

# **Discussion Paper**

## **ADF&G Procedures for Estimation of Recreational Catch of Pacific Halibut, Demersal Shelf Rockfish, and Sharks**

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September 18, 2007

### **INTRODUCTION**

This paper was prepared in response to a request by the Statistical Committee (SSC) of the North Pacific Fishery Management Council (NPFMC). In December 2006 the SSC asked the Council to “request a review of estimation procedures for charter-based sport fishing catches of halibut and associated incidental catches of demersal shelf rockfish and sharks.” The SSC noted that:

“estimates and projections of sportfishing catches can have important implications for the likelihood of achieving the Council’s biological, social, and economic objectives. Therefore, the procedures used to obtain estimates and projections, and associated confidence intervals and biases, should be thoroughly documented for the public and subjected to periodic review by the SSC or specially convened review panels. While ADF&G indicates that some analyses of the confidence intervals of the estimates and properties of the projections have been conducted, those analyses have not been broadly disseminated or reviewed within the Council arena.”

In 2000 the Alaska Department of Fish and Game (ADF&G) revised mail survey halibut harvest estimates for the years 1996-1998. ADF&G staff presented an overview of the mail survey and the reason for the corrections to the SSC in December 2000. Staff also presented summaries, operational plans, and reports on sport fishery statistics and on-site sampling programs to the SSC. The SSC minutes note that, “Though it was not possible to conduct an in-depth review of these programs, the methodologies appear sound and well-implemented.”

Although the SSC’s request was for information related to estimation of charter catch, most of the same methods are used to estimate the unguided, or non-charter catch<sup>1</sup> as well. The exception is the state’s mandatory saltwater logbook program which applies to charter boats only. In addition, many of the tools and methods used to estimate catches of halibut, demersal shelf rockfish, and sharks apply to salmon and other groundfishes including pelagic shelf rockfish, slope rockfish, Pacific cod, and lingcod.

### **INFORMATION NEEDS FOR MANAGEMENT**

#### **Halibut**

Information on the magnitude and composition of recreational halibut harvest is needed for stock assessment and for establishment of commercial fishery catch limits by the International Pacific Halibut Commission (IPHC). The IPHC stock assessment model is used to estimate exploitable biomass and evaluate harvest policies. The total sport fishery removals, including charter and non-charter (in pounds), since 1996 are included as model inputs. Total sport harvest is predicted and included as a component of the overall objective function used to fit the model. Age and sex composition of the sport removals are

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<sup>1</sup> This report differentiates between the terms catch, harvest, and release. “Catch” is used to describe the sum of fish hooked and subsequently harvested (kept) or released (i.e., catch = harvest + release).

predicted using the estimated survey selectivity because the length composition of the sport harvest is similar to the length composition of the survey catch (Clark and Hare 2006). Although sport removals are estimated, they are treated as constants by the model and variances of the sport harvest estimates are not used directly to express uncertainty in model estimates. In addition to removal estimates, the IPHC has also requested information on the size distribution of the sport harvest, timing of harvest, and daily bag limit distribution for stock assessment purposes as well as consideration of regulatory proposals.

Information from the recreational halibut fishery is also needed by the NPFMC to allocate halibut between the recreational and commercial sectors. The charter boat fisheries in IPHC regulatory areas 2C and 3A are managed under guideline harvest levels (GHLs) expressed in pounds. Analysis of allocation options requires information on catch history and current catch levels. Analysis of management alternatives, such as moratoriums or limited entry, vessel trip limits, seasons, size limits, bag limits, and annual limits requires information on participation by individual charter vessels, numbers of fish harvested by vessel, harvest per angler, size composition of the harvest, seasonal timing of harvest, etc.

### **Demersal Shelf Rockfish (DSR) and Sharks**

Because there are no federal Fishery Management Plans for recreational fisheries, the State of Alaska has assumed management authority for all recreational groundfish fisheries in the EEZ under a provision of the Magnuson-Stevens Act. Even though the Council doesn't regulate these removals, they are taken into account in management of the DSR fishery. DSR biomass is assessed using line transect estimates of yelloweye rockfish density multiplied by average weight in the commercial harvest and estimates of habitat area, and then adjusted to account for other DSR species based on proportions in the landed commercial catch. The acceptable biological catch (ABC) recommendation is based on  $F = M = 0.02$  applied to the lower 90% confidence limit of the biomass estimate. Estimated sport removals are therefore not currently needed for assessment of the stock or calculation of ABC. Sport fishery removals are inherently included in the assessment because the observed fish density is in part affected by past removals. The sport removals (including discard mortality) are needed for management of the fishery, however. The decision on whether to have a directed commercial fishery depends on the fraction of the ABC that is taken by the recreational fishery.

The Alaska Board of Fisheries requires information on the removals of DSR in Southeast Alaska to allocate between the commercial and recreational fisheries. In 2006 the Board established a 16% allocation to the sport fishery in the outside waters of Southeast Alaska and specified management measures that could be required inseason to manage the sport fishery within its allocation. Choice of appropriate management measures relies on analysis of size and bag limit information. Sport harvest and discard mortality are estimated from a combination of mail survey estimates, charter logbook data, and on-site data on species composition, size composition, and average weight by species.

The NPFMC manages commercial shark fisheries in federal waters. The NPFMC has recently established assessments for sharks in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA). Three alternate approaches for establishing the ABC for the GOA were presented in the last assessment. Two are based on the incidental commercial catch history and one is based on trawl survey point estimates of biomass. The GOA shark assessment document contains information on the numbers and spatial distribution of salmon shark harvest in the northern Gulf of Alaska, but no estimates of sport removals are included in the assessment. The assessments should take into account sport removals as well as any other available information on size, age, or spatial distribution.

## **OVERVIEW OF ADF&G PROGRAMS**

The ADF&G Sport Fish Division programs that provide information and estimates related to charter catch of halibut, DSR, and sharks include (1) the Alaska Sport Fish Survey, commonly called the statewide harvest survey (SWHS), (2) the Statewide Saltwater Guided Sport Fishing Reporting Program, (3) the

Southeast Alaska Marine Creel Survey, and (4) the Southcentral Alaska Halibut and Groundfish Harvest Assessment Project. These programs were developed to gather information on a wide variety of species and are statewide or regional in scope.

The following sections will provide a general description of each program, with focus on aspects related to halibut, DSR, and sharks. Recent operational plans for each project are provided electronically for supporting information on sampling designs and procedures used to analyze data for these as well as other species covered by these programs.

### **Statewide Harvest Survey**

The SWHS is a mail survey and has been conducted annually since 1977. Harvest and participation have been estimated every year, but catch has only been estimated since 1990. The current primary objective of the survey is to estimate participation, catch, and harvest for major sport-caught species statewide, by area, and by site (Jennings 2007). The precision target is to estimate participation and harvest to within 15% of the true values 95% of the time. Because of Alaska's vastness, providing participation and harvest estimates on a statewide basis using onsite creel surveys would be prohibitively expensive. The survey meets the needs for assessment and management of major fisheries, but also provides information for establishing priorities, formulating policies, rehabilitating fisheries through stocking and habitat enhancement or protection, planning public access acquisition, and evaluating economic benefits. Additional details are found in the project operational plan for estimation of the 2006 harvest (Jennings 2007).

#### *Design:*

Two surveys are conducted annually to estimate participation, catch, and harvest. The standard survey has been administered since 1977. The supplementary survey has been administered since 1991 and is conducted to obtain estimates of parameters that cannot be estimated from the standard survey. A detailed description of the survey procedures used to estimate harvest in 2006 is contained in Appendix A.

Standard survey questionnaires are sent to a stratified random sample of about 23,000 sport fishing households from a list of sport fishing households. Households have either: (1) at least one individual who purchased a sport fishing license, or (2) at least one individual holding a permanent identification (PID) card (a free card issued on request to Alaskan residents of at least one year who are 60 years of age or older) or disabled veteran (DAV) card. The list is incomplete due to acquisition of licenses late in the season, or due to incomplete or illegible names and addresses.

Sampling strata for the standard survey are two dimensional. The first dimension is residency of the sport fishing households. The residency dimension is defined so that each household within each residency group has an equal probability of being surveyed. Previous surveys have indicated that response rates and degree of incompleteness in the household computer file vary by group. The second dimension of stratification is defined according to the date of first license purchase by any household member in each household and was identified to address issues related to the incomplete nature of the Sport Fish License file. An "early" and "late" date of first license purchase grouping was defined differently for the Alaska resident grouping compared to the non-Alaska resident groupings. Combining both dimensions of stratification results in eight sampling strata.

