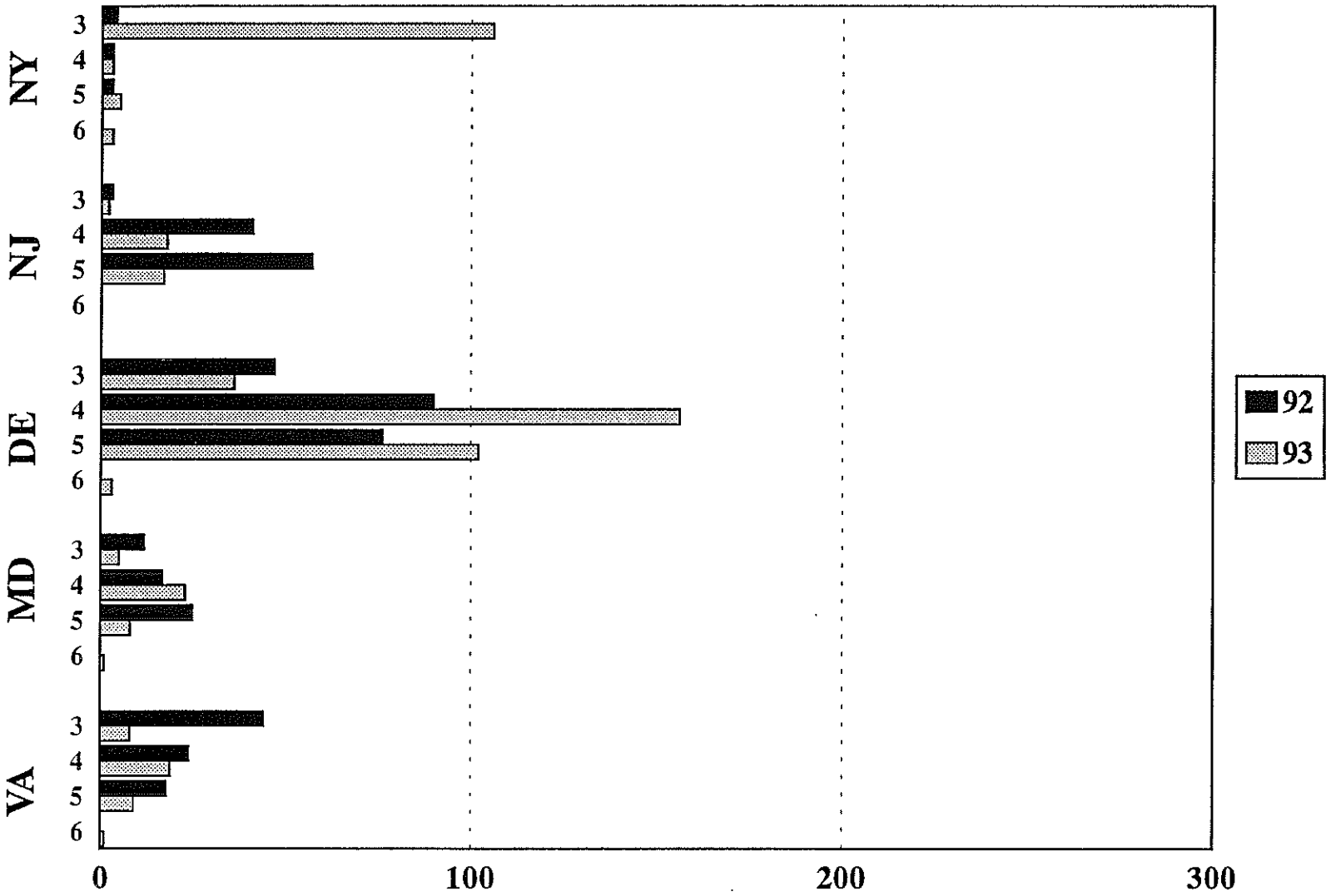
Weakfish Harvest PSE's

Mid-Atlantic States



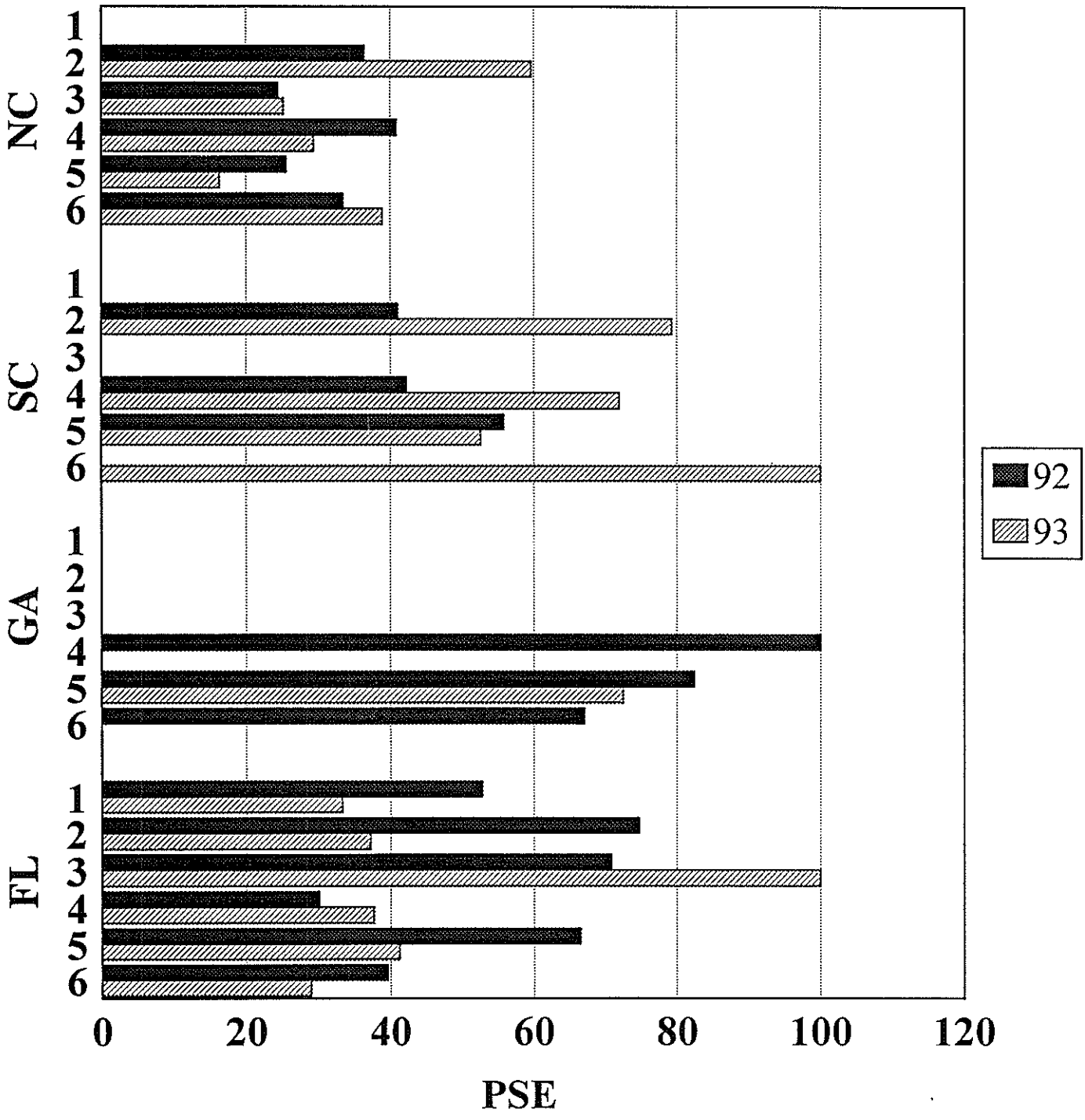
Weakfish N

Mid-Atlantic



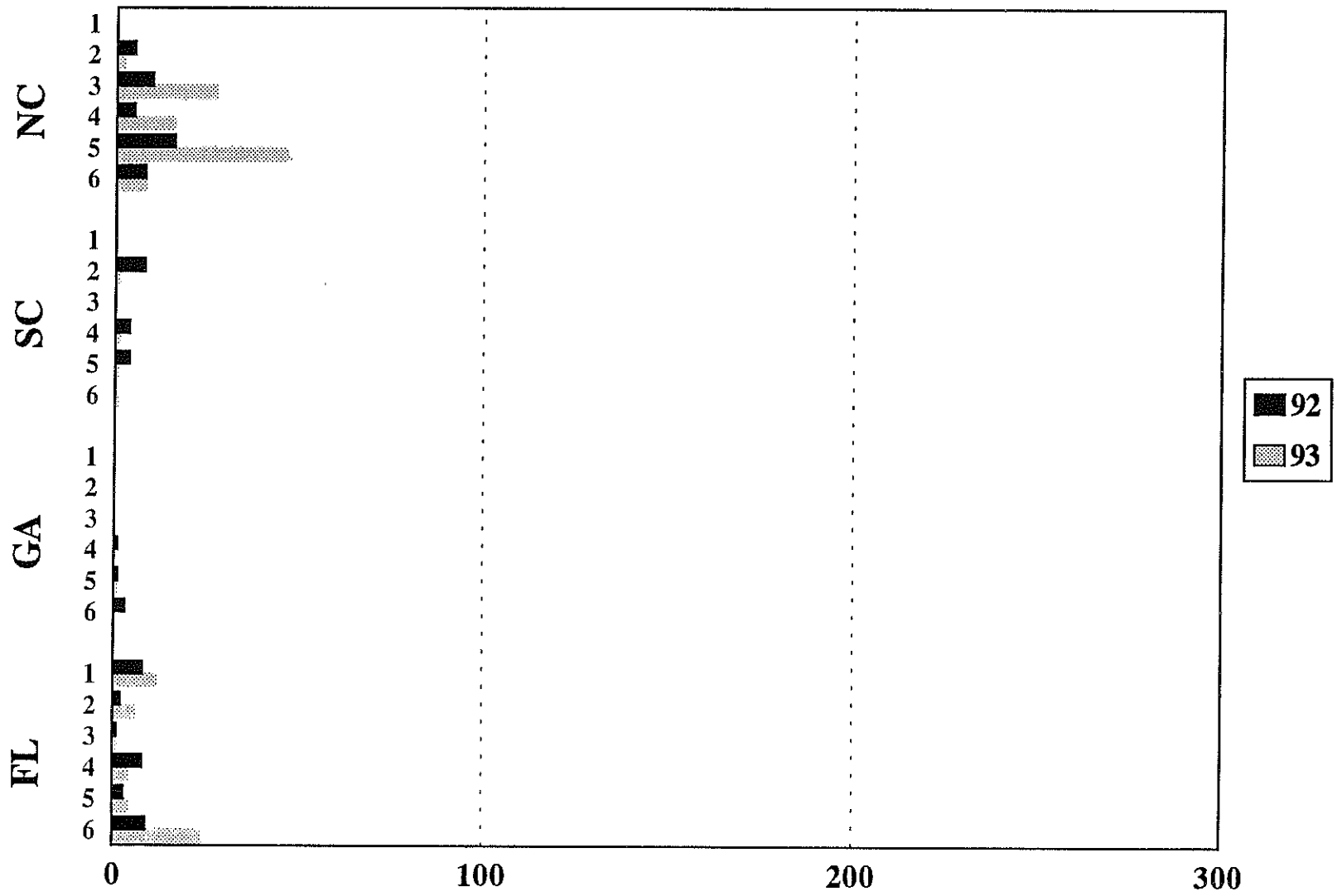
Weakfish Harvest PSE's

South Atlantic States



