PROJECT NARRATIVE

a. Identification of Problem

As the traditional groundfisheries of the Northeast begin the momentous changes that will occur over the next decade there exist many problems that must be overcome. Of the three priorities listed in The Federal Register this proposal directly addresses two: alternate employment of displaced fisherman and the development of under-utilized species harvesting. Since the benefits of this project are wide-ranging and comprehensive each problem will be discussed separately.

i. Alternate employment for displaced fisherman

As fishing effort is curtailed there will be a surplus of fisherman in the coastal communities. Though many will wish to be re-trained for other vocations some may choose to remain in the waterfront environment. An effort must be made to include these displaced fisherman in the lowest level of any monitoring effort involving fishing boats. They will act as a buffer between managers and active fisherman, thereby becoming an asset rather than a liability. In addition, others may be trained more fully in the operation of the system to act as trainers for boat operators and low level technical support personnel. This will require intuitive, menu-driven applications for down-loading survey information and other functions they will perform.

ii. Harvesting of under-utilized species

As fisherman find the harvesting of traditional fish stocks becoming increasingly restricted many will attempt to harvest under-exploited species such as Red Hake, Herring, Mackerel, Butterfish, Dogfish, Skates and Squid. A problem with many of these species is the location and tracking of large enough local populations to allow profitable harvesting. The delineation of these bodies of marine life, which can be spread over many square miles and move up and down in the water column is extremely difficult with the wheelhouse technology commonly used today.

The cross-sectional display of an echo sounder and even the two dimensional view of a side-scan sonar are simply too discrete for this wide-ranging application. When the local population in question is sufficiently dense this problem is not an impediment to profitable fishing. However, it is often the case that lower or varying densities are being harvested at or around the break-even level. This simple fact prohibits many smaller boats from entering these high-volume, narrow profit margin fisheries. What is needed is a display of two-dimensional sounding machine data extrapolated to a three-dimensional volume representing the fishing ground. This enhanced, aggregate display would address the need for identification of high density "pockets" and "veins".

iii. Data Collection on Mature Populations

In recent years catches on George's Bank and in the Gulf of Maine have declined steadily while fishing efforts have increased. Many boats are upgrading engines so they can tow more ground cables and bigger nets. Others are developing new methods or adapting old ones such as the steel wire long-line techniques used for bard bottom groundfishing (impossible with yesterday's mono-filament swordfish gear). Wheelhouse electronics make the harvesting process more efficient and more of an exact science. However, the management potential of the actual fishing effort is largely overlooked.

As stocks begin to increase an accurate and current model of mature breeding stocks will become vital to timely management decisions that will facilitate the maintaining of a maximum sustainable yield over time. These decisions are currently made with the best available information" mandated by the Magnuson act. The database that will be created by these collection units will enable managers to expand their "best available information" and thus more effectively manage stocks.

iv. Square Mesh vs. Diamond Mesh

Current prohibitions on diamond mesh cod-ends on Jefferies Ledge need to be studied for effectiveness. An ongoing monitoring of bycatch mortality over the life cycles of God and Haddock must be instituted. In addition, comparisons to other management techniques over long-term periods in regards to both stock rebuilding and economic considerations can then be effectively instituted.

v. Visual Data Displays

Currently when hard data is brought into discussions it is usually in the form of tabulated landing reports or research cruise data extrapolated to the extreme edge of its usefulness. A better system would be one where a manager could call up a color-coded display of an arbitrarily large area. It would model, for instance, where all the three-year-old Cod were caught in the months of July and August over the last five years. Another example could be a three-dimensional representation of a body of squid or whiting as it moved and changed over a twenty-four hour period. Again these should be a set of menu-driven functions.

vi. Research Boat Cruises

This monitoring system should be by no means limited to fishing vessels. Highly accurate research vessel data must be able to be tabulated under the same format (or an expanded version). This could be then used as the foundation for the database. Fishing vessel data, being less accurate but many times more voluminous will be the flesh upon these bones.

vii. A 'Common Ground" for Managers and Fishermen

There exists a certain amount of frustration among managers and fishermen alike. Meetings to discuss planned changes often deteriorate into shouting matches. As these changes to effect a balanced, sustainable ecosystem are implemented cooperation among managers and fisherman is essential. A monitoring system that benefits managers and fishermen together and separately is an ideal solution. The
manager gains the survey information generated by the fisherman. The fisherman gets a harvesting tool and a personal history accessible on an ongoing basis. Together they gain a

better picture of how the ecosystem is changing and are thus able to protect it and use it wisely.

viii. Expanding Monitoring on a Decreasing Budget

As the federal budget expands and contracts money available for monitoring of fish stocks will fluctuate to some extent. The cost of operating the smallest research ship from Wood's Hole in 1994 for two days of groundfish monitoring ($18,800) is approximately equivalent to the installation cost of a monitoring system onboard a fishing boat and the support of it for a year. As the monitoring budget shrinks during a period of decreased funding it will be important to maintain a level of monitoring that will allow effective, timely management of stocks. Actual research ship cruises must remain unchanged to maintain a continuum of such data sets. Thus, the cost of maintaining onboard monitoring systems must be kept as low as possible so that it can be sustained through periods of decreased funding.

b. Goals and Objectives

An example of the actual operation of the system is projected in appendix b. This has been included as an overview of the proposal's goals.

