NMFS Fisheries Observer Coverage Level Workshop:

Defining a Basis

July 29-31, 2003
Alaska Fisheries Science Center
7600 Sand Point Way NE
Seattle, WA 98115

Summary Report

January 2004

Report prepared by Graeme Parkes, MRAG Americas, Inc. Tampa, FL and Mark S. Kaiser, Department of Statistics, Iowa State University.

Workshop organized by James Nance, Dan Ito, and Tim Miller, NMFS

Table of Contents

1 INTRODUCTION

The purpose of this workshop was to bring together representatives from observer programs around the country to discuss observer coverage level issues and needs. The primary objective was to initiate a process that would lead to the establishment of sound, program-specific coverage levels.

The workshop was held over three days and divided up into four sessions:

Session 1: Program Overviews

The opening series of presentations provided an overview of the observer programs in each region. These overviews included, among other things, information on the impetus for each program, past and current objectives, the service delivery model employed, and challenges faced.

Session 2: Program-specific concerns

Session 2 comprised several detailed presentations on the metrics that are important in establishing coverage levels and disparities between ideal coverage levels and those that are actually implemented.

Session 3: Coverage level motivated research

Several presentations on current research in establishing observer coverage levels were made.

Session 4: Discussion

A moderator provided a brief synthesis of the ideas presented in the first three sessions. This was followed by a moderated discussion aimed at establishing an appropriate foundation for further research and exchange of ideas. A series of recommendations was drafted and agreed by the participants at the conclusion of the workshop.

The Workshop participants are listed in Appendix 1.

2 SYNTHESIS

By the nature of the issues, there was substantial overlap in the information presented in each of the three main sessions. Several topics recurred during the workshop at different levels of detail, and were approached from managerial, analytical and practical perspectives. This section presents a synthesis of the ideas raised in the presentations without attempting to divide them up between the three sessions.

The program overviews were presented regionally in a variety of formats. The observer programs covered by these presentations are listed in Table 1. Further details of the programs are provided in Appendix 2.

Table 1 Summary list of observer programs discussed during the meeting

Northeast Region	
	Northwest Atlantic Sustainable Fisheries Support
	New England and Mid-Atlantic Gillnet Fisheries
	Atlantic Sea Scallop Dredge Fishery –Georges Bank
Southeast Region	
	Shark Drift Gillnet Observer Program
	Southeastern Shrimp Otter Trawl Fishery
	Pelagic Longline Observer Program
	Southeast Region Shark Bottom Longline Observer Program
Southwest Region	
	California/ Oregon Drift Gillnet Fishery
	Small Mesh Set Gillnet Fishery
Pacific Islands Region	
	Hawaii Pelagic Longline Fishery
Northwest Region	
	Offshore Pacific Whiting Fishery
	West Coast Groundfish Observer Program
Alaska Region	
	North Pacific Groundfish Observer Program (NPGOP)
	Alaska Marine Mammal Observer Program

The characteristics of observer programs that affect the approach taken to develop and implement coverage requirements can be summarized as follows:

- Observer program goals and objectives: what is being monitored and for what purpose?
- Service Delivery Model, particularly the control over sampling implementation: voluntary, partial choice or mandatory

- Profile of the fishery being observed: complexity of gear types, vessel types (especially sizes) and target species; commercial vs. recreational fishery, including factors that may make vessels or fleets "unobservable"
- Funding

These characteristics also affect the selection of performance criteria for testing the adequacy of a given sampling strategy in meeting the goals and objectives of the observer program. The remainder of this synthesis is organized under these headings.

2.1 Observer program goals and objectives

The presentations showed a great diversity of observer programs with goals and objectives developed at a range of levels of specificity. Observer programs are generally established to perform one or more monitoring tasks that will help in some way with the management of the fishery, either from a scientific of regulatory standpoint. These monitoring tasks can be summarized as follows:

- catch/effort monitoring for in-season management and/or stock assessment;
- bycatch monitoring for in-season management and/or stock assessment;
- protected species monitoring;
- technical monitoring for better understanding of fishing effort and catch per unit effort; and
- compliance monitoring

All of the programs discussed during the workshop were designed to do one or more of these monitoring tasks. The required coverage levels associated with these different tasks can be quite different. For example, it is relatively straightforward to design a sampling strategy to obtain a parameter estimate for a target species, such as age at length, with a desired level of precision. However, it is more difficult to design a sampling strategy to detect very rare events such as interactions with marine mammals. In this latter case, the necessary level of sampling (i.e., trips covered) to achieve the desired precision may need to be much greater, but politically this becomes very hard to sell to the fishers who have to take observers on their boats. It is still harder to design a strategy to cover multiple objectives, particularly when these objectives vary in importance across the fishery being observed, and are often in conflict with each other.

One of the often-quoted goals of an observer program is a target level of coverage at the trip level, i.e., the proportion of the number of trips, or perhaps the days at sea for which vessels have an observer on board. However, the workshop participants agreed that this is not a good example of a program goal. Target coverage levels sometimes result from negotiations between the fishery managers and the industry on an acceptable amount of observer time on board (e.g., the North Pacific Groundfish Observer Program). More recently, Judges have mandated coverage level requirements as components of lawsuit settlements (e.g., the Hawaii longline observer program). This has had the effect of circumventing the necessary procedures for observer program design, resulting in arbitrary, and potentially poorly supported sampling coverage levels. Increasingly, managers are becoming aware of the need to more clearly define observer program goals and objectives before developing estimation methods and sampling designs appropriate to meet those goals and objectives. Performance criteria that provide a means of measuring the achievement – or not – of a particular goal are an important element of the overall picture. Under this framework, the coverage level becomes part of the sampling design that meets the stated goal, according to the adopted performance criteria.

2.2 Service Delivery Models

There is a great diversity of service delivery models in US observer programs, ranging from federal employees[1] (e.g. the Observer Cadre in the North Pacific Groundfish Observer Program), through government contracts let to private companies (e.g., West Coast Groundfish, Hawaii longline), to direct funding of observers by the industry (e.g. North Pacific Groundfish Observer Program). Each of these models has different implications for the way in which the government is able to exercise control over sampling implementation at the trip level.

Often, at the inception of a new observer program, the requirement to take an observer is voluntary, in order to foster cooperation between the government and the fishers. However, as the program grows it usually becomes clear that a voluntary program does not provide random unbiased coverage at the trip level. Many of the current programs around the US have moved from a voluntary to a mandatory requirement to carry an observer. Nevertheless, fishers often retain the option to choose which trip they take the observer on. This and other operational effects have lead to a concern that there is an “observer effect” in fisheries that carry observers on board for less than 100% of all trips. Vessels may change the way in which they work when they carry an observer. For example, they may fish in areas where they don’t normally fish either to avoid bycatch, or to spend less time at sea with the observer on board, or for some other reason. Any reactions to the presence of an observer such as this will result in bias in the observer data.