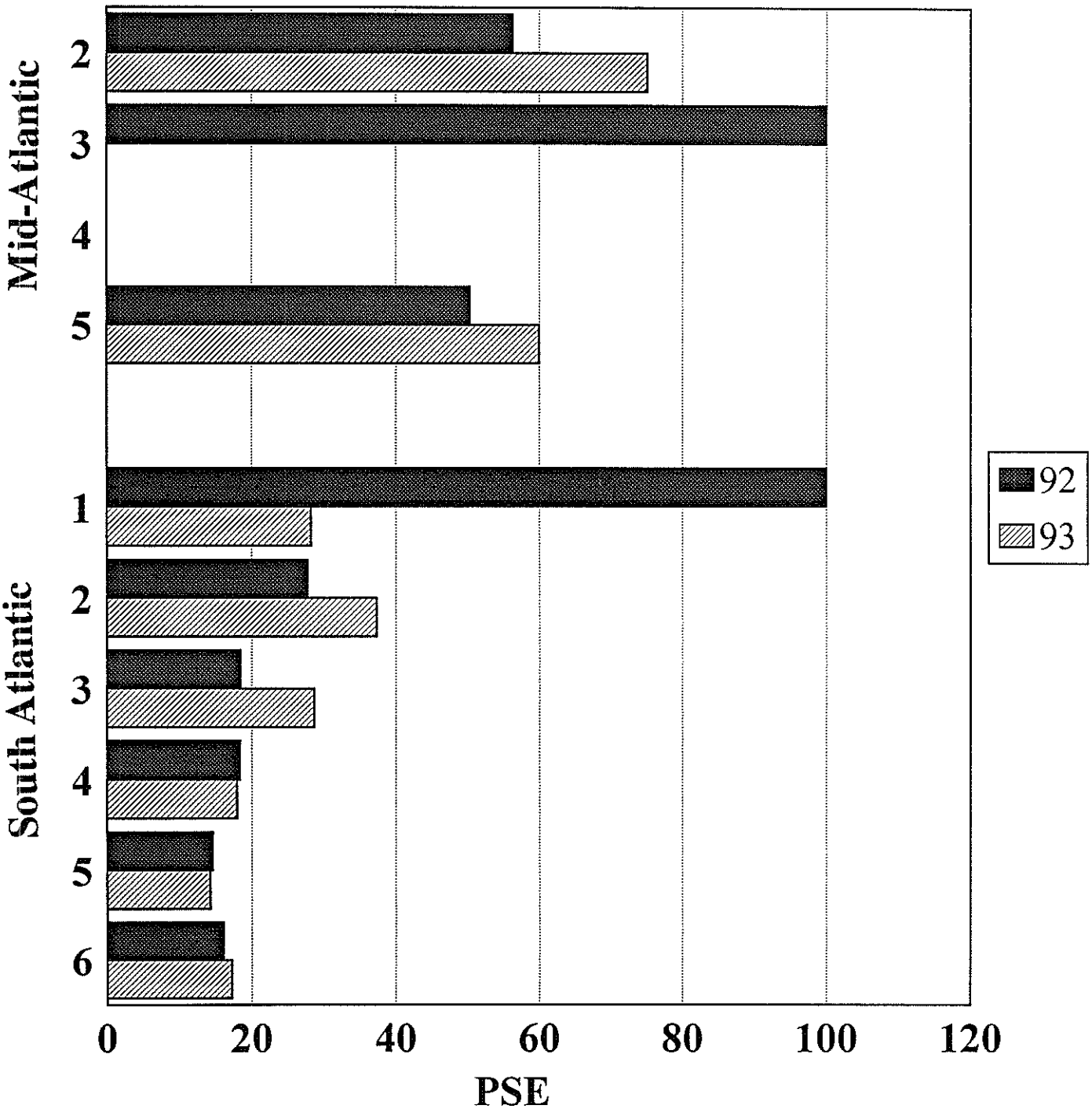
Weakfish N

South Atlantic



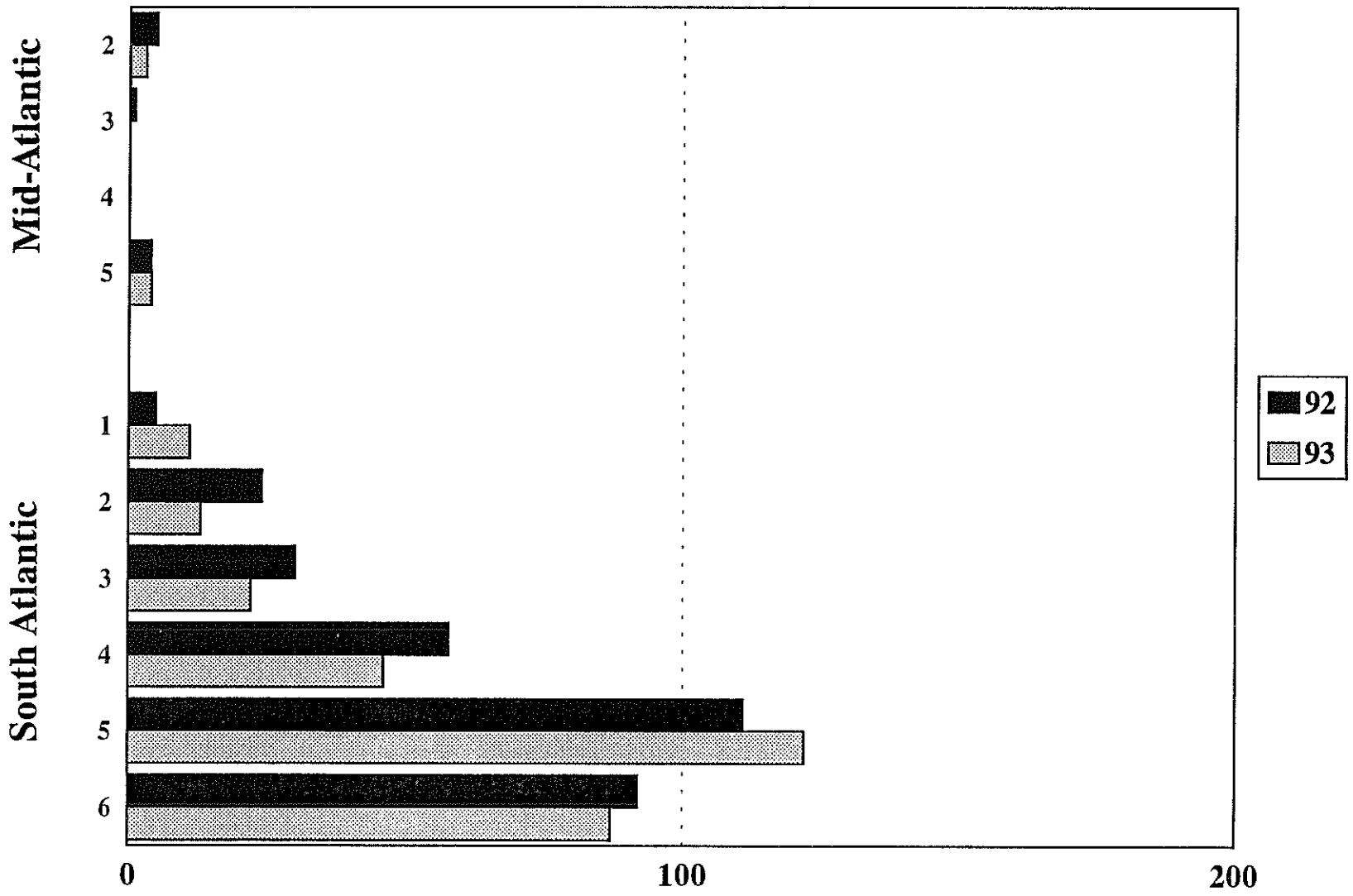
Red Drum Harvest PSE's

By Region & Wave



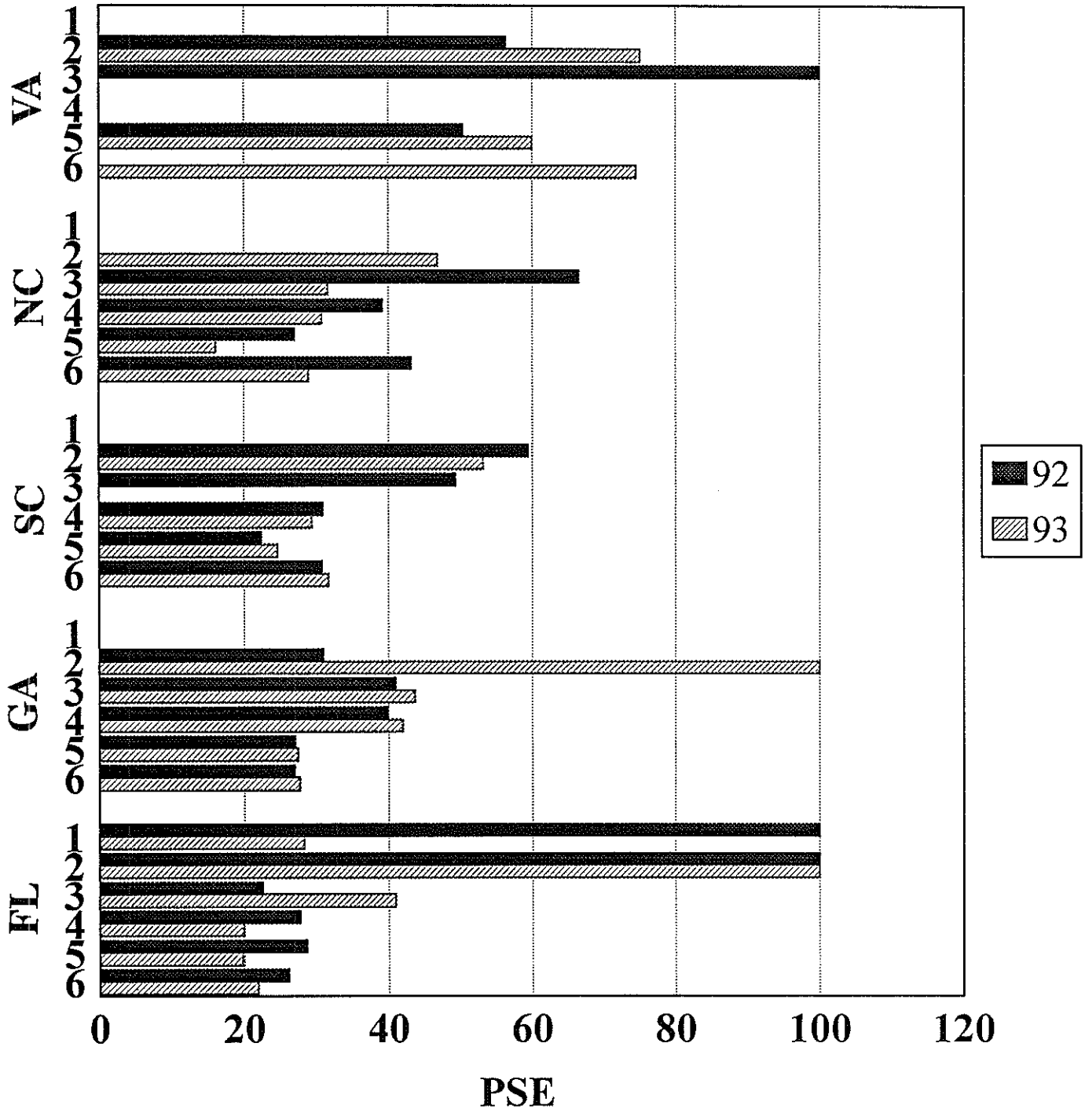
Red Drum N

by Region and Wave



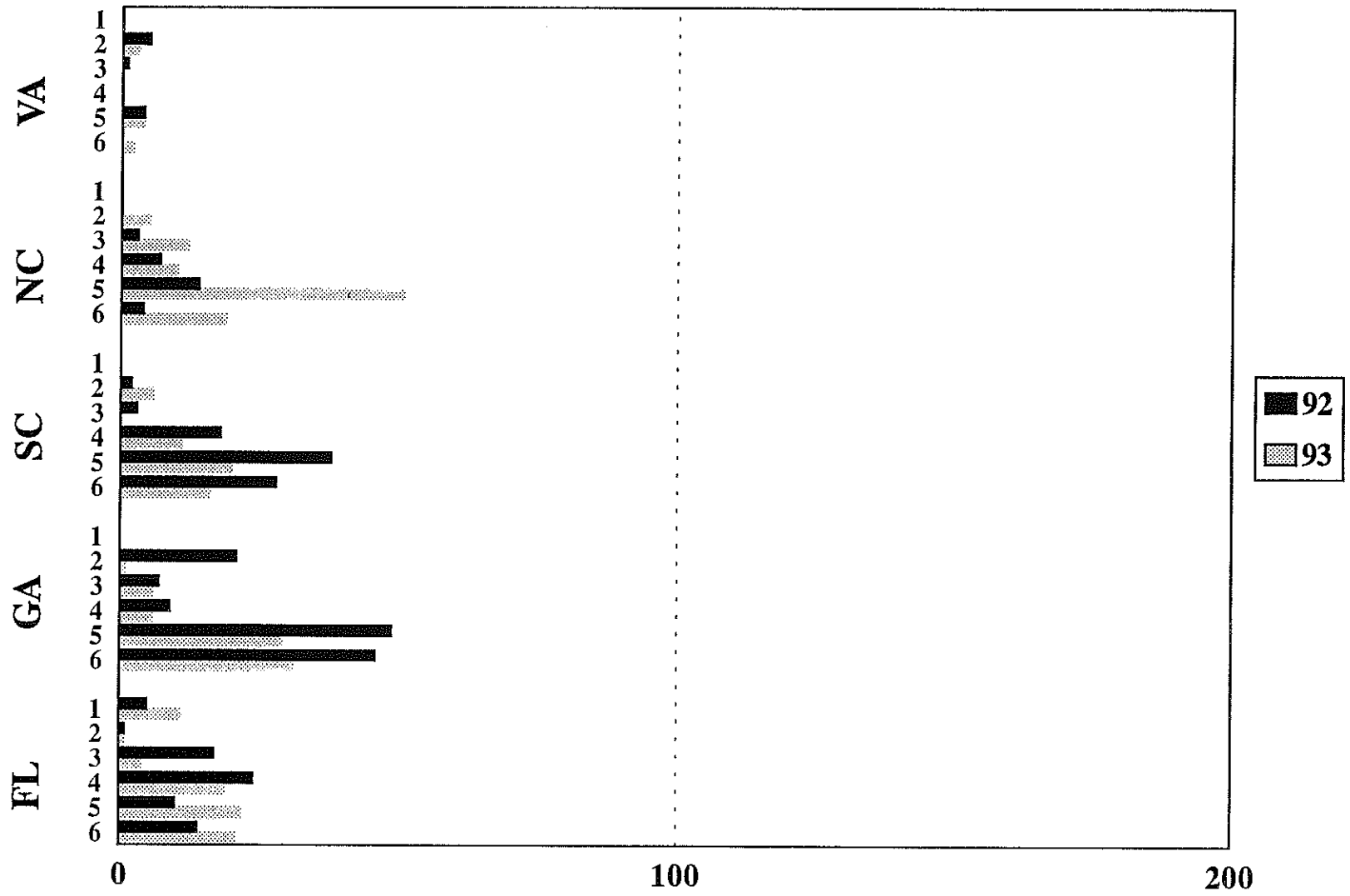
