Bering Sea and Aleutian Island (BSAI) Crab Fisheries Economic Data Report Review

Final Report

Submitted to

The Center for Independent Experts

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GLOSSARY

ADF&G – Alaska Department of Fish & Game

AFSC – Alaska Fisheries Science Center

AKFIN – Alaska Fisheries Information Network

AKR – NMFS Alaska Regional Office

AKT LLC – Aldrich, Killbride, and Tattone LLC; Certified Public Accountants

AP – Advisory Panel; standing advisory panel to a Fishery Management Council, composed of representatives of major segments of the fishing industry; catching and processing, subsistence and commercial fishermen, observers, consumers, environmental/conservation, sport fishermen, and other stakeholders.

BSAI – Bering Sea and Aleutian Islands

BSAI King and Tanner Crab Fisheries – The assemblage fisheries exploiting crab stocks in the BSAI managed under the BSAI Crab FMP; eight of these stocks are managed under the BSAI Crab Rationalization program, including Bering Sea Tanner crab, Bristol Bay red king crab, Bering Sea snow crab, Aleutian Islands golden king crab, and others. Note that Tanner crab is an informal designation for crab species of the genus *Chionocetes*, including Tanner (*C. bairdi*) and snow (*C. opilio*) crab species of the BSAI.

Bycatch (syn. Incidental catch, Non-target catch/species) – Fish other than the primary target species that are caught incidental to the harvest of the primary species. Bycatch may be retained or discarded. Discards may occur for regulatory or economic reasons (National Research Council [NRC], 1999). For shellfish, bycatch also includes sub-legal size or females of the target species.

Catch share – General term used to describe fishery management programs that dedicate a secure privilege to harvest a specific area of percentage of a fishery's total allowable catch (TAC) to individuals, communities, or associations.

CDQ – Community Development Quota – Harvest quota in federally managed fisheries in Alaska allocated to eligible communities in Western Alaska. A percentage of the TAC for certain BSAI crab fisheries is allocated to CDQ communities.

CFEC – Alaska Commercial Fisheries Entry Commission

CIE – Center for Independent Experts

COTR – Contracting Officer's Technical Representative

Council – North Pacific Fishery Management Council

CP (syn. C/P) – Catcher processor - In the context of the crab EDR data collection, refers to vessels that both harvest crab and process crab on board.

CR – Crab rationalization – Refers generally to Amendments 18 and 19 to the Fishery Management Plan for Bering Sea/Aleutian Islands (BSAI) King and Tanner Crabs. These amendments implemented a rationalized management regime with allocations structured to protect the interests of harvesters, processors, and defined regions and communities that historically participated in the program fisheries.

CV – Catcher vessel – In the context of the crab EDR data collection, it is a vessel that harvests crab but does not process crab on board. Crab harvested by catcher vessels is sold live and unprocessed dockside or delivered to processors.

Data element (syn. Variable, data object, database field) - In the context of the EDR data collection, a discrete item of information elicited in one or more of the EDR form questionnaires.

Deadloss – In a crab fishery context, crab that is harvested live but die prior to delivery for processing or dockside sales. Deadloss crab is considered an extraction from the resource and is counted against IFQ, but is typically discarded at the landing and is not purchased.

Derby-Style Fishery (syn. Race for fish) – A fishery in which catch volume is regulated in-season by adjusting season length, closing the fishery when TAC limit is reached; the resulting competition among licensed harvesters to maximize catch before season closure produces perverse economic incentives, including capital stuffing.

EDR – Economic Data Report

EEZ – Exclusive Economic Zone – Ocean territory extending from three to 200 miles offshore and within which the U.S. maintains jurisdiction over economic and resource management, including sovereign rights for the purpose of exploring, exploiting, conserving, and managing natural resources.

EIS – Environmental Impact Statement

eLandings – Electronic, web-based reporting system managed by ADF&G, NOAA Fisheries, and the International Pacific Halibut Commission for reporting commercial fishery landings and/or production in Alaska, including landings in the rationalized BSAI crab fisheries.

ESSRP – AFSC Economics and Social Science Research Program

Establishment survey – A survey in which the unit of analysis is a business or organization, rather than an individual or household.

Ex-vessel value (syn. Dockside value, Landed value, Gross landed value) – A measure of the gross dollar worth of commercial landings, usually calculated as the price per pound for the first purchase of commercial harvest multiplied by the total pounds harvested. Ex-vessel value typically includes post-season adjustments to the amount initially paid for fish upon landing, and excludes value of added value processing. In Alaskan commercial fisheries, this represents harvest sector revenues, in contrast to processing sector (first wholesale) revenues.

First wholesale value – The value from the first sale of fish from a processor to a buyer.

Fish ticket – A record of purchase and documentation of harvest; often records the species landed, the weight of each species, the gear used to catch the fish, catch dates, the fishery, the processor, the price paid for the fish, and the area fished.

Fishery – The combination of fish and fishermen in a region, the latter fishing for similar or the same species with similar or the same gear types.

Fishing mortality (syn. Mortality) – A measurement of the rate of removal from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous mortality is that percentage of fish dying at any one time.

Fixed costs – Production expenses that do not change as a function of the level of output of a production enterprise relative to a time period; e.g., salaries for salaried employees.

FMP – Fishery Management Plan – The document developed by the regional fishery management councils overseeing management of U.S. fisheries. The NPFMC has developed and implemented five FMPs for fisheries off Alaska, including the Fishery Management Plan for the Bering Sea and Aleutian Islands King and Tanner Fisheries. FMP provisions are developed and approved through the Council process and codified in regulations issued by NMFS.

Harvesters (syn. harvesting participants) – In the context of the BSAI crab fisheries, refers to individuals and entities that fish for crab.

IFQ – Individual Fishing Quota – Annual allocation of catch for a harvester holding QS; denominated in pounds as determined by QS and the annual TAC

In-Season Management – The set of fishery management activities that support monitoring, industry compliance, and enforcement of quotas while a fishery is open and being prosecuted.

IPQ – Individual Processor Quota – Annual allocation of harvested crab that a processor holding PQS holds exclusive, transferrable rights to receive; denominated in pounds as determined by PQS and the TAC.

IQ – Individual Quota – A type of catch share program in which shares are allocated to individuals or individual entities. Recipients are generally fishermen and shares are not transferable.

IRFA – Initial Regulatory Flexibility Analysis; decision analysis document required for federal agency rulemaking actions under the federal Regulatory Flexibility Act.

ITQ – Individual Transferable Quota – A type of catch share program in which shares are allocated to individuals or individual entities. Recipients are generally fishermen and shares are transferable.

IVQ – Individual Vessel Quota – A type of catch share in which shares are allocated to an individual vessel. Shares are attached to the vessel rather than the vessel owner and shares may or may not be transferable. This has been used most commonly in Canada.

Landings – Fishery resources caught by harvesters and brought on shore.

Magnuson-Stevens Fishery Conservation and Management Reauthorization Act – The primary law governing marine fisheries management in U.S. federal waters (16 U.S.C. 1801 *et seq*).

MEY – Maximum Economic Yield – The catch level that corresponds to the highest amount of profit that could be earned from a fisher.

Mortality – A measurement of the rate of death of fish, resulting from several factors but mainly predation and fishing.

MSA – Magnuson-Stevens Fishery Conservation and Management Act

MSY – Maximum Sustainable Yield – The largest average catch that can be taken continuously (sustained) from a stock under average environmental conditions.

NMFS (syn. NOAA Fisheries) – National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NPFMC – North Pacific Fisheries Management Council

OST – NMFS Office of Science and Technology

PNCIAC – Pacific Northwest Crab Industry Advisory Committee; industry advisory committee to the NPFMC

PQS – Processor Quota Share – Exclusive, transferrable privilege held by a processor to receive deliveries of a specific portion of the annual TAC from a crab fishery. PQS results in annual allocation of IPQ.

Processors (syn. processing participants) – In the context of the Alaska commercial fisheries, refers collectively, or to individual members, of the fishing industry sector that receives fish/shellfish catch from harvesters and processes the resource for the wholesale market.