1. The ultimate goal of this project is to create an integrated onboard computer system that will archive and retrieve data generated during fishing operations. As these units are installed in boats a central data cache will be created for use by N.M.F.S. managers. Analysis and modeling software will be added to this powerful management tool. This project calls for the development, testing and demonstration of an onboard system prototype.

2. The actual onboard unit will function as a position plotter. The three-dimensional surface generation functions and historical analysis incorporated in it will be state-of-the-art, comparing favorably with anything currently on the market. This will make the systems extremely attractive to the fishing community. By presenting these monitoring units as a harvesting tool they are both extremely desirable to have aboard and treated with proper attention once they are installed. The fact that a captain can build and access a personal history of archived information will ensure that he will strive for accuracy. This accuracy can be checked by comparing entered data with landing reports. Projected accuracy can be expected to be 90-95%, based on comparisons of hails (projected landing reports) and actual landed weights. A factor to be considered here is that it is considered extremely bad form in the fishing community to hail more than the boat actually offloads so figures are routinely rounded down slightly to avoid this. Accuracies of 99% are not uncommon and the operations that show a history of meticulous record keeping will be given priority. These numbers will likely improve when captains and crews realize the benefit to themselves of accurate reporting.

Additionally, the system will allow more efficient targeting of harvestable stocks, thus reducing incidental bycatch. The process that is used to tally target species will also be applied to bycatch categories, thus allowing analysis and identification of areas where bycatch is greater and thus allow captains to avoid them and harvest in a "cleaner" manner.

3. The actual operation of the monitoring system and the downloading procedures for

on-shore personnel will be carried out mainly by those unfamiliar with the inner workings of a computer. For this reason all functions will be intuitive, user-friendly and menu driven, mostly controlled by either a mouse or trackball device.

4. The downloading of fishing data will be part of the agreement with these preferred fishing boats. Furthermore, the downloaded data will be kept under as tight as security as is necessary to protect the interests of the individual boat captains.

5. The central database must be carefully planned out as the original surveying units are being developed. As much as possible they should adhere to the same formats and conventions. Ideally, each surveying system should be a scaled down version of the central unit, less managerial analysis software.

6. Though the systems will remain installed on the same boats, captains will have "accounts" so that when they move from one boat to another their data set will foltow them, allowing the incoming captain to upload his history to the system (or create one if necessary). Since there are a limited number of people qualified to operate these boats this should pose no problem.

7. A system must be developed that will allow comparison of different boats efforts. Factors such as horsepower, sweep length, headrope rise, ground cable length, spread of doors, the tuning of the net, tides, weather, towing speed, etc. affect the size of the catch. In addition, peeling the belly of the net back or dropping a rock through the cod-end will result in little or no catch, a fact which must be duly reported to preserve the accuracy of a survey. Such a formula will be developed and incorporated.

8. After a working prototype is developed it will be temporarily installed upon one of the three trawlers operated by New Meadows Trawlers and Kennebec Trawlers Prowler 80', Pursuit 78', Tori T. 76') for one twenty day tie-up block. During this period the boat will undertake normal fishing operations to test the operation and effectiveness of the system. If necessary, further modifications will be implemented and another test period undertaken.

9. The final demonstration and report presentation will be given in Wood's Hole for interested managers, fishermen and industry persons.

b. Need for Government Finanacial Assistance

In addition to the scope of this project the need for government assistance is necessary from a philosophical point of view. If the data generated by these units is to be systematically downloaded the government must be willing to bear most of the cost of developing, installing and maintaining them. Since the primary objective of the project is to create a database for the use of the National Marine Fisheries Service public funding is appropriate and creates an air of co-operation for the project to build upon. In order to handle the increased data storage requirements of the surveying procedures and processing needs of the three-dimensional surface generation functions these units will be more powerful than any currently on the market, thus more expensive. in light of the current state of the fishing industry, boats will be unable to acquire these systems on their own.

d. Participation by Others

This system will be developed with as much input as is available from N.M.F.S. Northeast Science Center, Woods Hole and the Northeast Regional Offices N.M.FS., Gloucester. Once funding becomes available contacts will be expanded and the system will be developed closely with them. Prior to approval of the grant, endorsement of the proposal by N.M.F.S. employees has been deemed inappropriate.