Red Drum Harvest PSE's

Virginia-Florida

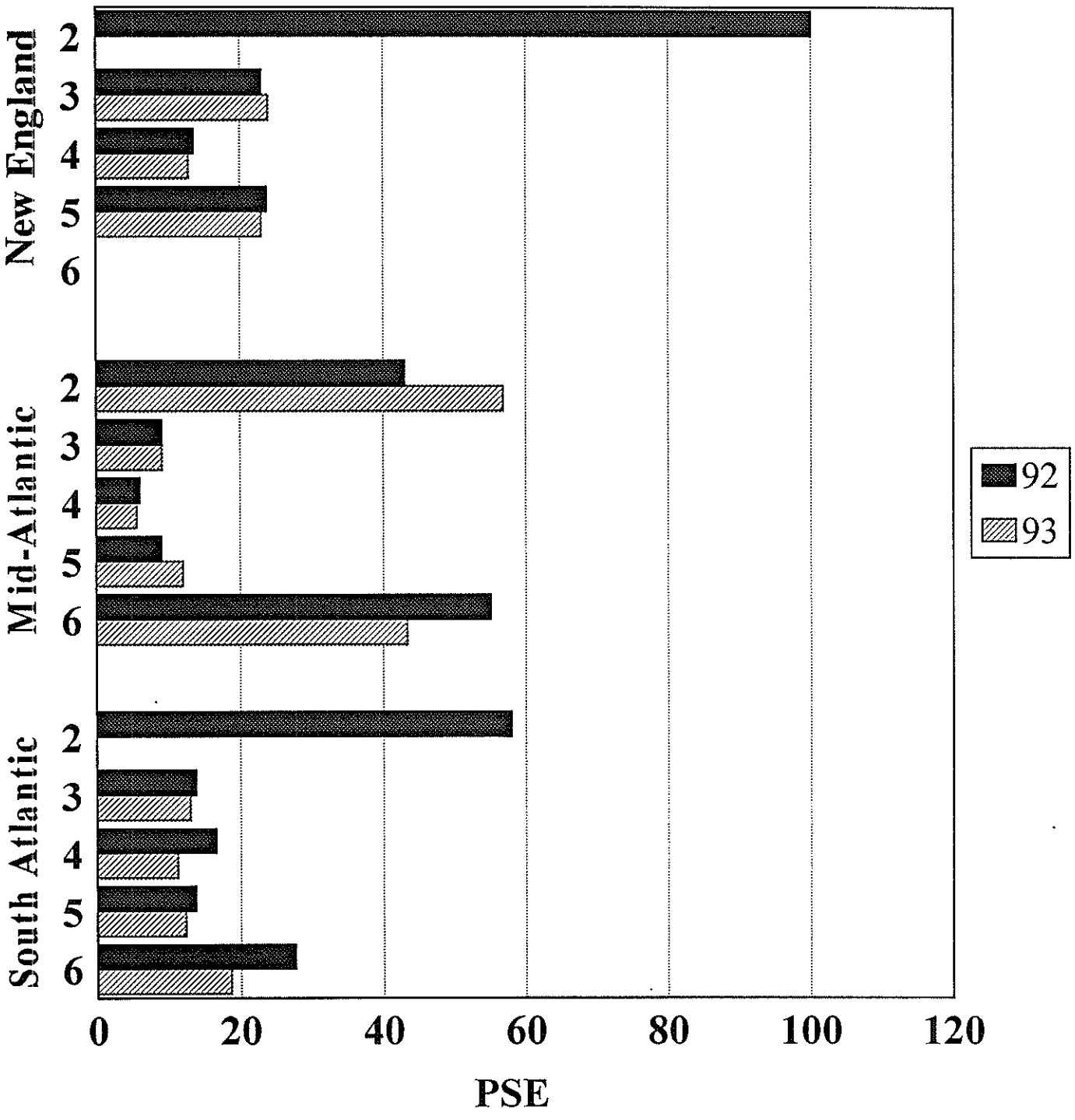


Red Drum N

Virginia-Florida

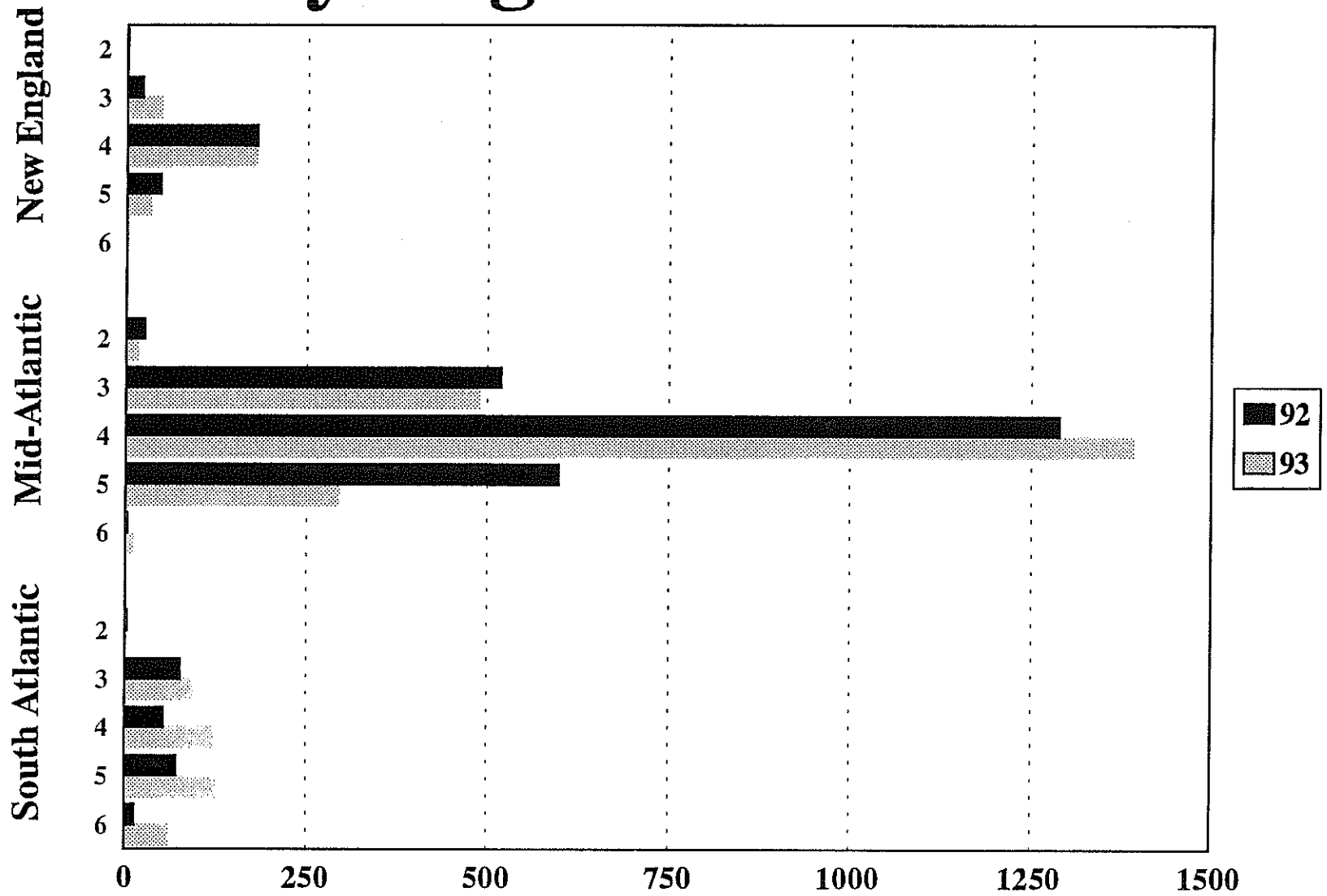


Summer Flounder Harvest PSE's By Region & Wave



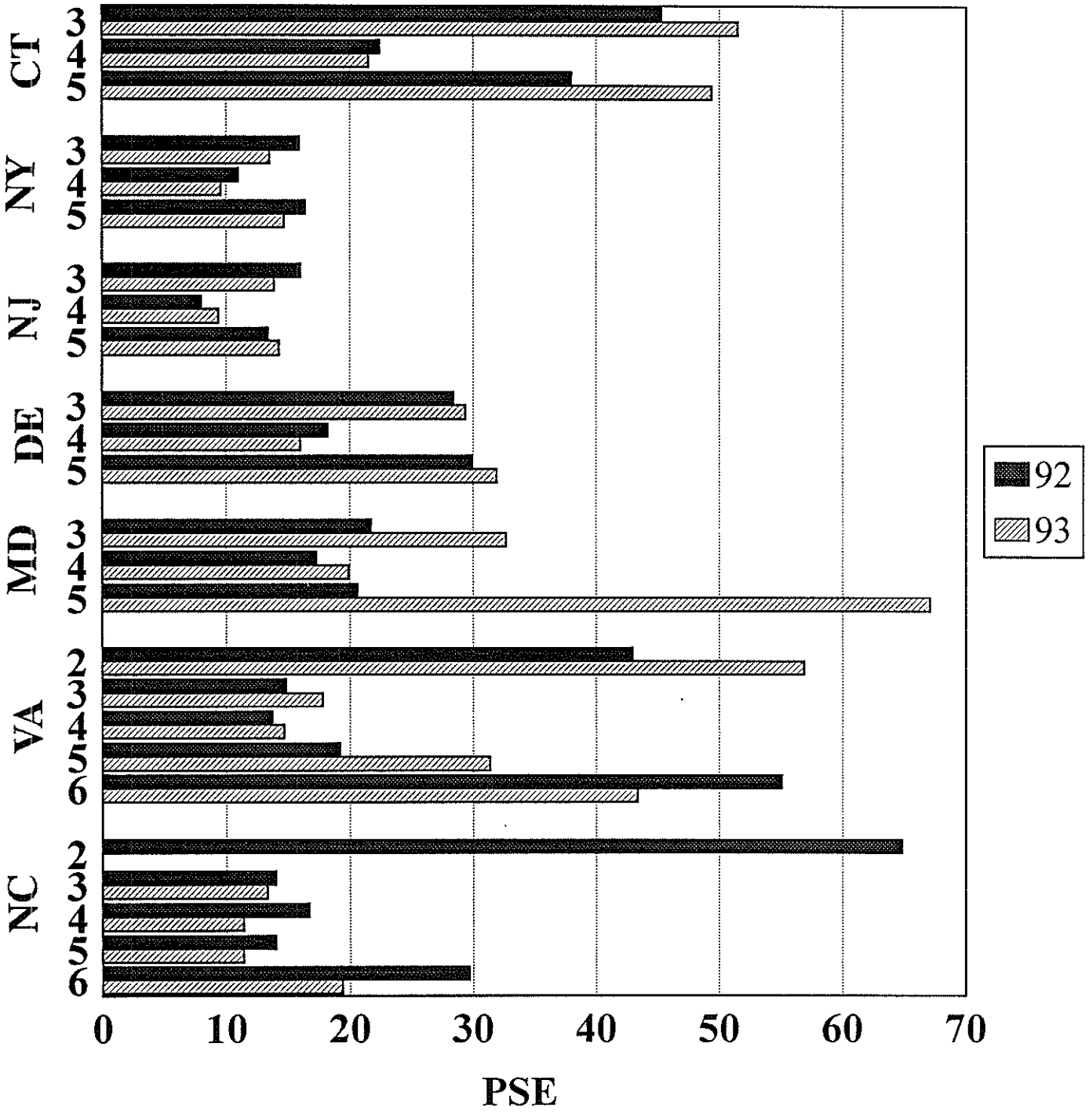