PSMFC – Pacific States Marine Fisheries Commission; industry advisory committee to the NPFMC

QA/QC – Quality Assurance and Quality Control

QS – Quota Share; represents a long-term dedicated privilege to harvest a percentage share of TAC in a fishery in which a QS holder is licensed to harvest. In the rationalized crab fisheries, QS is applied to the TAC to generate annual allocations of IFQ.
RAM – AKR Restricted Access Management

Rationalization – the general-use term for a rationalized management regime.

Rationalized Management Regime – A quota-based system for allocating natural resources; replaces the "derby-style" allocation regime

RIR – Regulatory Impact Review; assessment of benefits and costs of regulatory decision-making required of federal agencies under Executive Order 12866; typically combined with IRFA in decision analyses for fishery rulemaking.

SAFE – Stock Assessment and Fishery Evaluation; annual assessment required under FMP

Sector – A specific division of a fishery defined by unique characteristics, such as management regulations, gear types, fishing locations, purpose of activity, or vessel size. In the context of the crab EDR, this term is used interchangeably to refer to general industry sectors (processors and harvesters) or specific subsectors (catcher processors, catcher vessels, shoreside processors, and stationary floating processors).

Shoreside Processor – Any land-based person, company, or vessel that receives unprocessed or limited-processed fish or shellfish; except catcher/processors, motherships, buying stations, restaurants, or persons receiving fish for personal consumption or bait.

SSC – Scientific and Statistical Committee; technical advisory committee to a Fishery Management Council required under MSA to "assist it in the development, collection, evaluation, and peer review of such statistical, biological, economic, social, and other scientific information as is relevant to such Council's development and amendment of any fishery management plan."

Stationary Floating Processor (syn. Floating Processor) – Vessel operating as a processor that remains anchored or stationary in a single geographic location while receiving or processing crab.

Stock – A part of a fish population usually with a particular migration pattern, specific spawning grounds, and subject to a distinct fishery. A fish stock may be treated as a total or a spawning stock. Total stock refers to both juveniles and adults, either in numbers or by weight, while spawning stock refers to the numbers or weight of individuals that are old enough to reproduce.

Submitter – An individual required to complete and submit an EDR; e.g., a catcher vessel owner or operator, or processing plant owner or operator actively participating in the CR fisheries.

TAC – Total Allowable Catch (syn. Catch limit, Guideline harvest level, GHL) – The annual recommended or specified regulated catch for a species or species group, typically given in biomass (weight).

ToR – Terms of Reference

Variable Costs – Costs associated with factor inputs that change in proportion to output of a production process or activity of a business, e.g., the cost of raw crab purchased by a processor as an input to the production of finished product.

ACKNOWLEDGMENTS

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The EDR project requires accurate and precise data that reflects the real-world state of the Bering Sea and Aleutian Islands Crab Fishing Industry. Accordingly, we thank and acknowledge the following industry participants of the two-day public hearing, who offered their perspectives on the real-world state—their continued support in the EDR process will be paramount to its success:

- Nancy Harris, Harris Accounting Services
- Steve Minor, North Pacific Crab Association
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- Brett Reasor, Unisea, Inc.
- Dyann Provenzano, Puget Sound Accounting
- Elizabeth Wiley, Westward Seafoods

Special thanks are due to Dr. Brian Garber-Yonts for his successful management of the entire review process, furnishing the pre-review documents, hosting the panel review, and coordinating the post-proceedings tasks. Brian's effectiveness is reflected in the quality of this report. Additionally, we thank the following individuals: Ron Felthoven, NMFS; Roberto Koeneke, CIE; William Michaels, NMFS; Bob Ryznar, PSMFC; Manoj Shivlani, CIE; and Geana Tyler, PSMFC.

It was a learning and enjoyable experience to have the privilege working with the fellow CIE reviewers Dr. Susan Hanna, Professor Emeritus of Marine Economics, Oregon State University, Corvallis, OR; and Dr. Danna L. Moore, Associate Director Social & Economic Sciences Research Center, Washington State University, Pullman, WA.

Finally, many thanks are due to Tobin W. Curran for his assistance in reviewing the documents submitted for CIE review, drafting the report, and managing the overall project.

EXECUTIVE SUMMARY

From August 23rd to 25th 2011 the National Oceanographic Atmospheric Administration (NOAA) Fisheries, Alaska Fisheries Science Center (AFSC) and the Center for Independents (CIE) convened an expert panel review of the Bering Sea and Aleutian Island (BSAI) Crab Economic Data Report (EDR) Program. The EDR was implemented by AFSC under the direction of the North Pacific Management Council (Council), and was designed to determine the economic impact of replacing the "derby style" management regime to a rationalized management regime in the BSAI Fisheries.

The panel members independently reviewed the EDR to determine technical shortcomings, recommend best practices, and define objective standards and evaluation criteria in regard to the following aspects of the program: data collection and analytical objectives and associated data quality objectives, establishment survey questionnaire design, evaluation, and testing methodology, data collection administration and data management, protocols and metrics for data quality assessment, data quality control, analytical methodologies and treatment of uncertainty, and interpretation and conclusions of data analyses.

We have reviewed the data collection program through the lens of the MIT Information Quality Program's cumulated research results and industry practices. The key findings include the following:

- Reluctance of data collectors to provide data, and submitter burden;
- Inconsistent accounting methods across vessels and processors (the quality of the records differs by vessel);
- Difficulty in disaggregating data (i.e. fuel costs particular to crabbing during a multi-species fishing voyage).

Based on the review and the findings, we recommend the following improvements:

- Develop a "GAAP for Crab Fisheries EDR"
- Redesign the survey instrument to be less burdensome
- Develop a strategy to manage information as the product of a well-defined information production process, and to manage the life cycle of information product, including comprehensive database integrity rules and enforcement procedures.
- Make the metadata easily available for all data stakeholders in an easy to read manner.

This report only highlights key observations and findings of the BSAI EDR program. The reviewer will be glad to respond to any requests for clarifications or elaboration.

1. INTRODUCTION

The National Oceanographic and Atmospheric Administration (NOAA) Fisheries and Alaska Fisheries Science Center (AFSC) partnered with the Center for Independent Experts (CIE) to undertake an expert panel review of methodological practices employed in the development and administration of the Bering Sea and Aleutian Islands (BSAI) Crab Fisheries Economic Data Report (EDR) program. The crab EDR program was implemented by AFSC under the direction of the North Pacific Fishery Management Council (Council) and in accordance with 50 CFR 680.6 in 2005, concurrent with the transition to the rationalized management regime. The program is currently under consideration by the Council for substantial revisions to address changing analytical objectives, data quality limitations, and excessive submitter burden. To support implementation of the Council's final action concerning the BSAI crab EDR program using best scientific and methodological practices, AFSC sought guidance from independent experts in the fields of applied economic analysis of fishery resource management, design and testing of economic surveys of business establishments, and methods for data quality assessment and data quality control. To facilitate the development of guidelines for best scientific practices, the CIE appointed an expert panel to provide a review of methods and practices employed to date and provide independent reviews and recommendations for methodological improvements and appropriate standards.[1]

1.1 Background and Context

In 2005 the BSAI crab fisheries underwent a drastic change in management regime, directed by the Council and implemented by NOAA Fisheries. Prior to the regime change the fishery was regulated as a "derby-style", in which licensed harvesters competed to maximize their catch of the Total Allowable Catch (TAC) of harvestable crab before the fishery closed. Under the new regime, qualified harvesters and processors were allocated individually transferable quota shares in the fishery, which grant the holder the privilege to harvest and (in the case of processors) purchase a specified share of the TAC of crab stock. The resulting Quota Share privileges (QS, denominated as percentage shares) are transferrable to qualified buyers, as are the annually issued Individual Fishing Quota (IFQ, denominated in pounds as determined by QS and the annual TAC). This catch share system is referred to generally as "rationalization".