Sample sizes for each stratum are based on historic sampling levels that have achieved the objective criteria for precision. Sample sizes are allocated to be proportional to the relative stratum sizes (number of households per stratum) as approximated by the average of estimated stratum sizes from the 2002-2006 surveys. Allocation of samples between the two survey types is set so that the expected responses from each type would be approximately equal. The sample size needed to meet the objectives is derived empirically from past percentile confidence intervals calculated by using bootstrap techniques. The number of responding households for all strata is expected to be somewhat less than 11,000.

Reminder letters and questionnaires are mailed to nonrespondents. Responses from the households by mailing are used to provide information used to correct for nonresponse bias as outlined in Appendix A. The dates for sending the reminder letters and questionnaires are chosen to allow for adequate opportunity to respond to the previous mailing (see notes below regarding this issue). Households that fail to respond to the first mailing within a specified time period are sent a second mailing (first reminder). Households that don't respond to the second mailing are sent a third mailing (second reminder). Nonresident households with licenses purchased after mid-July are not sent a third mailing (second reminder).

The supplementary survey questionnaire is mailed to a stratified random sample of about 24,000 sport fishing households from the incomplete 2006 sport fishing household computer file described above. The same strata identified for the standard survey are used for the supplementary survey. Since 2001 the supplementary survey questionnaire has been formatted as a "split-ballot" survey instrument to address question order bias issues. Specifically, half of the households surveyed are sent one type of supplementary survey (charter/guided fishing activities first), and the other half is sent the other type of survey (charter/guided second). Households to receive each type of questionnaire are selected at random.

In addition to the news release, each mailing of the questionnaires for each survey is accompanied by a cover letter that describes the purposes of the survey and the importance of their participation. In addition, first and second reminder cover letters note that a response to the previous mailing had not yet been received, and re-emphasize the importance of responding. As with the news release the main purpose of the cover letters is to improve overall response rates.

#### *Data Collection:*

Each questionnaire consists of a cover letter, instructions, area descriptions, maps, and pages on which to record participation, catch, and harvest by area. The standard questionnaire collects effort, catch, and harvest data by species and site in each of 26 defined areas of the state (SWHS Areas). The number of anglers, number of trips, and number of days fished are collected on a site-specific basis only, i.e., effort information is not associated with target species. Sites are designed to correspond with major ports or fisheries and have changed over the years to improve the accuracy of reporting. Questionnaires include spaces for reporting fishing sites not listed on the form. The standard questionnaire lists halibut, rockfish, and sharks (among other species). Rockfish and sharks information is not requested by species due to space limitations and concerns for the accuracy of the information.

The supplementary questionnaire consists of two parts: a Map/Site Booklet that contains area descriptions, fishing site names and numbers, and fish size categories, and a multi-page form with a cover letter, instructions, and space in which to record the household's sport fishing information. Respondents are asked to report participation, catch, and harvest by sites listed in the Map/Site Booklet, but can also write in unlisted sites. The list of species does not vary by area as in the standard survey questionnaire, and anglers are asked to write in unlisted species.

#### *Analysis:*

Estimates for the standard survey are obtained for each stratum by first calculating mean angler participation, catch, and harvest of each species over all sport fishing households that return completed surveys. The means from each mailing are then calculated and tested for nonresponse bias. Exponential regression models are used to correct for nonresponse bias. A nonresponse bias correction factor is calculated for individual major sport fish species, various participation parameters, and for groups of minor sport fish species. Participation, catch, and harvest for each stratum are obtained by expanding the mean estimates by the total number of sport fishing households in each stratum. Variances and confidence intervals are obtained by bootstrapping. Total estimates are obtained by summing stratum estimates. Variances and confidence intervals for the total estimates are also calculated.

Estimates of participation, catch, and harvest are obtained for the supplemental survey in a manner similar to the procedures followed for the standard survey. Differences in the questionnaire design are directed at

providing estimates of participation, catch and harvest for guided and unguided fishing. These estimates are not obtained directly from the standard survey, instead responses from the supplementary survey are used to calculate parameters to either obtain estimates independently (e.g., shellfish), or combined with parameter estimates from the standard survey (guided and unguided fishing). Other parameters that are common to both surveys may be used to estimate parameters with greater precision by grouping responses across surveys (if similar).

*More Information:*

Halibut and rockfish catch and harvest estimates are available statewide, by region, or by site using the SWHS web query tool. Shark estimates are available for Southcentral Alaska only. The query tool can be accessed at: <http://www.sf.adfg.state.ak.us/statewide/participationandharvest/index.cfm>.

The most recent published SWHS report (2004 data) is available online: <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-40.pdf>

A team of ADF&G biologists and other staff met several times in 2004 and 2005 to review and make recommendations for improving the statewide harvest survey. The programmatic review document is available online: <http://www.sf.adfg.state.ak.us/FedAidPDFs/sp07-09.pdf>

### **Saltwater Charter Logbook**

The Sport Fish Division of ADF&G initiated a mandatory charter boat logbook program in 1998. The Board of Fisheries adopted regulations requiring annual registration of sport fishing guides and businesses, and logbook reporting. The logbook and registration program was intended to provide information on actual participation and harvest by individual vessels and businesses. Information on the amounts and locations of charter activity were needed by the Board of Fisheries for allocation and management of Chinook salmon, rockfish, and lingcod, and by the North Pacific Fisheries Management Council for allocation of halibut. In 2005 the Alaska legislature adopted statutes requiring guide and business licensing. The previous licensing of charter vessels through the Commercial Fisheries Entry Commission was repealed and replaced with vessel registration through the ADF&G logbook program.

Since 1998, the logbook design has undergone annual revision, driven primarily by changes or improvements in the collection of halibut and rockfish data. Halibut information was not collected from 2002 through 2005. With resumption of halibut data collection in 2006, the logbook was redesigned to require reporting of angler license numbers and the harvest and release numbers by angler in an effort to improve reporting and facilitate evaluation of the quality of logbook data.

This project updates and maintains a statewide database on the numbers of saltwater charter vessels and associated businesses, and their activities. The data are compiled to show where fishing occurs, the extent of participation, and the species and numbers of fish caught and harvested by individual clients. This information is essential for regulation and management of fisheries, for project evaluation, and for formulation of department policies and priorities that reflect angler needs, concerns, and preferences. Following is a summary of the logbook program. Full details are available in Sigurdsson (2007).

*Design:*

A logbook record is required for every charter vessel trip, defined as an outing with one group of clients that ends when the clients and their fish (if fish were kept) are offloaded. For trips returning to a dock, the logbook must be completed before offloading any clients or fish. For trips returning to sites without docking facilities, the logbook must be completed before the vessel or guide departs the landing site and before offloading any fish or clients from the vessel. Every fishing trip taken with clients must be recorded in the manner specified in the logbook. For the 2007 season, all activity between January 1 through April 1 was required to be submitted to ADF&G by April 16. Activity after September 30, 2007 must be postmarked or returned to ADF&G by January 15, 2008. Activity during the primary fishing season (April 2 – September 30, 2007) was required to be postmarked or returned to ADF&G according

to a weekly schedule as printed on the inside cover of the logbook. The final deadline for receipt of all 2007 data is January 15, 2008.

In 2007 about 4,500 logbooks were printed in Anchorage and sent to ADF&G regional and area offices throughout the state for distribution. Logbooks are issued in Seward and Valdez by tackle shop employees trained by Sport Fish Division logbook staff. Logbooks are mailed to remote guide businesses on request. Vessel registration and issuance of required vessel stickers happens at the time of logbook issuance. Instructions and statistical area maps are bundled with logbooks. Logbook pages include a pressure sensitive copy for the operator's records. Business owners can also submit a notarized affidavit to request a copy of their historical logbook data in electronic format.

#### *Data Collection:*

Each trip is associated with an individual licensed business and guide. Data collected include the date of trip; port or site of off loading; number of paying clients on the vessel (including those that did not fish, but not including "comped" anglers); primary statistical area fished; target species category (bottomfish, salmon, or both); number of boat hours fished; individual license or PID numbers of each crew, client, and "comped" angler; residency information (Alaska resident/nonresident); whether the angler was a client, crew, or "comp," and a listing of numbers of fish kept and released by each individual angler. Before 2006 the total numbers of fish kept and released were reported separately for clients and crew. Since 2006 catches have been reported by individual angler.