Summer Flounder N

by Region and Wave



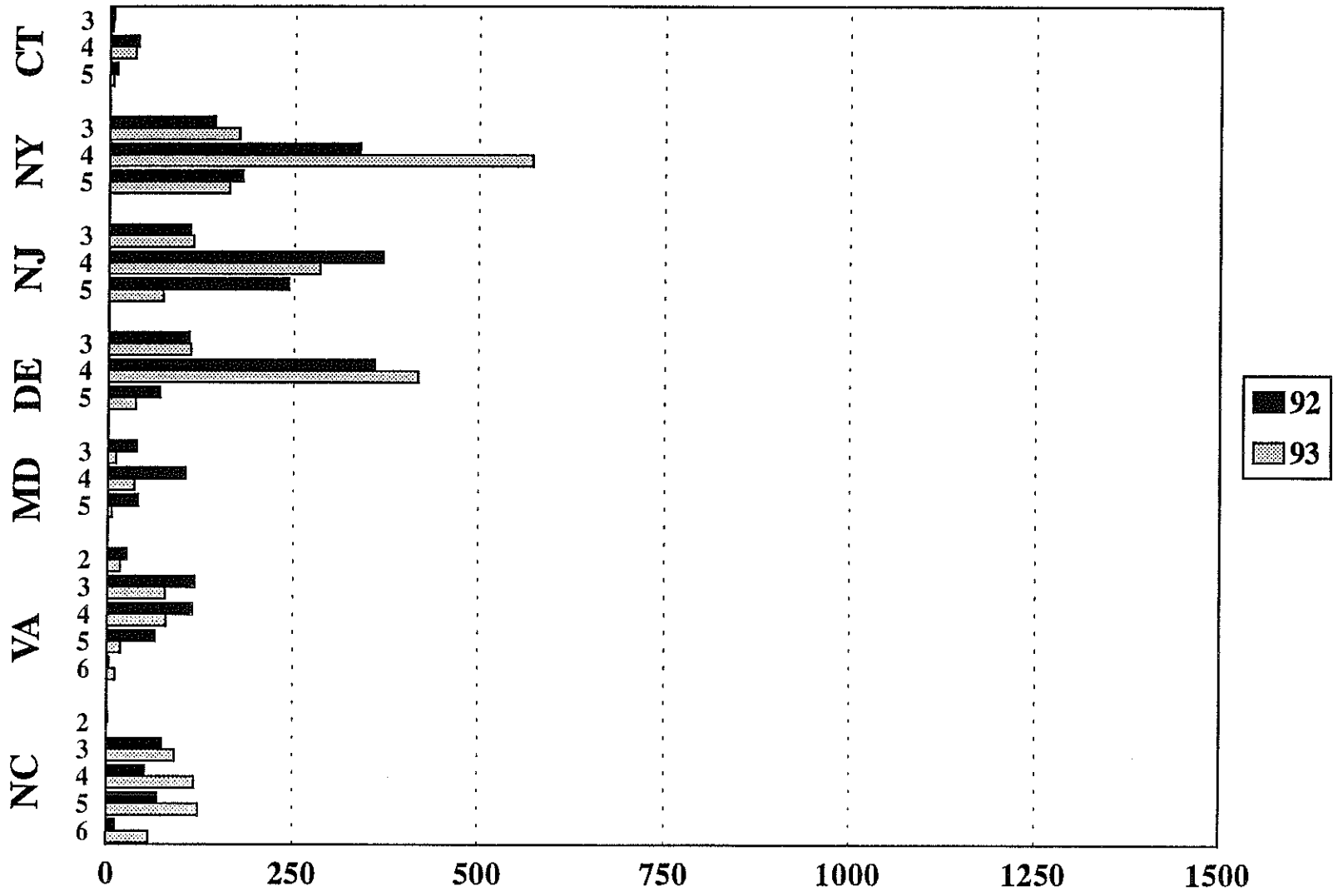
Summer Flounder Harvest PSE's

New England States



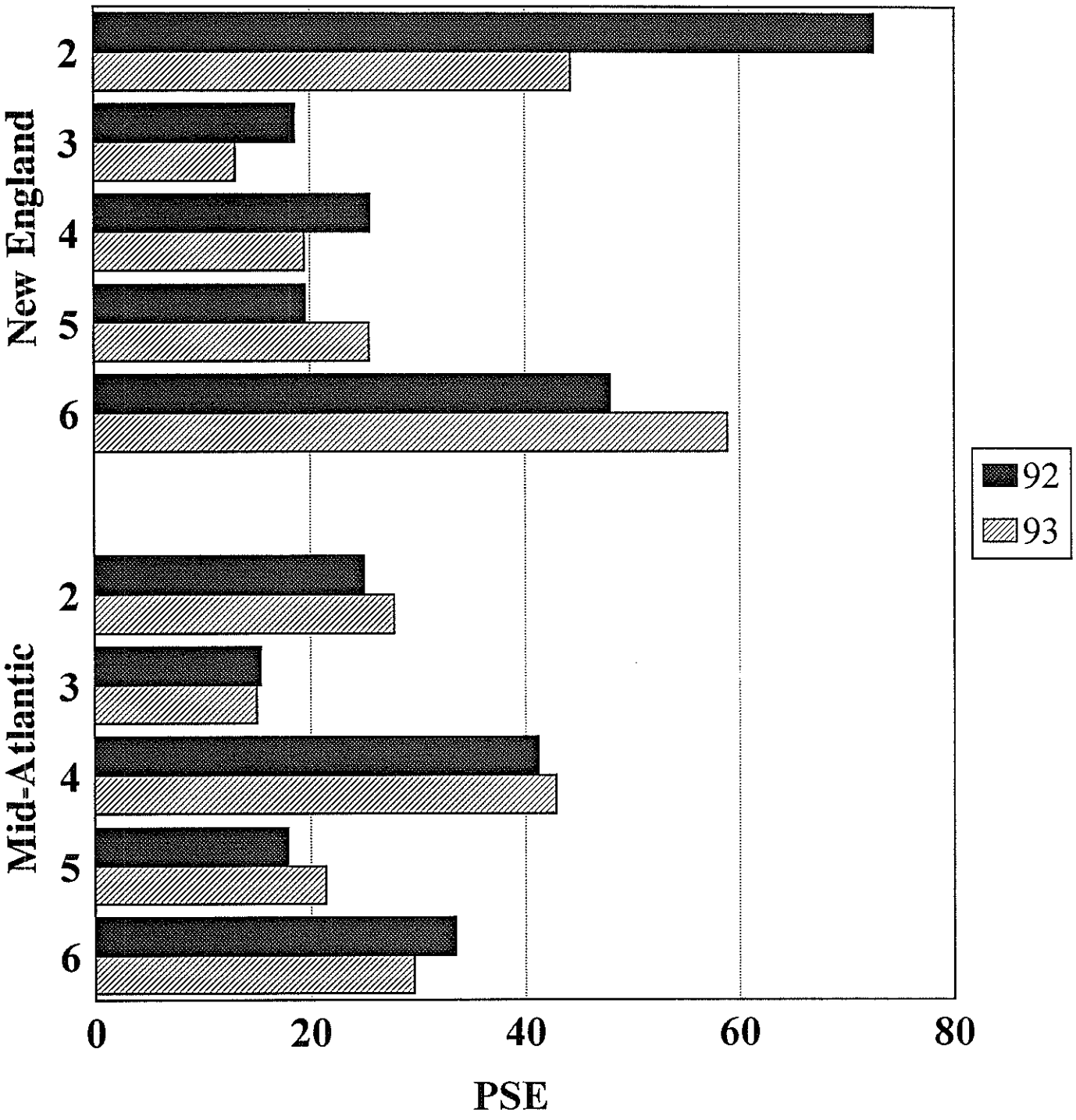
Summer Flounder N

Connecticut - North Carolina