Rationalization aims to ameliorate excess harvesting and processing capacity, and improve the economic performance of the crab fisheries by addressing low economic returns and economic instability for harvesters, processors, and communities. In anticipation of potential changes in the magnitude and distribution of benefits, employment, and other social and economic effects of the fishery, the Council tasked the AFSC with leading the development and implementation of

[1] Public Announcement: Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program, External Independent Peer Review by the Center for Independent Experts.

an extensive and mandatory annual EDR. The EDR program was designed to collect detailed cost, earnings, and employment data from crab fishery participants to support computation of a number of specific performance metrics to evaluate the effects of rationalization on fishery participants and to provide data and analysis in support of future management changes.[2]

The final design of the data collection, including data elements and survey questionnaires, was developed with extensive industry consultation and review by the Council. The EDR reporting requirement went into effect in 2005, with EDR baseline data submission required retroactively for 1998, 2001, and 2004 and subsequently, on an annual basis, for calendar year crab fishing activities for 2005 to present. The annual deadline for completed data reporting forms submission is June 28 for the previous calendar year.

Significant data quality limitations, associated principally with questionnaire design, were apparent with the first EDR submissions in 2005. To date, extensive efforts have been taken to investigate and validate the quality of the information reported in the EDR forms. Several informal focus groups have been held with EDR submitters and a more formal review has been conducted as follows: the contractor collecting the data in conjunction with the AFSC has prepared annual reports documenting questions raised by submitters and known or potential flaws in questionnaire design; a certified public accountant has been contracted to conduct annual records-check validation by means of mandatory audits of operational and financial records for a random sample of the submitted EDRs as well as selected for-cause and outlier audits; a formal industry committee established by the Council has conducted two reviews of the EDR forms and audit findings and provided data quality and reporting burden assessments; statistical and qualitative results of audit findings and industry assessments have been incorporated into a detailed metadata document and distributed for public review; the Council's Scientific and Statistical Committee has reviewed the metadata; and the Council has received a staff discussion paper on EDR data quality limitations and endorsed constraints on use of a substantial subset of EDR data.

The EDR is a census of all active crab fishery participants in the harvest and processing sectors and compliance is a mandatory condition of annual permit renewal. Therefore, data quality limitations do not arise from sampling design or unit nonresponse error. Rather, data quality limitations arise principally from error sources associated with availability and accuracy of records maintained by submitters, flaws in questionnaire design (including specification errors, excessive computations required of the submitter, and incompatibility with standard industry recordkeeping conventions), and coverage and measurement error due to frame design and changes in industry structure. Revisions to EDR forms were incorporated in 2006 and 2007 to address some identified data quality concerns; however, more significant revisions are subject to review by the Council. Further measures to improve data quality and utility, and reduce

[2] Public Announcement: Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program, External Independent Peer Review by the Center for Independent Experts.

submitter burden, will require substantial redesign of the EDR program and associated regulatory specifications. The Council has initiated a process to review the analytical objectives of the EDR program and develop revised regulations and reporting requirements. This process is currently ongoing, with decisions regarding objectives and data reporting requirements expected in December of 2011.[3]

The objective of the CIE review is to identify appropriate methodological best practices and standards for survey design, evaluation, and testing, and to define quality assurance and quality control (QA/QC) procedures to be employed in the EDR program redesign and subsequent administration. The program falls within the class of statistical data collection referred to in the scientific literature as an establishment survey, for which the existing methodological literature is limited and exists largely in government statistical agency documents, conference proceedings, and institutional knowledge. As an agency, NOAA Fisheries is relatively inexperienced with regard to conducting establishment surveys, particularly with respect to industry financial information, although it does conduct a number of administrative record reporting systems that include financial information. NOAA largely lacks specialized staff expertise and institutional knowledge of relevant methodologies and scientific standards for establishment survey methods for financial information and data QA/QC methods, and lacks specific standards appropriate for different data uses (e.g., administrative, research, or policy/management program evaluation). Therefore, a broader objective of the CIE review is to identify institutional gaps in appropriate managerial and scientific expertise to carry out statistical social and economic data collection as mandated by the Magnuson-Stevens Act[4] in the context of regulated fishing business establishments.[5]

1.2 Scope of Work & Review Questions

Panel members have performed a review of the documented record of the process of crab EDR design, evaluation, testing, and data quality assurance and quality control (QA/QC) employed to date in order to identify process and technical/scientific shortcomings, develop recommended best practices, objective standards, and evaluative criteria in these areas as applicable to the program setting and objectives set forth by the Council. Each CIE reviewer is requested to conduct the independent peer review in accordance with the Scope of Work (SoW) and Terms of Reference

[3] Public Announcement: Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program, External Independent Peer Review by the Center for Independent Experts

[4] The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the primary law governing marine fisheries management in US waters. Specifically, Magnuson-Stevens authorizes the establishment of Regional Fishery Management Councils to provide stewardship of US fishery resources. Through Fishery Management Plans (FMP), the Councils promote the fishing industry and optimum yield while protecting essential fish habitat. The preparation, monitoring, and revision of an FMP must take into account the social and economic needs of the States.

[5] Public Announcement: Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program, External Independent Peer Review by the Center for Independent Experts.

(ToRs). The ToRs are limited to evaluation and recommendations regarding scientific, methodological, and administrative standards and practices[6].

1.3 Reviewer's Role and Credentials

Dr. Richard Y. Wang was identified and selected by the CIE Steering Committee and Coordination Team on the basis of his expertise in the field of survey data Quality Assurance and Quality Control (QA/QC). Dr. Wang received his Ph.D. in Information Technology from the Massachusetts Institute of Technology (MIT), and has served as professor at MIT for ten years. He also held an appointment as University Professor of Information Quality, University of Arkansas at Little Rock.

Dr. Wang also served as the Chief Data Quality Officer and Deputy Chief Data Officer of the U.S. Army. He served as an advisor to Headquarters, Department of the Army, senior leaders for information management and data quality improvements. Dr. Wang also implemented data quality methodology, guidelines, and performance metrics for the Army Total Data Quality Management Program.

Dr. Wang is also the CEO of the Cambridge Research Group (CRG), an expert consulting firm focused on information management and data quality improvement. CRG has successfully served many clients in both the private and public sectors. Public sector clients include, but are not limited to, Director of National Intelligence (DNI), U.S. Department of the Interior (DOI), World Bank, Defense Logistic Information Services (DLIS), Environment Protection Agency (EPA), Defense Information Systems Agency (DISA), The US Federal Railroad Administration (FRA), the US Airforce Lean Sustainment Initiative, and the US Navy Space and Naval Warfare Systems Command (SPAWAR). Key private sector clients include Acxiom Corporation, Cedars-Sinai Health System, Dechert LLP, Freddie Mac, Lockheed Martin, and Sullivan & Cromwell LLP.

Dr. Wang coauthored Journey to Data Quality (MIT Press), Information Quality: Advances in Management Information Systems (M.E. Sharpe), Introduction to Information Quality (MITIQ Publications), Data Quality (Kluwer Academic), and Quality Information and Knowledge (Prentice Hall). His recent awards and certificates include the following:

- Certificate of Appreciation from LTG Susan Lawrence, U.S. Army CIO/G-6 (2011);
- Thank you letter from Mr. Ron Bechtold (SES), Army Architecture Integration Center (AAIC), CIO/G-6 (2011);
- Award from the University of Arkansas at Little Rock, for leadership in establishing the first-of-its-kind degree program for Ph.D. and Master of Science in Information Quality (2007);
- Certificate of Appreciation for excellent presentation and helpful participation in the Global Justice Information Sharing Initiative, U.S. Department of Justice (2006);
- Certificate of Appreciation from the Director of Central Intelligence and personal thank you letter from the Director of DNI, Mr. Dale Meyerrose (2005); and
- DAMA International Achievement Award. Previous recipients of this award include Ted Codd for inventing the Relational Data model and Peter Chen for originating the Entity Relationship model (2005).

[6] Public Announcement: Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program, External Independent Peer Review by the Center for Independent Experts.

1.4 Disclaimer

This reviewer is from a completely different field, unfamiliar with the agencies in the NOAA, such as the NFMS, SSC, AFSC, PSMFC, and their roles and responsibilities. Due to the independent review requirements, this report has not been verified for its correctness per CIE instruction. It is critical that this report be reviewed for factual errors.

