Appendix A
Partnerships

The following are examples of NOAA Fisheries' current partnerships for meeting at-sea research and monitoring requirements and for collaborative research to advance new vessel and resource management technologies.

ALASKA FISHERIES SCIENCE CENTER

Federal
NOAA/OAR Pacific Marine Environmental Laboratory (PMEL)
U.S. Fish and Wildlife Service

State
Alaska Department of Fish and Game (ADFG)
Pacific States Marine Fisheries Commission (PSMFC)

Industry
Einar Peterson
Groundfish Forum Inc.
Trident Seafoods

Academic
Oregon State University
Rutgers University
University of Alaska at Fairbanks
University of California at Irvine
University of Texas at Austin
University of Washington
University of Wisconsin

International
Dalhousie University, Halifax, Nova Scotia
Institute of Marine Research -Bergen, Norway
Japanese Fisheries Agency
Japanese Hokkaido University
North Pacific Anadromous Fish Commission
North Pacific Marine Science Organization (PICES)
Pacific Biologic Station: Dept. of Fisheries and Oceans (DFO) Canada
Pacific Research Institute of Fisheries and Oceanography Russia (TINRO) Laboratory

NORTHWEST FISHERIES SCIENCE CENTER

Federal
NOAA/OAR Pacific Marine Environmental Laboratory (PMEL)

State
Oregon Department of Fish and Wildlife
Pacific States Marine Fisheries Commission (PSMFC)
Washington Department of Fish and Wildlife

Industry
Coos Bay Trawlers Assoc.
Midwater Trawlers Cooperative
Oregon Trawl Commission
Pacific Whiting Conservation Cooperative

Academic
Oregon State University
University of Washington

International
North Pacific Marine Science Organization (PICES)
Pacific Biological Station: Dept. of Fisheries and Oceans (DFO) Canada

SOUTHWEST FISHERIES SCIENCE CENTER

Federal
Naval Postgraduate School
Naval Research Laboratory
U.S. Fish and Wildlife Service
U.S. Navy (USN)
U.S. Geological Survey, Menlo Park

State
Alaska Department of Fish and Game
California Department of Fish and Game
Pacific States Marine Fisheries Commission (PSMFC)

Industry
Arete Associates
C&C Technologies
Kaman Aerospace Corp.
Lotek Marine Technologies, Inc.
RDI Instruments
Simrad Inc.

Academic
Institute of Marine Sciences, University of Texas
Montana State University
Moss Landing Marine Laboratories, California State University, San Jose
Oregon State University
San Francisco State University
Scripps Institution of Oceanography, UC, San Diego
University of Alaska
University of California, Santa Barbara
University of Hawaii/JIMAR
University of New Brunswick
University of Washington

International
Centro De Investigaciou Cientifica y de Educacion Superior de Ensenada (CICESE)
Instituto Nacional de la Pesca (INP)
InterAmerican Tropical Tuna Commission
Investigaciones Mexicanas de la Corriente de California (IMECOCAL)
Sea Fisheries Institute of South Africa

SOUTHEAST FISHERIES SCIENCE CENTER

Federal
Minerals Management Service
Naval Research Laboratory
NOAA Atlantic Oceanographic and Meteorological Laboratory
NOAA Sanctuaries and Reserves Division
NOAA/NESDIS Coastwatch and Ocean Color
NOAA/NOS Grays Reef National Marine Sanctuary
U.S. Army Corps of Engineers (COE)
U.S. Geological Survey
U.S. Environmental Protection Agency (EPA)

State
Alabama Department of Natural Resources
Atlantic States Marine Fisheries Commission (ASMFC)
Florida Department of Environmental Protection
Georgia Department of Natural Resources
Gulf States Marine Fisheries Commission (GSMFC)
Louisiana Department of Wildlife and Fisheries
Mississippi Bureau of Marine Resources
North Carolina Department of Natural Resources
Puerto Rico Department of Natural Resources*
South Carolina Department of Natural Resources
Texas Parks and Wildlife Department
Virgin Island Department of Planning and Natural Resources*

Industry
Gulf and South Atlantic Fishery Development Foundation

Academic
Auburn University
Cape Fear Community College
Duke University Marine Laboratory
East Tennessee State University
Florida State University
Harbor Branch Oceanographic Institute
Louisiana State University
Mote Marine Laboratory
North Carolina State University
Scripps Institution of Oceanography
Texas A & M University
University of Miami
University of Maryland, Horn Point Laboratory
University of North Carolina at Chapel Hill
University of North Carolina at Wilmington
University of North Carolina/ Institute of Marine Science
University of South Alabama
University of Southern Mississippi
Virginia Institute of Marine Sciences

International
Instituto Nacional de la Pesca (INP)
Norway Institute of Marine Research
South Australia Fisheries Department

NORTHEAST FISHERIES SCIENCE CENTER

Federal

Brookhaven National Laboratory
Environmental Protection Agency (EPA)
Molecular Systematics Laboratory at the American Museum of Natural History
National Research Council (NRC)
National Science Foundation (NSF)
NOAA Coastal Ocean Program (COP)
NOAA Corps Operations Electronic Engineers and Technicians
Office of Naval Research
U.S. Army Corps of Engineers (COE)
U.S. Marine Mammal Commission
U.S. Navy (USN)
The Smithsonian Institution

State

Atlantic States Marine Fisheries Commission (ASMFC)
Maine Department of Marine Resources
Massachusetts Division of Marine Fisheries
New Hampshire Fish and Game Department
Rhode Island Department of Environmental Management

Industry

New England Aquarium
Simrad Inc.

Academic

Albion College
Boston University
College of the Atlantic's Center for Coastal Studies
Cornell University
Duke University
Harvard University - Museum of Comparative Zoology
Mote Marine Laboratory
Nova Southeastern University
Rutgers University
University of California at Irvine
University of Cambridge
University of Connecticut - National Undersea Research Program (NURP)
University of Maine
University of Maryland Chesapeake Biological Laboratory, Solomon
University of Massachusetts
University of Rhode Island
Woods Hole Oceanographic Institute (WHOI)
U.S. Global Ecosystem Dynamics (GLOBEC) Program*

International

Department of Fisheries and Oceans (DFO) Canada
International Council for the Exploration of the Sea (ICES)

Appendix B

Regional Perspectives: Research and Monitoring Needs

NORTHEAST REGIONAL SUMMARY

The Northeast region supports a valuable fishery resource in the North Atlantic (NA) comprised of a wide variety of finfish species (groundfish, small-pelagics, highly migratory species, recreationally-important species) and shellfish (American lobster, sea scallop, surfclam, ocean quahog, squids, northern shrimp). Fishery-independent abundance information and related biological and ecological data obtained from research vessels are key elements supporting management programs to meet NMFS' statutory responsibilities under the Magnuson-Stevens Fishery Conservation and Management Act (i.e. through the New England and Mid-Atlantic Fishery Management Councils), the Atlantic States Marine Fisheries Commission (ASMFC), the Northwest Atlantic Fisheries Organization (NAFO), USA-Canada bilateral agreements, and other national and international commitments. Protected species issues in the Northeast are among the most controversial and difficult faced anywhere in the nation. Many of the important species in the region are considered overfished and/or depleted, and management programs are intense. Bycatch of harbor porpoise, large whales and sea turtles and other threats to these species (e.g. ship strikes) necessitate estimates of abundance and potential biological removals to comply with provisions of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA).

Fishery Resource Monitoring and Protected Resources

A major proportion of the current and requested sea days needed to support the Northeast Fisheries Science Center's research program is devoted to fishery-independent monitoring of regulated resource species. These surveys include broad-spectrum, multispecies programs (e.g. Azarovitz 1981) and a few directed surveys for important fishery resources or difficult to sample species such as sea scallop, northern shrimp and surfclam (Northeast Fisheries Science Center 1997a; 1997b; 1998).

Fishery-independent monitoring in the Northeast Region is accomplished with a variety of survey types, and is heavily-reliant on the use of bottom trawling surveys to provide abundance indices for finfishes and invertebrates. The autumn bottom trawl survey, initiated in 1963, is the longest continuously running program of its type in the world, and has served as the model for similar programs nationally and in various parts of the developed and developing world. The utility of the surveys in providing unambiguous and relatively precise time series of abundance measures, free of the confounding effects of fisheries, has been reiterated in two recent studies completed by the National Research Council (1998a; 1998b). Major declines in the fishery-independent survey abundance indices of Northeast groundfish species, were the primary evidence used to justify implementation of very restrictive management measures, that have withstood the scrutiny of scientific peer reviews, both regionally and nationally, as well as in the federal courts.

The FRV DELAWARE II supports the Northeast Fisheries Science Center, Woods Hole, MA

Trawl surveys are based on a stratified-random sampling design (Cochran 1977; Azarovitz 1981; Pennington and Grosslein 1978; Pennington 1985). The relationship between sampling intensity (numbers of stations) and precision of abundance estimates has been evaluated. Precision of abundance estimators is variable (coefficients of variation from 20 to 100%), depending on the species (Northeast Fisheries Science Center 1988). The trawl surveys (conducted in the winter [1992-present], spring [1968 to present] and autumn [1963-present]) are multispecies in nature, providing information not only regarding currently-exploited stocks, but all components of the fish and invertebrate community available to the gear. Thus, major changes in the fish community, as have occurred in the Northeast, have provided a wealth of information on the ecosystem responses of intensive harvesting (Murawski 1991; Mayo et al. 1992; Fogarty and Murawski 1998). This multispecies sampling strategy has also allowed the collection of information on species prior to the development of intensive domestic fisheries (e.g. goosefish, spiny dogfish, windowpane flounder, etc.), and demonstrated the effects these developing fisheries had on resources, once targeted. The surveys, in conjunction with specialized cruises for fishery biology, provide sampling of a wide variety of biological rates including age and growth, onset of sexual maturity, food habits, etc. which are also critical components of fishery management science. There are no known alternative technologies to trawling surveys that would allow the collection of abundance and biological sampling information for broad array of species (200+species) commonly encountered on the Northeast Shelf.

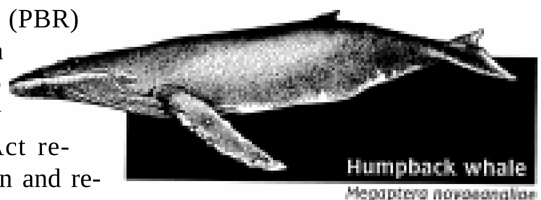
...sophisticated, dedicated research vessels minimize calibration uncertainty...

Improvements in the precision of stock abundance indices can be achieved by increasing and reallocating existing survey coverage (Northeast Fisheries Science Center 1988; National Research Council 1998a). For stocks currently under intensive management, and particularly where closed areas are a major component of the management program, there is a need to improve the density of survey fishing stations (National Research Council 1998b). We propose to address the precision issue by increasing days at sea (DAS) modestly in the spring and autumn surveys and augmenting these surveys with additional random and fixed stations in and around closed areas to monitor the effects of these management measures on the density of fishes. New statutory requirements including recent USA membership in NAFO will require some commitment to multinational research in support of management objectives for transboundary resources. Specifically, we anticipate the need to conduct directed research in conjunction with international partners (Canada, EU) on stocks of common interest including *Illex* squid, groundfishes, and deep-water resources in the North Atlantic. The latter activities may include a coordinated assessment of the deep ocean's fisheries resources along the mid-Atlantic ridge.

Piggy-backing on trawling surveys typically includes plankton sampling (to provide measures of primary and secondary production and larval fish abundance), and hydrographic measurements, important for defining habitat characteristics for resource species. The Northeast Fisheries Science Center's research program has recently been expanded, via congressional appropriations, to include hydroacoustic surveys of small pelagic species (herring, mackerel, butterfish, and others). These species are imprecisely indexed with current trawling surveys (coefficient of variation (CV) of 50-100%). Increasing stock assessment precision for small pelagic species is a priority since fisheries are expanding for these resources which are currently at a high level of historic abundance and are underexploited. Hydroacoustic surveys utilize equipment requiring quieting aboard ship, as well as the capability to deploy traditional sampling methods (nets) and new technologies (video) to verify acoustic targets. The hydroacoustic equipment will also be piggy-backed on trawling surveys to provide additional information on the distribution of pelagic fishes. The use of sophisticated (multi-purpose) and dedicated fishery research vessels, in order to minimize calibration uncertainty, is considered absolutely essential for the broad-scale trawling surveys if we are to continue to meet the needs of fishery managers. Additionally, owing to the need for piggy-backing and primary hydroaoustics surveys, these ships should be acoustically quiet.

Specialized surveys for shellfish species (sea scallop [1975-present], surfclam/ocean quahog [1965 to present] and northern shrimp [1983 to present]), generate relatively precise abundance indices and associated biological information needed in the management process (CV of 20%). The sea scallop survey needs to be conducted annually, given the extremely high harvest rates of the species; surfclam/ocean quahog are exploited less intensively, necessitating a biennial survey. These surveys deploy unique gear (dredges) and are used for piggy-backing to sample plankton and hydrography. Acoustic quieting of the survey ship is not an issue; these surveys can be conducted via long-term access to oceanographic (sea scallop) or other dedicated research vessels (surfclam). For apex predators (sharks), a standardized longline survey has been conducted infrequently in the past, in addition to specialized tagging cruises. Given the increased need for information on large coastal sharks, the survey should be conducted every second year, in order to monitor progress in meeting goals of the fishery management plan. The apex predator survey requires an oceanographic research vessel, while predator biology studies can be conducted via chartered fishing vessel.

The reauthorized Marine Mammal Protection Act (1994) created a wholly new data collection regime for US marine mammals governing the incidental taking of marine mammals in the course of commercial fishing operations. Fundamental to this new management regime is the development of a program which reduces the taking of marine mammals, first to below their Potential Biological Removal (PBR) and ultimately, to a rate approaching zero (the Zero Mortality Rate Goal). The Act requires the preparation and revision a stock assessment for each marine mammal stock using the best scientific evidence. Development of the assessment requires that the NMFS conduct regular population surveys and develop means by which stock structure can be assessed. It is this mandate that has led to the series of pelagic marine mammal surveys conducted by the NEFSC since 1994.



In North Atlantic waters, strategic stocks (those where fishery mortalities exceed the Potential Biological Removal or PBR) are assessed every three years. This includes both harbor porpoise and certain species in the pelagic delphinid complex (including common, spotted, bottlenose, and white-sided dolphins; pilot whales, and beaked whales). Harbor porpoise and the pelagic delphinids have significantly different behaviors and habitats; consequently, two separate surveys are required. These are scheduled in separate years. The NEFSC harbor porpoise and delphinid surveys were designed based on: 1) 1990-1995 NEFSC shipboard and 1978-1982 CeTAP (aerial) marine mammal survey data; 2) bycatch patterns in shelf-edge fisheries; and 3) stock assessment priorities. This dictates a survey area from Chesapeake Bay to at least the western boundary of the Scotian Shelf, principally between 10 nautical miles (nmi) north and south, respectively of the 100 f and 1000 f isobaths.

The use of ships as sighting platforms have been generally agreed upon worldwide as the most accurate approach to assessment of cetaceans (Hiby and Hammond 1989; Buckland, et al. 1993; Hammond et al. 1995). Specific requirements (multiple viewing stations, viewing station height and configuration) have been developed to ensure all animals are seen within the search radius and to provide low sighting errors. Multiple viewing stations are desired so that two teams can conduct independent surveys, which allows for corrections for observer error and animal surfacing probabilities. Alternative methods for estimating protected species abundance have been considered. Various hi-altitude forms of imagery (e.g., Synthetic Aperture Radar or SAR from satellites and aircraft) do not provide sufficient resolution. Aircraft have been used and are reasonably effective for locating and photographing large whales. However, for small and large cetaceans aircraft do not provide sufficient time on animals (remember the animals are relatively small and are submerged much of the time) to provide precise estimates. Aerial surveys significantly under report the occurrence of many small cetaceans. Aerial surveys are also more dangerous and are inefficient for offshore transects that require long transit times. Passive acoustics provide another alternative but there are few resources in place for sampling on the shelf. Although passive acoustics provide information on distribution, they are insufficient for abundance estimates, particularly for small cetaceans who are either present in large groups, or are relatively silent (e.g., harbor porpoise). Also, they lack the statistical basis for analyses that have been developed for line transects and frequently still require a ship (especially for wide area surveys with towed arrays). Additionally, active acoustics do not represent a real alternative to ships because they still require ship time and there is little data on acoustic signatures of most cetaceans.

A quiet vessel is required because of potential biases resulting from animals either avoiding or being attracted to the survey vessel. Cetaceans are able to detect the engine noise of a ship at distances far greater than those at which they can be detected by an observer on that ship. Movement in response to a survey ship is thus potentially a source of significant bias in line transect estimates of cetacean abundance (Au and

Perryman 1982;.Leatherwood et al. 1982; Hewitt 1985; Borchers and Haw 1990; Polacheck and Thorpe 1990; Turnock and Quinn 1991). Fishery research vessels also provide a platform to collect additional data. These include: habitat information (plankton tows, water column profiles, and acoustic abundance estimates for prey species); biological data (biopsy samples for genetic and contaminant analysis); more detailed behavioral (social interaction, interactions with fishing gear, surfacing intervals) and photographic data.

Marine turtle species are managed under the ESA; all commonly found in North Atlantic waters, are considered endangered under the ESA. The NEFSC proposes to begin pelagic turtles studies in FY2000 with a triennial study of distribution and abundance in the North Atlantic from Cape Hatteras to the Scotian shelf eastward to the limit of the EEZ. In this first survey, we propose to follow the same sighting protocol used for the harbor porpoise surveys conducted since 1990. This will allow the use of previously tested assessment models, and will allow the collection of collateral sighting information on porpoise. After the FY2000 survey is completed, the protocol will be reevaluated (particularly with respect to the CV of the estimate), and the survey protocol revised as necessary.