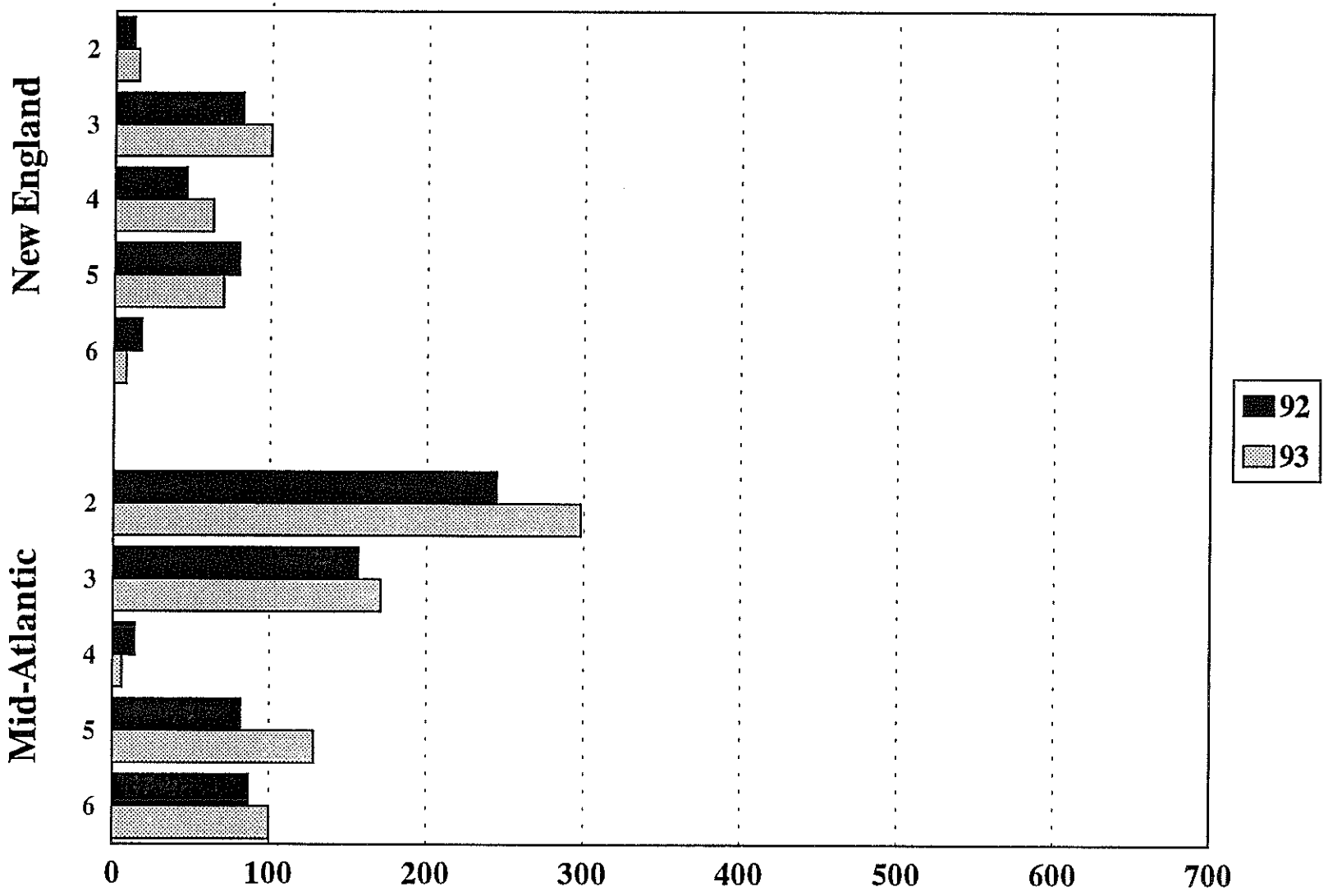
Winter Flounder Harvest PSE's

By Region & Wave



Winter Flounder N

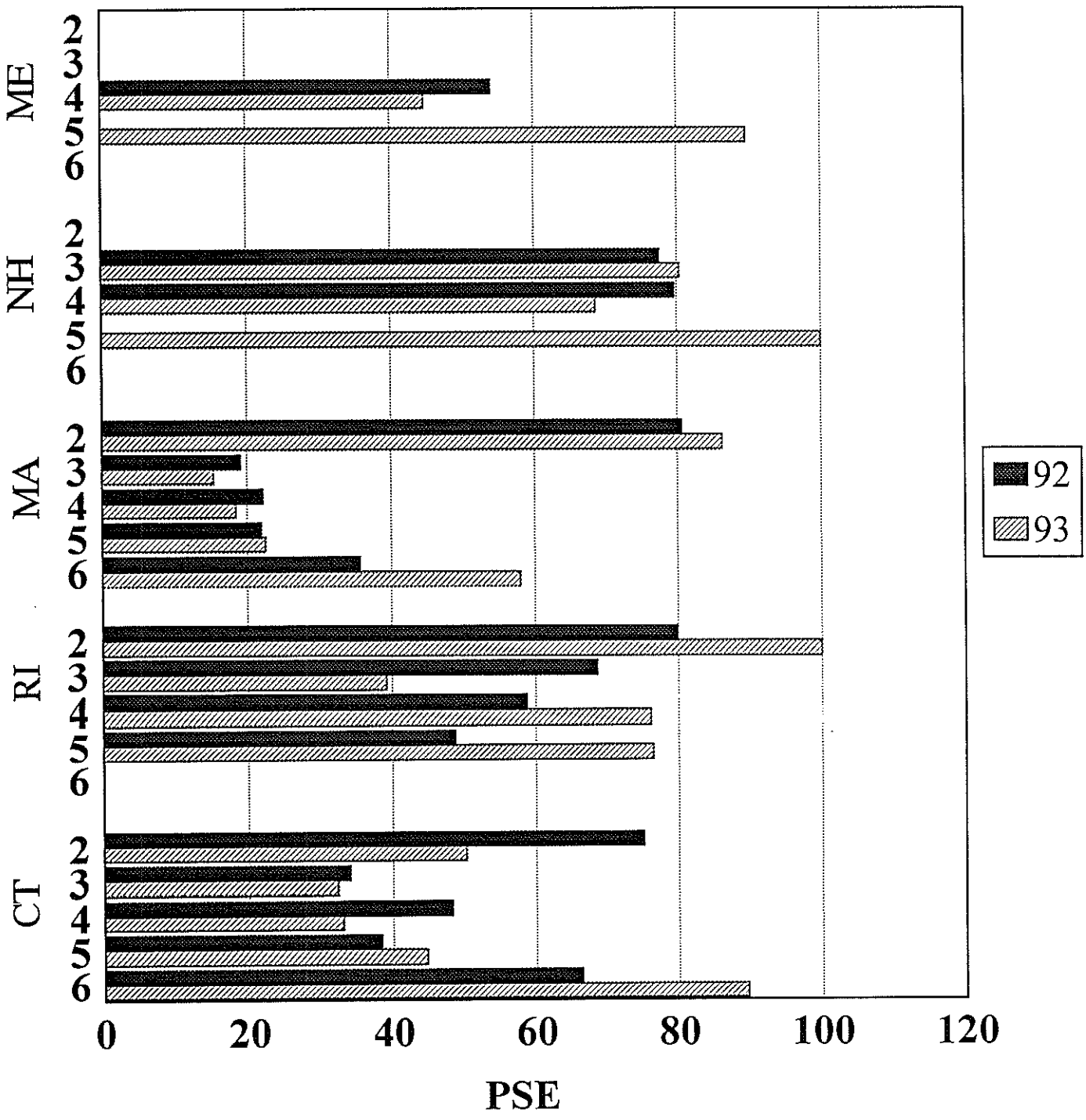
by Region and Wave



Winter Flounder Harvest

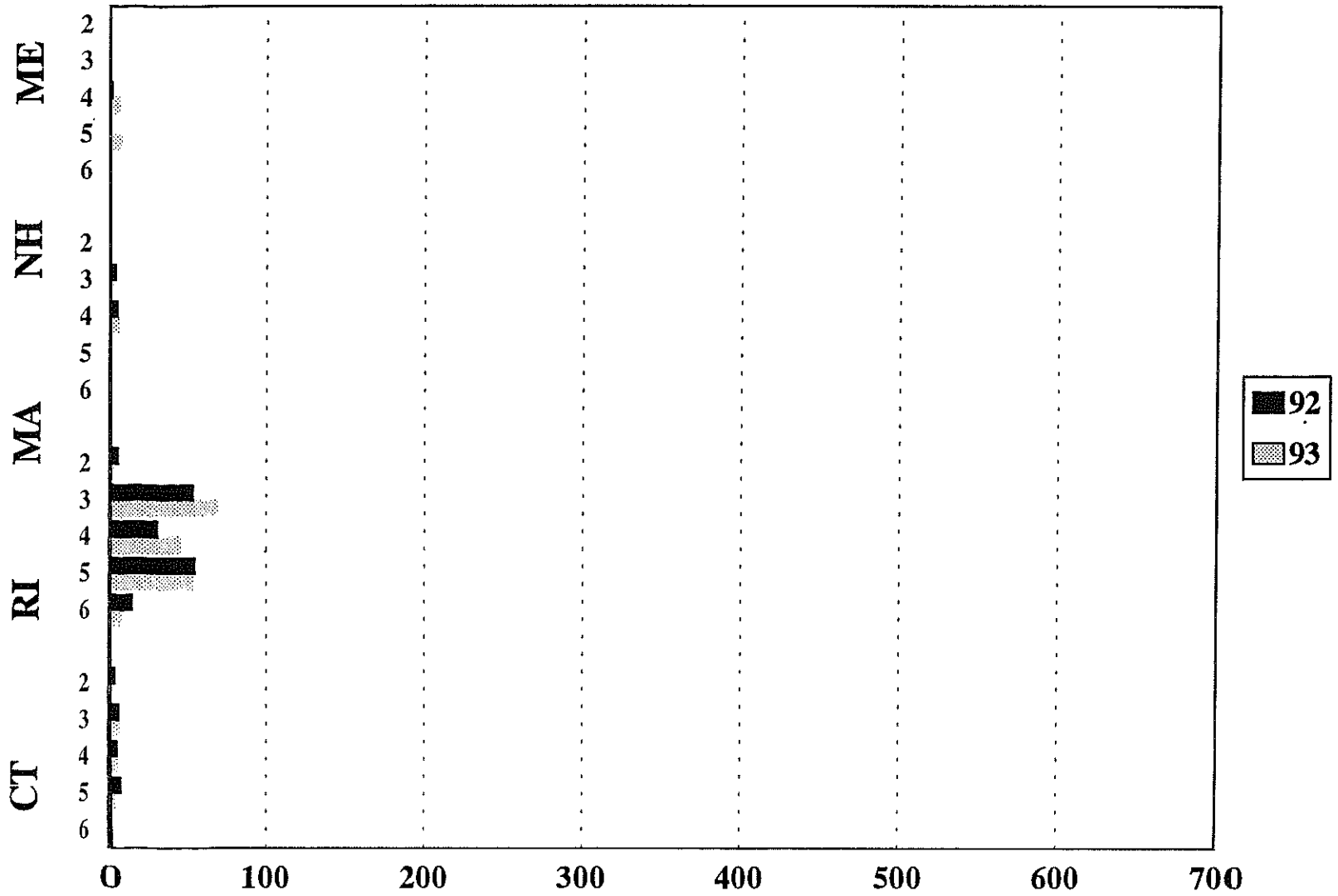
PSE's

New England States