2. SUMMARY OF FINDINGS FOR EACH TERMS OF REFERENCE (TORS)

We first present the methodology used in this independent review, and then summarize findings for each of the ToR questions. Throughout this report, the terms data and information are often used synonymously. In practice, managers differentiate information from data intuitively, and typically describe information as data that have been processed. Unless specified otherwise, this report will use the terms *information* and *data* interchangeably depending on the context.

2.1 Review Methodology

In reviewing the EDR data collection program, we applied research findings and employed industry practices developed at the MIT Information Quality (MITIQ) Program. The key concepts, models, and techniques (such as managing information as product, attending to various data stakeholders, understanding that the concept of data quality goes beyond accuracy to include other dimensions such as believability, and developing the information production map) are the results of his academic and professional experiences of the last two decades. The reader is referred to *Journey to Data Quality*[7] and MITIQ publications[8] for further details.

2.1.1 Four principles of managing information as a product

Fundamental to the MITIQ methodology are four principles for managing information as product:

1. Understand information consumers' needs;
2. Manage information as the product of a well-defined information production process;
3. Manage the life cycle of information product; and
4. Appoint an information product manager to manage information processes and products.

2.1.2 3Cs and Information Product Managers

Executing these four principles of the MITIQ approach are the roles and responsibilities of the data stakeholders: ***data collectors, data custodians, data consumers*** (referred to in the MITIQ

[7] Yang W, Lee et al. *Journey to Data Quality* (Cambridge, Massachusetts: The MIT Press, 2006)
[8] http://mitiq.mit.edu/publications.htm

research as the **3Cs**), and ***information product managers*** who are responsible for coordinating the delivery of high-quality information products to data consumers.

Data Stakeholders - Identifying the stakeholders of the BSAI Crab Fisheries EDR, and their respective roles and needs is a critical first step. The Council has identified the following stakeholders:

1. Crab Fisheries and Processors
2. North Pacific Fishery Management Council (Council)
3. NOAA Fisheries Alaska Fisheries Science Center (AFSC)
4. NOAA National Marine Fisheries Service (NMFS)
5. Pacific Northwest Crab Industry Advisory Committee (PNCIAC)
6. Pacific States Marine Fisheries Commission (PSMFC)
7. National Oceanic and Atmospheric Administration (NOAA)

Each of these organizations can be categorized as being a data collector, a data custodian, or a data consumer. In the data quality arena, it is not un-common that a data collector is also a data consumer, or a data custodian.

Data Collectors – As the name suggests, collectors are the provider of the raw data that is input to the EDR. It is clear that the Crab Fisheries and Processors (**Submitters**) are the front-line data collectors. It is their data that is being requested by the Council, AFSC, NMFS, et al. As such, it is imperative to consider them part of the larger operation of data collection for the purposes of the EDR.

Data Custodians - Custodians manage the data collected for the EDR. Custodians principally manage the data storage. In the BSAI context, the data custodians include AFSC staff together with PSMFC staff, which is under contract to manage the Alaska Fisheries Information Network (AKFIN) data warehousing program. The roles and responsibilities of the PSMFC staff and subcontractors are laid out in the PSMFC/AKFIN EDR draft documentation provided to the panelists on August 25, 2011.

Data Consumers - Consumers are the users of the information products delivered out of the EDR. In the review of the provided documents, these are the **Analysts**. It is vital that the Analysts have good, accurate, timely, and useful data for making management recommendations in the BSAI Fisheries.

Information Product Managers - Although each of the 3Cs bears responsibility to ensure that the information products (IP) available to data consumers are of the highest-quality and reflect the real-world state, it is the responsibility of the information product management (IPM) team to lead the process. The IPM collaborates with the 3Cs and orchestrates the smooth production of IP. In this context, the IPM ensures that data collected from the Crabbing industry reflect the

real-world pragmatically, are acceptable to and viewed by the crabbing industry as sufficiently accurate for the EDR purposes.

2.1.3 Data Quality Dimensions

Early MITIQ research identified various data quality dimensions[9] [10] which are now widely accepted in follow-up research and industry practices in the data quality field. Table 1 below provides an overview of the sixteen data quality dimensions. Some dimensions are more salient in the context of the BSAI EDR than others.

Table 1: Data Quality Dimensions

Dimensions	Definitions
Accessibility	the extent to which data is available, or easily and quickly retrievable
Appropriate Amount of Data	the extent to which the volume of data is appropriate for the task at hand
Believability	the extent to which data is regarded as true and credible
Completeness	the extent to which data is not missing and is of sufficient breadth and depth for the task at hand
Concise Representation	the extent to which data is compactly represented
Consistent Representation	the extent to which data is represented in the same format
Ease of Manipulation	the extent to which data is easy to manipulate and apply to different tasks
Free-of-Error	the extent to which data is correct and reliable
Interpretability	the extent to which data is in appropriate languages, symbols, and units, and the definitions are clear
Objectivity	the extent to which data is unbiased, unprejudiced, and impartial
Relevancy	the extent to which data is applicable and helpful for the task at hand
Reputation	the extent to which data is highly regarded in terms of its source or content
Security	the extent to which access to data is restricted appropriately to maintain its security
Timeliness	the extent to which the data is sufficiently up-to-date for the task at hand
Understandability	the extent to which data is easily comprehended
Value-Added	the extent to which data is beneficial and provides advantages from its use

[9] Leo Pipino, Yang Lee, and Richard Wang, "Data Quality Assessment," *Communications of the ACM* (April 2002): 211-218.
[10] Leo Pipino, Yang Lee, and Richard Wang;, "Beyond Accuracy: What Data Quality Means to Data Consumers," *Journal of Management Information Systems* 12, no. 4 (1996): 5-33.

2.2 Response to Terms of Reference

2.2.1 Review and discussion of data collection and analytical objectives defined by the Council, and associated data quality objectives, as context for evaluation of methods under the Terms of Reference (ToR) 2 through 10

The review task was completed prior to and during the August 23-25, 2011 Panel meeting. The data collection and analytical objectives are well thought-out and consistent with leading government and industry practices. There are two issues specific to the EDR data collection context, which are discussed where appropriate in the remainder of this report:

1. Data collection practices represent the best available science; and
2. Data collected is sufficiently accurate for scientific analysis.

2.2.2 Evaluation and findings regarding establishment survey questionnaire design, evaluation, and testing methodology employed to date and recommendations for improvement

During the public two-day Panel Review meetings, it became evident that there is a gap between the data collectors' (Submitters) perceived roles and responsibilities, and the data consumers' (Analysts) data needs. Generally, analysts need sufficiently accurate data to perform their tasks. Data is sufficiently accurate when it useful for testing hypotheses and evaluating program outcomes, particularly in this case, the ramifications of the BSAI King and Tanner Crab Fisheries rationalization program. The Analysts especially rely on quantifiable data elements such as labor cost, fuel cost, and insurance premiums.

Surprisingly, the Submitters are asking for *more* accurate data. It became clear during the discussions that the issue goes beyond Analysts simply having sufficiently accurate data. Submitters, in their assessment, cannot provide data that is accurate and precise enough to reflect the real-world state of the Fisheries. For example, several industry cost accountants in the Panel Review meetings stated that data values for items such as fuel costs are prorated, and in their best judgment and professional experience the EDR data collected (submitted by them) cannot represent the real fuel costs to be sufficiently accurate because of the complexity of Submitter activities in the Fisheries.

Their request for more accurate data collection may be, in fact, a demand they believe to be unattainable. Submitters are concerned that inaccurate and inconsistent data will lead to poor management decisions on the part of the Council, with potentially detrimental effects for the Industry. Data that both capture the real-world state of Submitter activities and also provide sufficiently accurate data for the Analysts must be the primary focus of the EDR data collection regime.