Putting an observer on board for 100% of trips may reduce the problem, but unless 100% of all fishing operations (e.g., hauls) are observed, an observer effect may remain, with associated bias in the data. The most likely manifestation of such bias is a tendency for catches to be underestimated when hauls are not monitored compared when they are monitored. Another possible effect is a greater probability that zero catches will be recorded when hauls are not monitored. There is therefore a need for control over sampling implementation not only at the trip level, but also at the haul level.

[1] Note that currently there are no NMFS observer programs that have only Federal employees as observers with no contractors (Cornish, pers. comm.)

2.3 Fishery profiles

The fishery profile is the characteristics of the fishery that is being observed; i.e., the types of vessels, types of gears and the target species, and whether the fishery is commercial or recreational. All of these characteristics have an influence on potential estimation methods and sampling designs. Some of the more influential characteristics, which may even make vessels unobservable by conventional methods, were discussed during the NMFS Small Boats Workshop in March 2003. This list is attached as Appendix 3.

The program overviews presented at the workshop showed that quite different approaches are used in different parts of the country. In the southeast, for example, different fisheries are covered by entirely separate observer programs, e.g. the directed shark gillnet fishery and the bottom longline fishery for sharks are observed under different programs. In the North Pacific, however, there is one very large observer program that covers all of various components of the Bering Sea and Gulf of Alaska groundfish fishery. This “fishery” is actually comprised of a large number of individual fisheries or management units. The managers of this program have estimated that if an individual fishery were defined as “a gear-type, target species, area specific element which is subject to inseason management of target catch, bycatch, and/or prohibited species catch (PSC)”, there would be approximately 50 such individual fisheries in the Gulf of Alaska alone. Many of these “fisheries” are poorly observed or not observed at all.

2.4 Funding

Another important issue raised in the program overviews was that of funding. This has a major effect not only on the level of coverage that can be achieved on a day-to-day basis, but also on the continuity of monitoring. Funding may be the deciding factor in the level of coverage achieved, because there may be insufficient funds to achieve the level required to meet the program goals. Programs then resort to implementing the highest level of coverage possible with the available funds (e.g., the Alaska salmon drift gillnet fisheries). If funding is not secure from year to year, then gaps can appear in the observer data time series, potentially causing difficulties for stock assessments (e.g., if biological data on the catch are not available).

3 A ROADMAP FOR CHANGE

3.1 Establishing a process

Figure 1 was drawn up during the workshop to illustrate a rational process for development of an observer program. The issue of coverage level is one of the components of the potential estimation method and sampling procedure, which are designed specifically to meet the program goals and objectives. This process diagram aims to provide a framework not just for the development of new programs, but for the further development and rationalization of existing programs. The following sections of this part of the report provide more detail on the main components of the process under the planning and design phases, as discussed during the workshop. The issues of funding, logistics and practical testing of the sampling design are discussed in relation to their effects on the implementation of the sampling design. The workshop noted that these issues often have an overriding influence on the sampling that can actually be achieved, but agreed that this is not a reason for not following the procedures outlined for the planning and design phases. Rather, their influence should feed back through the system into the simulation modeling phase to test the performance of the sampling design that is actually implemented, compared to the theoretical optimal approach.

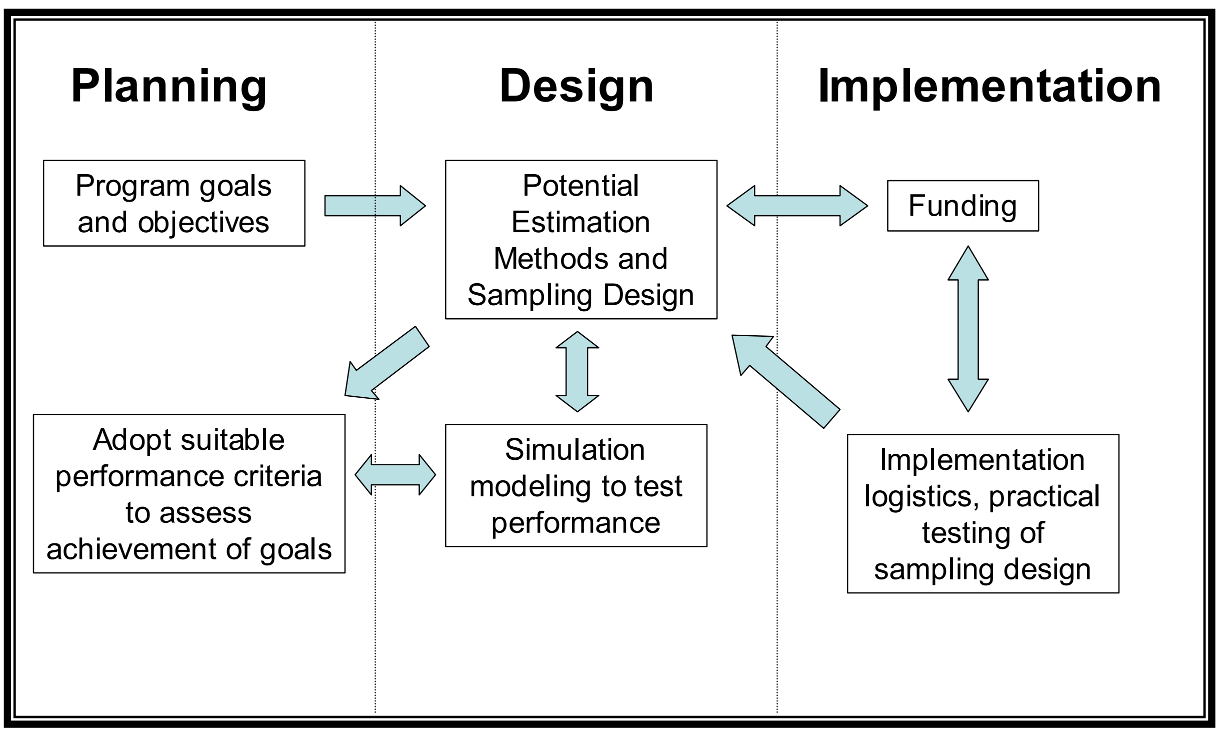

Figure 1 Process diagram for rational design and development of an observer program that incorporates coverage levels to meet specific program goals and objectives. Testing of the adequacy of coverage is achieved through the adoption of suitable performance criteria.