Halibut data was collected during the years 1998-2001 and 2006-2007. Before 2006, rockfish data were reported by pelagic and "other species" categories. Beginning in 2006, rockfish catch information was requested for pelagics, yelloweye, and all other non-pelagic (demersal and slope) species. Salmon shark information has included numbers of fish kept and released (1998, 2000-2006) and numbers kept only (2007). The column for released salmon sharks was dropped because operators recorded large numbers of spiny dogfish released in the salmon shark released column, effectively rendering that data useless.

Throughout most of Southcentral Alaska operators are asked to record the primary ADF&G groundfish/shellfish statistical area fished for bottomfish and salmon. In the Kodiak/Aleutian Islands portion of Southcentral Alaska, only salmon harvest is recorded by ADF&G salmon statistical area. Throughout Southeast Alaska statistical areas based on salmon stat areas are used for salmon and bottomfish. Some of the larger areas are subdivided to align with management area boundaries. The salmon stat areas do not extend beyond 3 nautical miles from shore. When fishing in federal waters beyond 3 miles, operators typically report the closest salmon stat area.

#### *Data Entry:*

Completed logbooks are returned to any ADF&G office. Incoming logbooks are date stamped and logged, then forwarded to Anchorage for review, final data entry, and archival. Review consists of scans for missing business and guide information, missing dates, missing statistical areas, invalid or missing fishing license numbers, etc. Follow-up calls are made to operators if necessary before and during keypunching. Data entry and editing programs flag problems such as harvest in excess of bag limits or harvest during closed seasons, and outlier reports are sent to area management staff for review and comment. These reports may again trigger follow-up calls to charter operators to resolve minor problems. Additional variables are added to the database to document data entry and editing, and to facilitate summarization of data by IPHC area or state management areas.

#### *Outreach and Verification:*

Increased emphasis was placed on outreach and data validation with redesign of the logbook in 2006, particularly during the early part of the season. Port samplers and management staff offered to conduct "courtesy logbook inspections" to make sure that logbooks were filled out correctly and answer any questions about how they should be filled out. Logbook data entry staff telephone charter operators to

resolve logbook reporting issues and improve future reporting. These calls were intended to improve data quality and reinforce the message to the guide industry that logbook data is important and is constantly being reviewed.

In December 2005, the Commissioner of Fish and Game issued a statement that detailed strategies for assuring the accuracy of reporting of Pacific halibut harvest for the saltwater charter logbook. These strategies included onsite (in the field) and off-site (from the Anchorage ADF&G office) verification procedures (Sigurdsson 2007, Appendix F1).

Onsite verification in 2006 and 2007 involved only total counts of harvested fish because much of the effort information, such as hours or statistical areas fished and numbers of fish released could not be observed. Whenever possible, creel survey and port sampling technicians counted and recorded numbers of harvested halibut, pelagic rockfish, non-pelagic rockfish, lingcod, and salmon sharks observed during interviews with charter vessel operators. Counts were not made at the expense of the technician's other primary duties or at the expense of regular activities conducted by the charter operation, so they were available for a portion of the boat trips only. Technicians were instructed to check with the skipper to ensure that no other fish were offloaded or still on board. Procedures for verifying fish counts are described in detail in the regional creel survey and port sampling operational plans. In addition to verification by regular creel survey crews, an additional sampler was employed in 2006 only to conduct logbook outreach and education and verify numbers of halibut only. This technician roved between Homer, Anchor Point, Ninilchik (Deep Creek beach), and Seward, with sampling effort distributed among the ports in proportion to the average number of bottomfish charter trips reported in logbooks during 2002-2005. The main purpose of this position was to increase the proportion of trips with halibut harvest that was verified, but it was also valuable from the standpoint of outreach and enforcement.

In 2006 ADF&G professional management staff also conducted courtesy logbook inspections and some enforcement checks that included counting and recording of harvested fish. These data were recorded and merged with the verification data from creel survey technicians for later evaluation.

Off-site verification consisted of a post season mail-out survey (post card) sent to randomly selected charter clients. The sampling frame was the list of license numbers recorded in logbooks, cross-referenced with the licensing database for acquisition of mailing addresses.

Logbook data will be compared to counts from verified and unverified onsite interviews at the boat-trip level. In addition, logbook data will be compared to estimates from the SWHS at the management area level. These comparisons are ongoing and are part of a more comprehensive evaluation of logbook data quality. A draft of this report is expected to be ready by the spring of 2008.

### **Southeast Alaska Creel Survey**

Creel surveys and harvest sampling have been conducted in some Southeast Alaska boat fisheries since 1972. The Southeast Alaska creel survey and catch monitoring program was primarily established to monitor harvest and hatchery versus wild contributions of Chinook salmon for compliance with the U.S./Canada Pacific Salmon Treaty and allocations of Chinook salmon by the Alaska Board of Fisheries. The program also provides estimates of coho and pink salmon harvest at selected ports, hatchery contributions and catch rates of coho salmon, sport and personal use shellfish effort and harvest of Dungeness crab, king crab, and shrimp, and lingcod harvest and mean weight. Specific objectives with respect to halibut and rockfish listed in the project operational plan (Jaenicke 2007) are:

1. Estimate the sport harvest of halibut and rockfish at Juneau, Sitka, and Ketchikan such that the estimates for each species are within 20% of the true value with 90% confidence,
2. Estimate the mean net weight of halibut harvested at Sitka, Juneau, Ketchikan, Craig/Klawock, Petersburg/Wrangell, Gustavus/Elfin Cove, and Yakutat such that the weighted mean is within 10% of the true mean with 90% confidence, and

3. Estimate the mean round weight of rockfish harvested at Sitka, Ketchikan, Craig/Klawock, and Yakutat such that the weighted mean is within 10% of the true mean with 90% confidence.

This project also receives funding for halibut data collection through a grant from the NOAA Office of Sustainable Fisheries. Objectives listed for that grant are to estimate:

1. The average net weight and harvest biomass of halibut harvested by both chartered and non-chartered anglers in each port surveyed in Southeast (IPHC Area 2C) and Southcentral (IPHC Area 3A) Alaska.
2. The geographic distribution of bottomfishing effort and harvest by both chartered and non-chartered anglers interviewed by port.
3. The length composition of halibut landed at each port.

In addition to these objectives, additional information is gathered related to management of salmon and Dolly Varden fisheries. Full details can be found in the project operational plan (Jaenicke 2007). A copy of the operational plan is sent to the IPHC nearly every year for their review of halibut estimation procedures. The remainder of this section will focus on procedures for halibut and rockfish. Although there are no objectives related to shark fisheries, a limited amount of information on numbers of fish harvested were collected at Elfin Cove in 2007.

#### *Design:*

Halibut and rockfish harvest is estimated with direct expansion creel surveys. A three-stage design is used at Ketchikan and Juneau. The first stage is the days to sample, which are selected at random. The various access sites (harbors and boat ramps) represent the second stage. At least two sites are selected randomly without replacement for sampling each day. The third stage is the boat-parties to be interviewed. The creel technician attempts to interview all exiting boat-parties at each site and tallies missed parties. A four-stage design is used for the Sitka survey. The four stages are (in order): access locations, days to sample, periods within the sampling day, and boat-parties. Inclusive dates sampled in 2007 were April 23-September 23 at all three ports.

Halibut harvested at all surveyed fisheries are measured to estimate mean net weight. Priority is given to halibut biological sampling on a fixed percentage of sampling days at each port. Halibut sampling days are assigned systematically. Sample size goals are established for the number of length measurements from each user group at each port. Sample size goals are established using an optimum allocation for stratified sampling (Thompson 1992) to meet the desired goals for precision of the mean weight estimates.

Rockfish landed at Craig/Klawock, Sitka, Ketchikan, and Yakutat are measured and weighed (when possible) for estimation of mean round weight.

It was quite common in some of the Southeast fisheries for a portion of the catch not to be available for sampling when the boat-party is intercepted. For example, an estimated 89% of charter-harvested halibut and 81% of private-harvested halibut arrived at the surveyed docks in Sitka in with incomplete bags in 2006. Before 2007 anglers were allowed to clean halibut and dispose of carcasses at sea as long as it was done in a manner that did not prevent determination of the number of fish caught. Effective June 1, 2007, NMFS regulations prohibited charter boats from cleaning at sea unless the carcass of the fish was retained intact, allowing a length measurement. This regulation was put into place to allow enforcement of the 32-inch maximum size limit on at least one of the fish in the daily bag limit for charter anglers. Creel survey technicians are instructed to measure halibut only if all of the boat-party's fish (or carcasses) are available to be sampled. In the case of rockfish, partial bag limits can be sampled as long as all fish of a given species are available.