These issues are part of nine dimensions Paul P. Biemer (2010) identified for a survey quality framework (Table 2), and stated that "ideally, the survey design should specify actionable and achievable objectives for each quality dimension, in accordance with both user and producer requirements."[11] Table 2 is referenced in the draft BSAI Crab EDR Database Data Quality Summary Report, furnished for CIE review.[12]

Table 2: Survey Quality Dimensions

Dimension	Description
Accuracy	Total survey error is minimized
Credibility	Data are considered trustworthy by the survey community
Comparability	Demographic, spatial, and temporal comparisons are valid
Usability/Interpretability	Documentation is clear and metadata are well-managed
Relevance	Data satisfy users needs
Accessibility	Access to the data is user friendly
Timeliness/Punctuality	Data deliveries adhere to schedules
Completeness	Data are rich enough to satisfy the analysis objectives without undue burden on respondents
Coherence	Estimates from different sources can be reliably combined

The primary problems with the EDR establishment survey relate to the following:

- Reluctance of data collectors (Submitters) to provide data;
- Submitter burden;
- Inconsistent accounting methods across vessels and processors (the quality of the records differs by vessel); and
- Difficulty in disaggregating data (i.e. fuel costs particular to crabbing during a multi-species fishing voyage).

This Report concurs with the insight provided in the Discussion Paper of November 2010

> Given the minimal feedback NOAA provides submitters about their individual performance in the audit process and minimal enforcement action taken against submitters who have been unable to provide sufficient documentation to support the accuracy and completeness of the EDRs they have submitted (except in cases of gross noncompliance). There is some danger that this lack of feedback has resulted in an impression within the crab industry that complete and credible evidence is unnecessary and virtually any response to the audit request is regarded as sufficient. To the contrary, the auditors have reported, and the metadata show, numerous

[11] Paul P. Biemer, "Total Survey Error: Design, Implementation, and Evaluation," *Public Opinion Quarterly* 74, no. 5 (2010): 817-848.
[12] Draft BSAI Crab EDR Database: Data Quality Summary AFSC/Economics and Social Science Research Program Updated August 10, 2011

instances of unsupported EDR values, based on rigorous review of evidence supplied to auditors.[13]

The lack of feedback from NOAA and the belief that any response to the audit is sufficient undoubtedly reinforces the Submitters' perception that the data collected is not sufficiently accurate for the Analysts purposes. The following recommendations address these issues.

2.2.2.1 Develop a "GAAP for Crab Fisheries EDR"

During the Panel Review meeting discussions with the AFSC, panelists, and Submitters, it was evident that all were concerned that data values were inconsistent across EDR reports. Importantly, the data stakeholders had not developed a consensus as to what methods should be applied to produce data values across vessels and other report variables required in the EDR survey. The reluctance of the Submitters to provide data, as well as the reporting burden, would be diminished with standardization of accounting methods and data disaggregation.

Specifically, the varying methods to pro rate cost values were identified as a barrier to accurate and useful data collection. A discussion followed, led by Richard Wang, regarding an acceptable approach for resolving this issue. Brian Garbers-Yonts and Richard Wang jointly recommended that AFSC propose a consistent method for each data element (such as fuel cost) that needs to be prorated. AFSC would make the method available for comments and revisions before final acceptance by the Submitters. In the discussion, this was informally referred to as the Generally Accepted Accounting Practice (GAAP) for Crab Fisheries EDR data that require pro rating. The Submitters (cost accountants and the Industry representative) were agreeable to the recommendation.

From the perspective of the MITIQ methodology, this would be a critical breakthrough if the Submitters (data collectors) and AFSC (data consumers) could jointly develop a "GAAP for Crab Fisheries EDR". To a large extent, this is a core data quality issue in the BSAI data collection program. The data stakeholders must consider the "common good" of the entire BSAI program, and use "common sense" to develop an approach that will provide high-quality data that are sufficiently accurate for AFSC Analysts.

Another related issue identified in the audit and review of the data is a lack of clear guidance as to what constitutes an acceptable form of Submitter support provided to auditors, and the assessment of a "supported" finding for a particular reported value. The auditors have consistently observed that internal monitoring, accounting, and documentation methods employed by EDR submitters vary widely in the industry. As the Council points out, this has presented the greatest challenge to both collecting and assessing the accuracy of the data, and has required that audit personnel exercise some judgment as to the completeness and sufficiency of evidence supplied to support a reported value. Developing a GAAP that is supported by all of

[13] Discussion Paper November 2011

the data stakeholders would ultimately address the issue, as the data collectors and data consumers will have collaborated for their common good.

2.2.2.2 Redesign the survey instrument to be less burdensome

Another key recommendation that was discussed in the Panel Review meeting was to redesign the survey instrument so that data collection would be less of a burden on the Submitters. This would be accomplished by AFSC using other available data sources such as the e-Landing database, satellite data, and Captain's Logs to supplement the submitter survey. Additionally, an AFSC data (quality) working group may collaborate with the industry cost accountants to determine if industry data collected and reported for other purposes is sufficiently accurate for the purposes of the EDR. Common sense would dictate that data sufficiently accurate for decision making by the vessel owners and captains should be sufficiently accurate for EDR economic analysis.

2.2.3 Evaluation and findings regarding data collection administration and data management to date and recommendations for improvement

In the review of the provided documents, no evident custodians could be identified. However, it became evident during the Alaska Fisheries Information Network (AKFIN) EDR Program Team's presentations (including Geana Tyler, who presented on the EDR data collection process, and Bob Ryznar who responded to questions about the database), and after reviewing the follow-up *Draft Alaska Fisheries Information Network Economic Data Reporting (EDR) Report*[14] furnished by Dr. Brian Garber-Yonts after the meeting, that the AKFIN Team (Table 3) are the data custodians in the EDR context.

The AKFIN team, as the EDR data custodians, have established the data systems architecture, including server and database design, security measures, web-based data tools, definition of EDR meta-data schema, etc. that have been developed. They have identified also the stakeholders and the data consumers, and have defined data user roles. The data management, data entry and review, access and security management, as well as audit triggers and processes, data stewardship, technology infrastructure as a process ownership.

The above practice is consistent with typical data management practices both in the public and private sectors. However, there are areas that can be further improved. As custodians, and also key members of the information product management team, they are responsible for the development of a strategy to manage information as the product of a well-defined information production process, and to manage the life cycle of information product. The strategy must

[14] Draft Alaska Fisheries Information Network Economic Data Reporting (EDR), Program Systems and Process Analysis, Version B1.0, August 16, 2011, NOAA Fisheries, Alaska Fisheries Science Center

encompass data assets of the entire organization (be it AFSC, NFMS, or NOAA) to ensure that useful data is available to support the strategic objectives of the organization.

Without an explicit strategy, the risk of decisions based on unreliable or unavailable data is increased and the full potential of the data assets will be limited. Development of such a strategy also directly addresses the primary concerns of the Submitters—that data is of little use for AFSC management decisions. Strategically, administration of data collection would be significantly improved by building partnerships and trust with the Submitters.

Table 3: Data Custodians - AKFIN EDR Program Team

Team Member	Entity	Job Focus	AKFIN Role	Program Board?
Bob Ryznar	PSMFC - AKFIN	AKFIN program mgmt	AKFIN Program Manager	X
Michael Fey	PSMFC - AKFIN	Council support	AKFIN Programmer	
A.K. Zebdi	PSMFC - AKFIN	technical support	AKFIN Programmer	
Rob Ames	PSMFC- AKFIN	Technical support	AKFIN Programmer	
Geana Tyler	PSMFC	Data collection, validation and entry	PSMFC EDR Program Manager	X
Camille Kohler	AKFIN (RDI)	RDI contract mgmt; non-EDR data requests	AKFIN Operations support; RDI contract management.	
Tom Fletcher	AKFIN (RDI)	EDR Crab Rat DB	AKFIN Database and Tools (contract PM and developer)	
Nicholas St. Gabriel	AKFIN (RDI)	EDR Crab Rat	AKFIN Database and tools (Contract developer)	X
Brian Garber-Yonts	NOAA (Seattle)	Research	NMFS BSAI Data Collection Program Manager	X
Liz Clarke	AKT	Audits	Audit execution	

2.2.4 Evaluation and findings regarding protocols and metrics for data quality assessment employed to date and recommendations for improvement

The data quality metrics and data quality controls are an integral part of data quality management. In this section we focus on data quality from a database systems perspective. Section 2.2.5 presents an accounting perspective of data quality, which is a novel practice.