Fishery Oceanography

Fishery oceanography programs are directed to solving fundamental problems linking environmental variability with recruitment success in marine resources. A mix of broad-scale surveys and process-oriented studies have been directed to efforts such as the GLOBEC (GLOBal ocean ECostems dynamics) Georges Bank program, which seeks to predict recruitment of important cod and haddock stocks there. Each survey consists of CTD (Salinity, Temperature, and Depth) casts for hydrography and MOCNESS (Multiple Opening Closing Nets Environmental Sensing System) tows to sample larval and pelagic juvenile fish and their planktonic prey and predators. The monthly surveys and station spacing were derived from the U.S. GLOBEC Georges Bank Program, which will be carried out for five years, 1994-1999, and were determined to be appropriate for the time and space scales of the target species and environmental events. There is considerable variability on Georges Bank in plankton distributions on the broadscale (C.V. = 60-100%), and given more vessel time we could double the station density to about 100 (20 km apart) and reduce the C.V. to <40%.

There is no present or future technology on the horizon that will replace the plankton-net sampler, and this alone requires the use of a research vessel. Video Plankton Recorders (VPR) now in use are essentially underwater microscopes which look at very small volumes on the order of a few milliliters. Additional process studies are needed since it appears that recruitment is a compound function of environmental factors operating on the egg and larval stages and density-dependent factors operating on the juveniles. At least one additional process cruise per year is requested to address some of the controlling hypotheses.

Ecosystem Monitoring

Ecosystem monitoring surveys currently document seasonal, interrenal and decadal variability in the plankton and oceanographic components of the Northeast Shelf ecosystem. The data provide indicators of broad-scale ecological and environmental changes in essential fish habitat and the marine ecosystem. The indicators can be used to evaluate potential impacts of these changes on stock recovery and stock productivity, e.g., to rule out environmental changes as a major contributing factor to declining abundance of fish stocks. Oceanographic regimes and accompanying circulation patterns vary from the Gulf of Maine to Georges Bank and the Middle Atlantic Bight. Consequently, it is necessary to sample the range of the entire shelf at a high level of temporal resolution, to reflect six seasonal regimes and regional oceanographic features. At present, two seasonal regimes are sampled during the spring and autumn bottom trawl surveys, a third is partially sampled during the winter trawl survey, and a fourth is very poorly sampled during the summer scallop survey. Additional DAS of piggy-backed coverage with dedicated surveys would augment coverage in late spring and summer. These additional cruises can be accomplished using a charter vessel. Some surface features (sea surface temperature, chlorophyll) may be monitored using satellite imagery. Information on vertical structure of water column in terms of water mass, chlorophyll and nutrient concentrations, and zooplankton abundance and species composition cannot be obtained from this source.

Ecosystem Habitat

Ecosystem habitat studies, now mandated in support of essential fish habitat (EFH) provisions of the MSFCMA, have used research vessel support sporadically in the past. However, given the increasing importance placed on the ecosystem effects of fishing (i.e. gear effects on benthic creatures and habitats), modest use of DAS for this purpose is required. Characterization of fishery habitats with remote technologies will increase our understanding of the role and importance of the sea floor in the life history of groundfish. Specific proposed research will (1) develop criteria and analytical techniques for the characterization of fishery habitats on kilometer scales using sidescan and multibeam sonar, (2) verify habitat interpretations fishery associations by ROV video surveys and benthic sampling, and (3) develop GIS techniques to optimize the usefulness of geophysical and biological data sets for fisheries and habitat studies. A quiet FRV is needed because much of the work will take place in <50 m of water where ship noise may affect the behavior of the target organisms and thus affect estimates of abundance from video transects and trawl samples. The work is best suited to FRVs that allow precise navigation and positioning, multiple independent winches to allow several pieces of equipment to be in the water simultaneously, and an onboard computer system to provide a link between GPS and GIS.

Additional research will investigate the effects of mobile fishing gears on benthic habitats in bottom communities on Georges Bank and in the Gulf of Maine. The study area on Georges Bank is closed to all bottom fishing and the recovery of the benthic community has been monitored since 1994. Sampling within and outside of the closed area in disturbed habitats is accomplished with bottom dredges, ROV photographic transects, and baited traps. The information will be used to identify adverse effects of mobile fishing gears on EFH and to estimate bottom-habitat recovery times following disturbance by fishing activities. The assessment of potentially damaging effects of fishing activities to EFH could lead to improved habitat management and maintenance of the biological productivity.

The highest priority unmet needs for vessel DAS in the Northeast Region are for:

- hydroacoustic surveys of small-pelagics on quiet FRVs,
- management-related and multinational research necessary to improve the precision of abundance estimates for important stocks and meet new international obligations,
- habitat studies related to the definition of essential fish habitat and the environmental effects of fishing,
- marine turtle sighting surveys, and
- marine mammal sighting surveys

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Southeast Regional Summary

The Southeast region extends over the Gulf of Mexico/Caribbean (GOM/C) and South Atlantic (SA) large marine ecosystems. With three Fishery Management Councils, perhaps a dozen Fishery Management Plans (FMPs) or equivalents, and about 200 stocks with significant exploitation and in need of assessment, the Southeast Region has focused its vessel activity on longterm monitoring, markedly limiting our involvement in process-oriented recruitment or ecosystem research. Our main goal is to provide fishery-independent information about year to year variations in abundance. We try to intersect abundances at two points in the life cycle: new recruits, and spawning stock, for as many stocks as possible. Five principles guide our strategy: surveys should 1) be synoptic; 2) be stockwide; 3) have a well defined sampling universe; 4) have useful precision; and 5) control bias. Our overall vessel strategy is a result of the trade-offs among objectives and constraints on attaining the ideal principles.

Resource Monitoring

In the Southeast Region, trawl surveys are very efficient at monitoring new recruits for a wide variety of FMP species, including those species of special management controversy like red snapper, king mackerel, and Spanish mackerel. Unlike other regions, trawling is not very effective at assessing the adult stocks of controversial FMP species. Therefore, we have invested heavily in the development of survey techniques to track year to year changes in abundance of adults of FMP species. Several types of surveys (usually identified by the primary gear used) are required to cover the array of species in the region. Survey types include: trap and video surveys for reeffish, longlining for sharks, plankton-based spawning stock indices (indices have been produced for bluefin tuna, Gulf of Mexico red drum, king mackerel, and Spanish mackerel; this list may expand considerably over the next few years), and research vessel mark/recapture operations for striped bass and red drum.

Use of survey monitoring data in the Southeast Region is similar to use in other regions. The catch per unit effort (CPUE) index for each species from each survey is used as a stand-alone description of probable path of abundance over time. This information is compared qualitatively with any other indices of abundance that may exist from fishery-dependent data. This independent use of the data is valuable both for this scientific evaluation, and for presentation of information to the interested public. Complete stock assessments can be intimidating to the public, and are often viewed as 'black boxes.' Although survey data are not without their detractors ("Why'd you sample there? Everybody knows you won't catch much!), most people understand the concept of a CPUE trend as an indication of an abundance trend. The CPUE indices fold in quantitatively into most assessments as tuning indices for virtual population analysis (VPA). "Tuning" has become the shorthand term for formal, mathematical minimization of the variation between patterns in available CPUE indices and patterns in population size estimated by VPA. The existence of the fishery-independent indices, and the tuning process, have removed major sources of subjectivity that assessment was criticized for one to two decades ago. The credibility of modern assessments, involving both fishery statistics and survey monitoring data, thus rests heavily on the existence of the survey data.

There are other uses of data collected aboard research vessels in the stock assessment process. Size, age, and reproductive biology data are routinely taken from specimens taken during survey cruises. There are some special analyses associated with Gulf of Mexico shrimp used first to evaluate, and now to monitor, the effectiveness of the Texas Closure shrimp management measure. The survey monitoring is really the only direct source of data that will warn the Council if changes in environmental conditions or shrimp population dynamics change the effectiveness of this major management measure over time. Trawl survey data are also used in the process of estimating finfish bycatch of the shrimp fleet in the Gulf, predicting commercial fishery CPUE from the sparse and discontinuous observer data via a General Linear Model (GLM) statistical technique. Although Southeast cruises dedicated to process oriented studies are rare, all cruises provide substantial information relevant to the biodiversity of the area. Major reference collections for ichthyoplankton (at Florida DEP in St. Petersburg, FL) and invertebrate plankton (at USM GCFL in Ocean Springs, MS) are supported by the SEAMAP program, and made available to government, academia, and other researchers upon request.

Determining Data Acquisition Methods

Long term commitment of dedicated vessels is vital to the success of the program. Seasonal timings of surveys are largely locked in by spawning and recruitment seasonality. Changing ships frequently over years would impose insurmountable costs, both in terms of lost precision due to heavy reliance on calibration, and actual dollar costs of conducting calibration estimations. The Southeast region has considerable experience with multiple vessel surveys through its Southeast Area Monitoring and Assessment Program (SEAMAP), which funds participation and coordination of state and university fishery research vessels. Multivessel surveys began in 1982, and only now have we accumulated enough intervessel calibration data to begin using the full power of our multiple vessel approach.

The Southeast Region already 'contracts' for vessel services through its SEAMAP and MARMAP programs. However, these activities have sometimes not shown up in previous compilations of contracted DAS, because data and analytical products, not sea days per se, are the subject of the cooperative agreements. In all cases, these cooperative agreements for stock assessment and monitoring purposes have involved dedicated research vessels owned by the states or universities. These vessels are usually much smaller than NOAA vessels and the agreements are focused on those surveys where the extended duration of NOAA vessels is not required, or on nearshore work too shallow for the large NOAA vessels.

In general, the Southeast Region does not contract for industry vessels for stock assessment and monitoring purposes, because no vessels have

The NOAA Ship OREGON II serves the Southeast Region from Pascagoula, MS.

been identified with the proper mix of duration capability, scientific party capacity, ability to work round the clock, ability to work in bad weather, and capability to operate multiple gear on the same cruise. The Southeast Region frequently contracts with industry vessels for gear technology research, or for special stock assessment related activities not involving long time series (e.g. purse seiner for red drum mark/recapture).

We are presently in transition, replacing the mechanically unreliable *Chapman* with the *Relentless*, adding trawl capabilities to the *Relentless*, and conducting a major repair on the *Oregon II*. Once these actions are complete (FY2000), our expected assignment of seadays among cruise activities will be as shown in Appendix D.

The selection of the cruises to be conducted (gear, area, season, targets) is our solution to the trade-offs among: 1) intent to provide indices for as many FMP species as possible; 2) attention to key species with high exploitation and/or special management concern; 3) total DAS limits; 4) competition for DAS in ideal seasons; 5) effectiveness of existing sampling techniques; 6) likelihood of successful development for new surveys; 7) differences in capabilities of available vessels; and 8) overall budget limits. Secondary but real concerns are providing for some investment in process-oriented research, maintaining broadscale environmental measurement capability, and longterm monitoring of the forage base.

Determination of Survey Duration and Frequency

Choices for durations of specific surveys tend to be governed by two of the five guiding principles - that a survey should be synoptic (i.e. a snapshot in time), and cover the full range of each targeted stock. Synoptic is a relative term in fisheries - for marine mammals, the averages obtained over 2 or 3 years of surveying might be considered synoptic. For trawl surveys in the presence of the Gulf of Mexico shrimp fishery, where fishing mortality rates may approach 1 per month, we compromise and call our 5 week cruises synoptic. For plankton surveys, synopticity takes on a different meaning, and one must consider the durations of the spawning seasons for the target species, and usually must increase seadays above that required to cover the spatial extent of the target stocks. Covering the full range of many stocks simultaneously is an ideal that is rarely met completely - spatial distributions differ, some trail off over long distances at low density, and political boundaries like the Mexican border add complications that for some species are best ignored, while for other species, must be addressed. Precision (usually expressed as the coefficient of variation (CV) for the mean for any individual stock) is determined by the number of stations (improving in approximate terms as the reciprocal of the square root of the number of stations), and the actual catch in the sampling gear (CV usually improves with increasing catch). Once a decision is reached on what spatial area is to be covered and what is acceptably synoptic, the number of stations is essentially fixed, unless one adds more vessels to the survey. Adding more vessels triggers concern about calibration, and usually bumps against budget constraints. The dependence of precision on catch influences our decisions about the details of gear used (size, deployment, etc), along with concerns about practical aspects like reliability and safety. With multispecies surveys, desire to operate at higher catch levels for rare species is limited by the prospects of overwhelming the gear, the ship, and the field party with catches the more abundant species. Once general expectations of duration are set for a specific cruise, the expectations must be reconciled with competing uses from other surveys with overlapping seasonal need. Compromise requiring downward adjustment of DAS is the norm. Surveys with higher management importance and longer time series have priority. It has been our longstanding policy to use ‘piggybacking’ wherever information needs can be met through that strategy.

Expectation of annual frequency is the starting point for most developing surveys. For populations expected to change slowly over years (long-lived species with low total mortality), less than annual frequency can be considered, and will be implemented to the extent that competition for DAS within particular seasons cannot be resolved. None of our surveys are more frequent than annual. Although there are multiple trawl and plankton surveys each year, the species and size mixes targeted in each are different.

Our overall strategies for providing monitoring surveys, and the tactical details within surveys, are thus the results of trade-offs between a large number of factors. These trade-offs are not evaluated via a formal set of objective functions. That kind of formalism would probably be impractical, indeed, impossible unless individual species could be given objective relative values. Instead, the collective judgement of the participating scientists, with guidance from the managers, and the ultimate authority of the budget, determine the mix.

Need for Fisheries Research Vessels

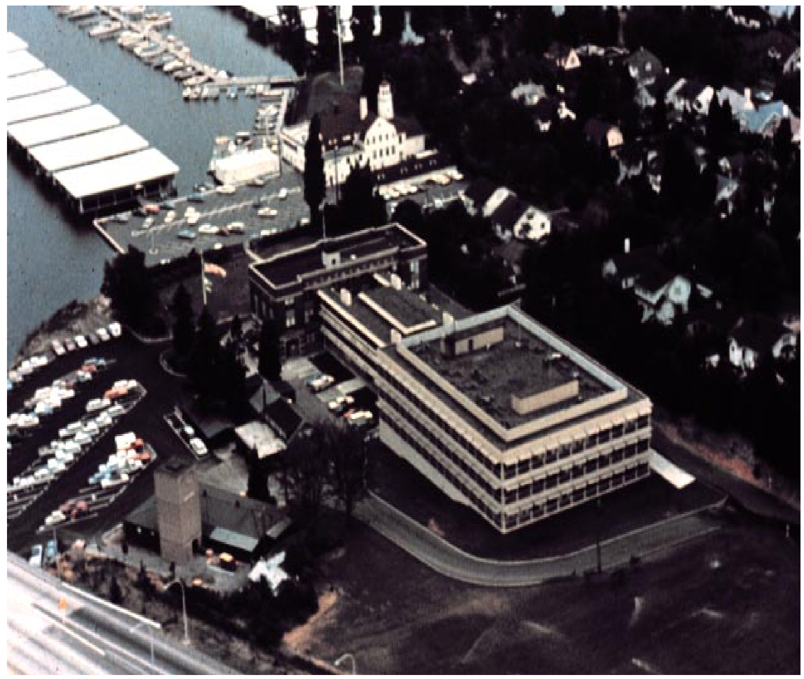
Dedicated FRVs available for long time periods are the ideal for all of the monitoring surveys. Given that it may not be possible to obtain FRV service for all, priority for assignment of surveys to available, dedicated FRV time would probably be: trawl surveys, reeffish surveys, mammal surveys, longline surveys, plankton surveys. A major complication to this simple ordering is the possible expanded use of acoustic techniques in future years. Management decisions in the southeast are not currently dependent on acoustic survey results, but we are experimenting with acoustic techniques in conjunction with trawl surveys and reeffish surveys. It may prove useful to piggyback acoustic efforts on other surveys as well. If so, the number of surveys absolutely requiring long-term, dedicated, quiet FRVs will increase.

Needs other than Resource Monitoring

Vessel needs not directly linked to long term monitoring can be expected to vary over years in response to funding, and new agency directions. Appendix D includes our expectations for the immediate future, a mixture of recent existing projects, and probable future directions. Not all activities would be needed every year. Most are placeholders for specific activities that will vary over time within longer term research program. For example, we expect several years of habitat research associated with Council definitions of essential fish habitat (EFH), and with possible development of a marine reserve strategy for fishery management. These activities are prime candidates for shorter term charter arrangements, either industry or research vessels as appropriate to each activity. Of course, abundance trends and environmental data collected during monitoring surveys are also part of the raw material for recruitment process, ecosystem function, and habitat characterization analyses.

Pacific Coast Regional Summary

Within the Pacific coast region is the California Current (CC) large marine ecosystem. This region encompasses the (Exclusive Economic Zone) EEZ off the coasts of California, Oregon and Washington and falls under the joint responsibility of the NMFS Northwest Region (NWR) and Southwest Region (SWR). Along this extensive coastline a diverse ecosystem harbors marine mammals and other protected resources, and supports valuable fisheries. These fisheries include coastal pelagics (anchovy, sardine, mackerel); anadromous species (salmon and trout); groundfish (83+ species); herring; sharks; migratory fishes; and invertebrates (shrimp, crab, squid, urchins). The Pacific Fishery Management Council has developed fishery management plans for the coastal pelagics, salmon, and groundfish. Other species are under state management. Monitoring impacts on marine mammals, recovery of depleted salmon stocks, and potential fishery yields for groundfish and pelagics requires that we can monitor trends in abundance of each of these species and understand the ecosystem, habitat and anthropogenic factors that cause these trends.



The Northwest Fisheries Science Center, Seattle, WA

The Eastern Tropical Pacific is the area of interaction between dolphins and the tuna fishery. In this area, NMFS monitors the status of impacted dolphin stocks, conducts research to better understand and potentially reduce the direct fishery impact on dolphins, and works to better estimate the potential for dolphin recovery

The FRV DAVID STARR JORDAN conducts marine mammal and oceanographic surveys in the eastern tropical Pacific Ocean.

through a better understanding the ecosystem interactions between dolphins and tunas.