3.2 Setting goals and objectives

It is of paramount importance for a rationally constructed observer program to have a clear expression of what it is that the managers and/or scientists need to know and, if possible, how precisely they need to know it. The development of such goals and objectives for a program ideally would stem from a consideration of the purposes for which data, estimates, and other potential products of the program are to be used in achieving. Issues that need to be resolved include the required spatial and temporal resolution of data and/or estimates, how quickly data need to be available for use, and the required form of data and/or estimates (e.g., counts of prohibited species caught or weight of total prohibited species catch). Workshop participants agreed on the need for development of well-defined objectives. It was less clear, however, in what manner such development could be pursued given the diversity of "users" and entities with at least partial responsibility for direction of the observer programs. In addition, it was noted that the appropriate objectives for a program may not be entirely static. This is not necessarily a contradiction for developing goals and objectives, but the degree of flexibility desired in a program certainly factors into a consideration of its objectives.

One of the primary recommendations agreed to by workshop participants was that the development of well-defined goals and objectives for each program should be pursued as a high priority (Section 4). This includes listing the types and forms of data, such as catch/effort, bycatch and protected species interactions that the program will collect, and the priority that should be given to these types. Also included is a list of quantities that are to be estimated from the data, again with attached priorities. For some such desired estimates it may be possible to quantify a desired or required (e.g., by statute) level of precision. For others, the quantification of precision may be less readily achieved, particularly in cases for which current procedures do not provide any measure of uncertainty. A common goal for all quantities to be estimated, however, should be that a quantification of uncertainty can be computed from the available data (i.e., data should be collected in such a way that uncertainty can be estimated).

It is important that goals and objectives formulated for each program be well-defined in the scope, resolution, and form of quantitative information desired. The phrase "well-defined" is used here to mean not subject to ambiguity. For example, a goal of providing "average coverage of 65%" in a fishery is not an unambiguous and is therefore not well-defined. What are the fundamental units of coverage? Vessels, trips, hauls, proportion of total catch, or days in a fishing season are all immediate possibilities. The "average" is an average over what? Not only is this goal not well-defined, but it is not based on an intended use of observer program data or estimates. This latter point, in particular, was a part of what motivated workshop participants to agree that observer coverage level is not adequate as a measure of program performance. Similarly, the "estimation of bycatch" is not a well-defined objective. What is the appropriate resolution? The overall fishery, each vessel, haul, management area, time period, or some combination of these factors are all possible in defining the desired resolution. Total bycatch only, bycatch for species groups, bycatch for individual species, or some combination? Bycatch as weight or bycatch as number and, again, for which species or species groups, if any? The goal of "estimating the number of halibut taken as prohibited species for use in in-season management of the pollock fishery" is certainly more tightly formed than the previous examples, but still does not reach the level of what is meant by well-defined. Does "for use in in-season management" mean that estimates are needed each week, each day, for each trip, for each vessel, for each haul, or on some other resolution? Even the overall goal of maintaining program flexibility to respond to changes is subject to at least some level of scrutiny in tightness of definition. Flexibility to the potential need for changes in desired spatial or temporal resolution of estimates? Flexibility in the attention paid to species that may be added or deleted from a list of high-priority prohibited species? Flexibility in the precision with which data need to be recorded, such as length or species categories for estimation of catch composition? Flexibility in responding to specific anticipated new technologies, such as an increase in the use of flow scales to record total catch in a given fishery?

The development of well-defined goals and objectives for observer programs is a challenging undertaking. Observer programs have many stakeholders, including managers, researchers, industry, and public interest groups. The implementation of Recommendation 2 from this workshop (Section 4) necessarily involves the cooperation of individuals from different agencies, programs within agencies, and non-governmental entities. But unless progress is made in this arena, observer programs will continue to be shaped by reaction to events rather than by design.

3.3 Potential Estimation Methods and Sampling Design

The range of potential estimation methods and sampling designs depends to a large extent on what the managers are prepared/able to do in order to obtain the data and information that the program is required to deliver. Here the question of mandatory vs. voluntary observer placement arises. The workshop participants again noted that certain types of vessels are either very hard or practically impossible to observe using conventional observer deployment strategies (see Appendix 3). These considerations can therefore override statistical aspects of sampling design (see below). In this case, the workshop noted recent technical advances that provide alternative means of collecting observer-type data, such as electronic monitoring using digital cameras[2]

There is a tendency in discussions of observer program design and implementation to pose questions such as "are the data adequate?", "is the coverage level adequate?", or "what is the level of bias?" Without context, such questions are meaningless and their consideration is detrimental to making progress in the development of observer programs. As emphasized in Section 3.2, it must first be determined in an unambiguous manner for what purpose data are to be deemed adequate or inadequate, what are the fundamental sampling units to be "covered", and what is meant by "bias" and in what quantities we may be concerned with such "bias". The range of sampling strategies and methods of estimation or prediction that may be "adequate" for meeting an intended objective depends first and foremost on definition of the objective.

Despite this fundamental truth, guidance in determining appropriate coverage levels is often developed in the absence of a clear definition of coverage, realistic objectives, and under

[2] The workshop received an additional presentation from Howard McElderry of Archipelago Marine Research, Ltd. Canada on the implementation of electronic monitoring in the British Columbia halibut longline fishery to document the bycatch.

assumptions that are not likely to be met in practice. The need to formulate a question in the first place is often overlooked. It was emphasized at the workshop that such efforts will not provide observer programs with concrete steps toward achieving improved design and performance, or in developing procedures with which to assess program performance.

It is often assumed that sampling survey methodology for finite populations is the most appropriate body of statistical knowledge for estimation by observer coverage, despite the fact that the very basic tenets of this statistical approach result in assumptions that cannot be met by any current observer program. A small number of observer programs use a census-based approach in which the "best available number" for every haul, trip, or vessel (depending on the situation and quantity under consideration) is obtained and then simply totaled. While the use of estimators from sampling theory is often superior to this simple (but expensive) approach, their aptness for estimation and inference in observer programs is by no means straightforward.

Both the strategy by which data are obtained (sampling plan) and the selection of statistical estimators to be applied are components of what may be called the *approach to statistical analysis.* Such approaches may be placed into broad categories along the following lines.

1. **Census Approach**. The goal of a census approach is a complete enumeration of the quantity of concern for each fundamental sampling unit. Although this is not technically a statistical approach at all, it is included here because there may well be some objectives in particular observer programs for which a census approach is a reasonable alternative. Quantification of salmon or halibut bycatch in certain fisheries could possibly be approached through a census approach. The number of mortalities of a rare marine mammal species may also, in some instances, be subject to a census approach. Quite generally, however, a census approach requires observation (without error) of each fundamental sampling unit of concern. Situations under which this is possible are expected to be the exception rather than the norm.