Scientifically, the data integrity in a relational database should conform to the following four integrity rules: Column Integrity, Entity Integrity, Referential Integrity, and User Defined Integrity.

- **Column Integrity** - All values of a field must be drawn from its domain, i.e., the set of acceptable values for the field.

During the Panel Review meetings, the AKFIN team explained that they have data quality checks for single data elements, both in the front-end web application as well as in the back-end Oracle database. This amounts to column integrity checks, such as missing values and out of range values. Additionally, the incoming EDR reports are checked for poor data quality such as missing values, out of range values, etc., followed by telephone calls if necessary. The web-enabled EDR reporting with data integrity checks is also a step forward.

In another example, "bait_species_code" has a description "this variable is derived from coding open-ended responses to "bait species" descriptions" and then the code values are also available in a corresponding table as shown in Table 4 below.

Table 4: Bait Codes

pcod	cod, cod heads
hlbt	halibut
hrng	herring
plk	pollock
salm	salmon
sard	sardine
sqid	squid
tuna	tuna
other	all other species

- **Entity Integrity** - Every entity (table) must have a primary key consisting of one or more columns. No component of a primary key is allowed to have a missing value. The primary key must be unique.

The AKFIN database assigns a unique primary key (such as the Owning Person Identifier) to each record. The AKFIN team recognizes that there may be violations of entity integrity (for, example in cases where historical records were not assigned a unique identifier), and does have a system for checking the entity integrity of the database.

- **Referential Integrity** - For each distinct foreign key in a relational database, there must exist in the database an equal value of a primary key from the same domain. If the foreign key is composite, those components that are themselves foreign keys must exist in the database as components of at least one primary key value drawn from the same domain.

- **User Defined Integrity** – Specific business rules defined by users.

During the Panel Review meeting, the AKFIN team explained that the referential integrity and the user defined integrity rules are not comprehensively implemented because they are waiting for the revised EDR forms to become available.

In general, we recommend that the comprehensive set of data integrity checks should be implemented to conform to the state of the best science. The "Bait Species Code" example, which has been developed for each data element in the EDR, is an excellent practice. The documentation for presenting this metadata should be made available in a format that is easy for all data stakeholders to review, and downloadable by Submitters to perform data integrity checks prior to submitting their data.

It should be noted that the ATK data assessment differs from the above database perspective. Their work is more focused on the integrity of the supporting documentation, which is driven by an accounting perspective.

2.2.5 Evaluation and findings regarding data quality control standards employed to date and recommendations for improvement

As mentioned earlier, the data quality metrics and data quality controls are an integral part of data quality management. In this section we discuss the accounting approach, referred to as the Data Validation Audit, which AFSC contracted to AFK.

The data validation audit of the submitted data seeks to determine the completeness of submitted data, and assesses the sufficiency of supporting documentation for each of the data elements in the EDR. This is distinctly in contrast to the data quality integrity practices discussed in Section 2.2.4, which presumes that data entered into the database (regardless of its quality in terms of the integrity checks) does in fact attempt to represent a real-world state.

This data validation audit is novel and unique from the perspective of data quality management in practice. An audit of the validity of reported data may have an impact in terms of policy enforcement (for example, it could be useful for fraud detection), but is beyond the scope of established data quality practices. This approach checks the value and consistency of the original documents against the database records, and also checks the existence of supporting Submitter documentation. This approach accomplishes what the database integrity rules cannot achieve, i.e. the validity of the data in terms of the real-world state.

In our review, we found the following Table 5 beyond the typical data quality practices. The downside of this approach, of course, is increased cost. However, as a data validation tool, this approach is rigorous.

Table 5: Audit Classifications Jointly Developed by AKT, PSMFC, NMFS[15]

Validation Code – Original Value	Is original value substantiated?	Is audited value substantiated?	Nature of Reporting Error	Correction	Validation Code – Audit Value
1	Yes	Yes (same)	No error; reported value is clearly substantiated by complete records	No	1
2	Yes	Yes (same)	Calculation error	Yes	1
3	Yes	Yes (same)	Misinterpretation of question	Yes	1
4	Yes	Yes (same)	Estimate is based on original documentation but flawed assumption/logic	Yes	4
5	Yes	Yes (same)	Data cannot be reported precisely as specified in EDR form and must be estimate; estimate is based on appropriate documentation and sound assumptions/logic and is considered validated	No	5
6	Yes	Yes (updated)	Original value was reported correctly based on original documentation, but corrected based on original documentation	Yes	1
7	No	No	Reported value is "best guess"; value is not derived from the records	No	7
8	No	Yes (new)	Original value is unsubstantiated; correction based on new documentation	Yes	1
9	No	No	No data reported	No	9
10	No	No	Item "Not Applicable" to vessel	No	10

[15] *Alaska Crab Economic Data Report Data Validation*, Report Prepared for Pacific States Marine Fisheries Commission, 2009 Calendar Year Data, November 2010

2.2.6 Evaluation and findings regarding analytical methodologies and treatment of uncertainty employed to date and recommendations for improvement

This ToR is outside the area of this reviewer's expertise. That being said, less time was spent discussing analytical methodologies of the EDR review process during the Panel Review meetings. Based on the limited discussion, the analytical methodologies and treatment of uncertainty did not constitute a significant issue in the EDR program.

2.2.7 Evaluation and findings regarding interpretation and conclusions of data analyses employed to date and recommendations for improvement

The conclusion of the data assessment, particularly related to collection efforts, does not place enough emphasis on building trust with the industry. We believe that significant improvements in the overall quality of the data will be realized by developing the practices of the Submitters along the lines previously discussed; to wit, fostering a partnership between the Submitters and AFSC, standardizing data elements using the GAAP, and development of a strategy to manage information as the product of a well-defined information production process.

2.2.8 Explicit determination as to whether this NMFS project presented the best available science

Data quality as an inter-disciplinary science is still in its formative stage. For example, *the ACM Journal of Data and Information Quality*[16], established by the Association of Computing Machinery and well-regarded as the first leading scientific journal for data quality, was first published in 2009. Most of the data quality programs implemented by the public and private sectors to date have been based on the program team's professional experiences, program context and constraints. Accordingly, the EDR project is on par with the prevailing industry practices. In fact, in certain areas, the project goes beyond the state-of-the-art practices. For example, in research and practice led by the MIT Information Quality Program over the last two decades, we have not witnessed a data quality project employing a Certified Public Accounting (CPA)[17] firm to audit EDR reports (about one third of the total EDR population reports, or some 20 randomly selected EDR reports). Furthermore, data elements in the EDR Master Data Dictionary (which provides the data and context for the underlying data element) were classified into three categories based on ten scores as shown in Table 4.

As far as the assumption that the data collectors have an interest to, and do provide, accurate data goes, the review of the EDR seems scientifically well established. In almost all cases, the 3Cs are part of a coherent enterprise (i.e. governmental agency, corporation, or joint-corporation product development teams) unified under managerial control with a common strategic vision. In the context of the BSAI EDR however, the Submitters (collectors) do not have sufficient

[16] http://jdiq.acm.org/
[17] AKT, LLP (Oregon, California, Alaska) http://www.aktcpa.com

incentive to act as a member of the EDR enterprise. Accordingly, there are two potential options available:

1. Study this relationship as a new phenomenon and develop new science; or
2. Develop incentives to bring the Submitters interests in-line with the Council's

That said, the data quality practice implemented in this NFMS project is still awaiting EDR form revisions. Furthermore, efforts and resources have not been dedicated to establishing a data quality management program that is sufficiently rigorous as the state-of-the-art best science.