In both of the above areas and for this broad range of species, NMFS engages in four principal areas of field investigations that require a research vessel: (1) resource monitoring, (2) ecosystem and habitat investigations, (3) recruitment forecasting, and (4) bycatch & gear impact studies. A probable mix of activities to be conducted from a new West Coast FRV and using chartered ship time are found in Appendix D.

Resource Monitoring

Marine Mammals

The mandate to conduct surveys and to estimate the abundance of marine mammal populations comes from directly from the legislative mandates of the Marine Mammal Protection Act of 1972 (MMPA) and the Endangered Species Act of 1973 (ESA). This need is reiterated in the NOAA Fisheries Strategic Plan (Strategies for the Achievement of Objective 5). For most species of marine mammal within U.S. jurisdiction, management is based on the PBR (Potential Biological Removal) approach specified in the 1994 amendments to the MMPA. This approach specifies the allowable levels of human-caused mortality based on a formula that requires knowledge of minimum population size for all species. Dolphin species which interact with the eastern tropical Pacific (ETP) tuna fishery are managed under a separate scheme, but which also requires an estimate of abundance. The International Dolphin Conservation Program Act of 1997 specifically mandates a 3-ship abundance survey for tropical dolphins in 1998 and a 2-ship survey in both 1999 and 2000. Because of this high demand on vessel time, plans for similar surveys around Hawaii or off WA-OR-CA have been deferred until at least 2001. Endangered species of marine mammal, including 8 species of large whales, are managed under provisions of the ESA and the MMPA. Research needs for endangered species are specified on a case-specific basis in their respective “species recovery plans”; however, a common element of all recovery plans to date is the need to estimate population size to monitor recovery. Many other sources of data are used to manage marine mammal populations, but the estimation of population size is the most important element in all management frameworks and ships surveys are the only practical method of estimating abundance for the vast majority of species.

...some surveys for tropical dolphins have been deferred until at least 2001 due to a lack of vessel time...

Visual sighting surveys from ships are the primary method of estimating marine mammal abundance. Other methods are used when they are suitable, but all other successful alternatives have been limited to surveys conducted close to shore (ground-based surveys within 3 nmi, mark-recapture from small boats within 30 nmi, aircraft surveys within 100 nmi). Ships are the only platforms available for the vast majority of truly pelagic dolphin, porpoise and whale species. Investigations into the feasibility of alternative high-tech solutions for estimating the abundance of pelagic species have not been very successful. The highest resolution satellite photographs may be adequate to see schools of dolphins or individual large whales near the surface, but would not allow researchers to distinguish between the 50+ species. Low frequency sounds produces by blue whales and fin whales can be received by Navy SOSUS listening stations and may, someday, be developed into a useful census tool, but such methods hold little hope for the 48+ other species. Most acoustic researchers agree that passive acoustic methods are more likely to aid rather than replace visual sighting methods ... and then only for a very few species. Aside from being the only feasible method of survey for the majority of species, research ships also have an advantage over all alternative survey platforms in allowing the simultaneous collection of a full suite of oceanographic and other measurements of cetacean habitat. For all these reasons, research ships will be the primary platform for whale, dolphin, and porpoise surveys into the foreseeable future.

Coastal Pelagics

The coastal pelagic species support valuable fisheries and are key components in the ecosystem. Significant advances in assessment technology, such as the Egg Production method, were built around these species in the 1980s. New advancements in assessment technology, such as LIDAR, are under current development. Long-term climate patterns, and short term el Nino events have substantial effects on the distribution and abundance of these species. In northern areas, these small-bodied fishes are comparable prey to young salmon, so changes in coastal pelagics abundance can change the predatory impact on the young salmon. Clearly the living marine resource monitoring program needs to include investigation of these species.

Salmon

Salmon investigations need to extend into the ocean to break a logjam in our ability to forecast probability for recovery of depleted stocks. Because salmon are an anadromous species, most monitoring of trends in salmon abundance has occurred in rivers where they spawn. There is growing recognition that this emphasis on the freshwater phase provides no ability to understand estuarine and oceanic phenomena that cause important changes in growth and survival of salmon. This understanding is critical to interpretation of the relative impact of harvest, freshwater habitat, and other factors on the past decline and future prospects for recovery of salmon. NOAA Fisheries needs to use at-sea research capabilities to understand trends in ocean productivity and predator-prey interactions that influence salmon. We need to understand how stress factors encountered by outmigrating salmon (including physical stress, prey availability, disease, predators, etc.) affect their survival. Pilot efforts in this area have been conducted from a variety of UNOLS and chartered vessels, but severe limitations have occurred because these vessels lack the multi-function capability (i.e. oceanographic, plankton, and trawl sampling) of a FRV.

Groundfish

The term “groundfish” oversimplifies the complexity of its biological and fishery situation. In fact, the Pacific Fishery Management Council’s Fishery Management Plan for groundfish includes 83 species. Examples are Pacific whiting (hake) which is an abundant migratory, schooling fish; yelloweye rockfish which is a sedentary, nearshore reef-oriented rockfish; and sablefish which are bottom-dwelling, deepwater fishes. The fishery is equally complex with catcher-processors using midwater trawls to target on whiting; bottom trawlers targeting flatfishes, rockfish and other species; various hook and line and pot gears targeting sablefish and rockfish; and recreational fisheries targeting nearshore rockfishes. It is convenient and useful to categorize groundfish into five groups based upon their habitat and target fishery. These include: (1) midwater (principally Pacific whiting); (2) deepwater (sablefish, dover sole, 2 thornyheads, grenadiers); (3) shelf (principally trawl-caught rockfish and lingcod); (4) nearshore rockfish (principally other rockfish species caught by hook and line or by recreational fishermen); and (5) nearshore flatfish.

NOAA Fisheries has used a combination of trawl, acoustic, plankton, and fixed gear methods to provide some survey coverage for many west coast groundfish species. However, for the five groundfish assemblages identified above, we have only been able to mount the following level of effort:

- triennial bottom trawl survey for shelf rockfish and lingcod using two chartered trawl vessels;
- midwater trawl survey for rockfish recruitment off central California using the NOAA vessel *David Starr Jordan*;
- annual, but sparse, bottom trawl survey for the deepwater complex using the NOAA vessel *Miller Freeman*;
- incidental coverage for nearshore flatfish in the shelf rockfish survey;
- no coverage for nearshore rockfish.

Historically there was a fish trap survey for sablefish, and in 1998 there will be initiation of a chartered bottom trawl survey for the deepwater complex.

Additional groundfish survey needs will require a combination of a dedicated FRV and chartered fishing vessels. The FRV will provide all-weather capability, large scientific staff, standardized and acoustically quiet, and capability for simultaneous multiple missions. The chartered fishing vessels will provide additional days-at-sea in coordination with the FRV to achieve adequate and timely coverage of the five assemblages of groundfish species. Neither a program based solely on one FRV, nor a program based solely on charter of local fishing vessels could meet the needs. Without an adequate survey program, stock assessments will have more uncertainty and prudent management should be more conservative. This will result in lost value from this fishery.

Ecosystem and Habitat Investigations

Monitoring surveys, as described above, provide information on trends in abundance for major species, but do not necessarily explain these trends. Understanding the reasons for these trends comes through investigation of the ecosystem and climate in which these species are found. In many cases, these investigations cross-cut protected species, harvested fish, and all living marine resources in the region. In addition, harmful algal blooms and degradation of marine habitat are factors that may significantly impact the productivity and value of our living marine resources. When the monitoring surveys are conducted from larger, multi-function FRVs, they can simultaneously collect and process a wide range of environmental, biological, and habitat data. These additional studies are often not feasible from chartered fishing vessels. In addition to this piggy-backing of some ecosystem studies on monitoring surveys, there is a need for specific studies of essential fish habitat and ecological processes. The west coast vessel needs include routine investigation of ocean productivity through California Cooperative Fisheries Investigations (CalCOFI) and other oceanographic surveys, directed studies of fish benthic habitat with ROVs and other new technologies, and specific studies of the biological and environmental factors that affect the growth and survival of young salmon and other fish. Additional sampling conducted on the ETP dolphin surveys, and the multi-species collections made during bottom trawl surveys provide opportunities to investigate some ecosystem issues. The impetus for such studies has increased due to the legal mandate for consideration of essential fish habitat, and the growing recognition that long-term changes are occurring in the marine ecosystems.

Recruitment

Understanding the effect of ecosystem and climate on trends in fish abundance provides an improved long-term perspective, but may not provide short-term forecasts. Specific surveys targeted on juvenile fish can provide a recruitment index which forecasts short-term changes in stock abundance. Such a recruitment index can be empirically calibrated to recruitment estimates coming from subsequent stock assessment results and adult monitoring surveys. In parallel, process-oriented fishery-oceanography research will provide understanding of the factors that most affect recruitment. A single-purpose recruitment index survey could be conducted from a FRV or from a chartered vessel. In some cases, a recruitment survey could be piggybacked on a monitoring survey if the time of year was correct and the vessel had sufficient capability. Field studies to understand the biological and environmental factors that affect recruitment cannot be conducted from fishing vessels. Although such studies rarely require the quieting and trawl capability of the FRV, they do require the multi-function oceanographic and plankton sampling capability of UNOLS vessels and FRVs. Past efforts have provided much insight into the factors that govern recruitment variability for coastal pelagics off California. Much of today's recruitment work is oriented towards providing measures of recruitment for key groundfish, understanding factors affecting recruitment for rockfish, and understanding factors affecting early ocean survival, hence recruitment, for salmon. Fishery-oceanography studies such as CalCOFI provide a long-term perspective on changes in the ocean climate, thus provide a context for interpreting fluctuations in recruitment.

Bycatch and Gear Impacts

The above studies are focused on the fish and their environment. There is also the need for understanding of the effects of the fishery itself. These include studies of bycatch survival, gear studies to reduce bycatch, effects of fishing gear on the habitat, etc. In many cases these studies are best conducted from actual fishing vessels in order to replicate actual fishing conditions. In some cases, a combination of a FRV and a fishing vessel may be necessary to provide the necessary testing and observing platforms.

Alaska Regional Summary

The marine ecosystem of the Gulf of Alaska/ Bering Sea-Aleutians (GOA/BS) supports major fish and shellfish resources and marine mammal populations for which NMFS has management authority or, in some cases, shared authority with other local, state or international bodies. The Bering Sea is the world's third largest semi-enclosed sea. It is bounded on the east by the broad continental shelf of the eastern Bering Sea and on the south by the Aleutian Island chain with an extremely narrow shelf. The eastern Bering Sea is divided into about 6 major habitats. Each with a characteristic oceanography, bottom habitat and species compositions. In the winter and spring the eastern Bering Sea is covered by sea ice which has a significant impact on the primary productivity cycle of the shelf oceanography. The Aleutian Islands serve as the barrier between the North Pacific Ocean and the Bering Sea with the strong oceanic current of the Alaska Stream flowing westward along their southern edge and pushing oceanic waters through a number of passes between the islands into the Bering Sea. Because of the narrow shelf, the Aleutian shelf does not support large fish populations but it does exhibit a high degree of bio-diversity with respect to invertebrate benthos. The deep central basin of the Bering sea is characteristic of an oceanic environment with a relatively low level of production. The Gulf of Alaska is the northeastern rim of the Pacific Ocean with a continental shelf less than half the width of the eastern Bering Sea, is less productive, and has more diverse habitats. The oceanography of the Gulf is driven by the flow of the Subarctic Current, the Alaska Stream, and the Alaska Coastal Current.

The fishery resources of the eastern Bering Sea shelf are dominated by walleye pollock, Pacific cod, five commercially important flatfish stocks, Pacific halibut, king crab, Tanner and snow crabs, and skates. Sablefish, Greenland turbot, grenadier, Pacific Ocean perch and pollock are abundant along the upper slope of the shelf break. The Aleutian Island resources are dominated by Atka mackerel, Pacific cod, four commercially important rockfish stocks, flatfish and pollock. In the Gulf of Alaska, the important groundfish resources are pollock, Pacific cod, Pacific halibut, eight rockfish species, arrowtooth flounder and other small flatfish. Beyond the shelf break, sablefish, Dover sole, thornyhead rockfish, slope rockfish species, and grenadiers are abundant. The crab and shrimp resources in the Gulf of Alaska supported major fisheries until their demise in the 1970s and early 1980s. The pelagic fish species in both areas are dominated by salmon, herring, capelin, eulachon, Pacific sand lance, smelts, and squid. These pelagic species along with juvenile walleye pollock make up the diet of most of the marine mammal and bird populations that forage off Alaska. Many of the stocks of groundfish and crab are long lived species whose abundances are driven by periodic recruitment of strong year classes. The abundance of many of the major fishery resources have undergone decadal scale cycles apparently associated with climatic regime shifts which impact recruitment, growth, and natural mortality. The standing stock of groundfish resources off Alaska within the U.S. EEZ has been estimated to range between 13 and 23 million metric tons since 1977 and have supported a total harvest of about 2.5 million tons. The crab fisheries have supported fisheries of 100 to 150 thousand tons although the species composition of the catch has varied greatly. During the same period, the Alaska salmon harvest has increased from about 25 thousand tons to almost 400 thousand tons in recent years. The fishery resources of Alaska are managed by three federal FMPs; Bering Sea-Aleutian Island Groundfish, Gulf of Alaska Groundfish, and Bering Sea Crab. The latter FMP is co-managed with the State of Alaska. The salmon and herring fisheries, a developing scallop fishery, and other near-shore or inside state water fisheries are managed by the State of Alaska.

The Alaska region has 37 stocks of more than 25 species of marine mammals. The National Marine Fisheries Service is responsible for the management of 33 stocks of large whales, small cetaceans, and pinnipeds under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). Estimates of abundance and potential biological removals (PBR) are known for 21 of the stocks. According to the criteria provided in the 1994 Amendments to MMPA, 10 stocks found in waters off Alaska are classified as strategic. The most commonly observed species in Alaska, e.g. gray whale, Steller sea lion, and harbor seal are normally found close to shore. Humpback whales traverse ocean basins to reach coastal feeding areas along Alaskan fjords and shorelines. Fin whales, on the other hand, remain in offshore waters. Northern Pacific right whales have just recently been observed during their sum-

The Alaska Fisheries Science Center, NOAA Western Regional Center, Seattle, WA

mer feeding along the mid-shelf domain of the eastern Bering Sea. Many of the smaller cetaceans and pinnipeds make shorter seasonal migrations of few hundreds of kilometers. These seasonal movements are often associated with extension and retreat of the Bering Sea sea ice and the extreme annual cycle of day-night photoperiod. The ability to enumerate the abundance of these stocks greatly depends on their seasonal migratory patterns, onshore versus offshore distribution, and their diving and haulout behaviors.

NMFS undertakes an annual survey effort off Alaska to assess the distribution and abundance of the major groundfish and shellfish resources

The 31 yr-old MILLER FREEMAN serves the Alaskan Region.

and many of the marine mammal stocks. The results from these surveys contribute to the annual effort to update the assessment of resources that are utilized in the resource management decision process. In addition, research programs are underway to expand our knowledge of the fishery/ oceanography to forecast recruitment specifically for pollock stocks, to assess the role of pollock in the ecosystem of the eastern Bering Sea, and to assess the carrying capacity of the Gulf of Alaska to support salmon during their oceanic life stages. The Alaska Fisheries Science Center uses a mix of different types of research vessels to carry out these assessment surveys and experimental cruises including 2 NOAA ships *Miller Freeman* and the *John N. Cobb* (~ 385 DAS), and charter vessels (~ 398 DAS). The current annual vessel usage totals 783 DAS of which about 86% is allocated to resource assessment monitoring for fish and marine mammals, about 16% is allocated to ecosystem research focused on the role of juvenile pollock in the eastern Bering Sea and salmon in the Gulf of Alaska, about 3%is allocated to recruitment research on biotic and physical processes that control pollock year class strength, and about 5% is allocated to bycatch and EFH research.

Assessment Monitoring Research

The current stock assessment survey strategy for the shelf groundfish and crab resources off Alaska, including a portion of the West Coast slope, is a combination of annual and triennial bottom trawl, longline, and acoustic surveys (echo-integration/mid-water trawl) that developed after the passage of the original FCMA. Trawl surveys for the Alaskan slope resources were last conducted in the late 1980s. The crab and groundfish resources on the eastern Bering Sea shelf are surveyed using standardized bottom trawls and a systematic design with 383 fix stations on a 20 nm grid covering 466,000 km2. The survey has been conducted annually since 1979 from June 1 to about August 4 to avoid the spring sea ice and inclement weather, yet early enough so that survey results can be incorporated into the fall stock assessment cycle for setting harvest levels for the upcoming crab and groundfish seasons. The survey is conducted by chartered commercial trawl vessels. The surveys are annual primarily to update abundance estimates for the 3 species of crab, which directly translate into harvest quotas, and to index recruitment levels of age 1 pollock. Even though the station density is quite low (1 station per 945 km2), the confidence intervals for the estimates of biomass based on simple sample variance are about ± 22% for pollock, ±37% for Pacific cod, ±15% for flatfish, and ±40% for crab. Given that length/age structured population models are still in development for crab, annual surveys are necessary given the population crashes observed in the early 1980s. Similar surveys for the shelf groundfish resources in the Aleutian Islands, Gulf of Alaska, and the West Coast are conducted on a triennial schedule rotated among the areas. In this case the survey designs are based on a stratified random station pattern with station densities of 1 station per 100 km2 for the West Coast, per 140 km2 for the Aleutian Islands, and per 350 km2 for the Gulf of Alaska. The higher station densities for the West Coast and the Aleutian Islands keep the confidence intervals near the same level of the Gulf and Bering Sea estimates. The geographic coverages by area are 300,000 km2 for the Gulf and just under 70,000 km2 in both the Aleutians and West Coast. All the surveys are scheduled to begin June 1 and end mid-August when weather is best and commercial fishing vessels are available for charter. This schedule provides sufficient time to incorporate survey results into the annual stock assessment process. The Aleutian and West Coast surveys require two charter vessels and the Gulf survey requires three vessels. The West Coast has been surveyed 8 times since 1977, the Aleutians have been surveyed 6 times since 1980, and the Gulf has been surveyed 5 times since 1984.