2. **Survey Sampling Approach**. The sampling approach is based on three fundamental assumptions. First, there exists a finite population of discrete units about which inference is to be made based on incomplete observation (i.e., not a census). Second, the quantity of interest is a characteristic (fixed, immutable value) for each unit in the population and, given that the unit is observed, may be recorded exactly. Finally, the selection of units in the population is completely under the control of the investigator who decides exactly which units are observed and which units are not. The last of these assumptions is well recognized as a major difficulty when faced with programs that must rely on voluntary (or partially voluntary) observer placement, or logistical realities that make some vessels or trips unobservable (e.g., small vessels without adequate safe space for an observer). But violation of the second assumption, that population units possess characteristics that can be observed without error, can be as detrimental to application of a sampling approach as the failure to be able to control observation. This is frequently not recognized in consideration of estimation strategies in observer programs. The sampling approach remains useful for the estimation of many quantities for which observer programs are a useful data gathering tool, however, it should not be taken as the *de facto* approach of choice for all needs.

3. **Model Based Estimators**. The statistical approach of modeling formulates a mathematical structure for conceptual quantities called *random variables* that are connected to both observable phenomena and, possibly, unobservable scientific constructs. Theoretical probability distributions are assigned to random variables, usually in the form of functions that depend on a set of unknown parameters. Properly constructed models connect important aspects of the real problem with values of the unknown parameters, and the goal of analysis then becomes estimation of those parameters, or functions of the parameters. This is a fundamentally different approach to statistical analysis than that of sampling, in which observable quantities are not connected with random variables and probability enters the problem only through the sampling plan used (i.e., the probabilities with which various population units are chosen to be observed). Any number of potential objectives of observer programs might be well addressed through the use of statistical modeling. The applicability of this approach in any given program, or for estimation of particular quantities within any program, will depend on a careful consideration of objectives, logistical realities, what underlying scientific knowledge exists, and whether the quantities being observed may be considered characteristics of discrete population units or are better conceptualized as realized values of random variables.

4. **Bayesian Approaches**. A Bayesian approach to estimation and inference in a given estimation problem is similar to that of the model based approach (see above), with the additional element that probability can be taken to constitute an epistemic construct. In short, a Bayesian approach equates knowledge with probability. A Bayesian analysis is well suited to situations that allow a sequential assessment of a given question, such as might occur over successive hauls or trips in a fishery. For example, in estimation of the species composition of catch on a given vessel for a given trip, all hauls observed before the current haul are taken as providing "prior information" relative to the species composition of the current haul.

There is no single correct statistical approach to estimation and inference in the analysis of data from observer programs. There is a need, however, for whatever statistical methods are used to constitute a *coherent* (logically based and internally consistent) set of procedures for estimation of and inference about values desired from observer programs. A great deal of work lies ahead for observer programs that desire the development of such a framework for the statistical treatment of data collected. The alternative is to rely on a disconnected and piecemeal approach that renders assessment in a programmatic manner difficult, if not impossible.

The Workshop participants reiterated that while there exist a number of statistical approaches that might prove valuable in estimation for observer programs, it will not be possible to investigate the efficacy or limitations of these approaches without prior and unambiguous specification of program objectives. Studies that rely on rely on broad assumptions about appropriate methods of estimation and inference to reach general conclusions about appropriate observer coverage should be treated with a high level of caution. There are many examples of studies that focus on one particular estimation problem for which a reasonable approach can be suggested. The caution in this case is that the results of these studies are specific to the case being studied and should not be generalized. There are other studies that attempt to reach general conclusions by asserting that the appropriate analyses are clear. These studies are misleading, potentially dangerously so. In reality, the multiple issues involved are not simple problems, have not been solved in a satisfactory manner, and cannot be resolved without the prior formulation of well-defined objectives.

3.4 Assessment of performance: selecting performance criteria

The development of meaningful performance criteria again depends in a critical manner on what objectives are defined for an observer program. The performance of statistical estimators is typically defined relative to “total error”, which becomes mean squared error under squared error loss (in a decision theoretic sense), and becomes variance under the additional condition of unbiased estimation.

Here, as in the consideration of estimators, simple answers are elusive. Squared error loss may, or may not, be a meaningful measure of error for a given problem. Absolute error might be a more meaningful criterion in some situations (e.g., counts of particular prohibited species). Robustness issues may play a larger role than efficiency (minimum variance for unbiased estimators) in some situations, as may the property of statistical estimators known as resistance (estimators are resistant if they are not greatly affected by a small number of extreme data values). The scale of intended estimation (haul level, trip level, vessel level, cooperative vessel group level, fishery level) is important. Sensitivity of additional analyses that depend on estimates from observer programs (e.g., stock assessment models) to errors in the various input factors is important.

Without well-defined objectives, untangling these various issues is not possible. Two points may be made, however. The first is that focus on the avoidance of “bias” as a sole performance criterion is misplaced. The problem of bias in estimation is relatively easily addressed, at least in theory. Under the conceptualization of a finite population of hauls, trips, or vessels, exactly *one* of these units would be chosen for observation, *at random,* and observed carefully *without error*. Given these two essential qualifications, any quantity desired could be estimated in an unbiased manner from this single observation, be that quantity total catch, total bycatch, bycatch by species or species group, length frequency distributions by species, probability of interaction with marine mammals, and so on. In fact, it could be easily demonstrated that such a strategy would be less susceptible to the possible causes of bias in estimators than nearly any other logistically possible approach to observing any particular fishery; such a strategy would be absolutely unbiased in nature. This does not mean, of course, that it would be a *good* idea to estimate quantities based on a single observation, which should be intuitively obvious. The point is that ubiasedness, *in and of itself*, is not a meaningful performance criterion; unbiasedness is a meaningful criterion only when combined with other aspects of estimation quality such as efficiency, robustness, resistance, or minimax properties (minimization of the maximum error, rather than some measure of average error).

The second point is that quantification of error as a percentage of the “true” value is not necessarily a meaningful criterion. It seems to have become common practice to assess estimation for quantities in observer programs as “adequate” if they are within 10% of the “true” value; this criterion appears commonly in simulation studies in which the "true" value is known, although it is without any force of reason or mathematical justification. Percentages are ambiguous mathematical quantities when applied to biological situations. Ten percent of 800,000 metric tons of total catch is 80,000 metric tons, while ten percent of 20 bottlenose dolphins is 2 dolphins. Are the biological ramifications of such errors in estimation the same (80,000 metric tons versus 2 dolphins)? It is, of course, impossible to say without a clear statement of well-defined objectives.

It must be recognized that "cut points" or "decision limits" relative to performance criteria may not be possible to set in a completely non-arbitrary manner. Nevertheless, progress in defining meaningful performance criteria will not be possible without a systematic approach to identification of program objectives, potential estimation and observational (sampling) strategies, and development of assessment tools. This was a recurrent theme of the workshop.

3.5 Simulation modeling: specific analytical issues

Simulation studies provide a valuable tool by which to investigate the properties associated with various strategies for observer deployment, use of alternative estimators, and assessment under various criteria. Pending the development of well-defined program objectives, there are a number of quantities that would clearly fall into the set of objectives for many programs (e.g., estimation of species composition of bycatch). It is therefore possible to make progress in the consideration of observer deployment strategies, alternative estimators, and possible performance criteria at the present time through the use of simulation; some information is already available from existing studies.