2.2.9 Recommendations for further improvements, including all elements of the EDR program development and evaluation process and appropriate institutional and scientific capacity

The effort must go beyond the AFSC's EDR data collection program. Although not intuitively obvious, it is logical to expect that as the EDR data collection program gains success, the issues identified in this report having been addressed, the data consumers will need to use various NOAA data sources to conduct economic analysis, as well as various administrative and decision support requirements. Many of these tasks will require more comprehensive year-to-year data (analogous to that of Census data) in order to perform appropriate multi-variable time series analysis, regression analysis, and other scientific statistical analyses. All of these analyses are dependent on data that are available, accessible, accurate, timely, consistent, complete, and credible.

2.2.10 Brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations

This task was completed during the closed session among the peer reviewers and the Chair August 23-25, 2011 Panel meeting. This reviewer has provided his perspective on the issues, effectiveness, and recommendations related to Data Quality/Data Assurance.

Overall, the panel review proceedings were professional, collegial, and productive, and the panel chair set the proper tone for the proceedings. The panelists, the AFSC, the PNCIAC, and the public participants engaged in a lively exchange of ideas and information, discussing issues and solution approaches. The vast majority of the public participants were well-intended in informing the panelists of the constraints they encountered, and cooperative in collaborating with the AFSC and the Panel to develop recommendations for improving the quality of data collected, as well as reducing the assessment burden to the data collectors.

As summarized previously, although there are various areas in which data quality can be improved in the EDR data collection life cycle, the most critical issue is the development of a revised survey instrument and corresponding methods, procedures, and standards that amount to a "GAAP equivalent for the Crab Fishery EDR purposes." Such a development must be a joint,

collaborative effort among all of the EDR stakeholders in order to achieve the desired effects of attaining "sufficiently accurate" data as a science and reducing the data collectors' burden in reporting, while simultaneously attaining the data collectors' endorsement that the data they provided for EDR compliance is "sufficiently accurate" for AFSC data consumers' scientific activities.

Importantly, Dr. Brian Garber-Yonts was effective and supportive during the entire panel review proceedings, successfully facilitating the pre-proceedings documents preview processes and post-proceedings tasks. Brian's effectiveness is reflected in the quality of the proceedings, as indicated in this review report.

3. CONCLUDING REMARKS

Based on our experience, for the proposed projects to be successful, input and collaboration with the fishery industry will be necessary. It is critical that the industry Submitters become a full partner in the development of the data collection enterprise.

The development of a GAAP for the purposes of the EDR could be implemented in phases, starting with a pilot focused on those data elements that are both top priority for economic analysis, and "easy to reach consensus on." A successful pilot would be followed by addressing the more contentious data elements, such as insurance premium costs. Many of the specific data elements may be a task on their own and require the entire data stakeholder governance body to attend to.

Finally, information needs to be managed as a product, with each data element serving a particular and specific management need through its life cycle. It is important for the NOAA, the AFSC, and the PNCIAC to initiate, establish and institutionalize their data quality management program and allocate appropriate resources to sustain the quality of data for the near term and in the long run. Too often, data quality is improved in the short-term, but deteriorates over time due to lack of resources.

APPENDIX 1: BSAI EDR REVIEW PUBLIC ANNOUNCEMENT

Bering Sea and Aleutian Islands Crab Fisheries Economic Data Collection Program
External Independent Peer Review by the Center for Independent Experts
Panel Review Meeting, August 23-25, 2011
NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA

Summary: NOAA Fisheries, Alaska Fisheries Science Center (AFSC) has partnered with the Center for Independent Experts (CIE) to undertake an expert panel review of methodological practices employed in the development and administration of the BSAI Crab Economic Data Report (EDR) program. The crab EDR program was implemented by AFSC under the direction of the North Pacific Fishery Management Council (Council) and in accordance with 50 CFR 680.6 in 2005, concurrent with the transition to the rationalized management regime, and annually to-date. The program is currently under consideration by the North Pacific Fishery Management Council for substantial revisions to address changing analytical objectives, data quality limitations, and excessive submitter burden. Final action by the Council to identify mandatory economic reporting requirements is expected in December 2011, with regulatory changes and implementation procedures to be developed subsequently. To support implementation of the Council's final action concerning the BSAI crab EDR program using best scientific and methodological practices, AFSC seeks guidance from independent experts in the fields of applied economic analysis of fishery resource management, design and testing of economic surveys of business establishments, and methods for data quality assessment and data quality control. To facilitate the development of guidelines for best scientific practices, the CIE has appointed an expert panel to provide a review of methods and practices employed to date and provide independent reviews and recommendations for methodological improvements and appropriate standards.

CIE has selected panelists for this review on the basis of their expertise and record of publication in these respective fields. Panel members will perform a review of the documented record of the process of crab EDR design, evaluation, testing, and data QA/QC employed to date in order to identify process and technical/scientific shortcomings, develop recommended best practices, objective standards, and evaluative criteria in these areas as applicable to the program setting and objectives set forth by the Council. The panel will meet in public at AFSC from August 23-24, 2011 to receive presentations from AFSC staff and contractors as well as public comments, to discuss the review materials and presentations, and question presenters and other meeting participants. The panel will spend the final day of the meeting in private session with the panel chair. Terms of Reference (ToRs) for the review have been established to guide the reviewers and focus the meeting on a tractable range of issues. Independent written peer reviews will be prepared by the panelists subsequent to the meeting, to be delivered to the CIE by September 9, 2011. The reviews, as well as a written summary of the panel meeting proceedings and findings prepared by the panel chair will be delivered to AFSC by September 30.

Background: In 2005 the Bering Sea and Aleutian Islands (BSAI) crab fisheries underwent a drastic change in management regime, under the direction of the North Pacific Fishery Management Council (Council) and implemented by NOAA Fisheries. Prior to the regime change, the fishery was regulated as a limited access "derby-style" fishery in which the pool of licensed harvesters effectively competed to maximize their catch of the harvestable crab, specified by fishery managers as the Total Allowable Catch (TAC) before the fishery closed. Under the new management regime, qualified harvesters and processors (buyers) were allocated individually transferable quota shares in the fishery, which grant the holder the privilege to harvest and (in the case of processors) purchase a specified share of the TAC for each of eight rationalized crab stocks. The resulting Quota Share privileges (QS, denominated as percentage shares) are transferrable to qualified buyers, and the annually issued Individually Transferable Quota (IFQ, denominated in pounds as determined by QS and the annual TAC). The particular catch share system implemented in BSAI crab fisheries of one of many potential share allocation systems, referred to generally as "rationalization." Among the Council's objectives in rationalizing the crab fisheries

were addressing excess harvesting and processing capacity, and improving the economic performance of the crab fisheries by addressing low economic returns and economic instability for harvesters, processors, and communities. In anticipation of potential changes in the magnitude and distribution of benefits, employment, and other social and economic effects of the fishery, the North Pacific Fishery Management Council (Council) tasked the Alaska Fisheries Science Center (AFSC) with leading the development and implementation of an extensive and mandatory annual economic data collection program (referred to as Economic Data Reports, or EDRs). The EDR program was designed to collect detailed cost, earnings, and employment data from crab fishery participants to support computation of a number of specific performance metrics to evaluate the effects of rationalization on fishery participants and to provide data and analysis in support of future management changes.

The final design of the data collection, including data elements and survey instruments/questionnaires, was developed with extensive industry consultation and review by the Council. The EDR reporting requirement went into effect in 2005, with EDR baseline data submission required retroactively for 1998, 2001, and 2004 and subsequently, on an annual basis, for calendar year crab fishing activities for 2005 to present. The annual deadline for completed data reporting forms submission is June 28 for the previous calendar year.

Significant data quality limitations, associated principally with questionnaire design, were apparent with the first EDR submissions in 2005. To date, extensive efforts have been taken to investigate and validate the quality of the information reported in the EDR forms. Several informal focus groups have been held with EDR submitters and more formal review has been conducted as follows:

- the contractor collecting the data in conjunction with the AFSC has prepared annual reports documenting questions raised by submitters and known or potential flaws in questionnaire design;
- a certified public accountant has been contracted to conduct annual records-check validation by means of mandatory audits of operational and financial records for a random sample of the submitted EDRs as well as selected for-cause and outlier audits;
- a formal industry committee established by the Council has conducted two reviews of the EDR forms and audit findings and provided data quality and reporting burden assessments;
- statistical and qualitative results of audit findings and industry assessments have been incorporated into a detailed metadata document and distributed for public review;
- the Council's Scientific and Statistical Committee has reviewed the metadata; and
- the Council has received a staff discussion paper on EDR data quality limitations and endorsed constraints on use of a substantial subset of EDR data.