### *Data Collection:*

The following information is recorded during creel survey interviews: Location sampled, number of rods fished, hours fished, trip type (charter or private), number of days in trip, primary statistical area fished, target category (bottomfish, salmon, or both), and numbers of fish kept and released by species (except sharks). In 2007 only, the numbers of halibut released were recorded by size class ( $< 32$  in or  $\geq 32$  in) and hook type (circle hook or “other” hook type). The same statistical areas are used as for logbooks. Charter skippers are interviewed for all charter trips to help ensure that the most accurate information is obtained. Logbook numbers and boat names were recorded for all charter vessels interviewed. Whenever possible, technicians counted and verified the reported numbers of fish harvested for later comparison to logbook data.

Fork length of halibut and total length of rockfish are recorded to the nearest millimeter. Halibut measurements are coded to indicate whether they are from whole fish or carcasses. Sex is not determined on either halibut or rockfish, and no age structures are collected. Rockfish are weighed using a digital hanging scale to the nearest 0.01 kg.

All data are recorded in the field on weather-resistant, machine-readable Mark Sense forms. Forms are scanned and converted to digital format as the season progresses. Halibut length data from Yakutat are edited and forwarded to Southcentral Alaska staff for inclusion in the Area 3A estimates.

Efforts are made to ensure that data collection procedures are standardized throughout the region. Technicians are supplied with the project operational plan which includes a creel technician manual outlining all sampling and data recording procedures (Jaenicke 2007; Appendix A1). Nearly all new creel survey technicians are provided with at least a 2-day onsite training session at the beginning of the season with either their crew leader or project supervisor.

### *Analysis:*

Procedures for analysis of creel survey estimates are described in detail in Jaenicke (2007). Procedures for estimation of halibut and rockfish mean weight and harvest in pounds are similar to methods used in Area 3A and are described later in the “Harvest Estimation and Projections” section of this paper.

### **Southcentral Alaska Halibut and Groundfish Harvest Assessment Project**

Unlike the Southeast creel survey program that was designed primarily to monitor salmon fisheries, the Southcentral sampling program was established specifically to monitor the recreational groundfish and halibut fisheries. The program primarily collects information on the composition of the harvest, and harvest is not estimated. Specific objectives with respect to halibut and rockfish have not changed substantially over the years and include (Meyer 2007):

1. Estimate the mean net weight and harvest biomass of halibut taken by each user group (charter/private) in each subarea of IPHC Area 3A (Kodiak, Lower Cook Inlet, Central Cook Inlet, North Gulf, and Eastern and Western Prince William Sound) and in Area 3A overall such that the mean weight estimates for each user group and subarea are within 10% of the true estimates with 90% confidence.
2. Estimate the length composition of the halibut harvest by subarea such that the estimated proportions of harvest in each length class are within 0.10 of the true proportions with at least 95% confidence.
3. Estimate the species composition of the rockfish harvest landed at Kodiak, Homer, Seward, Whittier, and Valdez during May through September such that the estimated proportions of each species are within 0.10 of the true proportions with at least 95% confidence.

4. Estimate the age, length, and sex composition of the principal rockfishes landed at Kodiak, Homer, Seward, Whittier, and Valdez during May through September such that the estimated proportions are within 0.10 of the true proportions with at least 95% confidence.
5. Estimate the geographic distribution of bottomfish effort and harvest by user group (e.g., private and charter) at each port during May through September such that the estimated proportions are within 0.10 of the true proportions with at least 95% confidence.

This project is also funded in part for collection of halibut data by NOAA Sustainable Fisheries. The objectives of that grant overlap with the above list and aren't repeated here.

Additional tasks include:

1. Estimate the proportions of the halibut harvest that was cleaned (and carcasses discarded) at sea at each port. These estimates may be needed to stratify estimates of mean weight or length composition (Objectives 1 and 2) at Homer. In addition, they provide information to evaluate potential bias of estimates at other ports due to cleaning at sea.
2. Estimate the proportions of released halibut that were caught on circle hooks versus non-circle hooks at each port. This information is needed to refine estimates of halibut release mortality in the sport fishery. This task was new for 2007.
3. Gather data on the depths of capture for pelagic and non-pelagic rockfish that were released. This information was collected on a trial basis for estimation of rockfish release mortality. This task was also new in 2007.

In addition, biological data have been collected since 1998 from salmon sharks, Pacific sleeper sharks, and spiny dogfish harvested in the recreational fishery in order to estimate the age, length, sex composition, and spatial distribution of harvest. No sampling objectives have been established for sharks because harvests are too small to generate reliable estimates for any given year. It is hoped, however, that age, length, and sex data can be compiled across a number of years and combined with commercial harvest sampling and other research programs to estimate life history parameters.

Full details of the study design, data collection, and analysis are found in the project operational plan (Meyer 2007). This operational plan is sent to the IPHC nearly every year for review of halibut estimation procedures.

#### *Design:*

A single technician is assigned to each of six ports (Kodiak, Homer, Deep Creek/Anchor Point, Seward, Whittier, and Valdez). The sampling season generally extends from mid- to late May to early September, with some variation from year to year.

Sampling consists of collection of biological data from harvested fish and interviews with charter boat skippers and private boat anglers. At all ports except Kodiak and Whittier, biological sampling and interviews are conducted on separate days. Five days per week are sampled, with two consecutive days off chosen at random. At ports other than Kodiak and Whittier, three biological sampling days and two interview days are selected at random such that each type is distributed proportionally between weekends and weekdays to minimize bias due to differences in user group composition. An effort is made to distribute interview and biological sampling effort between Deep Creek and Anchor Point proportional to harvest so those data can be pooled. Sampling hours and procedures vary somewhat by port but are described in detail in Meyer (2007).

On interview days, technicians attempt to obtain interviews for all boats on which halibut or groundfish were targeted or caught. Angler parties that target salmon and don't catch any halibut or groundfish are not interviewed. Biological sample size goals are set for halibut based on the standard sample size equation for estimating the population mean (Thompson 1992). Pilot values are selected from the year

with the highest CV during the last three years. Rockfish sample size goals are set for each port to provide at least 127 fish of the least common “primary” species in the harvest. The 127 figure is the minimum sample size for estimation of age or length composition to the desired criteria (Thompson 1987). The least common “primary” species is yelloweye rockfish at most Southcentral Alaska ports.

As in Southeast Alaska, samplers commonly encounter boats with a portion of their harvest already cleaned and carcasses disposed of at sea. This does not cause bias unless the length composition of these fish differs from the landed fish. Homer typically is the port with the highest proportion of charter-caught fish cleaned at sea (22-49% in recent years), and these fish are included in the Homer charter sample for estimation of mean weight. A list of vessels that clean at sea is identified, and a vessel is selected at random each day and provided with tubs in which to retain the carcasses of fish cleaned at sea. Average weight for the Homer charter fleet is then calculated as a weighted mean (Meyer 2007), with weights determined from interview data. Technicians at all ports are instructed not to sample the catch unless all of the fish (or intact carcasses) of each species (or all rockfish) have been returned and are available for sampling.

#### *Data Collection:*

The following information is recorded during interviews: Location sampled, time of interview, duration of trip in days, whether the trip is the first or second of the day (to facilitate logbook comparisons), total number of angler-days of fishing effort, hours fished, trip type (charter or private), primary statistical area fished, target category (several codes), and numbers of fish kept and released by species (including sharks). Numbers of halibut cleaned at sea are recorded and monitored as a potential source of bias, and are used in calculation of the charter mean weight for Homer. The numbers of halibut released were recorded by hook type (circle hook or “other” hook type) in 2007 only. Numbers of rockfish kept and released are reported by management assemblage (pelagic vs. non-pelagic), and the depth of capture was recorded in 2007 only for all released rockfish. The same statistical areas are used as for logbooks. Charter skippers are interviewed for all charter trips to help ensure that the most accurate information is obtained. Logbook numbers and boat names were recorded for all charter vessels interviewed.

Fork length of halibut and total length of rockfish are recorded to the nearest centimeter. Rockfish are weighed with a spring scale to the nearest 0.1 kg. Sex is determined for both species based on direct examination of gonads. The left otolith of halibut and both otoliths of rockfish are removed for age determination. The posterior dorsal fin spine is removed from dogfish, and a 15-20 cm long section of vertebrae is removed from the gill area of salmon sharks. Halibut otoliths are forwarded to the IPHC for ageing (ADF&G aged halibut otoliths before 1998). Rockfish otoliths are aged using the break-and-bake method. Dogfish spines are aged following procedures outlined in Ketchen (1975) and Nammack et al. (1985). Salmon shark vertebrae are frozen upon collection, then soaked in alcohol, sectioned and mounted on glass slides, and aged following Goldman (2002 and 2005).