Simulation studies are particularly helpful in exploring the behavior (statistical or mathematical behavior) of various estimators under conditions assumed in their derivation. Other areas of potential application include studies of robustness and/or resistance and the investigation of estimation at various levels of data aggregation (haul, trip, vessel, vessel group, fishery).

While simulation studies could be utilized to a much greater degree in the investigation of observer program design, it is also important to recognize their limitations. Their results must be interpreted with respect to the conditions imposed on the simulation conducted, and not necessarily extended directly to a wide range of actual fisheries. Simulation studies must therefore be carefully designed with a particular goal in mind. For example, a study conducted with a "simulated" fishery, under the assumption that simple or stratified random sampling is possible, may lead to a different conclusion about how many hauls, trips, or vessels are needed to achieve a given level of precision (assuming such can be defined) than a study conducted with a simulated fishery for which restrictions are placed on sampling (e.g., 40% of the vessels are not subject to mandatory placement of observers). It is also important to remember that we cannot simulate the real world. Rather, simulation is more profitably viewed as a statistical or mathematical version of a controlled laboratory experiment, in which many factors are controlled while a few are varied.

We also note that simulations conducted on the basis of re-sampling from "real" data sets do not alleviate these caveats; such simulations are conditional (in a probabilistic sense) on the particular observations available, technically on the empirical distribution function of one particular realized situation. Thus, while simulation studies cannot be expected to provide definitive answers to broad questions such as the "appropriate level of coverage" (however coverage is defined) for an observer program, properly interpreted, the results of simulation studies can provide valuable insights relative to the issues of the behaviors of possible estimators, methodological robustness to violation of assumptions, and the manner in which potential assessment criteria function.

4 RECOMMENDATIONS ADOPTED AT THE WORKSHOP

In concluding its discussions, the Workshop participants adopted the following eight recommendations:

1. The process diagram (**Figure 1**) should be adopted as a desirable concept for the development of new observer programs and for managing changes to existing observer programs.

2. Each existing observer program should initiate the development of “well-defined” goals and objectives with associated performance criteria;

3. A document should be developed that provides guidance for the development of new observer programs – including practical guidelines on the phases of development;

4. Program managers should emphasize outreach to industry and other constituents and encourage participation in the development of goals and objectives, and sampling design and implementation;

5. A workshop is needed to explore the problem of bias in observer data;

6. NMFS should develop a directory of potential internal and external resources to assist in analytical aspects of program development;

7. NMFS should develop better access to non-confidential observer data e.g., through a web site; and

8. Program managers should recognize that monitoring goals can be achieved using technologies other than observers.

APPENDIX 1. LIST OF PARTICIPANTS

Bisack, Kathryn D. (was not able to attend)
NOAA Fisheries, NEFSC
166 Water Street
Woods Hole, MA 02543
508-495-2258
Kathryn.Bisack@noaa.gov

Busscher, Kevin D.
NOAA Fisheries, Pacific Islands Regional Office
1601 Kapiolani Blvd
Suite 1110
Honolulu, HI 96814
808-973-2937
kevin.busscher@noaa.gov

Carlson, John
NOAA Fisheries, SEFSC
3500 Delwood Beach Rd.
Panama City, FL 32408
850-234-6541 ext. 221
John.Carlson@noaa.gov

Carretta, James
NOAA Fisheries, SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
858-546-7181
Jim.Carretta@noaa.gov

Cornish, Victoria
NOAA Fisheries, Office of Science and Technology
1315 East-West Highway, Room 12342
Silver Spring, MD 20910
301-713-2328 ext. 139
Vicki.Cornish@noaa.gov

Cusick, Jonathan
NOAA Fisheries, NWFSC
2725 Montlake Blvd E.
Seattle, WA 98112
206-526-6703
jonathan.cusick@noaa.gov

Dietrich, Kim S.
Association for Professional Observers
P.O. Box 30167
Seattle, WA 98103
206-547-4228
apo@apo-observers.org

Dobrzynski, Tanya
NOAA Fisheries, Protected Resources
1315 East-West Highway
Silver Spring, MD 20910
301-713-2322, ext. 160
Tanya.Dobrzynski@noaa.gov

Dorn, Martin
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-6548
Martin.Dorn@noaa.gov

Eagle, Tom
NOAA Fisheries, Protected Resources
1315 East-West Highway, Room 12342
Silver Spring, MD 20910
301-713-2322, ext. 105
Tom.Eagle@noaa.gov

Forney, Karin A.
NOAA Fisheries, SWFSC
110 Shaffer Rd
Santa Cruz, CA 95060
831-420-3908
Karin.Forney@noaa.gov

Gaichas, Sarah
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4554
Sarah.Gaichas@noaa.gov

Haflinger, Karl
Sea State, Inc.
P.O. Box 74
Vashon, WA 98070
karl@seastateinc.com

Hollowed, Anne
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4223
Anne.Hollowed@noaa.gov

Ianelli, James
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-6510
Jim.Ianelli@noaa.gov

Ito, Daniel
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4223
Dan.Ito@noaa.gov

Kaiser, Mark
Iowa State University, Department of Statistics
102 Snedecor Hall
Ames, IA 50011-1210
515-294-8871
mskaiser@iastate.edu

Karp, William (Bill)
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4194
Bill.Karp@noaa.gov

Kiraly, Sari
NOAA Fisheries, Highly Migratory Species
1315 East-West Highway, Room 13586
Silver Spring, MD 20910
301-713-2347 ext. 112
Sari.Kiraly@noaa.gov

Lai, Han-Lin
NOAA Fisheries, NWFSC
2725 Montlake Blvd E.
Seattle, WA 98112
206-860-3361
Han-Lin.Lai@noaa.gov

Lennert-Cody, Cleridy
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA 92037-1518
858-546-7190
clennert@iattc.org

Levesque, Juan
NOAA Fisheries, Southeast Regional Office
9721 Executive Center Drive, N
St. Petersburg, FL 33702
727-570-5312
Juan.Levesque@noaa.gov

Loefflad, Martin
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4195
martin.loefflad@noaa.gov

Mansfield, Bridget
NOAA Fisheries, Alaska Regional Office
P.O. Box 21668
Juneau, AK 99802
907-586-7642
Bridget.Mansfield@noaa.gov

McCracken, Marti
NOAA Fisheries, PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5736
Marti.Mccracken@noaa.gov

McElderry, Howard
Archipelago Marine Research Ltd.
525 Head Street
Victoria, British Columbia V9A 5S1
CANADA
250-383-4535
howardm@archipelago.ca