Both walleye pollock off Alaska and Pacific whiting are the dominate groundfish species in their respective areas off the West Coast. Foreign nations developed major fisheries on these stocks in the 1960s and 1970s. Prior to the Magnuson-Stevens Act of 1976, NMFS had no fishery data and little survey data to support international negotiations to regulate harvest levels. A major portion of these stocks occurs off bottom in the water column and is unavailable to sampling by bottom trawls. NMFS developed the echo-integration/mid-water trawl (EIT) survey method to assess pelagic fish aggregations. This acoustic assessment tool has been further refined by Norwegian researchers. EIT surveys follow a transect design using transect spacing of 5 to 20 nm to keep confidence intervals to within ±20%. Acoustic surveys were implemented in the mid-1970s to measure the mid-water component of the pollock and whiting stocks. These surveys are conducted on a triennial schedule to be synoptic with bottom trawl surveys. To cover the range of the stocks, the whiting survey requires a minimum of 60 DAS and the Bering Sea pollock survey utilizes about 70 DAS. The *Miller Freeman* has been used exclusively by NMFS fishery acoustic group since they upgraded to the EK-500 system with the transducers mounted on the ship's center board. When the U.S. fishing industry expanded into the winter spawning pollock fisheries in Shelikof Strait and around Bogoslof Island in the Bering Sea, NMFS established annual winter EIT surveys of 10 to 20 days in these areas respectively to track the biomass of these large dense spawning schools. The Bogoslof survey results are used by the Central Bering Sea Treaty to manage the international "donut hole" fishery over the Bering Sea basin. Use of the quiet FRV will result in an improvement in the accuracy of the acoustic survey results. The impact of vessel noise on avoidance behavior of fish can be significant, not only for pelagic species but also potentially shelf groundfish species. A multi-beam sonar system capability on the new FRV will be a valuable tool for assessing the bias resulting from fish avoidance of survey vessels and sampling gear, including bottom trawls.

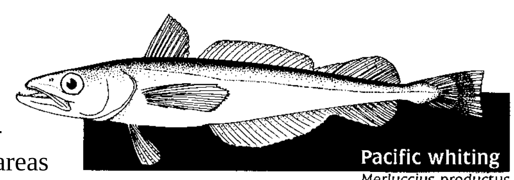
Longline surveys are conducted annually in the Gulf of Alaska and alternate biennially in the Aleutian region and eastern Bering Sea for indexing the abundance of the valuable sablefish resource inhabiting the upper continental slope down to 1000m depth. This survey was designed and initially conducted by the Japanese Fishery Agency. The survey uses the catch rate from standard longline gear to index the abundance of sablefish. The survey is now conducted by a domestic freezer longliner. The time series of the two vessel types were calibrated over a 6 year period to connect the two time series. The survey requires 96 vessel days. The data are critical to the annual stock assessment process and are also now relied upon to annually and regionally adjust individual fishing quotas (IFQs) throughout Alaskan EEZ on an annual basis.

...use of a quiet FRV will result in an improvement in the accuracy of acoustic survey results...

Teams responsible for preparation of annual stock assessment reports for the North Pacific Fishery Management Council have identified the need to expand or institute new groundfish surveys off Alaska to improve stock assessments. Currently the staffing, vessel time, and infrastructure do not exist to support these high priority survey needs. The list includes:

- Biennial rotation of summer acoustic survey for pollock in the eastern Bering Sea and the Gulf of Alaska (the Gulf survey would require 70 to 90 DAS but there are no previous surveys of the area to estimate DAS). This would replace the existing triennial summer acoustic survey effort.

- Extend the winter Bogoslof Island acoustic survey of spawning pollock to known spawning areas along the Aleutian chain (require about 20 DAS of a quiet FRV)



- Biennial rotation of a summer/fall bottom trawl survey of the upper continental slope of the eastern Bering Sea (30 DAS were required in 1991 when the last survey was conducted) and the Gulf of Alaska (based on the last survey in 1987 expect survey would require about 70 DAS to cover the fishing grounds with reasonable level of confidence).

- Increase the frequency of the current triennial summer bottom trawl surveys in the Gulf of Alaska and the Aleutian Islands to an alternating biennial cycle.

- Develop new methodologies to improve surveys for shelf and slope rockfishes that tend to form aggregations in non-trawlable areas in the Gulf of Alaska and the Aleutian Islands and for Atka mackerel which school in large, tight schools in Aleutian passes. Standard trawl survey estimates of biomass may have confidence interval as large as ±100%. Testing of new methodology will require about 30 DAS per year per species (group). It is anticipated that implementation of such surveys would require annual commitment of 40-60 DAS given the geographic distribution of the directed fisheries.

- Conduct seasonal groundfish sampling to estimate seasonal cross shelf distribution patterns and seasonal changes in food habits and key life history parameters of important fish stocks (4 - 8 day charter trawler). This information will be necessary to develop spatially explicit assessment models that address species interactions in the Gulf of Alaska, Bering Sea and Aleutian Islands.

The best survey platform for the expanded acoustic surveys is a dedicated quiet FRV equipped with the standard scientific acoustic system. The other surveys could be conducted from a chartered vessel from the commercial fleet if the proper steps are take to standardize and calibrate their sampling. Note that all these surveys, except for the winter Aleutian acoustic survey, would be conducted during the summer months and therefore requiring multiple vessels.

The second level of unmet assessment survey needs would be to increase the frequency of all the biennial surveys sets to an annual schedule in the eastern Bering Sea, Gulf of Alaska, and Aleutian Islands.

The current dedicated ship survey effort for marine mammals is focused on relationships of the Steller sea lions in the Gulf of Alaska and Aleutian Islands to their associated forage fish stocks (60 DAS). Significant increases in the research effort are needed to assess the potential fishery impacts on the foraging success of Steller sea lions and sea birds in the Gulf of Alaska and Aleutian Islands. A large fraction of the Gulf of Alaska pollock fishery and the Aleutian Island Atka mackerel fishery take place within designated critical habitat for Steller sea lions. The research will provide information to develop commercial fishing practices that minimize the potential impacts on the availability of key forage fish. The priority for sea lion research has greatly increased with the continued decline of sea lion stocks and with the recent listing of the western U.S. stock as endangered. Furthermore, NGOs recently filed a lawsuit against NMFS for inadequate consideration of Steller sea lion critical habitat when the 1998 fishing quotas were set for the Bering Sea/ Aleutian Island groundfish fisheries. In the coming months, the NPFMC and NMFS will reconsider the management regime for the Atka mackerel fishery in the Aleutian Island and the pollock fisheries in the Gulf and southeast Bering Sea. If fishing is further restricted by season change, reduced quotas, and/or enlarged buffer zones, then NMFS will likely be required to conduct research on an annual basis to determine the efficacy of their management actions. An additional 40 DAS of *Cobb* time is currently used annually to monitor various species of whales and seals in the near shore area of eastern Gulf of Alaska Other marine mammal assessments are periodically conducted from chartered aircraft when aerial survey methods are appropriate.

The following projects for monitoring marine mammal populations have been identified as unfunded priority research areas that will require research vessel time (the first item has an urgent priority currently not fully met):

- Winter, spring, and summer surveys of Steller sea lion critical habitats in the Aleutian Island, southeastern Bering Sea and the Gulf of Alaska to assess sea lion population abundance and seasonal availability of prey species in the critical habitat, and to map movements and diving of sea lions relative to their critical habitat and distribution of available prey. Given the size of the 2 or 3 largest habitats and the need for fine scale sampling, scientists have not reached a conclusion on sample size requirements for each survey site per season. This research will likely require a quiet FRV to monitor the prey species and oceanography throughout the critical habitat which can launch a small vessel to take scientist ashore to assess and tag sea lions. The total annual sea day requirement is estimated to be about 180 (30 DAS in two habitats for 3 seasons per year for a 5 year period, this adds 120 DAS to the 60 DAS currently chartered).

Second level priority survey needs that should be undertaken in the near future are:

- Assessment surveys to document the recovery of the large whales (humpback, right, fin, and sperm whales) in the north Pacific Ocean to estimate their abundance to improve estimates of potential biological removals (PBR). Because these whales are deep diving animals, surveys require vessels. Aircraft are not appropriate observation platforms. The amount of ship time will be determined based on the accepted ±30% confidence interval which requires 40-80 sitings per species per survey. The survey design can potentially be optimized by using the Sound Surveillance System (SOSUS) or Integrated Underwater Surveillance System (IUSS) military system to identify and locate of potential whale stocks. The best vessel to conduct this research would be a quiet FRV with the full suite of biological and oceanography sampling tools. Given the potential size of the geographic areas, the survey is expected to require a minimum of 40 DAS per year. Annual surveys would be rotated among possible target areas and species.

- Assessment surveys of the various species of ice seals in the Bering Sea will require about 30 DAS per year during the spring recession of the sea ice to transit the offshore ice edge, assess prey species, and determine feeding habitats of the animals. The ideal vessel would be a quiet FRV that could conduct fish surveys and monitor the oceanography while counting ice seals. The frequency of the survey would be once every 3 to 5 years.

Recruitment Research

The NOAA multi-agency Fisheries-Oceanography Coordinated Investigations (FOCI) program was developed in the mid-1980s to determine the biotic and physical processes in the ocean that impact survival of the early life stages of walleye pollock. The goal of the program is to develop a model to forecast the future recruitment or year class strength of age 0 fish. Recruitment in pollock is highly variable from year to year, most year classes are very small but periodically a year class will be extremely large which will dominate the population and support the fishery for many years. The FOCI program initially focused on the spawning pollock aggregation in Shelikof Strait and has expanded to spawning areas located in the southeast Bering Sea with funding from NOAA's Coastal Ocean Program. The ultimate goal is to identify a subset of key bio/physical processes that influence pollock survival which can be monitored on a regular basis to drive the recruitment forecasting model. FOCI research conducts a full range of fishery and oceanographic sampling throughout the late winter and early spring periods on an annual basis, alternating experimental emphasis between the Bering Sea and Shelikof Straits. The FOCI Program in total utilizes about 85 DAS of *Freeman* time. About 25 of these days are for Shelikof Strait, 18 are shared to deploy and retrieve of oceanographic moorings in the Gulf and southeast Bering Sea, and 42 for Southeast Bering Sea Carrying Capacity project. The program also shares time aboard chartered UNOLS vessels and cooperating foreign research vessels (generally Japanese research ships). The expansion of the program into the Bering Sea is now using about 25 sea days of time previously used by Shelikof recruitment process studies in the past. This research would be reestablished if time aboard an FRV or UNOLS charter became available:

- Gulf FOCI experimental research on recruitment processes during the critical April/May larval period, 30 DAS on FRV or charted UNOLS vessel

Ecosystem Research

The scientific community is rapidly moving to an ecosystem approach to carry out our stewardship responsibilities for managing living marine resources of the north Pacific Ocean and the Bering Sea. This move is being driven by concerns associated with global warming and decadal scale climate regime shifts. These processes may contribute to major fluctuations in composition of dominate fish species in the ecosystems, and unexplained declines in marine mammals and sea birds which, as top predators, depend on the carrying capacity of the ecosystem to support their populations at healthy levels. The FOCI program has expanded their research emphasis to determine the role of juvenile pollock in the Bering Sea ecosystem. Juvenile pollock are considered to be a nodal species within the Bering Sea. The FOCI ecosystem research currently uses about 20 *Freeman* DAS and shares about 30 more with their Recruitment investigations. In addition, OAR charters about 30 DAS of UNOLS vessel time and Japanese researchers provide about 50 DAS of vessel time equivalent to a FRV.

At the current time, the program has a priority need for about 30 additional sea days aboard an FRV during August to examine the ecological role of younger stages of juvenile pollock. The duration and timing of this research is determined by the timing of pollock life cycle and not sample size requirements.

There are a number of new research programs on the horizon that will support research on the Alaska ecosystems to improve our understanding of the relationships and dynamics of the fishery and marine mammal and sea bird resources. GLOBEC has recently established the North Pacific Climate Change and Carrying Capacity Program for the Gulf of Alaska which will investigate the dynamics of the oceans productivity and its potential to limit salmon production in the North Pacific. This program is closely aligned with the NMFS Ocean Carrying Capacity (OCC) project to map the marine distribution and abundance of juvenile salmon stocks in the Gulf of Alaska and measure their marine survival in relation to ocean productivity and physical oceanography. The NMFS OCC program currently charters 60 DAS using a commercial trawler to conduct near surface trawling to map fish distribution, therefore the need for a quiet trawler. This research would best be conducted from a quiet FRV to reduce fish capture avoidance and provide the collection of full suite of biological and physical oceanographic parameters. Another area of research supported by these new funds include the ecology of the sea floor habitat as part of the new emphasis to define essential fish habitat. Many of the coast areas off Alaska are uncharted and the sea floor habitats are unknown. It would be very valuable to equip future FRV with multi-beam sonar to characterize sea floor. This would also benefit the determination of essential fish habitat and improve the accuracy of fish monitoring surveys. The current vessel (quiet FRV) needs of the NMFS OCC salmon research are:

...modern FRVs with full fishery and oceanographic capabilities will be in high demand and access to them will be highly competitive...

- Four surveys (fall, winter, spring, summer) for 30 day each to measure marine abundance and distribution of juvenile salmon in the Gulf of Alaska. The duration of these surveys is driven primarily by the need for synoptic coverage of a large area and not the precision of the abundance estimates. The ideal vessel is a quiet FRV.

Other future research programs that will target ecosystem research in the near future are likely to be the North Pacific Research Board (Dinkum Sands) and an Alaska research foundation using funding from the *Exxon Valdez* ocean spill settlement. If the two funding sources become a reality, the North Pacific science community will significantly increase research in the marine ecosystems off Alaska. Modern research vessels with full fishery/oceanography capability will be in high demand and access to them will be extremely competitive.

Bycatch, Essential Fish Habitat, and Seafloor Impacts

With the recent passage of the SFA, the need to reduce bycatch of non-target species in the Alaska commercial fisheries and to determine the impact of fishing operations on the seafloor habitat has become a much higher research priority. Currently bycatch research is annually utilizing about 6 to 20 DAS on commercial charter vessels. Ship use will likely stay at this level, but it is anticipated that the fishing industry will increase the utilization of Exempted Fishing Permits to develop and test new bycatch saving devices under commercial fishing conditions. This research is expected to be conducted in cooperation with state, federal, and academic researchers. The SFA also requires the identification and description of Essential Fish Habitat (EFH) and the minimization of adverse fishing impacts on EFH. Currently in Alaska, NMFS scientists are in the early phase of investigating the seafloor impact by fishing gear. The initial work is focused on developing research tools and techniques for observing seafloor changes and monitoring recovery over time. NMFS scientists are also in the early phases of research to identify EFH for the life stages of many species for which the level of information in Alaska is well below the prescribed NMFS guideline for describing EFH. This habitat research is currently using about 43 vessel days on chartered commercial fishing vessels (25) and on the *Cobb* (18). This research is new and could be expanded into a major research program in Alaska if the developmental research is successful and increased funding and staffing become a reality. The future anticipated vessel needs are:

- Expanded research on seafloor impacts by commercial fishing could reasonably use an additional 40 DAS aboard a chartered fishing vessel.

- Hydrographic survey to detail bathymetry and seafloor habitat typing of the Alaska EEZ shelf and upper slope, 25 DAS/yr.

Pacific Oceania Regional Summary

The Southwest Fisheries Science Center is responsible for providing scientific information and advice 1) for management of domestic fisheries in the U.S. EEZ in the central and western Pacific, 2) for support of U.S. interests in international management of Pacific highly migratory species, and 3) for the recovery and management of the endangered Hawaiian monk seal and protected Pacific sea turtles. Research to address each of these responsibilities requires the acquisition of data using a suite methods, with emphasis on research vessels.

The vast geographic extent of the oceanic area that comprises the central and western Pacific region offers a unique set of challenges that must be overcome in order for the Southwest region to meet its stewardship responsibilities. The EEZ associated with Hawaii and the U.S.-affiliated islands totals approximately 1.7 million square nautical miles, which is equivalent to the total EEZ encompassing the entire continental U.S. plus Alaska. In addition, the U.S. participates or has interest in international fisheries on Pacific highly migratory species that operate throughout an estimated 15 million square nautical miles of this huge region.

Economic Importance

Fisheries are important and generally healthy throughout the central and western Pacific region. Three of the top ten U.S. ports, based on ex-vessel value and including foreign landings, are located in the region: Pago Pago, American Samoa (1), Agana, Guam (4), and Honolulu, Hawaii (7); the standing for each of these ports among the top 10 U.S. ports is shown in parenthesis. Fisheries have significant economic as well as cultural values throughout the Pacific island region. The largest U.S. tuna cannery operation is located in Pago Pago, the most important U.S. transhipment center for high-value sashimi is in Agana, and the longline fishery for swordfish and tuna along with its support structure, which are based primarily in Honolulu, are notably important in the economy of Hawaii.

Fisheries Management Plans for Domestic Fisheries

NOAA Fisheries conducts biological and ecological research in support of four Fishery Management Plans (FMPs) which the Western Pacific Regional Fishery Management Council (WPRFMC) has in place for the management of domestic fisheries operating in the central and western Pacific. The FMPs are 1) Western Pacific Pelagics Plan, which includes swordfish, marlins, tunas, sharks and a number of other pelagic species; 2) Western Pacific Crustaceans Plan, which includes primarily spiny and slipper lobsters in the Northwest Hawaiian Islands and spiny lobster in the Mariana archipelago; 3) Western Pacific Bottomfish Plan, which includes mostly snappers and related species in the region, as well as Hancock Seamount armorhead resources; and 4) Precious Corals Plan (Federal approval has been given and State of Hawaii approval is pending to reinstate harvesting of precious corals in the main and Northwest Hawaiian Islands.)