Prior to 2007 all data were recorded on weather-resistant, machine-readable Mark Sense forms. Forms were scanned and converted to digital format at the end of the season. In 2007 interview data were entered directly into field computers with a custom data input application with error trapping and lookup tables. Biological data were entered directly into protected Excel spreadsheets with data validation checks.

Efforts are made to ensure that data collection procedures are standardized throughout the region. Technicians are supplied with the project operational plan and a separate Field Procedure Manual that provides background management and biological information, in-depth descriptions of sampling procedures, and detailed administrative information. All technicians receive 2-3 days of hands-on training with periodic visits from the supervisor, and data quality is monitored inseason.

*Analysis:*

Procedures for analysis of creel survey estimates are described in detail in Meyer (2007). Procedures for estimation of halibut and rockfish mean weight and harvest in pounds are similar to methods used in Area 2C and are described in the following section.

## HARVEST ESTIMATION AND PROJECTIONS

### Halibut Harvest Estimation

Many halibut are filleted or gutted before the technician reaches the sampling site. Since many fish cannot be weighed, the IPHC length-weight relationship is employed to estimate the mean net weight of all measured halibut. Mean net weight is estimated for each user group ( $g$ ) in each SWHS area ( $a$ ) as the mean of the predicted weights over all  $n_{ga}$  sampled fish (Nielsen and Schoch 1980):

$$\bar{w}_{ga} = \frac{\sum_{k=1}^{n_{ga}} \alpha L_{gak}^{\beta}}{n_{ga}}, \quad (1)$$

where  $L_{gak}$  = the observed length of fish  $k$  (to the nearest cm),  $\alpha = 6.921 \times 10^{-6}$  for net weight in pounds, and  $\beta = 3.24$  (Clark 1992). According to Dr. William Clark (IPHC, personal communication), no correction need be made for transformation bias because the length-weight relationship was based on a large sample and the residual variance is extremely small. Variances of the mean predicted weights are estimated using standard normal procedures but considered minimum estimates because variation inherent in the length-weight relationship is not incorporated. Mean weight estimates are presented in pounds net weight (headed and gutted) rather than kilograms because that is the standard unit used by halibut management agencies.

The accurate estimation of mean weight assumes that the samples are representative of the sizes of fish harvested in each area. This may not be true if average weight changes over time and sampling is not proportional to harvest. Cleaning of halibut at sea can also introduce bias if there is a tendency to clean small fish. Sampling dates, locations, and hours of the day are chosen to maximize the percentage of harvest encountered by sampling, but incomplete temporal or spatial coverage is a potential source of bias. For example, halibut are not sampled at some road accessible lodges in Southeast Alaska, or at remote lodges in Southeast Alaska and on Kodiak Island. Sampling is sometimes restricted to a portion of the season at some ports. In Lower Cook Inlet, sampling is only conducted at the Homer harbor, and the small charter fleet operating out of Seldovia and numerous private access points on the south side of Kachemak Bay are unsampled.

Except as noted below, harvest biomass  $B$  is estimated for user group  $g$  in SWHS area  $a$  as:

$$\hat{B}_{ga} = \hat{H}_{ga} \hat{w}_{ga}, \quad (2)$$

where  $\hat{H}_{ga}$  = the Statewide Harvest Survey estimate of number of halibut harvested, and  $\hat{w}_{ga}$  = the estimated mean weight of halibut harvested by user group  $g$  in area  $a$ .

Mean weight for charter harvest in Lower Cook Inlet area is estimated as a weighted mean for fish cleaned in port and fish cleaned at sea. Equations are provided in Meyer 2007 (Appendix D).

The variance of the estimated harvest biomass is estimated as (Goodman 1960):

$$v(\hat{B}_{ga}) = \hat{H}_{ga}^2 v(\hat{w}_{ga}) + v(\hat{H}_{ga}) \hat{w}_{ga}^2 - v(\hat{H}_{ga}) v(\hat{w}_{ga}). \quad (3)$$

Harvest biomass point estimates are summed over SWHS areas to estimate harvest biomass by user group for each IPHC Regulatory Area (2C or 3A). The average weight for each user group  $g$  is estimated by dividing the summed biomass estimates by the summed harvest estimates:

$$\hat{w}_g = \sum_a \hat{B}_{ga} / \sum_a \hat{H}_{ga}, \quad (4)$$

Variance of the average weight for each user group is obtained with Markov-Chain Monte Carlo methods using the Bayesian program WinBUGS (Gilks et al., 1994). Normal sampling error is assumed for average weights and harvest estimates.

Overall average weight is estimated as:

$$\hat{w} = \hat{B} / \hat{H} = \sum_g \hat{B}_g / \sum_g \hat{H}_g = \sum_g \sum_a \hat{B}_{ga} / \sum_g \sum_a \hat{H}_{ga}, \quad (5)$$

with estimated variance:

$$v(\hat{w}) = \frac{1}{\hat{H}^2} \left[ \frac{\hat{v}(\hat{H}_1) [\hat{w}_1 \hat{H}_2 - \hat{B}_2]^2}{\hat{H}^2} + \frac{\hat{v}(\hat{H}_2) [\hat{w}_2 \hat{H}_1 - \hat{B}_1]^2}{\hat{H}^2} + \hat{v}(\hat{w}_1) \hat{H}_1^2 + \hat{v}(\hat{w}_2) \hat{H}_2^2 \right] \quad (6)$$

where subscripts 1 and 2 index charter and private user groups, respectively.

### Halibut Harvest Projections

Each fall the IPHC performs a stock assessment to estimate the exploitable biomass and make halibut catch limit recommendations for the following year. The total allowable removals for the upcoming year are determined as a percentage of the exploitable biomass under the current IPHC fixed exploitation rate harvest strategy. The total allowable removals is called the constant exploitation yield, or CEY. Because the halibut stock has not been allocated to specific user groups, sport harvest is deducted (along with subsistence harvest, legal-size waste, and legal-size bycatch in other fisheries) from the CEY. The remainder is available to be harvested by the commercial fishery, subject to other considerations.

Since at least the early 1990s the IPHC has deducted an end-of-season projection of the most recent year's harvest from the CEY when determining the commercial fishery catch limit. Even with this one-year lag, the deduction will tend to underestimate the sport removals if they are increasing. There are consequences to both positive and negative projection error. If the projections exceed the actual harvest (or final estimate of it), the commercial fishery catch limits are set lower than they otherwise would have been. If the projections are too low, there is a risk that the removals will exceed the CEY.

ADF&G first provided projections at the request of the IPHC in 1996. With the exception of 2006, annual projections (numbers of fish) for Southeast Alaska were based on either the moving average of the ratio or the linear regression between the inseason creel survey estimates for sampled ports (primarily utilizing data from Ketchikan, Juneau, and Sitka) and the SWHS final estimates. The linear trend projection based solely on SWHS data was used for Area 2C in 2006 largely because creel survey interview data had not yet been compiled due to diversion of data entry staff to logbooks. In addition, the creel survey ratio method had consistently been under-projecting harvest relative to the final estimates.

The first Area 3A projections in 1996 were linear trend forecasts from the previous 6 years of SWHS harvest estimates, with the charter and non-charter proportions assumed to be the same as the most recent SWHS estimates. The basis of the linear projection was the previous 7 years in 1997 and the previous 8 years in 1998. In 1999 a retrospective evaluation showed that projections based on the previous 5 years had the lowest average percent error (for charter and private combined), and the 5-year basis has been used since with periodic evaluation. Starting in 2000 the projections were made separately for charter and

private by SWHS area and summed. SWHS estimates were produced for eastern and western Prince William Sound (PWS) beginning in 2001. In 2004 the PWS projections were based on the previous 3-year trend in each section, and the previous 4-year trend was used to project 2005 harvest. The PWS sections were separated to better reflect the increasing harvest in the western sound due to increased access provided by the Whittier tunnel improvements.

The time series of annual projections from all methods and final estimates of charter harvest are shown in Figure 1. Because the mean weight for the current year is applied to the projections of the harvest in numbers, almost all of the error in the harvest biomass projections is due to error in projecting numbers of harvested fish. Errors ranged from -22.6% to +17.7% for the Area 2C charter fishery, and from -13.8% to +24.4% in Area 3A. The average absolute errors in predicting charter harvest were 14.2% in Area 2C and 8.8% in Area 3A. Figure (1) clearly shows there is considerable variation from year to year in harvest, with no predictable pattern.