In addition, the following companies and institutions will be involved with the various software engineering aspect of the project:

Hardware interfacing and position plotter technology:

Names removed to protect the innocent

Hardware will be acquired through and supported by the following companies and institutions (see appendix c):

Names removed to protect the innocent

The interfacing and digitizing of sounding machine data will be worked on with the advice of:

Names removed to protect the innocent

Testing of the system will be undertaken with the co-operation of:

Names removed to protect the innocent

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e. Government Activities

This project is designed to complement and augment current N.M.F.S. surveying efforts. The creation of a database of commercial fishing boat data will be an important management tool and will become more valuable as the installation of these systems on the fishing fleets of the Northeast expands. It will allow for swift management movements that can be justified with information generated by the commercial harvesters they affect.

Additionally, valuable information will be gained that will allow studies of underutilized species. Currently there are no government programs to study harvesting possibilities and this will provide a tremendous opportunity to develop a broader understanding of this field.

f. Statement of Work

1. Design and Display of Three-Dimensional Volumes and Database Optimization

Investigate further mathematical modeling of three-dimensional surfaces and volumes and their graphical display on a computer screen with the co-operation of the Computer Science and Mathematics departments at Virginia Polytechnical Institute and State University. In addition, strategies for implementing the most efficient and flexible database will be explored. A portion of this work has already been completed and coded.

2. Preliminary Database design

In conjunction with the Northeast Regional offices of the National Marine Fisheries Service and the Woods Hole Oceanographic Institute a study of existing data formats and surveying procedures will be undertaken. A database design will be developed to meet the requirements of the fisheries management staff and information resource management personnel.

3. Hardware Acquisition

The necessary hardware and software will be secured to allow development and operation of the prototype system. A graphical user interface (GUI) developer will also be acquired to allow production of a comprehensive front end that will allow operation by those with minimal training.

4. System Development

The collection application will be developed in the C programming language. This will allow portability over a maximum number of platforms. The operating system will be an OSFi compatible UNIX to meet security requirements and allow future interfacing. A portion of the coding has already been completed at this time.

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5. Hardware Acquisition

Working closely with consultants from [redacted] modules will be created to allow the system to be interfaced with various combinations of LORAN-C receivers, Global Positioning System (GPS) receivers and sounding machines.

6. System Testing

Depending upon the availability of the trawlers operated by [redacted] and [redacted] the prototype system will be installed upon [redacted]. The system will be closely monitored and adjusted while the boat undergoes normal fishing operations. The data collected will be stored for the demonstration stage.

7. Demonstration and Report Presentation

The system will be transported to Wood's Hole at the end of the grant period. A final report will be presented and the system will be demonstrated. A plan will also be presented to implement a wider scale monitoring network and a management interface to generate reports and visual displays of aggregate data sets.

g. Project Management

The project will be managed by Dominic Tracey. Mr. Tracey is uniquely qualified to develop such a system. He will receive a Bachelors Degree in Computer Science from Virginia Polytechnical Institute and State University in the Spring of 1995. This is one of the top software engineering programs in the country.

In addition, he was employed full-time as a commercial fisherman for the six years previous to the fall of 1993, when he returned to complete his degree. His experience has included all major methods of harvesting but primarily he has been involved in the bottom trawling industry of the Gulf of Maine and George's Bank. He has also fished aboard a squid and mackerel processor in the international waters of the mid-Atlantic and has spent six months as the bosun on two factory trawlers in the Gulf of Alaska and the Bering Sea. He has served as captain aboard three boats that he operated in the Gulf of Maine.

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h. Project Impacts

The ramifications of this project are enormous. In addition to the monitoring of groundfish stocks there will be the ability to investigate and expand harvesting possibilities for under-utilized species. There is currently no management plans for these species so data gathering is invaluable for creating one. This demonstrates the functionality and flexibility of the system in that it can be further customized to study many aspects of commercially harvestable marine resources. Employment opportunities for displaced fishermen will be created in the communities where systems are deployed. They can be trained to perform all the downloading and training functions that will be necessary for field operations. At a more abstract (but perhaps as significant) level it will allow fishermen take a more active part in the management process and managers to gain valuable insight into the harvesting processes. Finally, in generating a clearer picture of the marine ecosystem it will allow fishermen to more effectively target species and thus reduce incidental bycatch.

i. Project Evaluation

Beyond the functionality of the collection system software there are several aspects of this project that will be judged for success. The user-friendliness of the system will be critical: the position plotter, the survey data entry functions and the downloading procedures must all be intuitive and menu driven. The ultimate mark of success will be the acceptance of both the management and the harvesting communities.