Miller, Tim
NOAA Fisheries, University of Washington
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4205
Tim.Miller@noaa.gov

Nance, James M.
NOAA Fisheries, SEFSC
Galveston Laboratory
4700 Ave. U
Galveston, TX 77551
james.m.nance@noaa.gov

Nishida, Tom (Tsutomu)
Research Coordinator for Ocean Resources
National Research Institute of Far Seas
Fisheries (NRIFSF)
5-7-1, Oriodo
Shimizu, Shizuoka 424-8633 JAPAN
81-543-36-6037
tnishida@affrc.go.jp

Parkes, Graeme
MRAG Americas, Inc.
110 South Hoover Blvd., Suite 212
Tampa, FL 33609
813-639-9519
Graeme.Parkes@mragamericas.com

Petersen, Donald A.
NOAA Fisheries, Southwest Region
501 West Ocean Blvd., Suite 4200
Long Beach, CA 90802
562-980-4024
Don.Petersen@noaa.gov

Potter, David
NOAA Fisheries, NEFSC
166 Water Street
Woods Hole, MA 02543
508-495-2258
David.Potter@noaa.gov

Rago, Paul
NOAA Fisheries, NEFSC
166 Water Street
Woods Hole, MA 02543
508-495-2393
Paul.Rago@noaa.gov

Rossman, Marjorie
NOAA Fisheries, NEFSC
166 Water Street
Woods Hole, MA 02543
508-495-2111
Marjorie.Rossman@noaa.gov

Ryder, Cheryl
NOAA Fisheries, AFSC
7600 Sand Point Way N.E.
Seattle, WA 98115-0070
206-526-4052
Cheryl.Ryder@noaa.gov

Showell, Mark A
Bedford Institute of Oceanography
Marine Fish Division
1 Challenger Dr.
Dartmouth, Nova Scotia B2Y 4A2
CANADA
902-426-3501
showell@mar.dfo-mpo.gc.ca

Skalski, John
University of Washington
School of Aquatic and Fisheries Science
Puget Sound Plaza, Suite 1820
1325 Fourth Avenue
Seattle, WA 98101-2509
206-616-4851
jrs@cbr.washington.edu

Tromble, Galen
NOAA Fisheries, Alaska Regional Office
P.O. Box 21668
Juneau, AK 99802
907-586-7442
Galen.Tromble@noaa.gov

Turk, Teresa
NOAA Fisheries, Office of Science and Technology
1315 East-West Highway, Room 12342
Silver Spring, MD 20910
301-713-2316
Teresa.Turk@noaa.gov

Van Atten, Amy S. (was not able to attend)
NOAA Fisheries, NEFSC
166 Water Street
Woods Hole, MA 02543
508-495-2266
Amy.Van.Atten@noaa.gov

Wetherall, Jerry (was not able to attend)
NOAA Fisheries, PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5386
Jerry.Wetherall@noaa.gov

AFSC: Alaska Fisheries Science Center
NEFSC: Northeast Fisheries Science Center
SEFSC: Southeast Fisheries Science Center
SWFSC: Southwest Fisheries Science Center
NWFSC: Northwest Fisheries Science Center
PIFSC: Pacific Islands Fisheries Science Center

APPENDIX 2. SUMMARY DETAILS OF US OBSERVER PROGRAMS DISCUSSED DURING THE OBSERVER COVERAGE WORKSHOP

Northeast Fisheries Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Northwest Atlantic Sustainable Fisheries Support) Otter trawls, pelagic longlines, sea bass and lobster pots	Target: Mutispecies groundfish, monkfish, summer flounder, *Illex* squid, *Loligo* squid, Atlantic mackerel, scup, spiny dogfish, weakfish, bluefish Atlantic croaker, black sea bass, swordfish, tunas, sea scallop, American lobster Other commercially landed: Butterfish, shark, flounder, hake, skate, tautog, tilefish Bycatch: Common dolphin, pilot whale, loggerhead turtle, various seabirds, finfish, and invertebrates	▪ Monitor biological characteristics of catch ▪ Estimate takes of protected species ▪ Monitor discards ▪ Monitor catch in certain cases ▪ Participation in program may be either mandatory or voluntary.	Days at Sea 2003: Otter Trawl (1711) Longline (29) Pots and Traps (3) Total fraction of all trawl fisheries covered is less than 1% as is the coverage of lobster pot vessels and sea scallop fisheries outside of the Georges Bank Closed Area II fishery.	▪ Funded by protected species in 1990s ▪ Now 75 to 80% funded by groundfish, following law suit	▪ bias, ▪ funding, ▪ If voluntary (vessels can refuse observer) ▪ changing requirements ▪ % coverage is inadequate performance criterion

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(New England and Mid-Atlantic Gillnet Fisheries) Gillnets	Target: Atlantic cod, Pollock various flounders, spiny and smooth dogfish, monkfish, Atlantic croaker, weakfish, bluefish, menhaden, mackerel, shad, spot, Spanish mackerel, striped bass Other commercially landed: Winter and clearnose skate, sea robin, Atlantic herring, little skate Bycatch: Harbor porpoise, harbor seal, grey seal, harp seal, bottlenose dolphin, white-sided dolphin, pilot whale, loggerhead, Kemp Ridley, and green turtles, various seabirds and finfish	▪ Monitor biological characteristics of catch ▪ Estimate takes of protected species ▪ Monitor discards ▪ Monitor catch in certain cases ▪ Participation in program is mandatory. ▪ Fleet size: Approximately 1000 vessels	Days at Sea 2003: Gillnet (590) Total fraction of all gillnet fisheries covered is approximately 2-5 % of days fished. Additional days have been spent in recent years observing beach haul seine, beach anchored gillnets, and stop seine fisheries.	▪ Internal funding for program	▪ bias, ▪ funding, ▪ changing requirements ▪ % coverage is inadequate performance criterion

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Atlantic Sea Scallop Dredge Fishery – Georges Bank) Sea scallop dredges	Target: Atlantic sea scallop Other commercially landed: Monkfish, winter, summer, and yellowtail flounder, lobster, crabs Bycatch: small crabs, spotted hake, various flounders	▪ Monitor biological characteristics of catch ▪ Estimate takes of protected species ▪ Monitor discards ▪ Monitor catch in certain cases ▪ Participation in program is mandatory. ▪ Fleet size: Approximately 185 vessels	Days at Sea 2003: Scallop Dredge (574) Total fraction of the sea scallop dredge fishery covered is approximately 25 % (In 1999).	▪ Closed area coverage is funded by participants ▪ Open area coverage is Federally funded	▪ bias, ▪ funding, ▪ changing requirements ▪ % coverage is inadequate performance criterion