As stated earlier, the projections were originally developed to assist the IPHC by providing “ballpark” estimates of sport harvest for partitioning the annual CEY. ADF&G didn’t start reporting the charter and private projections separately to the IPHC until 2000. They were never intended to be used by the Council to make long-term allocation decisions for the charter fishery. In the case of the projections used in Area 3A (and in 2C in 2006), they were simply projections of past trends and the only real data from the current year were the average weights.

In 2007 the IPHC did not deduct the charter projections from the CEY, but opted instead to deduct the guideline harvest levels of 1.432 M lb Area 2C and 3.650 M lb for Area 3A under the philosophy that these were the management targets that would be adhered to through NPFMC or NMFS action. If the IPHC continues to deduct the GHs under the assumption that the charter fisheries will be managed to stay within them, then only the private harvest will need to be projected.

Some SSC members suggested that double exponential smoothing might improve the recent forecasts of numbers of fish harvested. This was evaluated recently with a retrospective comparison of 3-7 year linear trend forecasts with double exponential forecasts of charter harvest. The methods were evaluated by comparing the mean squared deviations and mean absolute deviations over the years for which a forecast was possible for each method (2002-2006). Double exponential forecasts were generated using Mintab™, with optimal smoothing parameters obtained by minimizing the mean squared deviations (default option). The results show that the double exponential method performed slightly better than the 5- or 6-year linear trend projections for Areas 2C and 3A, but the 5-year linear projections were within the confidence intervals of the double exponential forecasts (Table 1).

Staff of ADF&G would appreciate any suggestions from the SSC to improve the time series projections. The available time series of harvest data for Areas 2C and 3A are listed in Tables 2 and 3. Average weights are listed in Tables 4 and 5. These estimates and their standard errors can be provided electronically upon request. We are also looking for alternate ways to model the ratio between creel survey estimates and SWHS estimates to improve the Area 2C projections. This approach seems most promising because it takes advantage of actual data from the year in question. For the same reason, we are also searching for indices of sport harvest in Area 3A that could be used to improve the accuracy of the forecasts and be available in time to make projections. Some examples found so far include numbers of boat launch passes sold in Whittier and amounts of fish carcasses ground in the Homer harbor.

## **Rockfish**

Rockfish harvest (in pounds) is estimated using the same basic equations described above for halibut, except that calculations are done separately for each species or assemblage, and may be done with pooled user group data.

Estimates of recreational removals in the Southeast Outside Area were provided for the 2006 demersal shelf rockfish assessment. Information from the SWHS, creel surveys, and charter logbooks were combined to obtain estimates of total mortality including discards. A discard mortality rate of 100% was assumed. The methods and assumptions of estimation are documented in O'Connell (2005; pp 785-786). Average weights from the commercial harvest were used because there was no length data from the sport harvest. ADF&G began collection of length and weight data from sport-harvested rockfish in Southeast Alaska in 2006.

For Southcentral Alaska, Meyer (2000) estimated mean weight for each species using length-weight parameters estimated for species with adequate sample sizes, and length-weight parameters for assemblages (pelagic shelf, demersal shelf, and slope) for less common species. The general linear model was used to test for differences in length-weight parameters among ports, years, and sexes. Species composition was estimated using standard normal equations for proportions.

Discard mortality has not yet been estimated for Southcentral Alaska. Estimates of the numbers of released fish are available from the SWHS, and indicate that the release component is nearly as large as the harvest in recent years (Meyer and Stock 2002). Interview data indicate that pelagic shelf species make up the great majority of released rockfish except in Prince William Sound. Depth of capture information was collected through onsite interviews beginning in 2007 to develop estimates of discard mortality. Size data are not available from released fish.

## **Sharks**

SWHS estimates of shark harvest (all species combined) are only available from the SWHS since 1996. Standard errors are quite large and there is concern among ADF&G staff over the accuracy of these estimates. Spiny dogfish and salmon shark are the most common species caught in the recreational fishery. Although spiny dogfish are caught in high numbers at times in some areas, very few are retained. Anecdotal reports from charter clients and private anglers suggest that spiny dogfish are poorly handled when released, to the degree that there is probably a substantial mortality of discards. Estimation of dogfish removals in the sport fishery would be difficult given the lack of information. The SWHS estimates of shark harvest might be apportioned by species using onsite interview data in Southcentral Alaska, but sampling was not designed to optimize data collection for sharks. Sample sizes are too small to produce reliable estimates of species composition. No information on spiny dogfish catch has been collected in Southeast Alaska, and only 60 spiny dogfish were sampled from the harvest throughout Southcentral Alaska from 1998 to 2006.

Spiny dogfish incidental catch rates have been summarized for Southcentral Alaska bottomfish fisheries. These catch rates are not considered to be reliable indicators of relative abundance because they are not standardized and most charter boat operators and private anglers actively avoid them.

Estimation of salmon shark harvest appears more straightforward. Logbook data are probably the best source of data on numbers of salmon sharks harvested because charter anglers account for the vast majority of harvest. Size and sex data are available for salmon sharks from port sampling in Southcentral Alaska only. Length, sex, and age data were collected from 332 harvested salmon sharks throughout Southcentral Alaska from 1998 to 2006. Average round weight is estimated from the length weight relationships:

$$w(kg) = 3.2 \times 10^{-6} PCL(cm)^{3.383} \text{ for males, and}$$

$$w(kg) = 8.2 \times 10^{-5} PCL(cm)^{2.759} \text{ for females (Goldman and Musick 2006).}$$

Estimates of salmon shark harvest by weight have not yet been assembled, but it should be a straightforward matter of multiplying average weights by numbers harvested from the logbooks. Expanding the estimates to account for unguided harvest may be possible using long-term average

proportions of harvest by charter and private anglers. Catch and release mortality is a concern for managers but there is practically no information available that could be used to estimate the post-release mortality rate.

Data are also available to estimate age composition of the recreational harvest. Goldman (2002) first aged salmon sharks using vertebral sections, many of which were collected from the Southcentral Alaska recreational fishery. Since then, ADF&G Sport Fish Division has collected over 200 more vertebrae and is working with Dr. Goldman to re-estimate growth parameters for male and female salmon sharks.