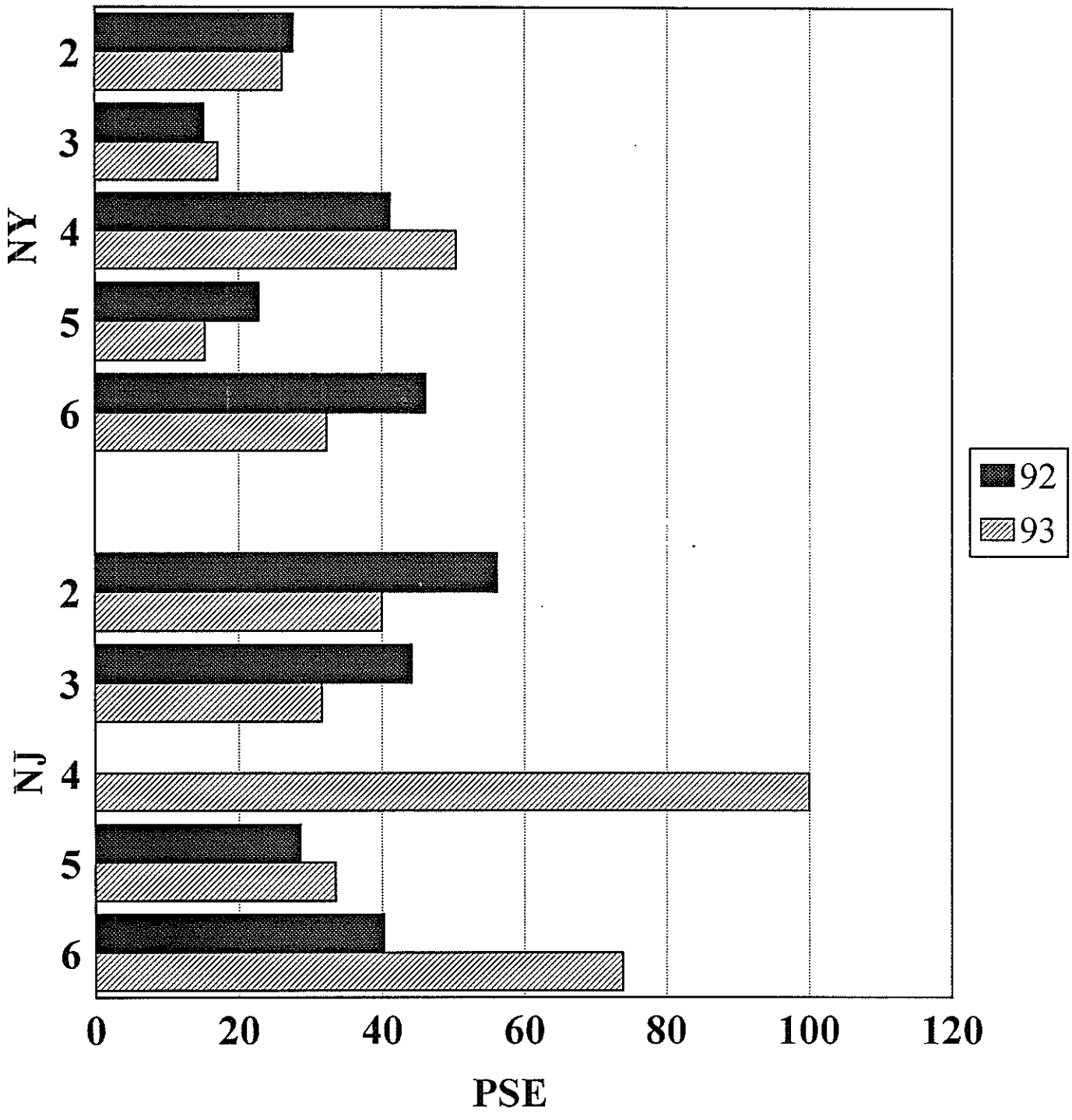
Winter Flounder N

New England



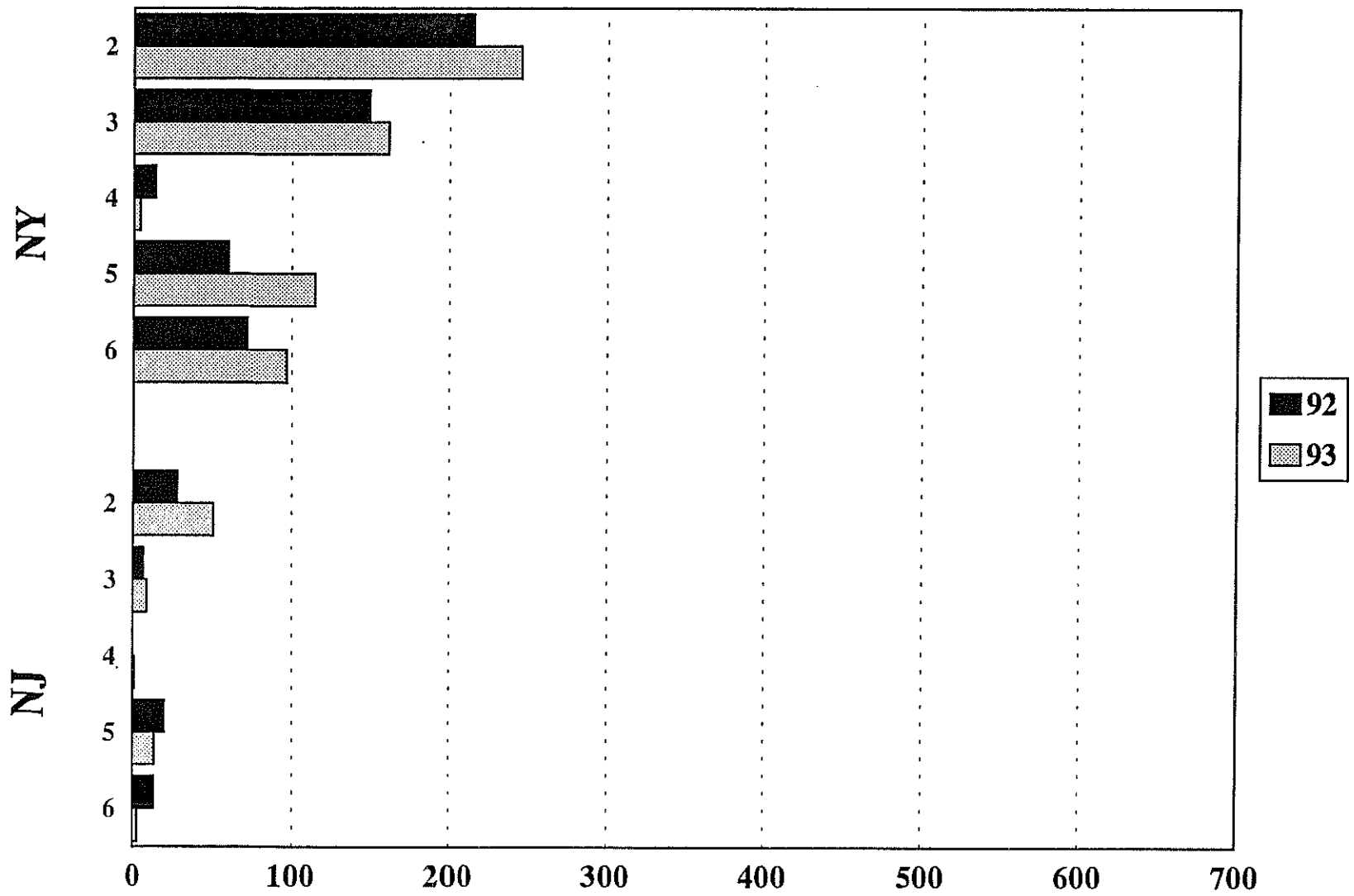
Winter Flounder Harvest PSE's

Mid-Atlantic States



Winter Flounder N

Mid-Atlantic



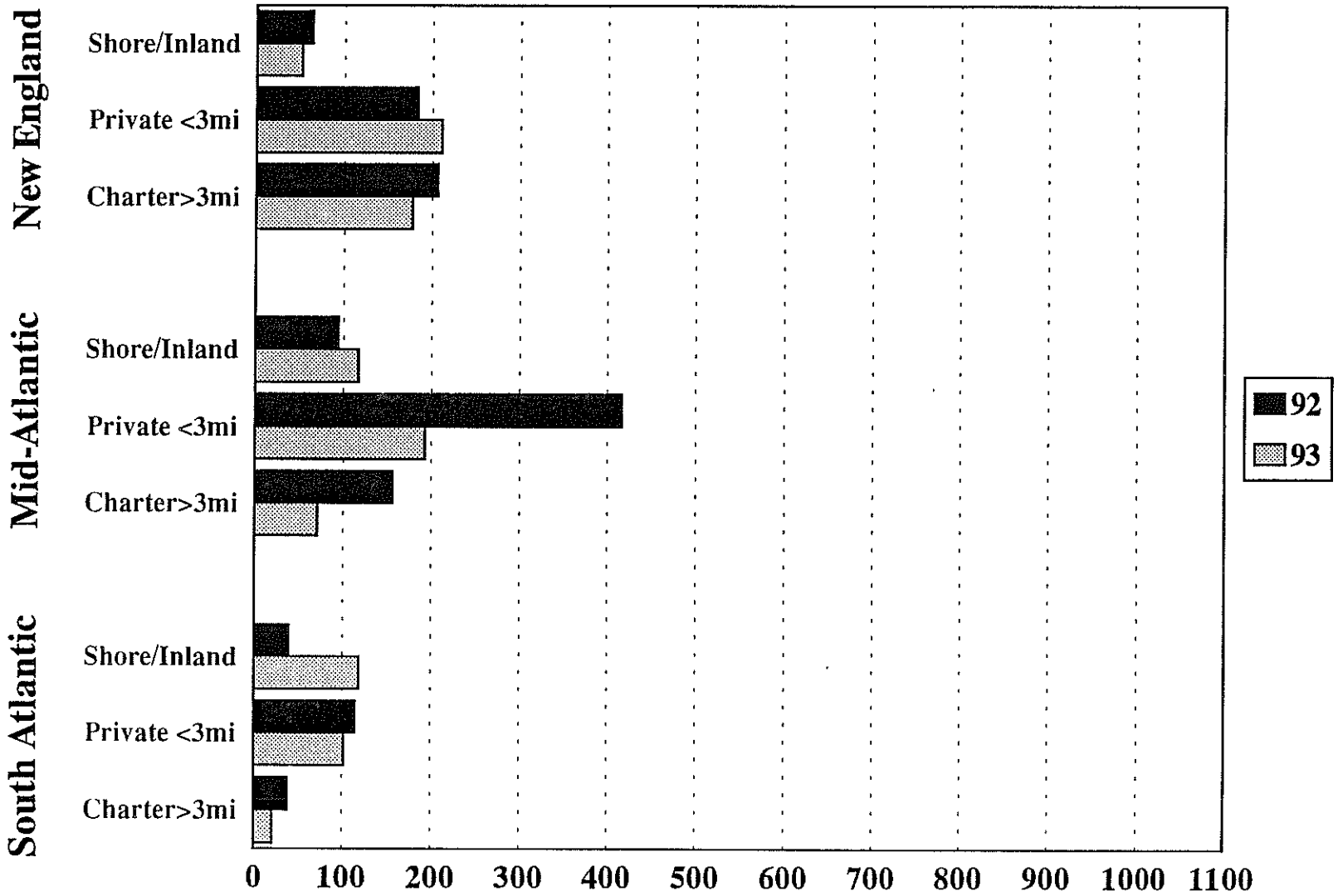
Appendix F.