Southeast Fisheries Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Shark Drift Gillnet Observer Program) Shark gillnet	Target: Small and large coastal shark (harvested inside the EEZ from West Palm Beach, Florida to North Georgia Other commercially landed: Coastal pelagic (King and Spanish mackerel, little tunny, blackfin tuna, cobia) Bycatch: Wide variety of species	▪ Protected species monitoring (category II fishery) ▪ Directed shark catch, ▪ Teleost bycatch ▪ Compliance with closed area ▪ Participation in program is mandatory.	Coverage of shark directed gillnet fishing gear is 100 % at all times, unless coverage is waived by NOAA Fisheries.	▪ Fully funded since 2001	▪ Funding high cost ▪ Observer retention (seasonal) ▪ Limited time to sample directed catch and bycatch
(South-eastern Shrimp Otter Trawl Fishery) Shrimp otter trawl	Target: Penaeid shrimp (brown, white, and pink) Other commercially landed: None Bycatch: 1 Atlantic bottlenose dolphin, 1 West Indian manatee, and 411 sea turtles since 1992. Also red snapper, Atlantic croaker, longspine porgy, and other groundfish	▪ Refine catch rate estimates of finfish and shrimp by area and season for use in stock assessments ▪ Major bycatch issue ▪ Evaluation of Bycatch Reduction Device and Turtle Excluder (TED) ▪ Participation in	>10,500 sea days since 1992 < 1% of total shrimp effort	▪ Limited funding fluctuates annually	▪ Limited funding fluctuates annually ▪ Annual coverage remains at < 1% of total shrimp effort

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
		program is voluntary. ▪ Fleet size: ▪ Approximately 5000 USCG documented vessels, and an unknown number of state registered vessels			
(Pelagic Longline Observer Program) Pelagic longlines	Target: Swordfish directed fishery inside and outside of EEZ, primarily in North Atlantic Ocean Other commercially landed: Yellowfin, bigeye, and albacore tuna, dolphinfish, shortfin mako, porbeagle, and other sharks (fin market) Bycatch: Variety of billfish, sharks, bluefin tuna, escolar, marine mammals, sea turtles, seabirds, oilfish, lancetfish, occasional rare rays and finfish	▪ Catch and effort data ▪ Bycatch of protected species ▪ Data for use in stock assessment analyses by U.S. scientists and ICCAT ▪ Biological sampling ▪ Participation in program is mandatory. ▪ Fleet size: ▪ Approximately 250-300 vessels with 150-200 vessels active	5% coverage by set effort is the sampling target, and has varied from 2.5 % to >5 % prior to 2002, now 8%	▪ Internal funding for program	▪ Mandatory program, but vessels may choose when to take observer within each quarter ▪ 20% of the vessels selected have never taken an observer

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
		year round			
(Southeast Region Shark Bottom Longline Observer Program) Bottom longline	Target: Large coastal sharks (sandbar, blacktip, silky, spinner, tiger, bull, lemon, nurse, scalloped, great, and smooth hammerhead), small coastal sharks (Atlantic sharpnose, blacknose, bonnethead, finetooth) Other commercially landed: Pelagic sharks (shortfin mako, common thresher), dolphinfish, barracuda, snappers/groupers, tunas/swordfish (less than 1000 fish in 4 years) Bycatch: 37 sea turtles from 1994-2001 (26 loggerheads, 4 leatherbacks, 7 unknown), 1 dolphin Other bycatch data is being prepared.	▪ Fishery dependent data for use in stock assessments, ▪ Development of management policies ▪ Biological sampling for age and growth studies ▪ Participation in program was voluntary from 1994 to 2002, now mandatory ▪ Fleet size: ▪ 643 limited access permits active as of 10/19/2001 (253 directed permits and 390 incidental permits)	~2% coverage Florida through North Carolina under voluntary program ~6% coverage Louisiana through New Jersey under mandatory program	▪ Internal funding for program	▪ Still have problems with placing observers on randomly selected vessels (low compliance) ▪ Safety concerns

Southwest Fisheries Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(California/ Oregon Drift Gillnet Fishery) Swordfish/ Shark drift gillnet (>14" mesh)	Target: Swordfish and thresher shark (common and bigeye) Other commercially landed: Mako shark, opah, louver, and tunas (albacore, bluefin, and yellowfin) Bycatch: Blue shark, common mola, whales (sperm, humpback, fin, short-finned pilot, minke whale), Dall's porpoise, dolphin (short-beaked common, long-beaked common, Risso's, Pacific white-sided, northern right whale dolphin), California sea lion, northern elephant seal, loggerhead and leatherback sea turtles	▪ Protected species catch monitoring (cetaceans and turtles) ▪ Monitoring use of pingers - effectively reduced mammal problem ▪ Participation in program is mandatory. ▪ Fleet size: Marine Mammal Authorization Certificates are held by 95 vessels, and approximately 75 are active.	Number of sets decreasing Cover ~21% of sets now	▪ Fully funded by NMFS, protected species since 1990	▪ 15-20% of vessels are unobservable, now accounting for an increasing proportion of total effort

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
Southern California Small-mesh Drift Gillnet Fishery Drift gillnet (>3.5" but <14" mesh)	Target: yellowtail, white seabass, barracuda Bycatch: California sea lion, short-beaked common dolphin	▪ Protected species monitoring (cetaceans, pinnipeds, sea turtles) ▪ Small selective fishery in southern California ▪ Each set may have a different target, but tunas are not allowed to be landed ▪ Participation in program is mandatory.	~10% of sets covered	▪ Fully funded by NMFS, protected species for initial 3 years (2002, 2003, 2004)	▪ Only 8 of 40 vessels can accommodate observers ▪ Fleet effort and associated observer coverage varies each season

Hawaii Longline Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Hawaii Pelagic Longline Fishery) Pelagic longline	Target: Bigeye, yellowfin, and albacore tuna Other commercially landed: Marlin (blue, striped, shortbill spearfish, sailfish), shortfin and longfin mako, dolphinfish, wahoo, opah, barracuda, pomfrets, thresher shark (bigeye and pelagic), skipjack tuna, and swordfish Bycatch: Sharks (blue, oceanic white tip, crocodile, silky bignose), salmon, pelagic stingray, lancetfish snake mackerel, escolar, oilfish, *Cubiceps* spp., common mola, manta ray, remoras, sea turtles (loggerhead leatherback, olive ridley, green), Black-footed and laysan albatross, dolphin (Risso's, bottlenose, spinner, common, spotted), whales (short-finned pilot, false killer, humpback, sperm)	▪ Protected species monitoring (mainly turtles) ▪ Biological data on fish ▪ Catch composition (line counts) ▪ Participation in program is mandatory. ▪ Fleet size: ▪ 164 Federal limited entry longline permits allowed in the fishery with approximately 110 vessels actively fishing	4% of trips covered from 1994 to 1999 Increased from 10% in 2000 to 25% in 2002	▪ Fully funded by NMFS	▪ Coverage level by judicial order ▪ Mandatory ▪ "Systematic plus" selection of trips ▪ Safety a big issue