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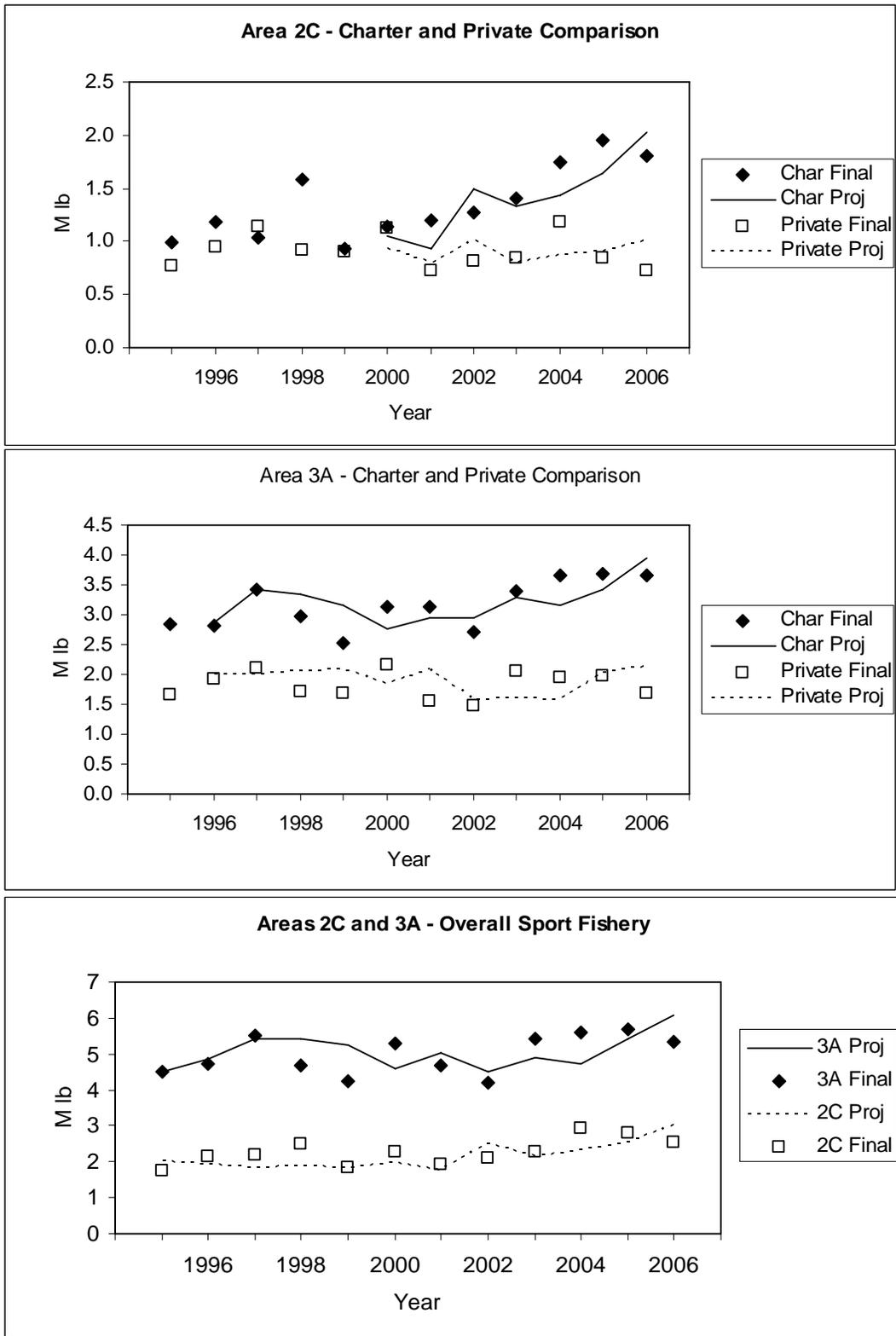
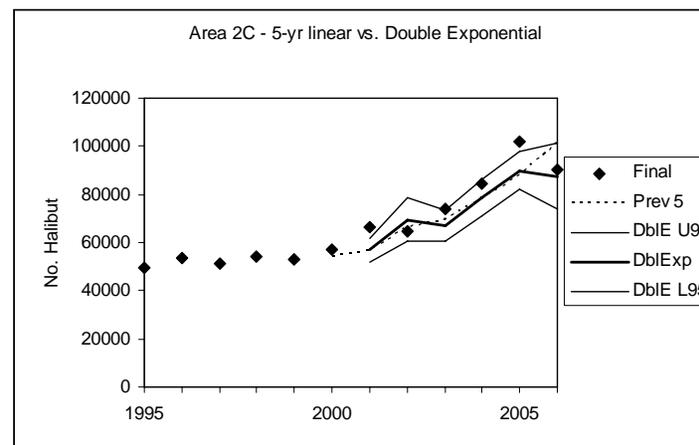


Figure 1. Comparisons of ADF&G end-of-season harvest projections to final mail survey estimates produced the next year, 1995-2006.

Table 1. Comparison of linear trend and double exponential forecasts of charter harvest (numbers of fish) for Areas 2C and 3A. Forecasts were generated from statewide mail survey estimates (Final CharHarv) and compared on the basis of the mean squared deviations (MSD) and mean absolute deviation (MAD) between the projection and the mail survey estimate.

Area 2C											
Year	Final CharHarv	Forecasts					DbIExp	DbIE L95	DbIE U95		
		Prev 3	Prev 4	Prev 5	Prev 6	Prev 7					
1995	49615										
1996	53590										
1997	51181										
1998	54364	53028									
1999	52735	53819	55147								
2000	57208	54314	53122	54401							
2001	66435	57613	57985	56453	56974		56944	52114	61773		
2002	64614	72493	67857	66390	63987	63483	69490	60359	78621		
2003	73784	70158	71464	69331	68541	66650	67008	60778	73238		
2004	84327	75627	77487	77806	75720	74619	78453	70865	86041		
2005	102206	93955	88002	87750	87104	84694	89969	82064	97874		
2006	90471	110587	107580	101424	99404	97551	87517	73921	101114		
MSD 2002-2006 (x10E6):		124.73	111.43	78.89	81.97	100.64	<b>52.53</b>				
MAD (%):		11.55	9.82	8.55	8.59	9.58	<b>7.79</b>				



Area 3A											
Year	Final CharHarv	Forecasts					DbIExp	DbIE L95	DbIE U95		
		Prev 3	Prev 4	Prev 5	Prev 6	Prev 7					
1995	137843										
1996	142957										
1997	152856										
1998	143368	159565									
1999	131726	146804.7	150874.5								
2000	159609	121520	131931.5	138203.1							
2001	179131	161142	149044	149755.4	151291.4		186023	152944	219101		
2002	169781	204227	187251.5	173975.3	170556.5	169075.4	180090	149801	210379		
2003	184638	179679	193483.5	186792.3	178058.2	175527.3	165804	129956	201653		
2004	224315	183357	189724	199775.8	195379.2	188098	207931	172757	243106		
2005	235769	247445.3	227068.5	223970.5	227734.9	221629.3	237564	200217	274911		
2006	204115	266038.3	263036	249069.8	245328.1	247431	235110	200225	269994		
MSD 2002-2006 (x10E6):		1371.90	1025.48	556.91	528.85	694.28	<b>338.67</b>				
MAD (%):		15.30	12.61	8.32	8.10	9.74	<b>7.90</b>				

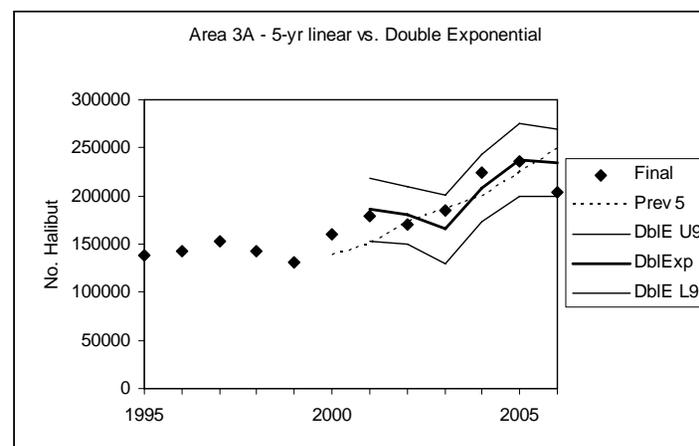


Table 2. Statewide mail survey estimates of IPHC Area 2C recreational halibut harvest (numbers of fish), by statewide harvest survey area and user group, 1977-2006.

Year	Glacier Bay		Haines-Skagway		Juneau		Ketchikan		Pburg/Wrangell		Prince of Wales		Sitka		Area 2C Overall		
	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Total
1977	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,404
1978	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,107
1979	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13,024
1980	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24,828
1981	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21,777
1982	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36,762
1983	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	41,313
1984	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	46,684
1985	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	45,594
1986	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44,251
1987	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	43,153
1988	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	54,907
1989	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	73,532
1990	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	65,031
1991	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	71,926
1992	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	70,000
1993	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	85,027
1994	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	88,740
1995	3,763	3,327	173	683	5,508	9,637	7,025	7,458	4,606	4,882	15,078	5,730	13,462	7,990	49,615	39,707	89,322
1996	4,848	2,770	353	856	7,340	9,074	6,207	9,109	4,544	5,690	17,385	5,881	12,913	7,927	53,590	41,307	94,897
1997	3,444	5,798	264	743	7,190	14,092	5,626	8,059	3,566	6,851	12,589	8,612	18,502	9,050	51,181	53,205	104,386
1998	3,559	3,631	0	564	4,807	9,746	4,222	7,089	4,723	4,272	15,748	8,280	21,305	8,998	54,364	42,580	96,944
1999	3,962	3,590	132	747	6,186	9,336	3,900	7,089	3,487	4,646	16,692	9,047	18,376	9,846	52,735	44,301	97,036
2000	4,527	9,112	0	499	6,045	10,627	5,118	8,547	3,318	6,612	17,558	11,302	20,642	7,733	57,208	54,432	111,640
2001	5,909	9,203	87	777	6,360	7,853	3,843	6,263	3,518	4,827	21,729	6,481	24,989	8,115	66,435	43,519	109,954
2002	6,666	7,656	424	796	7,455	8,192	4,578	6,188	2,675	4,067	23,231	7,729	19,585	5,571	64,614	40,199	104,813
2003	8,438	11,329	281	855	8,838	11,692	5,043	3,767	3,621	3,948	22,686	6,621	24,877	7,485	73,784	45,697	119,481
2004	10,605	13,631	296	567	6,662	12,882	9,412	10,526	5,183	6,966	20,478	10,603	31,691	7,814	84,327	62,989	147,316
2005	12,680	14,709	282	481	10,915	14,747	8,520	7,231	6,121	5,755	30,559	8,385	33,129	9,056	102,206	60,364	162,570
2006	10,114	9,315	537	368	7,043	7,600	9,210	5,328	5,627	10,174	24,781	11,486	33,159	6,249	90,471	50,520	140,991

Table 3. Statewide mail survey estimates of IPHC Area 3A recreational halibut harvest (numbers of fish), by statewide harvest survey area and user group, 1977-2006.