The TOWNSEND CROMWELL operates out of Honolulu, Hawaii.

International Management of Pacific Highly Migratory Species

NOAA Fisheries has increasing responsibilities for providing scientific advice in support of U.S. interests in international management of Pacific highly migratory species. The establishment of regional international management of highly migratory species in the Pacific is a priority goal for the U.S. Department of State. NOAA Fisheries is providing substantial leadership to attain that goal and to establish international bodies for management of highly migratory resources in the central and western Pacific (similar arrangements are underway for a third management body in the eastern tropical Pacific). Considerable progress has resulted from High Level Multi-Lateral meetings, including the U.S., to establish international management of highly migratory species in the western South Pacific. The U.S. also has signed an agreement with Japan, that has been opened to other Pacific-Rim countries, which established the Interim-Scientific Committee for the Management of Tuna and Tuna-Like Species in the North Pacific (ISC). The U.S. also has several treaties, including the South Pacific Tuna Treaty, that involve fishery resources in the central and western Pacific. A significant expansion in research vessel needs is anticipated in order to meet NOAA Fisheries responsibilities associated with the international management of Pacific highly migratory species as well as to take advantage of opportunities for international cooperative research. For example, several countries (including Japan, Taiwan, and Australia) have already informally expressed interest in conducting cooperative research with NOAA Fisheries using multi-national research vessels to conduct investigations on highly migratory species biology, ecology, stock assessment, and bycatch issues.

...FRVs are needed for international management of Pacific highly migratory species...

Recovery of and Fisheries Interactions with Protected Species

The Hawaiian monk seal is the most highly endangered marine mammal that is found exclusively in U.S. waters. Hawaiian monk seal research and recovery efforts require major research vessel usage, amounting to 100 research vessel days in FY 1998 to conduct population monitoring and assessment, pelagic foraging ecology research, and habitat restoration actions. Research related to the recovery of Pacific sea turtles has required limited and sporadic research vessel time in the past. However, it is anticipated that up to 45 days a year, probably piggy-backed on other research operations, may be required for sea turtle research as the result of the recent implementation of the Pacific Sea Turtle Recovery Plan. New research to address mitigation of seabird mortality caused by longline fishing will require an estimated 30 sea days per year beginning in 1998 and extending for a minimum of three years.

Need for Quiet FRV

A “quiet” fisheries research vessel is required primarily for using hydroacoustic methods for 1) obtaining fisheries independent assessments of tunas and other pelagic species, 2) conducting assessments of prey species in ecosystem research involving Pacific highly migratory species and the Hawaiian monk seal, and 3) conducting assessments of seamount armorhead resources. In addition, a “quiet” fisheries research vessel is needed for research related to the mitigation of longline fishery interactions with Pacific sea turtles. Recent studies conducted by the Japanese, and reported at the 49th Tuna Conference held during May 18-21, 1998 have shown that “ship noise” dramatically affected the accuracy of hydroacoustic methods for assessing southern bluefin tuna in waters off western Australia. Japanese investigators concluded that a “quiet” ship will be required to make fisheries independent assessments of tunas using hydroacoustic methods. Collaborative research with the Japanese on highly migratory species will require the use of a quiet FRV to ensure data comparability.

Use of Charter Vessels

Charter vessels may be suitable to meet part of the vessel needs in the central and western Pacific, e.g., pot fishing for lobster assessment and some activities related to Hawaiian monk seal monitoring and assessment. However, efforts to charter vessels in Hawaii have not been successful due to lack of suitable vessels. The latter is a serious problem throughout the central and western Pacific. For example, in 1995 when the NOAA R/V *Townsend Cromwell* was in the shipyard for repair and upgrading, no bids were received from Hawaii in response to a Request For Proposal (RFP) to charter a vessel to support monk seal monitoring and population assessment studies. Instead, bids were received only from the mainland and it was necessary to add 30 days to the charter for round-trip transit time (15 days each way) between southern California and Hawaii. This added considerable costs to the charter. Other attempts to charter vessels in Hawaii have also failed either due to no response or the lack of qualified vessels. In the late 1980’s, the NOAA Pacific Marine Environmental Laboratory (PMEL) chartered a vessel in Hawaii to install equipment for physical oceanography studies. The vessel mysteriously disappeared at sea and all lives aboard were lost, including several NOAA and cooperating scientists. After the vessel was lost, vessel safety standards were called into question.

Use of University and Other Vessels

At sea fisheries research will be conducted using University of Hawaii/Hawaii Underseas Research Laboratory (HURL) vessels, funded by the NOAA /HURL program and granted to the NMFS through a peer-reviewed competitive process. The vessels will include a submersible, ROV, and tender/research vessel. They will be used to conduct operations 1) to evaluate bottomfish assessment methods in refugia and 2) to evaluate potential precious coral harvesting interactions with Hawaiian monks seals and seal habitat. Informal discussions indicate that proposals for both research topics have been well-received and that the bottomfish assessment methods cruise will operate this fiscal year for and that the precious coral/monk seal habitat cruise will be approved, but may delayed until FY 1999. Each operation is for 15 days.

Use of Satellite Remote Sensing

Satellite remote sensing (e.g., SST, ocean color, and altimetry) is extensively used to monitor ocean features, processes, and general conditions important in fisheries and protected species research in the central and western Pacific. It is also widely used to assist in the design of research cruise sampling, to guide research vessel operations (near-real time digital imagery is transmitted to the research vessel during research operations at sea), and to interpolate and extrapolate in situ observations made from research vessels and buoys. Classified assets remote sensing is also being used in Hawaiian monk seal research. While there is wide use of satellite remote sensing in the central and western Pacific, it must be stressed that in spite of its many strengths and applications, satellite remote sensing cannot replace the need for research vessels.

Research Cruises

For FY 1998 and for the past several years, 243 sea days have been allocated for field research operations in the central Pacific on the NOAA *R/V Townsend Cromwell*. Research cruises on the Cromwell are conducted to obtain information required to support each of the FMPs, except Western Pacific Precious Corals, as well as to conduct research related to the recovery of Hawaiian monk seals. In addition, 30 sea days of ship time aboard UH/HURL research vessels is anticipated in FY 1998, as noted in section above on university and other vessels. In the current fiscal year the number of research vessel sea days directed to fisheries related investigations is 173 and to the recovery of the Hawaiian monk seal is 100.

Resource Monitoring and Assessment

Resource monitoring and assessment cruises are conducted 1) to obtain information on the abundance of spiny and slipper lobsters in the Northwest Hawaiian Islands (NWHI); main Hawaiian island bottomfish, and Hawaiian monk seals and 2) to obtain biological information in support of stock assessments of swordfish, bigeye tuna, blue shark, and other pelagic species. The number of sea days directed to resource monitoring and assessment is 148.

Ecosystem and Habitat Investigations

Ecosystem and habitat investigations provide data required to develop understanding of the ecology 1) of pelagic resources, with emphasis on swordfish, in the oceanic frontal ecosystems and 2) of lobsters and Hawaiian monk seals in the Hawaiian insular ecosystem. The number of sea days spent on ecosystem and habitat investigations is 95.

Recruitment

Recruitment research on lobsters in the NWHI is investigated as piggy-back operations on lobster assessment cruises.

Bycatch and Gear Impacts

Bycatch and gear impacts research is conducted by NMFS observers during commercial fishing operations aboard Hawaii-based pelagic longline vessels. This work includes observations on fishing interactions with sea turtles, seabirds and marine mammals. Observers also place satellite transponders on sea turtles that are caught inadvertently in longline fishing operations and released to study post-hooking survival. Research on bycatch and gear impacts is also piggy-backed on lobster and pelagic resources assessment research cruises.

Unmet Needs for Research At Sea

There are substantial unmet needs for ship time to conduct research to support FMPs and WPRMC needs; to meet expanding NOAA responsibilities related to international management of Pacific highly migratory species; to meet SFA requirements including definition of EFH and reduction of bycatch; and protected species needs including, mitigation of seabird mortality caused by the Hawaii-based longline fishery and recovery of the Hawaiian monks seal and protected Pacific sea turtles. Specific needs include:

Monitoring and Assessment

International management of Pacific highly migratory species. 90 days/year, Quiet FRV. Research required to meet international commitments for population assessment of tunas and billfish; future work will use hydroacoustics for fisheries independent population assessment of tunas; unique opportunities for international cooperative research.

Hancock Seamount armorhead assessment. 30 days/biannually. Quiet FRV. Hydroacoustic assessment of armorhead resource. Resource included in WPRFMC Bottomfish FMP; presently moratorium of fishing; population assessment required using modern hydroacoutics.

Seabird mitigation: 30 days/year, charter RV. High priority issue with Southwest Regional Administrator because of seabird mortality caused by Hawaii longline fishery which has the potential to severely limit fishery; substantial pressure from conservation groups to take mitigation actions.

Blue shark population biology and assessment: 45 days/year, charter RV. High priority issue with Southwest Regional Administrator due to shark finning and related issues; unique opportunity to do cooperative research with Japanese.

NWHI lobster assessment and recruitment. 30 days/year, Charter FV. Needed to expand information for determining NWHI lobster fishery annual quota. WPRFMC taking action to change quota from NWHI archipelago-wide to bank specific to prevent overfishing on certain banks.

Bottomfish assessment in Guam and northern Mariana islands. 90 days/year, Charter FV. Last assessments of bottomfish for these areas completed in mid-1980’s. Considerable political pressure to complete assessments due to concerns of overfishing in specific locations.

Ecosystem and Habitat Investigations (including EFH)

Oceanic ecosystems. 60 days/year, Quiet FRV. Research in support of international management of Pacific HMS. Future research will use hydoacoustics for assessing prey species. Management of Pacific HMS high priority issue with Southwest Regional Administrator and Department of State.

Hawaiian monk seal pelagic ecology. 60 days/year, 50% Quiet FRV, 50% Charter RV. Information vital to recovery actions and to evaluate potential fishery interactions. Quiet FRV required for using hydroacoustics to measure prey fields and related research. High priority issue with Marine Mammal Commission and NMFS.

Clients for information

The main clients for scientific advice produced by NOAA Fisheries, including information based on data and experiments conducted from research vessels, include: 1) WPRFMC, NMFS/SWR, and Department of State for management of central and western Pacific fishery resources, and 2) NMFS/FPR and the Marine Mammal Commission for recovery and management of the Hawaiian monk seal, and 3) NMFS/FPR and SWR, and international sea turtle conservation organizations, e.g., South Pacific Environment Program (SPREP) the recovery and management of protected Pacific sea turtles.

SOUTHERN OCEAN REGIONAL SUMMARY

The Southern Ocean (LME) includes the marine area south of the Antarctic Convergence, the boundary between the cold Antarctic waters and warmer sub-Antarctic waters. The area is managed by member nations of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). The Convention applies to the populations of finfish, mollusks, crustaceans, and all other species of living organisms, including birds, found south of the Antarctic Convergence.

The U.S. Antarctic Marine Living Resources (AMLR) Program is a national program providing information needed for the development and support of U.S. policy regarding the conservation and management of the marine living resources in the ocean areas surrounding Antarctica. The Program is managed by the NMFS Southwest Region. It supports U.S. participation in both the Commission and Scientific Committee of CCAMLR, and is directed towards achieving the conservation objectives of the Convention. The Program emphasizes directed research to manage the Antarctic marine living resources from an ecosystem perspective.

The conservation standard of the Convention (Article II) requires that Antarctic marine living resources be managed from an ecosystem perspective. This is an unique goal for international conservation agreements, offering challenges and opportunities for the countries involved in the Convention and for the U.S. AMLR Program. According to the Convention, any harvesting and associated activities must be conducted so as to:

- prevent any harvested populations from falling below the level that ensures the greatest net annual increment;
- maintain the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources;
- restore depleted populations; and
- prevent or minimize the risk of changes in the marine ecosystem that are not potentially reversible over two to three decades.

Members of the Convention are: Argentina, Australia, Belgium, Brazil, Chile, France, Germany, India, Italy, Japan, New Zealand, Norway, Poland, Republic of Korea, Russia, South Africa, Spain, Sweden, Ukraine, United Kingdom, United States, Uruguay, and the European Economic Community. Bulgaria, Canada, Finland, Greece, Netherlands, and Peru are acceding states and most send observers to the Commission's meetings.

The functions of the Commission are to:

- facilitate study of Antarctic marine living resources and the ecosystem of which they are a part;
- compile data on the status of and changes in the distribution, abundance and productivity of harvested and dependent or related species and populations of Antarctic marine living resources;
- ensure the acquisition of catch and effort statistics; and
- formulate, adopt, and revise conservation measures on the basis of the best scientific information available.

The Commission has met 16 times starting in 1982. The Commission has produced conservation (management) measures for depleted stocks of finfish, including regulations defining mesh sizes and prohibiting all directed fisheries for several demersal species in the waters of South Georgia, the South Orkneys, the Antarctic Peninsula, and Kerguelan Islands; set Total Allowable Catch (TAC) limits for several finfish, crab and krill species; designed a program of data gathering; agreed to and implemented a system of observation and inspection; agreed to measures for developing a new Antarctic crab fishery; and agreed to measures to help member countries deal with the occurrence of widespread illegal and non-reported fishing.

The Antarctic Marine Living Resources Convention Act of 1984 (P.L. 98-623) was signed into law on November 8, 1984, implementing the Convention for the United States. Congress found that a directed research program, as well as a basic research program concerning the marine living resources of Antarctica, is essential to achieve U.S. objectives under the Convention. The Secretary of Commerce, in consultation with the heads of appropriate Federal agencies, is required to design and conduct the U.S. program of directed scientific research.

During the last ten years, the U.S. AMLR Program supported the Commission's and Scientific Committee's need for information, both through analysis of commercial fisheries data and through directed ecological research on selected key species groups in the Antarctic marine ecosystem. For resources presently being harvested such as krill, crabs and finfish, the AMLR Program has focused on evaluation and validation of fisheries catch data and related biological data. Directed research on prey species has been conducted annually in integrated study areas to detect and interpret trends in various predator parameters being evaluated. The monitoring system is designed to distinguish between changes in key components due to harvesting of commercial species and changes due to environmental variability, both physical and biological. Results and recommendations are presented each year by the U.S. AMLR Program to the Scientific Committee's Working Groups on Fish Stock Assessment (WG-FSA) and Ecosystem Monitoring and Management (WG-EMM).

During FY 1998, the Program addressed several research and logistic issues. It investigated predator/prey interactions, collected predator standard methods data at Cape Shirreff and NSF's Palmer Station, conducted a commercial-sized bottom trawl survey for finfish species along the peninsula, completed construction of the field camp at Cape Shirreff, disassembled and retrograded two structures on Seal Island, transferred equipment and supplies to Cape Shirreff, and provided logistical support for the NSF summer camp at Copacabana (Admiralty Bay, King George Island). Details of the AMLR field research program are published annually in a series of field season reports available from the Southwest Fisheries Science Center while scientific results are published in peer reviewed journals. Data and preliminary reports are also provided to the CCAMLR Scientific Committee and its working groups.

Specific objectives completed during FY 1998 were to:

a. Complete a large-area survey during Leg I to map meso-scale (10's to 100's of kilometers) features of water mass structure, phytoplankton biomass and productivity, and zooplankton constituents (including krill) in the areas from Elephant Island along the Antarctic Peninsula to Livingston Island.

b. Calibrate acoustic hull-mounted transducers before large-area survey on Leg I and at end of field season.

c. Collect continuous measurements of ship's position, sea surface temperature, salinity, turbidity, chl-a, fluorescence, air temperature, barometric pressure, relative humidity, wind speed and direction, and solar irradiance (ultraviolet, visible, infrared).

d. Conduct predator (seal and seabird) research at Cape Shirreff and Palmer Station field sites.

e. Conduct bottom trawls for finfish at selected sites in the area around the South Shetland Islands to determine abundance and distribution of several protected fish species.

f. Complete construction of the field camp at Cape Shirreff, Livingston Island.

g. Disassemble and retrograde storage building and bird observation blind on Seal Island.

Ship Requirements

The AMLR Program requires Antarctic field work to meet its mandated objectives. Much of the directed research data requested by the Scientific Committee involves the collection of synoptic (within season) data from diverse projects, e.g., land-based, open water, and pack ice studies on prey, predators, and environmental conditions. The AMLR Program must have support of a dedicated vessel throughout the austral summer and possibly other seasons as appropriate.

The dedicated vessel must have the capability to accommodate a combination of trawl, acoustic, plankton, and fixed gear. Prey (krill) biomass surveys are conducted annually using hull-mounted transducers. This requires use of a quiet ship capable of operating 24-hours a day for up to 30 days in waters containing numerous icebergs while carrying a scientific party of 25 people. The ship also must be able to deploy several oceanographic and net sampling systems. The Program also conducts bottom trawls of finfish in areas characterized by rough bottom terrain, ice bergs and heavy seas. Finally, the ship must be capable of supporting small boat operations. The Program operates remote land based camps which require extensive logistical resupply and retrograde of materials. In addition, the Program conducts surveys of pinnipeds at frequent intervals which requires a ship to operate in areas of heavy ice including pack ice.

During the last three years, the Program has used a chartered research vessel. Prior to that it used a NOAA vessel. See Appendix D for required number of DAS.

Appendix C

At-Sea Mission Requirements

This table presents NOAA Fisheries' at-sea mission requirements (actual and planned) as identified by the Data Acquisition Workshop. Major field surveys are enumerated by program heading, allocation of ship-time (Days-At Sea), seasonal timing, geographic focus, survey frequency, ship-type, and survey objective. The survey objective codes are: E=Ecosystem; R=Recruitment; M=Monitoring. For each ecosystem, annual subtotals of DAS are aggregated by supporting vessel-type. In some instances, surveys are conducted less than annually and their DAS are not directly additive to an annual sum. To avoid double-counting, subtotals and totals were reduced by one-half of DAS for affected biennial surveys, one-third of DAS for affected triennial surveys, etc. These special cases are noted by parentheses enclosing the days-at-sea requirement.