West Coast Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Offshore Pacific Whiting Fishery) Mid-water trawl	Target: Pacific whiting Other commercially landed: Yellowtail and widow rockfish Bycatch: Pacific ocean perch, salmon, Pacific white-sided dolphin, Dall's porpoise, California sea lion, northern elephant seal	▪ Total catch data and bycatch estimates for in-season management ▪ Biological data ▪ Fleet size: ▪ 13 processing vessels (7 catcher/processors and 6 mothership processors with 28 catcher vessels)	All trips observed; 2 observers on every vessel Nearly all hauls observed [Large vessels with ideal sampling situations (sampling station with specific requirements). Flow scales. Motion compensated platform scales.]	▪ Direct observer costs-industry funded ▪ NOAA Fisheries operational costs-government funded	▪ Designed funding for staff and program infrastructure ▪ Suitable regulations establishing mandatory observer coverage
(West Coast Groundfish Observer Program) Primarily bottom otter trawl	Target: This is a multi-species fishery that catches multiple groundfish species including many species of rockfish (There are 82 species in the FMP). Other commercially landed: Species closely associated with any of the target groundfish.	▪ Total discarded catch information ▪ Bycatch estimates ▪ Biological data of discarded catch ▪ Participation in program is mandatory.	Coverage is 10% of landed catch, mainly trawlers, some fixed gear and open access state managed gears.	▪ Federal funding	▪ Limiting species (bycatch) can close a fishery ▪ Mixture of sampling and whole haul enumeration ▪ Small vessel size makes sampling diffcult

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
	Bycatch: Groundfish species of concern, salmon, Pacific halibut, Dungeness crab, marine mammals, and seabirds				

North Pacific Groundfish Observer Program

Gears	Species	Goals of Program	Current coverage levels	Funding	Challenges
(North Pacific and Bering Sea Groundfish, Trawl and Fixed Gear Fishery) Huge variety of gears including trawls, longlines, and pots/traps	Target: Large number of species (All major groundfish harvested in U.S. Federal waters of the Gulf of Alaska and Bering Sea/ Aleutian Islands Other commercially landed: None Bycatch: Halibut, salmon, king and tanner crabs, marine mammals, seabirds, other groundfish	▪ Catch/effort ▪ Bycatch ▪ Biological information ▪ Protected ▪ Monitor and promote compliance ▪ Participation in program is mandatory. ▪ Fleet size: ▪ 350 vessels and 20 shore plants	Variable coverage; >125ft 100% of Days at Sea (200% in CDQ and AFA fisheries), 60-124 ft 30% of Days at Sea >30,000 observer days per annum Mandatory, but 30% vessels chose when they take observer Shore processing plants >1000 mt/mo. = 100 % coverage of processing days, shore processing plants >500 mt/mo. = 30 % coverage of processing days Coverage levels agreed by negotiation with industry	▪ Direct observer costs-industry funded ▪ NOAA Fisheries operational costs-government funded	▪ Mixture of sampling and whole haul enumeration ▪ Concerns with service delivery model (but it works…)

Alaska Marine Mammal Observer Program

Gear	Species	Goals of Program	Current coverage levels	Funding	Challenges
(Alaska Marine Mammal Observer Program) Nearshore salmon gillnet fisheries 1990-91 Prince William Sound Alaska Peninsula 1999-2000 Cook Inlet 2002-2003 Kodiak set gillnet fishery	Target: Salmon (sockeye, chum,coho, pink, Chinook) Other commercially landed: None Bycatch: Flatfish, harbor porpoise, common murre, common loon, arctic tern, marbled murrelet, white-winged scoter	▪ Monitoring of injury to and mortality of marine mammals ▪ Prince William Sound fishery: ensure with 95% certainty that the PBRs of key marine mammals are not exceeded ▪ Overall aim: zero mortality ▪ To achieve maximum opportunistic coverage with resources available ▪ Participation in program is mandatory. ▪ Fleet size: ▪ Drift vessels-581 permits issued; Set gillnet-745 permits issued with 559 active in 1999	Covers all State managed fisheries Cook Inlet program achieved 3-5% 10 year observation cycle	▪ Protected species (Marine Mammal Protection Act)	▪ High deployment logistics costs ▪ Achieving coverage levels necessary to achieve monitoring goals ▪ Coverage needed to achieve monitoring goals when PBR is very low

APPENDIX 3. FACTORS THAT CAN MAKE FISHING VESSELS HARD TO OBSERVE USING CONVENTIONAL OBSERVER DEPLOYMENT TECHNIQUES.[3] [4] [5]

Factor	Detail
1) distance from shore	distance a vessel goes from shore to fish; can change safety gear requirements and time at sea
2) type of gear/ fishing method	longline, net, etc.; can increase exposure to observer or decrease space on deck
3) size of fish	large (sharks, swordfish, etc.); can decrease space for observer on deck
4) capacity of fish hold	how much fish can a vessel hold; can increase time out fishing
5) weather	weather of a day the observer is to deploy; can prevent deployment
6) accommodations	adequate observer berthing space; can they sleep in a safe, escapable location
7) economic issues	cost of carrying the observer to the industry; can limit scope of program industry vs. program costs
8) goals of the observer program	the objects of a program; will affect how vessels are covered
9) length of seasons/ time and area closures	derby style, long seasons, closure of inside areas; will dictate when and where the vessels will fish
10) seasonality	does the season take place during the winter or summer months; can have an affect on observer deployment
11) size of vessel	the length and width of a vessel; can be an indicator if space may be available for an observer
12) maintenance/ age of vessel	the general upkeep, seaworthiness and age of the vessel
13) work space	the amount of deck space available for an observer to sample
14) power of vessel	the horsepower of the engine; vessel can be limited in number of crew/ observer by horsepower
15) fleet characteristics	are there a small number of large vessels and the rest small or vice versa?
16) crew/ captain experience	judging the captain's skippering or the crew's deck abilities
17) crew size	maximum capacity of vessel vs. average crew size
18) length of trip	day trip vs. multiple day trips
19) observer feedback	the feedback of observer about vessels
20) insurance carried by the vessel	insurance level and rates; does the addition of the observer increase the cost or cancel the vessel's coverage
21) observer personal safety issues	is the personal safety of the observer endangered by a culmination of issues

[3] Identified during the NMFS Small Boats Workshop, Seattle, March 2003
[4] For this exercise, it was assumed the observer programs would be fully funded and regulations governing the placement of observers would be in place
[5] The Workshop participants noted that it was not necessarily just one of the items listed in Table 2 that would cause a vessel to be difficult or impossible to deploy an observer onto. Often it is the interaction between one or more of these factors that results in the problem – e.g. size (11) and length of trip (18).