Year	Central Cook Inlet		Lower Cook Inlet		Kodiak		North Gulf		EPWS (Valdez)		WPWS (Whittier)		PWS		Yakutat		Area 3A Overall			
	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Total	
1977	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17,840
1978	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30,978
1979	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34,681
1980	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	39,830
1981	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	51,582
1982	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	54,799
1983	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	75,465
1984	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	77,344
1985	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	81,451
1986	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	115,619
1987	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	101,044
1988	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	168,215
1989	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	154,072
1990	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	179,482
1991	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	189,398
1992	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	192,265
1993	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	224,575
1994	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	237,784
1995	44,584	36,737	56,114	30,719	6,512	7,477	16,331	7,348	--	--	--	--	12,474	12,297	1,828	628	137,843	95,206	233,049	
1996	41,573	40,234	67,997	37,971	5,155	9,050	15,421	8,802	--	--	--	--	9,897	12,433	2,914	322	142,957	108,812	251,769	
1997	43,442	44,828	67,923	37,723	5,814	11,418	17,633	10,203	--	--	--	--	13,883	14,573	4,161	765	152,856	119,510	272,366	
1998	43,780	41,371	60,823	33,395	4,919	10,749	16,486	8,254	--	--	--	--	13,086	11,215	4,274	892	143,368	105,876	249,244	
1999	38,654	30,601	53,321	32,931	8,022	10,573	15,088	10,789	--	--	--	--	14,204	13,396	2,437	1,208	131,726	99,498	231,224	
2000	48,569	45,422	65,189	42,547	8,600	12,684	18,655	10,463	--	--	--	--	14,690	16,490	3,906	821	159,609	128,427	288,036	
2001	53,990	33,628	65,130	29,734	8,031	8,080	20,795	9,716	8,672	5,265	4,372	2,447	13,044	7,712	2,359	1,379	163,349	90,249	253,598	
2002	44,718	28,680	60,883	32,742	8,877	8,118	22,267	13,814	6,486	5,291	4,485	4,115	10,971	9,406	1,892	480	149,608	93,240	242,848	
2003	45,559	32,149	63,881	48,505	8,025	10,455	27,032	16,281	8,624	6,337	5,424	3,985	14,048	10,322	5,084	292	163,629	118,004	281,633	
2004	50,915	35,192	76,164	49,431	12,285	10,600	34,484	22,156	12,219	10,389	7,443	6,293	19,662	16,682	3,698	899	197,208	134,960	332,168	
2005	54,057	31,491	81,004	52,143	12,402	11,720	35,605	18,280	11,759	7,225	7,381	5,685	19,140	12,910	4,694	542	206,902	127,086	333,988	
2006	55,915	28,704	79,560	45,263	14,219	11,000	32,387	16,681	9,119	6,633	9,264	6,030	18,383	12,663	3,651	576	204,115	114,887	319,002	

Table 4. Average weight estimates for charter and private recreational halibut harvest in IPHC Area 2C, 1977-2006. Average weights from before 1995 were provided by the IPHC and the methods used to derive them are unknown.

2C Year	Glacier Bay		Haines-Skagway		Juneau		Ketchikan		Pburg/Wrangell		Prince of Wales		Sitka		Area 2C Overall			
	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Total	
1977	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.4	
1978	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.4	
1979	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.4	
1980	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.4	
1981	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.6	
1982	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.2	
1983	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.6	
1984	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.3	
1985	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.0	
1986	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.8	
1987	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.9	
1988	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.6	
1989	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.6	
1990	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.4	
1991	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.0	
1992	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.4	
1993	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.3	
1994	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.6	
1995	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.9	19.3	19.6
1996	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.1	22.8	22.4
1997	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.2	21.4	20.8
1998	--	--	20.5	21.7	20.5	21.7	13.8	17.4	49.9	33.0	29.1	20.5	31.0	20.0	29.1	21.5	25.8	
1999	--	--	13.0	20.2	13.0	20.2	23.2	21.5	37.4	23.8	12.1	21.2	20.8	17.6	17.8	20.4	19.0	
2000	--	--	15.8	19.5	15.8	19.5	24.1	25.2	27.6	20.4	13.4	15.9	23.3	22.5	19.8	20.7	20.2	
2001	--	--	15.8	15.3	15.8	15.3	21.4	19.6	31.2	18.1	12.8	15.4	20.4	16.2	18.1	16.6	17.5	
2002	38.7	27.1	16.1	19.6	16.1	19.6	21.8	18.4	35.8	22.9	11.2	14.0	22.2	20.7	19.7	20.2	19.9	
2003	37.3	25.9	18.1	19.1	18.1	19.1	17.1	14.9	25.8	20.3	10.9	10.9	20.3	14.0	19.1	18.5	18.9	
2004	36.0	25.8	17.5	19.2	17.5	19.2	20.7	16.8	22.3	18.1	11.8	13.1	21.9	17.3	20.7	18.8	19.9	
2005	27.8	12.9	16.0	14.6	16.0	14.6	18.2	13.8	25.3	15.7	9.9	12.7	24.4	15.1	19.1	14.0	17.2	
2006	28.8	17.5	14.3	12.9	14.3	12.9	18.9	13.5	26.4	15.4	9.7	10.7	25.3	16.8	19.9	14.3	17.9	

Table 5. Average weight estimates for charter and private recreational halibut harvest in IPHC Area 3A, 1977-2006. Average weights from before 1991 were provided by the IPHC and the methods used to derive them are unknown.

3A Year	CCI		LCI		Kodiak		NG		E PWS (Valdez)		W PWS (Whittier)		Yakutat		Area 3A Overall		Total
	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	Char	Priv	
1977	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.0
1978	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.1
1979	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.5
1980	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.4
1981	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.6
1982	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.2
1983	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.6
1984	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.3
1985	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.0
1986	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.6
1987	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.9
1988	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.6
1989	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.6
1990	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.4
1991	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.5
1992	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.3
1993	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.4
1994	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18.9
1995	17.3	13.3	20.4	17.7	27.2	27.8	20.4	16.8	29.3	23.4	--	--	--	--	20.6	17.5	19.4
1996	16.9	14.6	20.2	13.0	30.8	25.7	15.8	16.1	26.8	36.3	--	--	--	--	19.7	17.6	18.8
1997	15.9	15.0	21.3	15.0	30.4	26.6	26.4	14.9	35.1	26.5	--	--	--	--	22.3	17.6	20.2
1998	18.8	13.2	18.7	13.0	27.1	25.9	22.3	16.9	28.4	25.6	--	--	35.5	35.5	20.8	16.2	18.9
1999	17.4	16.0	16.5	13.8	27.5	23.4	20.9	16.8	26.3	21.5	22.2	27.2	43.3	22.6	19.2	17.0	18.3
2000	17.7	13.1	18.2	14.7	25.6	23.8	17.6	21.9	26.9	22.7	23.8	28.4	41.5	19.4	19.7	16.9	18.4
2001	15.4	14.1	20.4	15.6	21.5	23.5	18.0	21.6	29.9	24.6	18.2	17.9	36.6	23.0	19.2	17.1	18.4
2002	15.1	14.1	19.1	14.9	18.8	20.1	17.6	10.5	27.0	22.9	18.3	35.5	36.7	22.3	18.2	15.9	17.3
2003	15.9	17.4	21.7	16.3	21.2	24.5	19.9	12.7	33.4	22.1	16.2	21.7	36.8	21.6	20.7	17.3	19.3
2004	14.8	12.7	19.7	14.1	19.3	19.8	17.5	12.8	25.5	16.0	18.7	18.7	33.3	17.8	18.6	14.4	16.9
2005	16.2	18.1	17.8	13.5	19.6	17.1	14.3	15.9	25.0	13.3	17.9	19.5	41.1	21.4	17.8	15.6	17.0
2006	15.8	13.2	17.6	12.8	22.1	19.6	15.3	13.8	27.9	21.4	18.8	19.4	38.7	19.0	17.9	14.6	16.7