The relationship between assessment precision (and accuracy) as a function of survey duration and frequency of sampling effort is discussed in the main body of the report (pages 16-20). There is direct correspondence from consideration of statistics and stock assessment theory to proper specifications of sampling effort, ship-based capability, and days-at-sea. This correspondence relies heavily on a conceptual calculus that is based as much on prior knowledge and experience (and additionally, the expertise and execution by the field party), as on the scientific theory underpinning the survey design. To this end, Appendix C classifies the broad-scale considerations behind each project and establishes the supporting vessel-type and DAS requirement. Rather than elaborating project-by-project, logical groupings illustrate generic attributes based on sampling methodology, spatial and temporal considerations, life history characteristics of the target organism(s), and anticipated field and weather considerations.

Despite that all survey methods share common elements of statistical design, their inherent technological differences lead to a certain degree of specialization. Direct surveys elucidate patterns of population abundance, age composition, and distribution for a fishery resource by simple extrapolation of the number (or weight) of animals observed-per-unit-area, using a given sampling gear, to the entire survey area.

In practice, the subject area is circumscribed and subdivided (stratified) into sampling quadrants or grid squares based on considerations of geography, depth, salinity, temperature, etc., that may impact gradients in animal density. The systematic selection of grid squares to occupy can ensure more adequate dispersion of sampling stations that also minimizes bias and reduces variability. The logistics involved in sampling along equally spaced tracklines or grid coordinates often result in considerable savings in running time; thus maximizing the economic and information return on survey costs. Table items are cross-referenced to general survey attributes, and helps qualify the projected DAS requirement.

The three survey types are:

(1) Systematic grid-based surveys: Targeted stations are designated at centers or corners of grid square coordinates. Survey methods include trawl, longline, purse seine, gillnet, trap or pot gear fished at pre-assigned Lat./Long. coordinates over standard sampling periods (e.g., minutes, hours, days, weeks).

(2) Systematic trackline (line-transect) surveys: Observations are conducted in a linear fashion across rows or columns in the grid field. Surveys include acoustic (echo-integration) systems and sighting surveys (visual counts) while continuously underway for extended time periods (e.g., daylight hours, 24 hr operation, days, weeks).

(3) Special project and process surveys: These include ichthyoplankton (egg and larval) samplers; tagging; physical, chemical and biological oceanography; bottom-typing; diver, manned-submersible and ROV observations at grid coordinates, along tracklines, or synoptic with transient or recurring biophysical phenomena (i.e., hours, days, weeks, months). In this category, survey vessels also provide essential transportation and logistical support for remotely-based field parties on a seasonal or year-round basis.

The contributing factors of overall survey expanse, transit times, day/night operations versus 24-hour capability, mechanical failure and repair, and weather states impacting vessel operations are implicit in every DAS specification.

	Program/Cruise Name	DAS	Season	Area	Frequency	Ship Type	Objective/Type
1.0	**Northwest Atlantic Ecosystem**						
1.1	Bottom Trawl Survey	48	Aut	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M/R/E;1
1.2	Bottom Trawl Survey	48		Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M/R/E;1
1.3	Bottom Trawl Survey	24	Wtr	Cape Hatteras - Georges Bank	Annual	Quiet FRV	M/R/E;1
1.4	Trawl Survey/Tech. Development	24	Wtr/Aut	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M;3
1.5	Fishery Biology Studies	24	Spr/Aut	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M/R/E;3
1.6	Large Cetacean Biology	30	Wtr/Sum	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M/E;2/3
1.7	Small Cetacean Biology	45	Wtr/ Sum	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	M/E;2/3
1.8	Small Pelagics Acoustic Surveys	24	Wtr	Cape Hatteras - Georges Bank	Annual	Quiet FRV	M/R/E;2
1.9	Atlantic Herring Acoustic Survey	24	Aut	Georges Bank - Gulf of Maine	Annual	Quiet FRV	M/R/E;2
1.10	Essential Fish Habitat	24	Spr/Aut	Cape Hatteras - Nova Scotia	Annual	Quiet FRV	E;3
1.11	Mgt. Related/ Multinational Surveys	24	Wtr/Aut	Mid-Atlantic Ridge/Cape Hatteras	Annual	Quiet FRV	M/R/E;1
1.12	Harbor Porpoise Distribution	75	Spr/Wtr	Cape Hatteras - Gulf of Maine	2yrs-on/2yrs-off	Quiet FRV	M/E;2
	Quiet FRV Subtotal	414					
1.13	Northern Right Whale	30	Spr/Sum	Georges Bank - Nova Scotia	Annual	Quiet RV	M/E;2
1.14	Harbor Porpoise Abundance	60	Sum	Cape Hatteras - Nova Scotia	Trienniel	Quiet RV	M/E;2
1.15	Porpoise/Small Cetacean Surveys	(60)	Sum	Mid-Atlantic/Gulf of Maine	Trienniel	Quiet RV	M/E;2
1.16	Marine Turtle Survey	(60)	Sum	Cape Hatteras - Nova Scotia	Trienniel	Quiet RV	M/E;2
	Quiet RV Subtotal	90					
1.17	Sea Scallop Survey	28	Sum	Georges Bank - North Carolina	Annual	Oceanog. RV	M/R/E;1
1.18	Fisheries Oceanog. Process Studies	60	Spr/Sum	Cape Hatteras - Nova Scotia	Annual	Oceanog. RV	R/E;3
	Oceanographic RV Subtotal	88					
1.19	Surf Clam/Ocean Quahog Survey	(36)	Sum	Cape Hatteras - Georges Bank	Bienniel	Charter RV	M/R/E;1
1.20	Apex Predator survey	49	Spr	Florida - Georges Bank	Bienniel	Charter RV	M/E;3
1.21	Apex Predator Biology	19	Sum	Cape Hatteras - Nova Scotia	Annual	Charter Longl.	M;3
1.22	Ecosystem Monitoring	66	Seasonal	Cape Hatteras - Nova Scotia	Annual	Charter	E/R;3
	Charter Subtotal	134					
	Northwest Atlantic Total	726					
2.0	**Gulf of Mexico/Caribbean Ecosystem**						
2.1	SEAMAP Groundfish Survey	43	Aut	Gulf of Mexico	Annual	Quiet FRV	M;1
2.2	SEAMAP Groundfish Survey	37	Sum	Gulf of Mexico	Annual	Quiet FRV	M;1
2.3	Small Pelagic Acoustics Survey	48	Aut	Gulf of Mexico	Annual	Quiet FRV	M;2
2.4	SEAMAP Reef Fish Survey	57	Sum	Gulf of Mexico	Annual	Quiet FRV	M;3
2.5	Deep Water Reef Fish Survey	30	Spr	Gulf of Mexico	Annual	Quiet FRV	M;1
2.6	OCULINA/Gag Grouper Survey	16	Spr	Gulf of Mexico	Annual	Quiet FRV	M;1
2.7	Shark Longline	31	Sum	Gulf of Mexico	Annual	Quiet FRV	M;3
2.8	SEAMAP Ichthyo./Mar. Mammals	46	Spr	Gulf of Mexico	Annual	Quiet FRV	M;2
2.9	SEAMAP Ichthyo./Mar. Mammals	28	Aut	Gulf of Mexico	Annual	Quiet FRV	M;2
2.10	Marine Mammal Surveys	(60)	Sum	Gulf of Mexico	Trienniel	Quiet FRV	M;2
2.11	Marine Mammal Surveys	(60)	Sum	Caribbean	Trienniel	Quiet FRV	M;2
	Quiet FRV Subtotal	336					
2.12	Cold Core Ring /MESHS	15	Spr	Gulf of Mexico	Annual	Oceanog. RV	R;3
	Oceanographic RV Subtotal	15					
2.13	SEAMAP Conch Survey	40	Sum	Caribbean	Trienniel	Charter St. RV	M;1
2.14	SEAMAP Lobster Survey	(40)	Sum	Caribbean	Trienniel	Charter St. RV	M;1
2.15	SEAMAP Reef Fish Survey	(40)	Sum	Caribbean	Trienniel	Charter St. RV	M;1
	Charter State RV Subtotal	40					
2.16	Red Drum Survey	55	Sum	Gulf of Mexico	Pentenniel	Charter Purse Seiner	M;1
2.17	Bycatch research	60	Quarterly	Gulf of Mexico	Annual	Charter FV	B;3
2.18	Inshore Shark Nursery Surveys	30	Spr	Gulf of Mexico	Annual	Charter	M;1/3
2.19	Reef Fish - Oil,Gas Structure assoc.	40	Sum	Gulf of Mexico	Annual	Charter	M;3
2.20	Essential Fish Habitat Investigations	60	Spr	Gulf of Mexico	Annual	Charter	E;3
	Charter Subtotal	245					
	Gulf of Mexico/Caribbean Total	636					
3.0	**South Atlantic Bight Ecosystem**						
3.1	OCULINA/Gag Grouper Survey	16	Spr	Atlantic Coast	Annual	Quiet FRV	M;1
3.2	Shark Longline	30	Sum	Atlantic Coast	Annual	Quiet FRV	M;2
3.3	Marine Mammal/Ichthyoplankton	60	Sum	Atlantic Coast	Trienniel	Quiet FRV	M;2
	Quiet FRV Subtotal	106					
3.4	S. Atlantic Bight Recruit. Exp.	50	Wtr	Atlantic Coast	Annual	Oceanog. RV	R;3
	Oceanographic RV Subtotal	50					

3.5	MARMAP Atlantic Reef Fish Surv.	60	Sum	Atlantic	Annual	Charter St. RV	M;1
3.6	SEAMAP Atlantic Trawl Surveys	60	Spr/Sum/Aut	Atlantic	Annual	Charter St. RV	M;1
	Charter State RV Subtotal	120					
3.7	Expand Incidental Harvest Research	40	Quarterly	Atlantic	Annual	Charter FV	B;3
3.8	SEAMAP Striped Bass Tagging	30	Wtr	Atlantic Coast	Annual	Charter	M;3
	Charter Subtotal	70					
	South Atlantic Bight Total	346					
4.0	**Gulf of Alaska/Bering Sea Ecosystem**						
4.1	Bottom trawl slope survey	60	Sum	Gulf of Alaska/Bering Sea	Biennial	Quiet FRV	M;1
4.2	Pollock acoustic/trawl survey	70	Sum	Bering Sea	Biennial	Quiet FRV	M;2
4.3	Pollock acoustic/trawl survey	(90)	Sum	Gulf of Alaska	Biennial	Quiet FRV	M;2
4.4	Pollock acoustic/trawl survey	10	Wtr	Bogoslov Is./Bering Sea	Annual	Quiet FRV	M;2
4.5	Pollock acoustic/trawl survey	20	Wtr	Shelikof Strait/Gulf of AK	Annual	Quiet FRV	M;2
4.6	Acoustic/trawl pollock spawning	20	Wtr	Aleutian Islands	Annual	Quiet FRV	M;2
4.7	FOCI - study of pollock	25	Spr	Shelikof Strait	Annual	Quiet FRV	R;3
4.8	FOCI Ecosystem	30	Spr/Aut	Bering Sea	Annual	Quiet FRV	E/R;3
4.9	FOCI Ecosystem/juvenile pollock	30	Sum	Bering Sea	Annual	Quiet FRV	E/R;3
4.10	Steller sea lion prey studies /assess.	180	Wtr/Spr/Sum	Aleutians/GOA/EBS	Annual	Quiet FRV	M;2/3
4.11	Ocean Carrying Capacity	120	Quarterly	N. Pacific	Annual	Quiet FRV	E;3
	Quiet FRV Subtotal	565					
4.12	FOCI - study of pollock	25	Spr	Shelikof Strait	Annual	Oceanog. RV	R;3
4.13	FOCI Ecosystem	30	Spr/Aut	Bering Sea	Annual	Oceanog. RV	E/R;3
	Oceanographic RV Subtotal	55					
4.14	Marine mammal surveys	(150)	Sum/Aut	Gulf of Alaska/Bering Sea	Quadrenniel	Quiet RV	M;2
	Quiet RV Subtotal	(150)					
4.15	Groundfish bottom trawl survey	225	Sum	Gulf of Alaska	Biennial	Charter 3-Trawlers	M;1
4.16	Groundfish bottom trawl survey	(140)	Sum	Aleutian Is.	Biennial	Charter 2-Trawlers	M;1
4.17	Sablefish longline survey	75	Sum	Gulf of Alaska	Annual	Charter Longliner	M;1
4.18	Sablefish longline survey	(30)	Sum	Aleutian Is.	Biennial	Charter Longliner	M;1
4.19	Sablefish longline survey	(30)	Sum	Bering Sea	Biennial	Charter Longliner	M;1
4.20	Crab & groundfish bottom trawl	135	Sum	Bering Sea	Annual	Charter 2-Trawlers	M;1
4.21	Early marine salmon distribution	42	Sum	E. GOA/SE Alaska Inside	Annual	Charter Trawler	M;3
4.22	Sablefish and rockfish assess. res.	35	Sum	E. Gulf of Alaska	Annual	Charter Trawler/Longliner	M;1
4.23	Trawl bycatch & EFH research	49	Sum	Bering Sea/Gulf of Alaska	Annual	Charter Trawler	B/E;3
4.24	Seafloor impacts	40	Sum	Bering Sea/Gulf of Alaska	Annual	Charter Trawler	B;3
4.25	Ocean Carrying Capacity	60	Spr/Sum	N. Pacific	Annual	Charter Trawler	E;3
4.26	Salmon Stock ID	14	Sum	E. Gulf of Alaska/SE Alaska Inside	Annual	Charter	M;3
4.27	Nearshore groundfish dist. & biology	32	Quarterly	Gulf of AK/Bering Sea/Aleutian Is.	Quarterly	Charter	M;1
4.28	Whale photo ID/pinniped assessment	40	Sum	SE Alaska	Annual	Charter	M;2
4.29	Marine Mammal surveys	(150)	Sum/Aut	Gulf of Alaska/Bering Sea	Quadrenniel	Charter	M;2
4.30	Ice seal assessment	30	Spr	Bering Sea	Annual	Charter	M;3
4.31	Lg whale assessment/IUSS network	40	Sum	North Pacific	Annual	Charter	M;2
4.32	Little Port Walter Supply	17	Year-round	E. Gulf of Alaska/SE Alaska Inside	Annual	Charter	M;3
	Charter Subtotal	834					
	Gulf of Alaska/Bering Sea Total	1454					
5.0	**Pacific Oceania Ecosystem**						
5.1	Fish/marine mammal interactions	60	Spr/Aut	Main Hawaii Islands	Bi-annual	Quiet FRV	M;3
5.2	Subtropical front ecosystem	85	Wtr/Sum	Central Pacific	Annual	Quiet FRV	E/M;3
5.3	Pacific HMS assessment	90	Variable	Oceanic Pacific	Annual	Quiet FRV	M;2
5.4	Swordfish research	60	Wtr	Central Pacific	Annual	Quiet FRV	M;1
5.5	Blue shark pop. biology/ bycatch	45	Variable	Oceanic Pacific	Annual	Quiet FRV	M/B;1/3
5.6	Monk Seal assessment	60	Spr/Aut	NW Hawaiian Islands	Annual	Quiet FRV	M;3
	Quiet FRV Subtotal	400					
5.7	Marine Mammal Survey	(150)	Sum/Aut	Central Pacific	Quadrenniel	Quiet RV	M;2
	Quiet RV Subtotal	(150)					
5.8	Sea turtle ecology & assessment	45	Wtr/Sum	Oceanic Pacific	Annual	Charter RV	M/E;2/3
5.9	Longline seabird mitigation study	30	Wtr	Central Pacific	Annual	Charter RV	B;1
5.10	Monk seal ecology	50	Variable	NW Hawaiian Islands	Annual	Charter RV	M/E;2/3
	Charter RV Subtotal	125					
5.11	Marine Mammal surveys	(150)	Sum/Aut	CentralPacific	Quadrenniel	Charter	M;2
5.12	Monk seal ecology	50	Variable	NW Hawaiian Islands	Annual	Charter	M;2/3
5.13	Lobster assessment	60	Spr	NW Hawaiian Islands	Annual	Charter	M;1