Proportional Standard Errors and Sample Sizes by Species/Region/Area

Bluefish Harvest PSE's

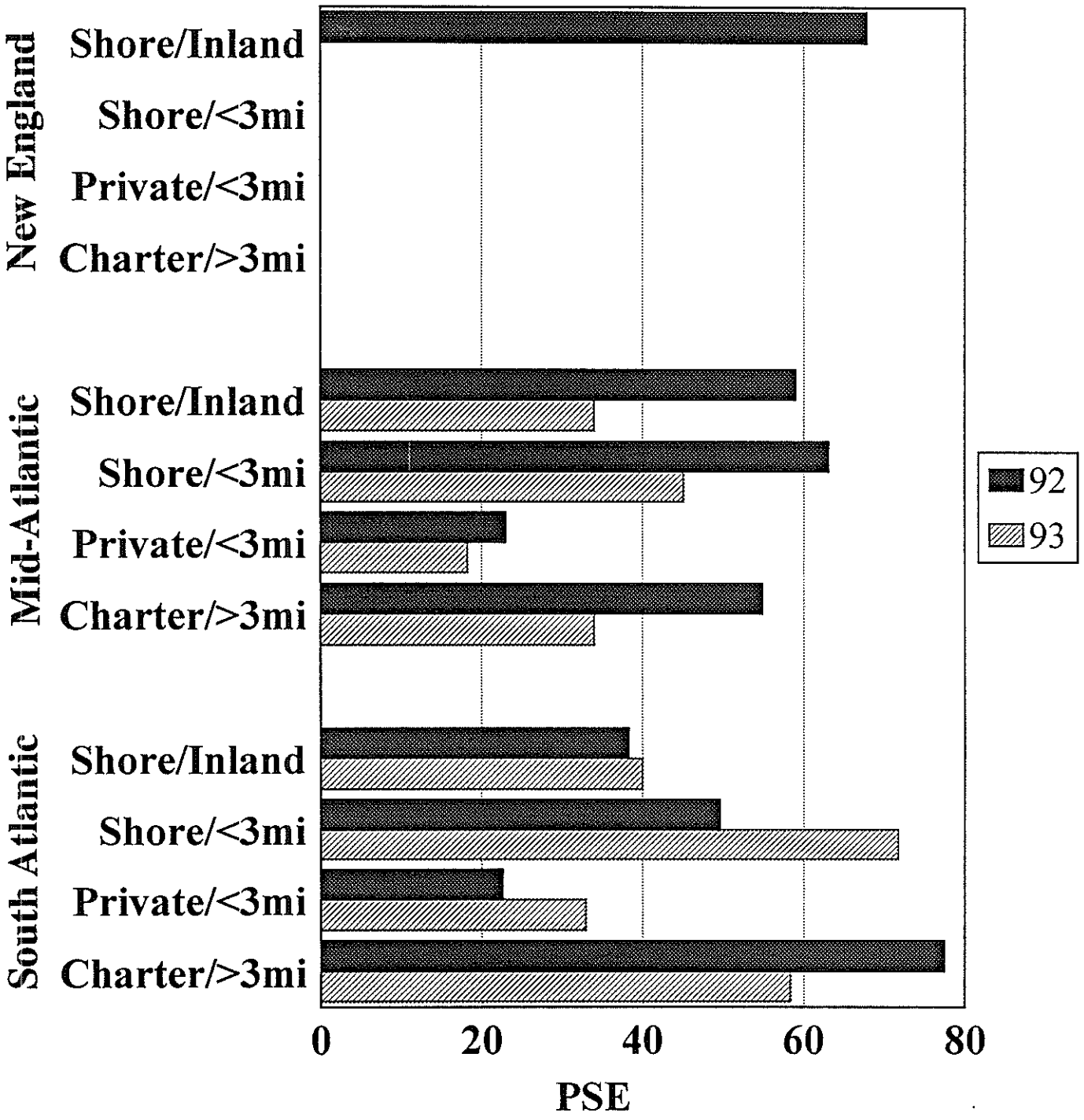
By Region, Mode & Area

Bluefish N
by Region, Mode and Area

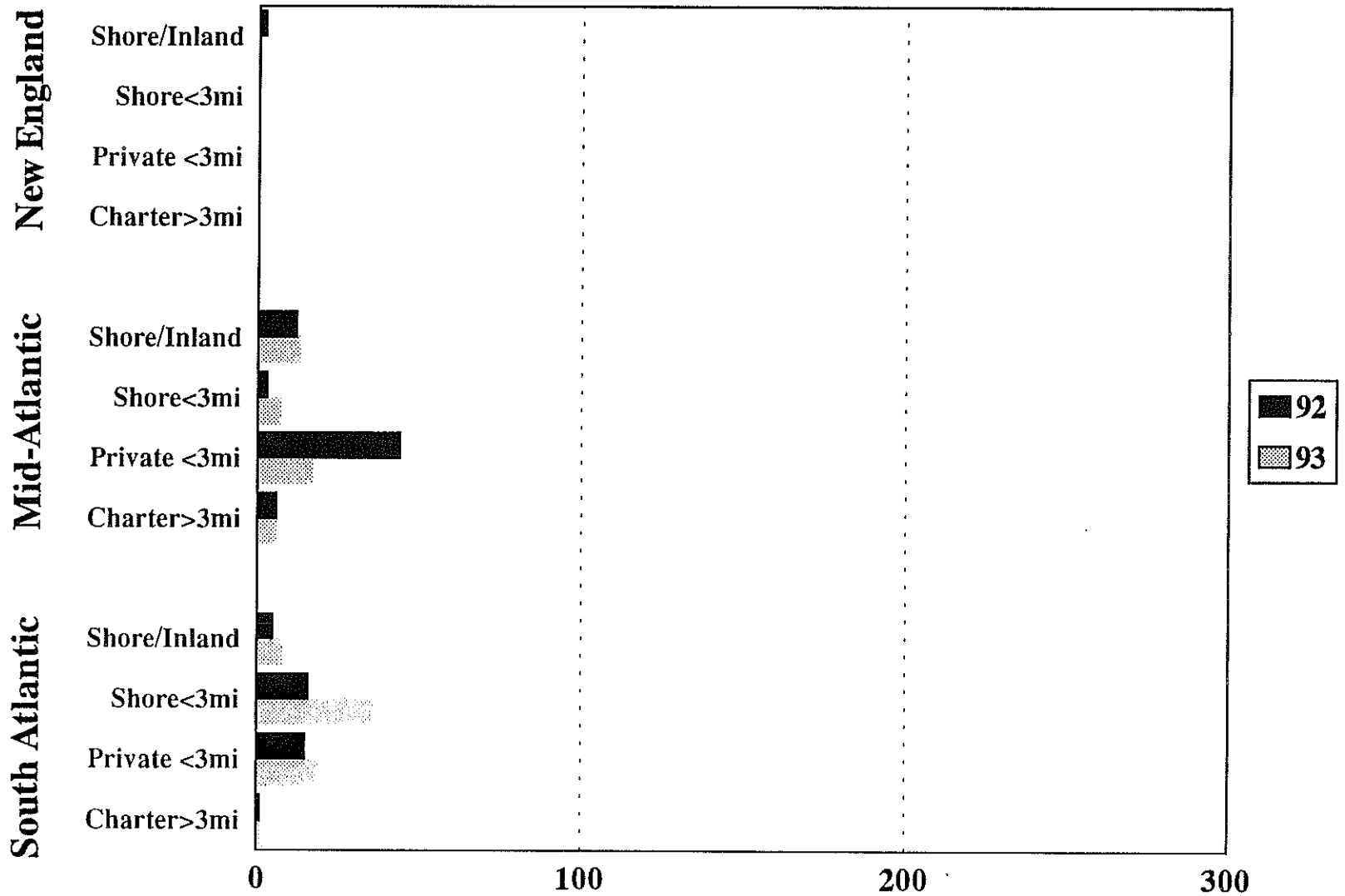


Weakfish Harvest PSE's

By Region, Mode, & Area

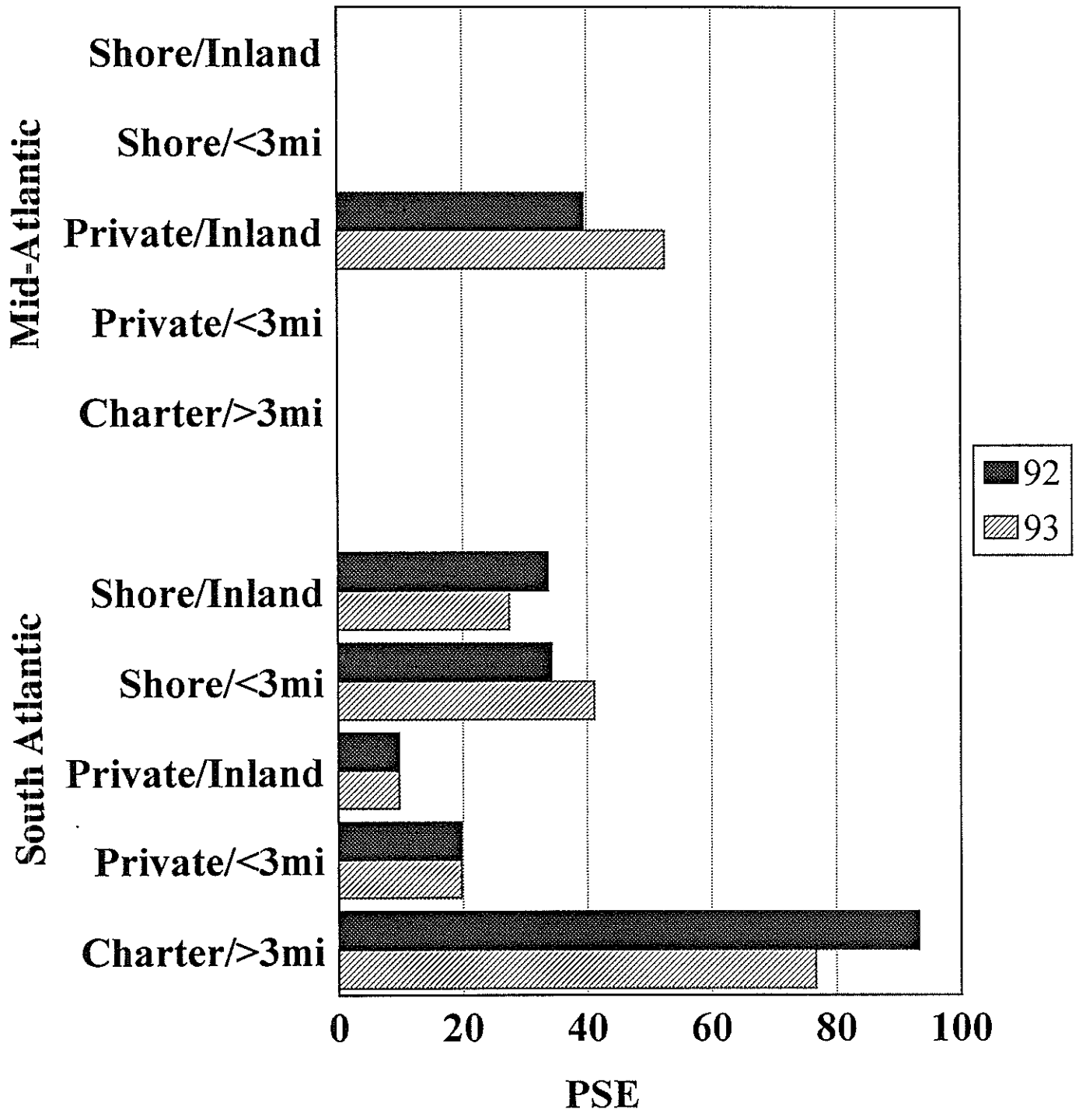


Weakfish N
by Region, Mode and Area

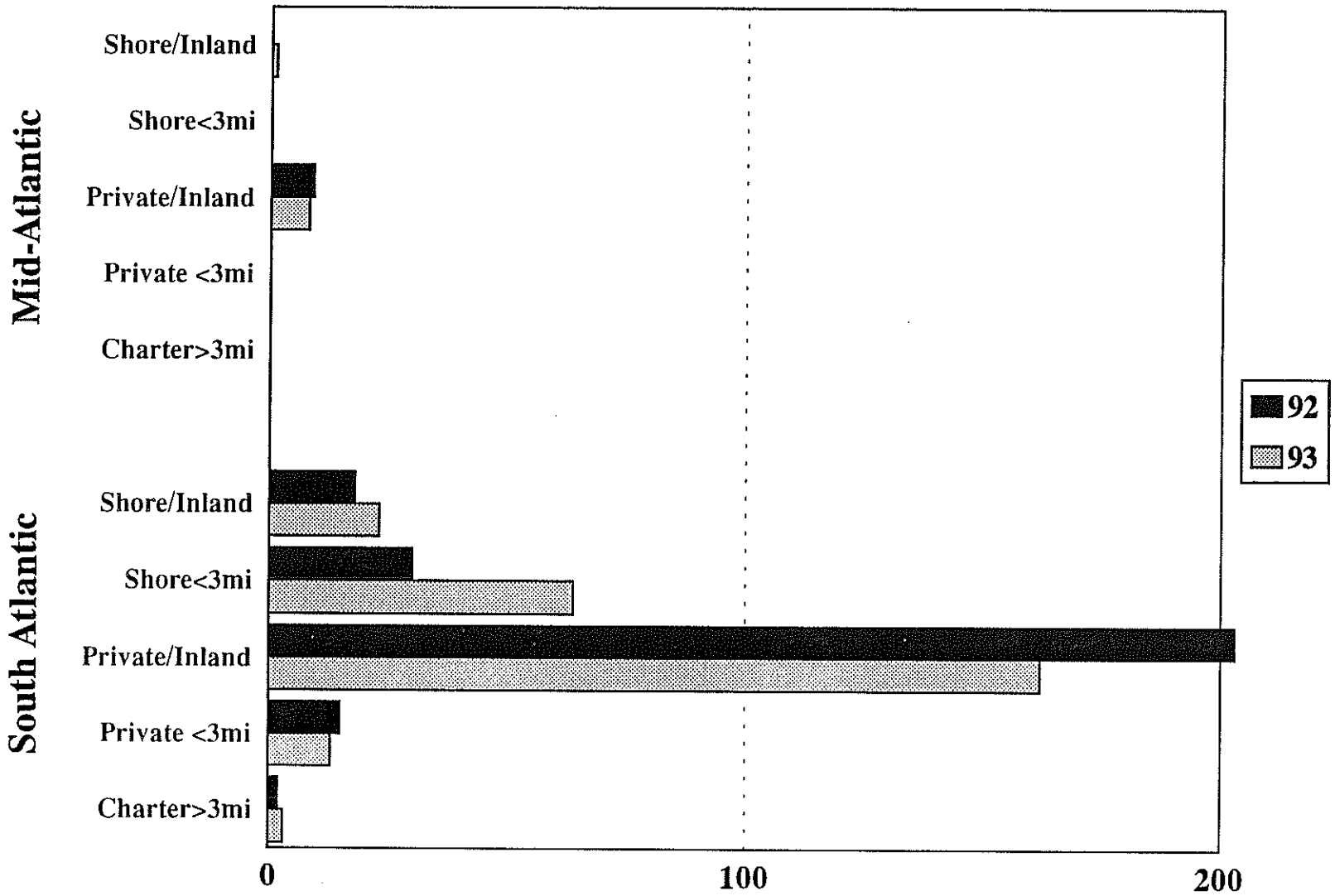


Red Drum Harvest PSE's

By Region, Mode, & Area