5.14	Bottomfish assessment	30	Variable	Main Hawaii Islands	Annual	Charter	M;1
5.15	Bottomfish assessment	45	Variable	Guam	Annual	Charter	M;1
5.16	Bottomfish assessment	45	Variable	Nothern Marianas Islands	Annual	Charter	M;1
	Charter Subtotal	230					
	Pacific Oceanic Total	755					
6.0	**6. California Current Ecosystem**						
6.1	Sardines, anchovies, mackerel	60	Sum	Washington - Mexico	Annual	Quiet FRV	M/E;2
6.2	Sardines, anchovies, mackerel	60	Sum	Washington - Mexico	Annual	Quiet FRV	M/E;2
6.3	Sardine biomass	(30)	Sum	Washington - California	Bienniel	Quiet FRV	M;2
6.4	Salmon survival	60	Spr/Sum	Washington, Oregon	Annual	Quiet FRV	E/R;3
6.5	Monitor squid	20	Wtr	California	Annual	Quiet FRV	M;1
6.6	Groundfish spawning biomass	90	Wtr	Washington - California	Annual	Quiet FRV	M;1
6.7	Pacific whiting acoustic /trawl	60	Sum	British Columbia - California	Annual	Quiet FRV	M;2
6.8	Slope species abundance	60	Aut	Washington - California	Annual	Quiet FRV	M/E;2
6.9	Rockfish larval production	9	Wtr	California	Annual	Quiet FRV	M;1
6.10	Rockfish population studies	25	Sum/Aut	Washington - California	Annual	Quiet FRV	E/M;1
6.11	Juvenile salmon offshore	28	Spr/ Sum	California	Tri-annual	Quiet FRV	E/R;1
6.12	Juvenile rockfish	38	Spr	California	Annual	Quiet FRV	R/M;1
6.13	Juvenile Pacific whiting	10	Spr	California	Annual	Quiet FRV	R/M;1
6.14	Groundfish recruitment	75	Spr/Sum	Washington - California	Annual	Quiet FRV	M/R;2
6.15	Groundfish habitat/ ecosystem	80	Spr	Washington - California	Annual	Quiet FRV	E/R;1
6.16	Coastal pelagics technology	20	Variable	California	Annual	Quiet RV	M;3
	Quiet FRV Subtotal	695					
6.17	Gray whale research	20	Wtr	California coast	Annual	Quiet RV	M;2
6.18	Marine mammal surveys	150	Sum/Aut	California Coast	Quadrenniel	Quiet RV	M;2
6.19	Tuna/porpoise surveys	(150)	Sum/Aut	Eastern Tropical Pacific	Quadrenniel	Quiet RV	M;2
6.20	Tuna/porpoise Assessment Tech.	60	Sum	Temperate North Pacific	Annual	Quiet RV	M;2
	Quiet RV Subtotal	230					
6.21	Circulation studies	24	Quarterly	California	Quarterly	Oceanographic RV	E;3
6.22	Ocean productivity	60	Quarterly	Washington, Oregon	Quarterly	Oceanographic RV	E;3
6.23	Ocean productivity	30	Monthly	Washington, Oregon	Monthly	Oceanographic RV	E;3
6.24	Habitat evacuation (larvae)	28	Spr/Aut	California	Bi-annual	Oceanographic RV	E;3
6.25	CalCOFI	52	Spr/Aut	California	Bi-annual	Oceanographic RV	E;1
6.26	CalCOFI	40	Quarterly	California	Quarterly	Oceanographic RV	E;1
	Oceanographic RV Subtotal	234					
6.27	Tuna/porpoise surveys	150	Sum/Aut	Eastern Tropical Pacific	Quadrenniel	Charter w/helicopter	M;2
6.28	Marine Mammal surveys	(150)	Sum/Aut	California Coast	Quadrenniel	Charter	M;2
6.29	Groundfish trawl survey	220	Sum	Washington - California	Annual	Charter 4-trawlers	M/E;1
6.30	Groundfish longline/pot survey	60	Sum	Washington - California	Annual	Charter Hook & Line	M;1
6.31	ESA prey study	7	Sum	Washington, Oregon	Annual	Charter Trawler	M;3
6.32	Shark monitoring	32	Spr/Sum	California	Annual	Charter Longliner	M;1
6.33	Shark monitoring	20	Sum	California	Annual	Charter Hook & Line	M;1
6.34	Flatfish abundance	40	Sum	Washington - California	Bienniel	Charter 2-trawlers	M;1
6.35	Predator-prey	24	Spr/Sum	Washington, Oregon	Monthly for 6 mos.	Charter trawler E;1	
6.36	Salmon ocean survival (predators)	20	Spr/Sum	Washington, Oregon	Bi-annual	Charter Trawler	E;1
6.37	Bycatch reduction and survival	20	Aut	Washington, Oregon	Annual	Charter Trawler	B;3
6.38	Sablefish bycatch mortality	20	Sum	Washington, Oregon	Annual	Charter Trawler	B;3
6.39	Gear impacts	20	Variable	Washington - California	Annual	Charter	B;3
6.40	Juvenile salmon in bay	26	Quarterly	California	Quarterly	Charter	E/R;1
6.41	Salmon/marine mammal interaction	30	Sum	Washington - California	Annual	Charter	E;2
	Charter Subtotal	689					
	California Current Total	1848					
7.0	**Southern Ocean Ecosystem**						
7.1	AMLR predator/prey interaction res.	120	Austral SumAntarctic Ocean		Annual	Charter FRV	E/M;3
	Charter FRV Subtotal	120					
7.2	Southern Ocean GLOBEC studies	60	Austral SumAntarctic Ocean		Annual	Oceanographic RV	E/R;3
	Oceanographic RV Subtotal	60					
7.3	AMLR crab & fish stock surveys	60	Austral SumAntarctic Ocean		Annual	Charter RV	M;1/2
	Charter RV Subtotal	60					
	Southern Ocean Total	240					

Appendix D

Assessment Status by Species

Currently there are 727 stocks covered by Fisheries Management Plans (FMP). Because fiscal resources are not sufficient to allow an abundance index to be developed for each stock, priorities must be set to allocate those resources to the obtain most important data first. The following table lists stocks covered by FMPs. Quality of stock abundance data and data collected from special at-sea research studies is displayed for the current scenario for each species (0 is no surveys; - is marginal; + is good). The quality indicator is a measure of quality/quantity of at-sea data collected, not the analytical procedures they feed into. When the DAS requirements outlined in the Plan are implemented, current studies may be augmented, and new studies may be initiated, noted a data quality/quantity index in the respective column. The vessel type and gear type currently used to conduct the surveys is noted in the last two columns.

Marine mammal and turtle species are listed in the second table using a similar system. The quality/quantity of data currently obtained and which will be obtained under the new Plan is listed for each stock and species. For both tables, the mission through which each species is assessed is identified in the first column. The numbers cross reference to the mission descriptions given in Appendix C. Both tables are also cross referenced to Appendix C to enable the species and the mission which assesses it to be linked.

FMP SPECIES		Stock Assessment			Process Studies				
Mission Code	LME Region/FMP Species	Current	Augmented	New	Current	Augmented	New	Current FRV Support	Current Charter Support
	Gulf of Alaska								
4.3, 4.5, 4.10	Walleye pollock	+	+	+	+	+	+	Trawl/Acoustic	Trawl
4.12, 4.15								Egg & Larvae	
4.15, 4.23, 4.27	Pacific cod		+	+				Trawl	Trawl
4.1, 4.15, 4.17	Sablefish	+	+	+	+		+	Trawl	Longline
4.10, 4.15, 4.24	Atka mackerel	-	+				+	Trawl	Trawl
4.15	Flatfish (4 sp.)	+	+				+	Trawl	Trawl
4.1, 4.15, 4.23	Arrowtooth flounder	+	+				+	Trawl	Trawl
4.1	Dover Sole	-	+	+			+	Trawl	Trawl
4.1, 4.17	Thornyhead rockfish (2 sp.)	-		+			+	Trawl	Trawl
4.1, 4.15, 4.22	Pacfic ocean perch	-	+	+	+		+	Trawl	Trawl/Sub.
4.1, 4.15, 4.22	Shortraker rockfish	-	+	+	+		+	Trawl	Trawl/Sub.
4.1, 4.15, 4.22	Rougheye rockfish	-	+	+	+		+	Trawl	Trawl/Sub.
4.15, 4.22, 4.24	Other Rockfish (29 sp.)	-		+			+	Trawl	Trawl
4.15	Sculpins	+	+				+	Trawl	Trawl
4.15	Sharks	-	-				+	Trawl	Trawl
4.15	Skates	+	+				+	Trawl	Trawl
4.23	Eulachon	-					+	Trawl	Trawl
4.23	Smelts	-					+	Trawl	Trawl
4.23	Capelin	-					+	Trawl	Trawl
4.1, 4.17	Rattail (3 sp.)	-	+				+		Longline
4.10, 4.23	Squid	0					+	Trawl	Trawl
4.23	Octopus	-					+	Trawl	Trawl
4.11, 4.21, 4.25	Salmon (5 sp.)	+			+	+		Trawl	Purse Seine
	Bering Sea/Aleutian Islands								
4.2,4.4,4.6,4.8-10	Walleye pollock	+	+	+	+	+	+	Trawl/Hydroacoustic/	
4.13, 4.20, 4.23								Egg & Larvae	
4.16, 4.20, 4.23	Pacific cod	+	+				+		Trawl
4.20,4.23	Yellowfin sole	+					+		Trawl
4.1, 4.16, 4.20	Greenland turbot	-	+	+			+		Trawl/Longline
4.1, 4.16, 4.20	Arrowtooth flounder	+		+			+		Trawl
4.16, 4.20	Rock sole	+					+		Trawl
4.16, 4.20	Flathead sole	+					+		Trawl
4.1, 4.16, 4.20	Sablefish	-	+	+	+		+		Longline
4.1, 4.16, 4.20	Pacific ocean perch	-	+	+			+		Trawl
4.1, 4.16, 4.20	Sharpchin/Northern rockfish	-	+	+			+		Trawl
4.1, 4.16, 4.20	Shortraker/Rougheye rockfish	-	+	+			+		Trawl
4.1, 4.16, 4.20	Thornyhead rockfish (2 sp.)	-	+	+			+		Longline
4.16, 4.20 4.24	Rockfish (4 sp.)	-	+				+		Trawl
4.10, 4.16 4.24	Atka mackerel	-	+		+	+	+		Trawl

Assessment Status

FMP SPECIES		Stock Assessment			Process Studies				
Mission Code	LME Region/FMP Species	Current	Augmented	New	Current	Augmented	New	Current FRV Support	Current Charter Support
4.1	Squid	0					+		
4.16, 4.20	Flatfish (5 sp.)	+					+		Trawl
4.1, 4.16, 4.20	Rattails (3 sp.)	-	+				+		Longline
4.16, 4.20	Sculpins	+	+				+		Trawl
4.16, 4.20	Sharks	0	-				+		
4.16, 4.20	Skates	+	+				+		Trawl
4.23	Eulachon	-					+		Trawl
4.23	Smelts	-					+		Trawl
4.23	Capelin	-					+		Trawl
4.23	Octopus	-					+		Trawl
4.20, 4.23, 4.24	Blue king crab	+					+		Trawl/Pot
4.1, 4.23, 4.24	Brown king crab	-		+			+		Trawl/Pot
4.20, 4.23, 4.24	Red king crab	+					+		Trawl/Pot
4.20, 4.23, 4.24	Tanner crab (3 sp.)	+					+		Trawl/Pot
4.23, 4.24	Alaska scallops	-					+		Trawl
Northwest Atlantic (includes mid-Atlantic)									
1.17; 1.10;	Atlantic sea scallop	+			+		+	Dredge	
1.1; 1.2; 1.10	American lobster	+			+			Trawl	
1.1; 1.2; 1.10	Atlantic cod (2 stocks)	+		+	+		+	Trawl	
1.1; 1.2; 1.10	Haddock (2 stocks)	+			+		+	Trawl	
1.1; 1.2; 1.3	Yellowtail flounder (4 stocks)	+			+			Trawl	
1.1; 1.2; 1.10	American plaice	+		+	+		+	Trawl	
1.1; 1.2; 1.10	Redfish	+		+	+			Trawl	
1.1; 1.2; 1.10	Witch flounder	+		+	+		+	Trawl	
1.1; 1.2; 1.10	White hake	+			+			Trawl	
1.1; 1.2; 1.10	Pollock	+		+	+			Trawl	
1.1; 1.2; 1.10	Windowpane flounder	+			+			Trawl	
1.1; 1.2; 1.3	Winter flounder (3 stocks)	+			+			Trawl	
1.1; 1.2; 1.10	Silver hake (2 stocks)	+			+			Trawl	
1.1; 1.2; 1.10	Red hake	+			+			Trawl	
1.1; 1.2; 1.10	Ocean pout	+			+			Trawl	
1.3; 1.1; 1.2	Summer flounder	+			+		+	Trawl	
1.1; 1.2; 1.3	Black sea bass	+			+			Trawl	
1.1; 1.2; 1.3	Scup	+			+			Trawl	
1.2; 1.10; 1.4	Bluefish	+			+		+	Trawl/Acoustic	
1.19; 1.1; 1.11	Surf clam	+	+		+	+		Dredge	
1.19; 1.1; 1.11	Ocean quahog	+	+		+			Dredge	
1.1; 1.2; 1.3	Squid (2 sp.)	+		+	+		+	Trawl	
1.2; 1.8; 1.10	Atlantic mackerel	-	+	+	-	+	+	Trawl/Acoustic	
1.2; 1.1; 1.9	Atlantic Herring	-	+	+	-	+	+	Trawl/Acoustic	

FMP SPECIES		Stock Assessment			Process Studies				
Mission Code	LME Region/FMP Species	Current	Augmented	New	Current	Augmented	New	Current FRV Support	Current Charter Support
1.1; 1.2; 1.8	Atlantic butterfish	+	+	+	+		+	Trawl/Acoustic	
1.2; 1.1; 1.3	Spiny dogrfish	-	+					Trawl	
1.1; 1.2; 1.3	Skates	-	+					Trawl	
1.20; 1.21	Apex Predators	-	+		-	+		Longline	
	South Atlantic								
	Golden crab	0							
3.5	Shrimp (4 sp.)	+	+						
	Jewfish	0							
	Nassau grouper	0							Trawl
3.1;3.4;3.5	Vermilion snapper	+					+		
3.1;3.4;3.5	Red porgy	+					+		
3.1;3.4;3.5	Gag grouper	+					+		Trap
3.1;3.4;3.5	Red snapper	-					+		Trap
3.1;3.4;3.5	Grouper (15 sp.)	+	+				+		Trap
3.1;3.4;3.5	Tilefish (3 sp.)	-	+				+		Trap
3.1;3.4;3.5	Grunt (11 sp.)	+					+		Trap, longline
3.1;3.4;3.5	Sea bass (3 sp.)	+					+		Longline
3.1;3.4;3.5	Triggerfish (3sp.)	-	+				+		Trap
3.5	Jack (7 sp.)	-					+		Trap
3.1;3.4	Spadefish	-					+		
3.1;3.5	Hogfish	-					+		
3.1;3.4;3.5	Snapper (12 sp.)	-					+		
	Wreckfish	0							
3.1;3.4;3.5	Porgy (8 sp.)	+					+		Trap
	Red drum	0							
	Coral (5 families)	0							Trap
3.4	King mackerel	+							
3.4	Spanish mackerel	+							
3.4	Cobia	-							Trawl
	Cero	0							Trawl
	Dolphin	0							Trawl
	Little Tunny	0							
	Gulf of Mexico								
	Stone crab	0							
2.1;2.2	Brown shrimp	+						Trawl	
2.1;2.2	Pink shrimp	+						Trawl	
2.1;2.2	White shrimp	+						Trawl	
	Royal red shrimp	0							
	Rock shrimp	0							
2.1;2.2	Seabob shrimp	+						Trawl	

Assessment Status

FMP SPECIES		Stock Assessment			Process Studies				
Mission Code	LME Region/FMP Species	Current	Augmented	New	Current	Augmented	New	Current FRV Support	Current Charter Support
	Coral (5 families)	0							
	Spiny lobster	0							
	Slipper lobster	0							
2.1;2.2;2.9	King mackerel	+						Trawl, plankton	
2.1;2.2;2.9	Spanish mackerel	+						Trawl, plankton	
2.1;2.2	Cobia	+						Trawl	
	Cero	0							
	Dolphin	0							
	Little Tunny	0							
2.1;2.2	Bluefish	+						Trawl	
2.1;2.2;2.9	Red snapper	+	+				+	Trawl, plankton	
	Nassau grouper	0							
	Jewfish	0							
2.4	Vermilion snapper	+					+	Trap/video	
2.1;2.2;2.4	Amberjack (3 sp.)	-	+				+	Trawl	
2.1;2.2;2.9	Triggerfish (2 sp.)	-	+				+	Trawl, plankton, trap video	
	Banded rudderfish	0							
2.4	grunt (3 sp.)	-	+				+	Trap/video	
	hogfish	0							
2.4	Snapper (12 sp.)	-		+			+	Trap/video	
2.4	Tilefish (5 sp.)	-		+			+	Trap/video	
2.4	sea bass (3 sp.)	+					+	Trawl, trap/video	
2.4	Sand perch (2 sp.)	+					+	Trawl, trap/video	
2.4	Grouper (13 sp.)	-	+	+			+	Trap/video	
2.4	Porgy (6 sp.)	-	+				+	Trap/video	
2.9	Red drum	+	+					Plankton	M/R
2.7	Coastal Sharks	-	+					Longline	
	Caribbean								
2.15	reeffish (139 taxa)	-	+				+		Trap
2.13	Queen conch	-	+				+		Trap
2.13	Conch (12 sp.)	-	+				+		Trap
2.14	Lobster	-	+				+		Trap
	Sponges	0					+		
	Coral (6 sp.)	0					+		
	Misc. Invertebrates (15 families)		0					+	
	Algae	0							
	Seagrasses	0							
	Atlantic-wide								
	Swordfish	0					+		
	Blue marlin	0							

FMP SPECIES Mission Code	LME Region/FMP Species	Stock Assessment: Current	Stock Assessment: Augmented	Stock Assessment: New	Process Studies: Current	Process Studies: Augmented	Process Studies: New	Current FRV Support	Current Charter Support
	White marlin	0							
	Sailfish	0							
	Spearfish	0							
3.2;1.2	Shark (39 sp.)	-	+					Longline	
	Bluefin tuna	+	+					Plankton	
	West Coast								
6.11;6.36	Chum salmon	+	+						
6.11;6.36	Chinook salmon (14+ runs)	+	+						
6.11;6.36	Coho salmon (multiple runs)	+	+						
	Pink salmon	+	+						
	Sockeye salmon	+							
6.3; 6.4; 6.1	Northern anchovy	-	+					Trawl	
6.29	Lingcod	-							Trawl
6.29; 6.10	Canary rockfish	+	+						Trawl
6.29; 6.10; 6.8	Pacific ocean perch	-							Trawl
6.8; 6.10	Thornyhead (2 sp.)	-	+					Trawl	
6.29; 6.10	Bocaccio	-	+						Trawl
6.29; 6.10	Yellowtail rockfish	+	+						Trawl
6.7; 6.13	Pacific whiting	+	+					Trawl/hydroacoustic/ Egg & Larvae	Trawl
6.30; 6.8	Sablefish	+	+		+			Trawl	Trawl
6.8	Dover sole	+	+					Trawl	
6.29; 6.34; 6.8	English sole	-	+						Trawl
6.29; 6.34; 6.8	Petrale sole	-	+						Trawl
6.30; 6.10; 6.29	Rockfish (46 sp.)	-	+						Trawl
6.29	Jack mackerel	-	+					Trawl	
6.29; 6.34; 6.8	Pacific cod	-							Trawl
6.29; 6.34; 6.8	Arrowtooth flounder	-	+						Trawl
6.30; 6.8	Flatfish (8 sp.)	-	+					Trawl/longline/pot	
6.30; 6.25; 6.26	Shark (3 sp.)	-	+					Trawl/longline/pot	
6.30; 6.25; 6.26	Skate (3 sp.)	-						Trawl/longline/pot	
6.8	Ratfish	-						Trawl	
6.8	Grenadier (3 sp.)	-	+					Trawl	
6.25; 6.26	Cabezon	-						Trawl	
6.25; 6.26	Kelp Greenling	-						Trawl	
6.25; 6.26	California scorpionfish	-						Trawl	
6.9; 6.10	Cowcod	-						Trawl	
6.9; 6.10	Treefish	-						Trawl	