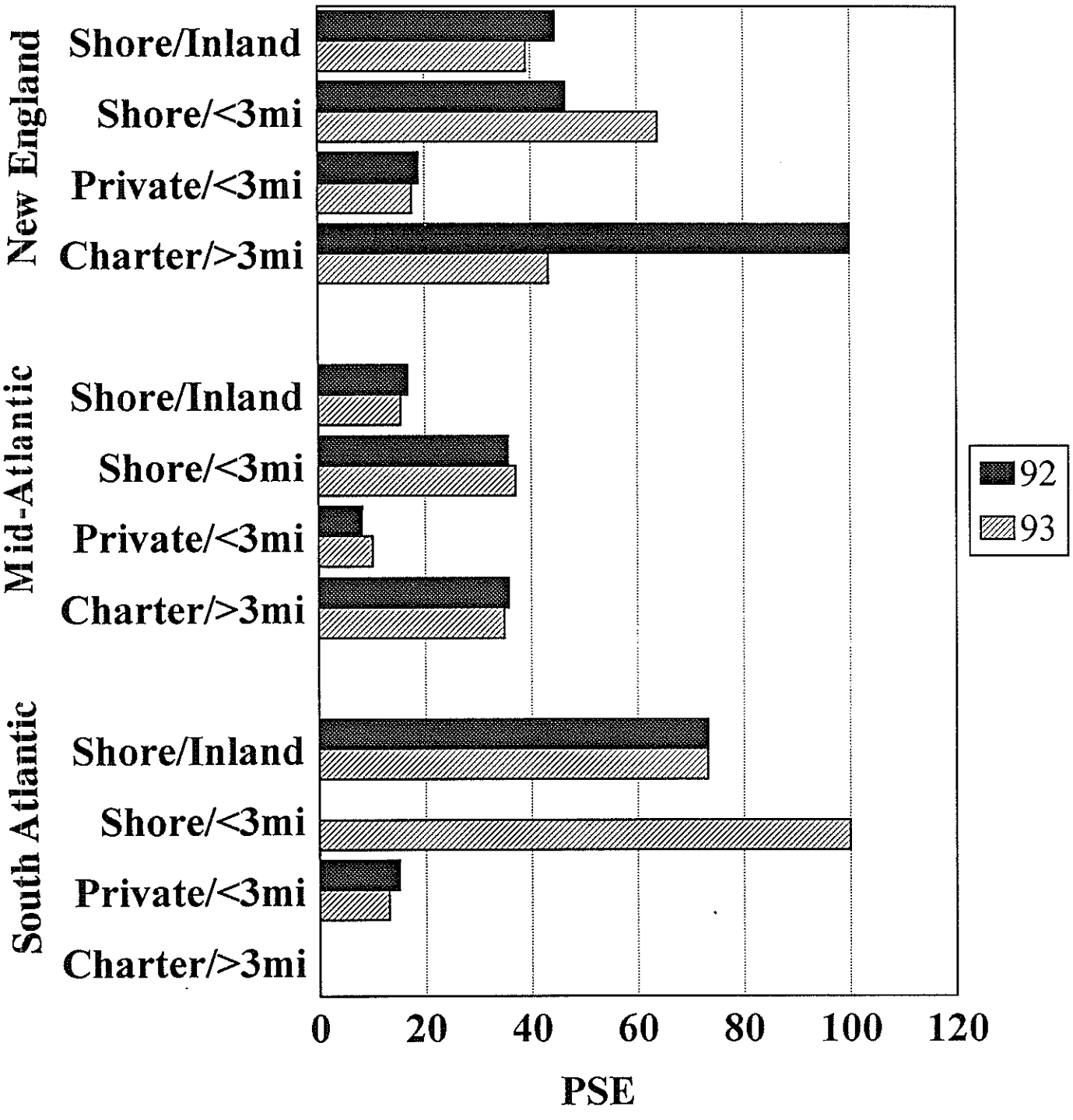


Red Drum N
by Region, Mode and Area

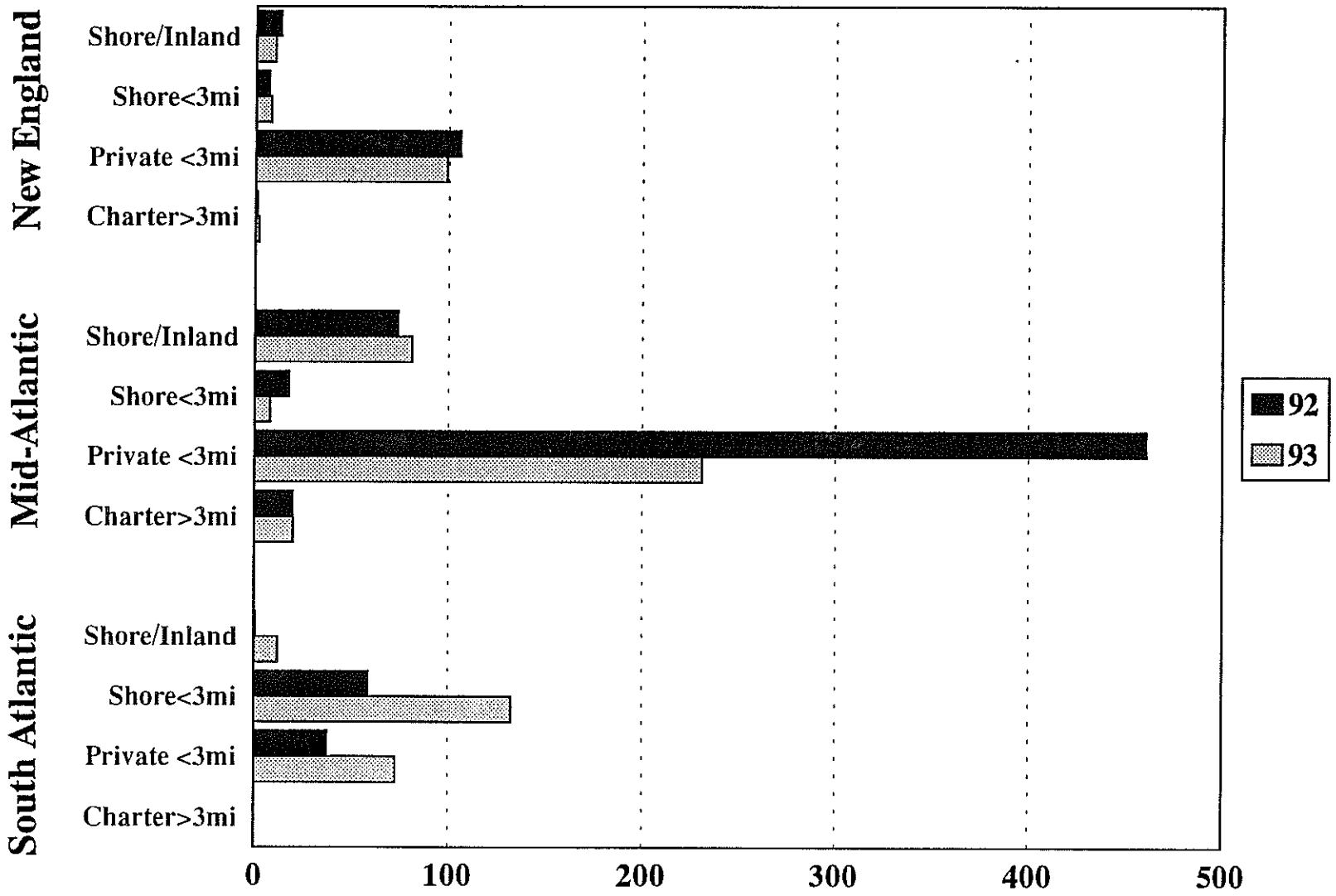


Summer Flounder Harvest PSE's

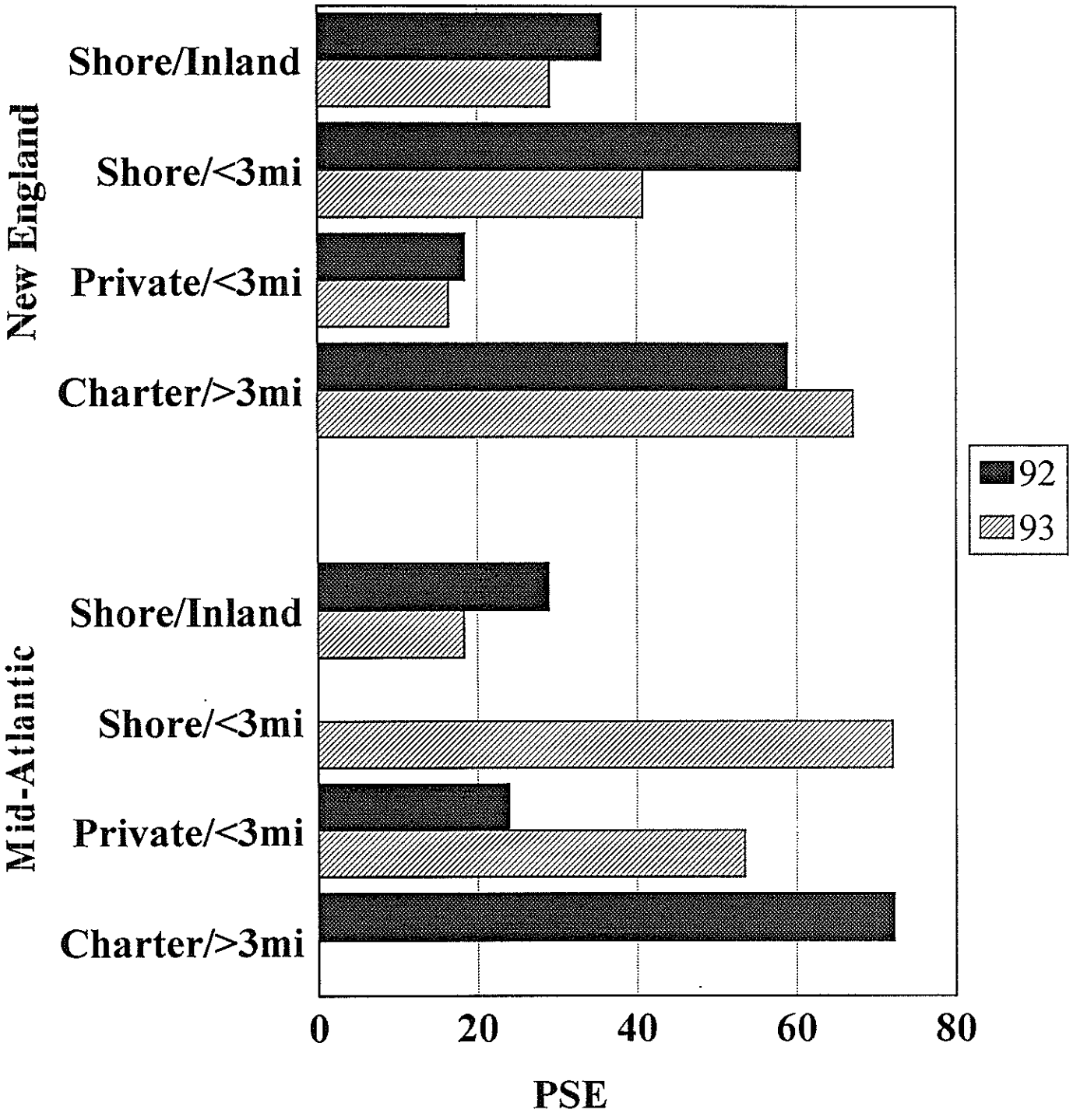
By Region, Mode, & Area



Summer Flounder N by Region, Mode and Area

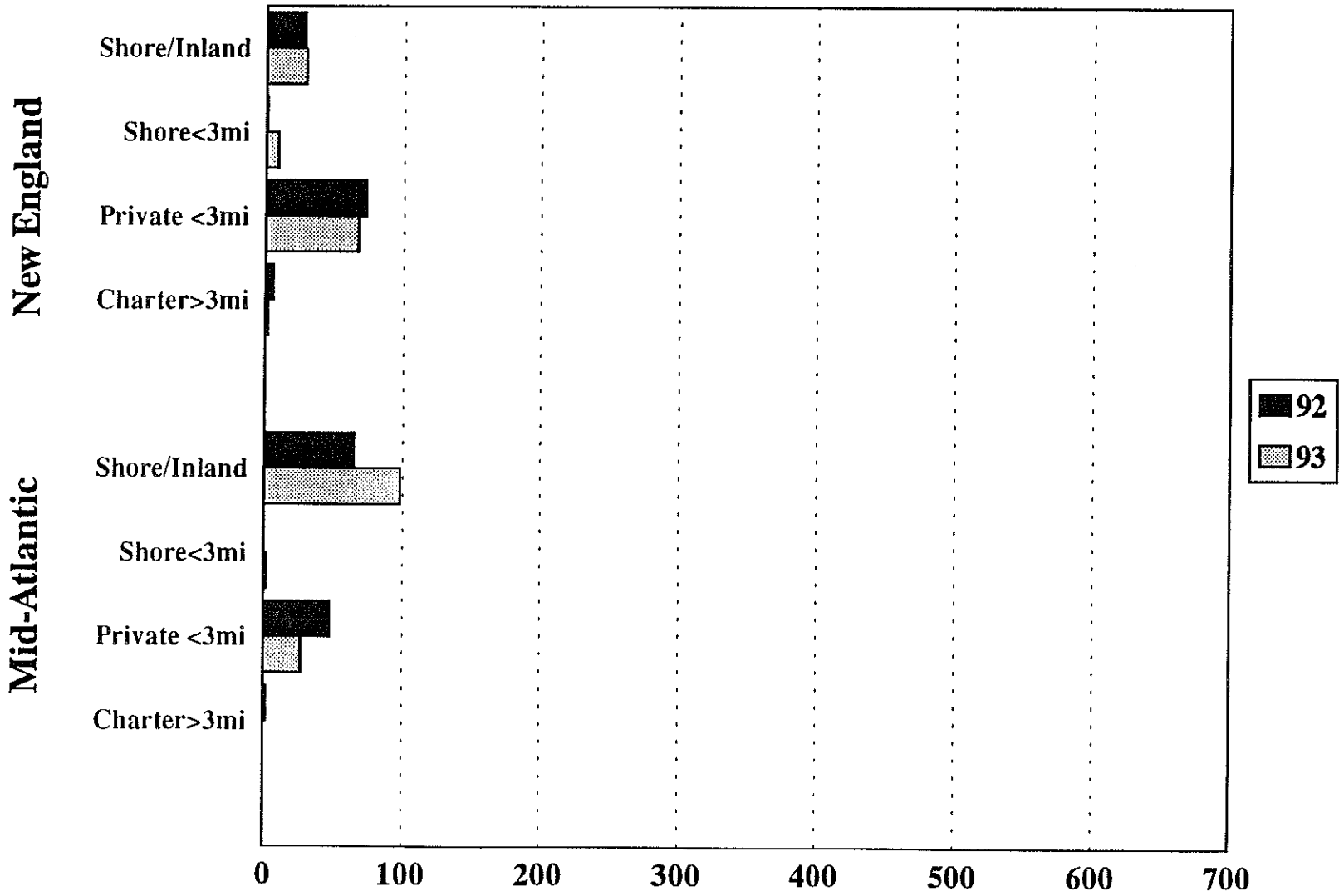


Winter Flounder Harvest PSE's By Region, Mode, & Area



Winter Flounder N

by Region, Mode and Area



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