FMP SPECIES		Stock Assessment			Process Studies				
Mission Code	LME Region/FMP Species	Current	Augmented	New	Current	Augmented	New	Current FRV Support	Current Charter Support
	Pacific Oceania								
5.13	Spiny lobster (2 spp.)	+	+		+	+		Pot	
5.13	Slipper lobster	-			+			Pot	
	Corals (12 spp.)	0			-				Submersible
5.14	Pelagic armorhead	-						Trawl	
5.15	Snapper (10 sp.)	-			+	+	+	Trawl/Handline	Submersible
5.15	Seabass (2 sp.)	0							
5.3	Trevally (2 spp.)	0							
5.3	Other Jacks	0							
5.14	Grouper (2 spp.)	-						Trawl/Handline	
5.3	Emperor (2 spp.)	0							
5.3	Alfonsin	0							
5.3	Yellowfin tuna (2 stocks)	-	+		+			Longline	Purse seine
5.3	Albacore (2 stocks)	+			+	+		Longline/Troll	
5.3	Skipjack tuna (2 stocks)	-	+		+			Longline	Purse seine
5.3	Marlin (3 spp.)	-			+			Troll/Longline	
5.3	Bigeye tuna	+			+	+	+	Longline/Trawl	
5.3	Auxis sp.	0							
5.3	Scomber sp.	0							
5.3	Allothunnus sp.	0							
5.4	Swordfish	-	+		+	+	+	Longline/Trawl	
5.3	Sailfish	-			-			Troll/Longline	
5.4	Shortbill spearfish	0			+			Troll/Longline	
5.4	Wahoo	0			+			Troll/Longline	
5.4	Mahimahi	0			+			Troll/Longline	
5.5	Pelagic shark (multiple sp.)	0			+	+	+	Longline/Trawl	
5.14	Opah	0			-			Longline	
5.14	Oilfish	0						Longline	
5.14	Escolar	0						Longline	

	PROTECTED SPECIES			Population Estimation			Special Studies				
Survey Code	LME/Species	Stock	ESA/MMPA Status	Current	Augmented	New	Current	Augmented	New	Current FRV Support	
	Alaska										
	Baird's beaked whale	Alaska									
4.30	Bearded seal	Alaska				+			+		
	Beluga whale	Beaufort		+							
	Beluga whale	Eastern Chukchi Sea			-	+					
	Beluga whale	Norton Sound 1		-	+						
	Beluga whale	Bristol Bay		-	+						
	Beluga whale	Cook Inlet2	Strategic	+	+						
	Bowhead whale	Western Arctic	Endang./Strat.	+							
	Cuvier's beaked whale	Alaska									
	Dall's porpoise	Alaska									
4.31	Fin whale	Alaska	Endang./Strat.			+					
	Gray whale	Eastern N. Pacific		+							
	Harbor porpoise	Alaska		+							
	Harbor porpoise	Alaska-Aerial		+							
4.29	Harbor porpoise	Alaska-vessel		+	+						
4.29	Harbor seal	Southeast Alaska		+	+						
4.29	Harbor seal	Gulf of Alaska2		+	+						
4.29	Harbor seal	Bering Sea				+					
4.28, 4.31	Humpback whale	Western N. Pacific	Endang./Strat.			+					
4.28, 4.31	Humpback whale	Central N. Pacific	Endang./Strat.	-		+					
4.28	Killer whale	Resident		-	+		+			Sight. svy	
4.28	Killer whale	Transient		-	+		+			Sight. svy	
4.31	Minke whale	Alaska				+					
4.31	Northern right whale	North Pacific	Endang./Strat.		+	-					
4.14	Northern fur seal	Eastern N. Pacific	Depleted/Strat.	+			+	+			
	Pacific white-sided dolphin		North Pacific								
4.30	Ribbon seal	Alaska				+			+		
4.30	Ringed seal	Alaska				+			+		
4.31	Sperm whale	Alaska	Endang./Strat.			+					
4.30	Spotted seal	Alaska				+			+		
	Stejneger's beaked whale	Alaska									
4.10	Steller sea lion	Eastern U.S.	Threat./Stratigic	+	+		+	+			FWS-Sight svy
4.10	Steller sea lion	Western U.S.	Endang./Strat.	+	+		+	+			FWS-Sight svy
	Pacific										
6.18	California sea lion	U.S.		+			+				
6.18	Harbor seal	California		+			-				
	Harbor seal	OR/WA coast		+			-				
6.18	Harbor seal	WA inland		+			-				
6.18	Northern elephant seal	CA breeding		+			-				
6.18	Guadalupe fur seal	Mexico to CA		-							
5.12	Northern fur seal	San Miguel Island (CA)			+			+			
6.18	Hawaiian monk seal	Hawaii	Endang./Strat.	+			+			Transit/Support	
6.18	Harbor porpoise	Central CA		+			+			Sight. Svy	Aerial Charter
6.18	Harbor porpoise	Northern CA		+							Aerial Charter
6.18	Harbor porpoise	OR/WA coast		+			+				Aerial Charter
6.18	Harbor porpoise	WA inland				Aerial Charter					
6.18	Dall's porpoise	CA/OR/WA		+						Sight. Svy	

Survey Code	PROTECTED SPECIES LME/Species	Stock	ESA/MMPA Status	Population Estimation Current	Population Estimation Augmented	Population Estimation New	Special Studies Current	Special Studies Augmented	Special Studies New	Current FRV Support	
6.18	Pac. white-sided dolph.	CA/OR/WA				+				Sight. Svy	
6.18	Risso's dolphin	CA/OR/WA		+						Sight. Svy	
6.18	Bottlenose dolphin	CA coastal		-			+				Aerial Charter
6.18	Bottlenose dolphin	CA/OR/WA offsh.		+						Sight. Svy	
6.18	Striped dolphin	CA/OR/CA		+						Sight. Svy	
6.18	Common dolphin (short-beaked)		CA/OR/CA		+						Sight. Svy
6.18	Common dolphin (long-beaked)		CA		+						Sight. Svy
6.18	Northern right whale dolphin		CA/OR/WA		+						Sight. Svy
6.18	Killer whale	CA/OR/WA		+			+			Sight. Svy	
6.18	Killer whale	Southern resident		+			+				
6.18	Pilot whale (short-finned)	CA/OR/WA	Strategic	+						Sight. Svy	
6.18	Baird's beaked whale	CA/OR/WA		+						Sight. Svy	
6.18	Mesoplodont beaked wh.	CA/OR/WA	Strategic	-	+		+			Sight. Svy	
6.18	Cuvier's beaked whale	CA/OR/WA		+			+			Sight. Svy	
6.18	Pygmy sperm whale	CA/OR/WA		+			+			Sight. Svy	
6.18	Dwarf sperm whale	CA/OR/WA		+			+			Sight. Svy	
6.18	Sperm whale	CA/OR/WA	Endang./Strat.	+			+			Sight. Svy	
6.18	Humpback whale	CA/OR/WA	Endang./Strat.	+			+			Sight. Svy	Contract/charter
6.18	Blue whale	CA/Mexico	Endang./Strat.	+			+			Sight. Svy	Contract/charter
6.18	Fin whale	CA/OR/WA	Endang./Strat.	+						Sight. Svy	
6.18	Bryde's whale	E.. Tropical Pac.		-						Sight. Svy	
	Sei whale	E. North Pacific	Endang./Strat.			-				Sight. Svy	
6.18	Minke whale	CA/OR/WA	Strategic	+						Sight. Svy	
5.11	Rough-toothed dolphin	Hawaii									
5.11	Risso's dolphin	Hawaii									
5.11	Bottlenose dolphin	Hawaii									
5.11	Pantrop. spotted dolphin	Hawaii									
5.11	Spinner dolphin	Hawaii		-							
5.11	Striped dolphin	Hawaii									
5.11	Melon-beaked whale	Hawaii									
5.11	Pygmy killer whale	Hawaii									
5.11	False killer whale	Hawaii									
5.11	Killer whale	Hawaii									
5.11	Pilot whale (short-finned)	Hawaii									
5.11	Blainville's beaked whale	Hawaii									
5.11	Cuvier's beaked whale	Hawaii									
5.11	Pygmy sperm whale	Hawaii									
5.11	Dwarf sperm whale	Hawaii									
5.11	Sperm whale	Hawaii	Endang./Strat.			-					
5.11	Blue whale	Hawaii	Endang./Strat.			-					
5.11	Fin whale	Hawaii	Endang./Strat.			-					
5.11	Bryde's whale	Hawaii									
	Eastern Tropical Pacific										
6.19	Pantrop. spotted dolphin	Northeast ETP	Depleted/Strat.	-	+		-			Sight. Svy	Sight. svy.
6.19	Pantrop. spotted dolphin	West.-so. ETP		-	+		-			Sight. Svy	Sight. svy.
6.19	Pantrop. spotted dolphin	Coastal ETP		-	+		-			Sight. Svy	Sight. svy.
6.19	Spinner dolphin	Eastern ETP	Depleted/Strat.	-	+		-			Sight. Svy	Sight. svy.
6.19	Spinner dolphin	whitebelly		-			-			Sight. Svy	Sight. svy.

Survey Code	PROTECTED SPECIES LME/Species	Stock	ESA/MMPA Status	Population Estimation Current	Population Estimation Augmented	Population Estimation New	Special Studies Current	Special Studies Augmented	Special Studies New	Current FRV Support	
6.19	Spinner dolphin	Costa Rican		-			-			Sight. Svy	Sight. svy.
6.19	Spinner dolphin	Tres Marias		-			-			Sight. Svy	Sight. svy.
6.19	Com. dolph. (sht-beaked)	Northern ETP		-	+		-			Sight. Svy	Sight. svy.
6.19	Com. dolph. (sht-beaked)	Central ETP		-	+		-			Sight. Svy	Sight. svy.
	Atlantic										
	Harbor seal	Western N. Atlant.		+			-				
	Gray seal	N.west N. Atlant.		+			-				
	Harp seal	N.west N. Atlant.									
	Hooded seal	N.west N. Atlant.									
1.13	N. Atlantic right whale	Western N. Atlant.	Endang./Strat.	+			+			Sight. Svy	
1.13	Humpback whale	Western N. Atlant.	Endang./Strat.	+			+			Sight. Svy	
1.13-5	Fin whale	Western N. Atlant.	Endang./Strat.	+			-				Sight. svy.
	Sei whale	Western N. Atlant.	Endang./Strat.	-	+						Sight. svy.
1.14, 5	Minke whale	Canadian E. coast		+							Sight. svy.
	Blue whale	Western N. Atlant	Endang./Strateg.	-	+						Sight. svy.
1.15	Sperm whale	Western N. Atlant.	Endang./Strateg.	+			-				Sight. svy.
	Dwarf sperm whale	Western N. Atlant.	Strategic	-	+						Sight. svy.
	Pygmy sperm whale	Western N. Atlant.	Strategic	-	+						Sight. svy.
	Killer whale	Western N. Atlant.		-							Sight. svy.
	Pygmy killer whale	Western N. Atlant.		+							Sight. svy.
	North. bottlenose whale	Western N. Atlant.		-							Sight. svy.
1.15	Cuvier's beaked whale	Western N. Atlant.	Strategic	-	+		-				Sight. svy.
1.15	True's beaked whale	Western N. Atlant.	Strategic	-	+		-				Sight. svy.
1.15	Gervais' beaked whale	Western N. Atlant.	Strategic	-	+		-				Sight. svy.
1.15	Blainville's beaked whale	Western N. Atlant.	Strategic	-	+		-				Sight. svy.
1.15	Sowerby's beaked whale	Western N. Atlant.	Strategic	-	+		-				Sight. svy.
1.15, 4	Long-finned pilot whale	Western N. Atlant.		+							Sight. svy.
	Short-finned pilot whale	Western N. Atlant.	Strategic	+							Sight. svy.
1.15	Risso's dolphin	Western N. Atlant.		+							Sight. svy.
1.14	Harbor porpoise	Gulf Maine/Bay F.	Strategic	+			+				Sight. svy.
1.14	Atlant. wt-sided dolphin	Western N. Atlant.		+			-			biopsy cruise	Sight. svy.
	White beaked dolphin	Western N. Atlant.		-	+					biopsy cruise	Sight. svy.
1.15	Common dolphin	Western N. Atlant.	Strategic	+			-			biopsy cruise	Sight. svy.
1.15	Atlantic spotted dolphin	Western N. Atlant.	Strategic	+							Sight. svy.
1.15	Pantrop. spotted dolphin	Western N. Atlant.	Strategic	+							Sight. svy.
1.15	Striped dolphin	Western N. Atlant.		+							Sight. svy.
	Spinner dolphin	Western N. Atlant.		-	+						Sight. svy.
1.15	Bottlenose dolphin	W. N. Atlant, offsh.		+			-			biopsy cruise	Sight. svy.
	Bottlenose dolphin	W. N. Atlant coast	Strategic	-	+		-			biopsy cruise	Sight. svy.
	Gulf Of Mexico (GOM)										
2.8-10	Bottlenose dolphin	GOM, OCS		+			-			Sight. svy	
2.8-10	Bottlenose dolphin	GOM,shelf edge, slope		+			-			Sight. svy	
2.8-10	Bottlenose dolphin	Western GOM coastal		+			-			Sight. svy	
2.8-10	Bottlenose dolphin	N. GOM coastal		+			-			Sight. svy	
2.8-10	Bottlenose dolphin	East. GOM coast.		+			-			Sight. svy	

	PROTECTED SPECIES			Population Estimation			Special Studies				
Survey Code	LME/Species	Stock	ESA/MMPA Status	Current	Augmented	New	Current	Augmented	New	Current FRV Support	
2.8-10	Bottlenose dolphin	GOM bay coastal	Strategic	-	+		-				
2.8-10	Atlantic spotted dolphin	Northern GOM		+						Sight. svy	
2.8-10	Pantrop. spotted dolphin	Northern GOM		+						Sight. svy	
2.8-10	Striped dolphin	Northern GOM		+						Sight. svy	
2.8-10	Spinner dolphin	Northern GOM		+						Sight. svy	
2.8-10	Rough-toothed dolphin	Northern GOM		+						Sight. svy	
2.8-10	Clymene dolphin	Northern GOM		+						Sight. svy	
2.8-10	Fraser's dolphin	Northern GOM		+						Sight. svy	
2.8-10	Killer whale	Northern GOM		+						Sight. svy	
2.8-10	False killer whale	Northern GOM		+						Sight. svy	
2.8-10	Pygmy killer whale	Northern GOM		+						Sight. svy	
2.8-10	Dwarf sperm whale	Northern GOM	Strategic	-	+					Sight. svy	
2.8-10	Pygmy sperm whale	Northern GOM	Strategic	-	+					Sight. svy	
2.8-10	Melon-headed whale	Northern GOM		+						Sight. svy	
2.8-10	Risso's dolphin	Northern GOM		+						Sight. svy	
2.8-10	Cuvier's beaked whale	Northern GOM		+			-			Sight. svy	
2.8-10	Blainville's beaked wha.	Northern GOM		-	+		-			Sight. svy	
2.8-10	Gervais' beaked whale	Northern GOM		-	+		-			Sight. svy	
2.8-10	Pilot whale, short-finned	Northern GOM	Strategic	+			-			Sight. svy	
2.8-10	Sperm whale	Northern GOM	Strategic	+			-			Sight. svy	
2.8-10	Bryde's whale	Northern GOM		+			-			Sight. svy	
	Atlantic										
1.16	Loggerhead sea turtle	Atlantic/GOM	Threat./Strat..	-			-				
1.16	Green sea turtle	Atlantic/GOM	Endang./Thrt.	-	+						
1.16	Kemp's ridley sea turtle	Atlantic/GOM	Endang./Strat.	-	+						
1.16	Leatherback sea turtle	Atlantic/GOM	Endang./Strat.	-	+		-				
1.16	Hawksbill sea turtle	Atlantic/GOM	Endang./Strat.	-	+						
	Pacific										
	Loggerhead sea turtle	Japan	Threat./Strat.								
	Green sea turtle	Hawaii	Threat./Strat.			+				Transit/Support	
	Olive ridley sea turtle	Mexico	Threat./Strat.								
	Leatherback sea turtle	Mexico	Endang./Strategic								
	Hawksbill sea turtle	Hawaii	Endang./strategic				+				
	Southern Ocean										
7.1	Macaroni penguin	Southern Ocean			-						Transit/Support
7.1	Gentoo penguin	Southern Ocean			-						Transit/Support
7.1	Chinstrap penguin	Southern Ocean			-						Transit/Support
7.1	Adelie penguin	Southern Ocean			-						Transit/Support
7.1	Brown skua	Southern Ocean			-						Transit/Support
7.1	Antarctic fur seal	Southern Ocean			-						census svy.s
7.1	Crabeater seal	Southern Ocean			-						census svy.s