The EDR is a census of all active crab fishery participants in the harvest and processing sectors and compliance is a mandatory condition of annual permit renewal. As such, data quality limitations do not arise from sampling design or unit nonresponse error. Rather, data quality limitations arise principally from error sources associated with availability and accuracy of records maintained by submitters, flaws in questionnaire design (including specification errors, excessive computations required of the submitter, and incompatibility with standard industry recordkeeping conventions), and coverage and measurement error due to frame design and changes in industry structure. Revisions to EDR forms were incorporated in 2006 and 2007 to address some identified data quality concerns; however, more significant revisions are subject to review by the Council. Further measures to improve data quality and utility, and reduce submitter burden, will require substantial redesign of the EDR program and associated regulatory specifications. The Council has initiated a process to review the analytical objectives of the EDR program and develop revised regulations and reporting requirements. This process is currently ongoing, with decisions regarding objectives and data reporting requirements expected in December of 2011.

The objective of the CIE review is to identify appropriate methodological best practices and standards for survey design, evaluation, and testing, and to define quality assurance and quality control (QA/QC) procedures to be

employed in the EDR program redesign and subsequent administration. The program falls within the class of statistical data collection referred to in the scientific literature as an establishment survey, for which the existing methodological literature is limited and exists largely in government statistical agency documents, conference proceedings, and institutional knowledge. As an agency, NOAA Fisheries is relatively inexperienced with regard to conducting establishment surveys, particularly with respect to industry financial information, although it does conduct a number of administrative record reporting systems that include financial information. NOAA largely lacks specialized staff expertise and institutional knowledge of relevant methodologies and scientific standards for establishment survey methods for financial information and data QA/QC methods, and lacks specific standards appropriate for different data uses (e.g., administrative, research, or policy/management program evaluation). As such, a broader objective of the CIE review is to identify institutional gaps in appropriate managerial and scientific expertise to carry out statistical social and economic data collection as mandated by the Magnuson-Stevens Act in the context of regulated fishing business establishments.

CIE Review Process and Panel Selection:

NOAA Fisheries (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) for the review of the BSAI Crab EDR Program was established by AFSC staff and the NMFS Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee.

The panel meeting Chair is chosen by AFSC and serves principally to facilitate the panel meeting to ensure the discussion remains focused on the Terms of Reference, and coordinate the production of the summary report of the panel meeting proceedings and any conclusions or findings reached by the panel during the meeting.

Panel Meeting Chairman
Dr. Christopher Anderson
Associate Professor, Department of Environmental and Natural Resource Economics
University of Rhode Island, Kingston, RI

Panelists selected by CIE for this review are the following:

Dr. Susan Hanna
Professor Emeritus of Marine Economics
Oregon State University Corvallis, OR

Dr. Danna L. Moore
Associate Director
Social & Economic Sciences Research Center
Washington State University, Pullman, WA

Dr. Richard Wang
Director, MIT Information Quality Program
Massachusetts Institute of Technology, Cambridge, MA

Panel members were identified and selected by the CIE Steering Committee and Coordination Team on the basis of their expertise in applied economic analysis in commercial fisheries and fishery management, business and economic survey design methodology and implementation in regulated industries, and survey data QA/QC, respectively. Consultation with AFSC and other NOAA staff regarding panel selection was limited to identifying general qualifications and areas of expertise, and to ensure that agency staff and panelists are mutually free of any conflict of interest.

Further information on the CIE process can be obtained from www.ciereviews.org.

Scope of Work and Terms of Reference

Each CIE reviewer will conduct the independent peer review in accordance with the Scope of Work (SoW) and Terms of Reference (ToRs). The ToRs are limited to evaluation and recommendations regarding scientific, methodological, and administrative standards and practices.

Terms of Reference

1. Review and discussion of data collection and analytical objectives defined by the Council, and associated data quality objectives, as context for evaluation of methods under ToRs 2 through 10.
2. Evaluation and findings regarding establishment survey questionnaire design, evaluation, and testing methodology employed to date and recommendations for improvement
3. Evaluation and findings regarding data collection administration and data management to date and recommendations for improvement
4. Evaluation and findings regarding protocols and metrics for data quality assessment employed to date and recommendations for improvement
5. Evaluation and findings regarding data quality control standards employed to date and recommendations for improvement
6. Evaluation and findings regarding analytical methodologies and treatment of uncertainty employed to date and recommendations for improvement
7. Evaluation and findings regarding interpretation and conclusions of data analyses employed to date and recommendations for improvement
8. Explicit determination as to whether this NMFS project presented the best available science
9. Recommendations for further improvements, including all elements of the EDR program development and evaluation process and appropriate institutional and scientific capacity
10. Brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations

Scope of Work for CIE Reviewers:

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by AFSC staff in advance of the peer review (See Appendix 1);

2) Participate during the panel review meeting and conduct an independent peer review in accordance with the ToRs;

3) Independently complete a written peer review report addressed to the "Center for Independent Experts." Each reviewer's report will include an Executive Summary providing a concise summary of the findings and recommendations. The main body of each reviewer's peer report will consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification. Reviewers shall provide a critique of the NMFS review

process, including suggestions for improvements of both process and products. Each panel member's independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

4) Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report. Although the individual CIE peer reports shall be submitted directly to CIE for review and approval by the CIE Steering Committee, the Summary Report is not considered a CIE product because it does not undergo the CIE review process. Furthermore, CIE reviewers are not required to reach a consensus, and should provide a brief summary of their views on the summary of findings and conclusions reached by the review panel during the meeting in accordance with the ToRs.

Schedule of Milestones: August 8, 2011	AFSC staff to provide CIE Reviewers all pre-review documents
August 23-25, 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting.
September 9, 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
September 23, 2011	CIE submits CIE independent peer review reports to the COTR
September 30, 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Key Personnel:

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APPENDIX 2: BACKGROUND MATERIAL PROVIDED IN ADVANCE OF REVIEW

Abbot, K., B. Garber-Yonts and J. Wilen. 2010. Employment and remuneration effects of IFQs in the Bering Sea/Aleutian Island crab fisheries. *Marine Resource Economics* 25:333-354.

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APPENDIX 3: STATEMENT OF WORK FOR DR. RICHARD WANG

External Independent Peer Review by the Center for Independent Experts

Review of the Bering Sea and Aleutian Islands Crab Fisheries

Economic Data Collection Program

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: : In 2005 the Bering Sea and Aleutian Islands (BSAI) crab fisheries underwent a drastic change in management regime, moving to an individual quota-based system (also referred to as "rationalization") which involved both harvesters and processors. Among the Council's objectives in rationalization are addressing excess harvesting and processing capacity, and improving the economic performance of the crab fisheries by addressing low economic returns and economic instability for harvesters, processors, and communities. In anticipation of potential changes in the magnitude and distribution of benefits, employment, and other social and economic effects of the fishery, the North Pacific Fishery Management Council (Council) tasked the Alaska Fisheries Science Center (AFSC) with leading the development and implementation of an extensive and mandatory annual data collection program (referred to as Economic Data Reports, or EDRs). The EDR program was designed to collect detailed cost, earnings, and employment data from crab fishery participants to support computation of a number of specific performance metrics to evaluate the effects of rationalization on fishery participants and to provide data and analysis in support of future management changes.

The final design of the data collection, including data elements and survey instruments/questionnaires, was developed with extensive industry consultation and review by the Council. The final design was specified in detail in the Code of Federal Regulations (CFR).

The EDR reporting requirement went into effect in 2006, with EDR baseline data submission required retroactively for 1998, 2001, and 2004 and subsequently, on an annual basis, for calendar year crab fishing activities for 2005 to present. The annual deadline for completed data reporting forms submission is July 1 for the previous calendar year. Significant data quality limitations, associated with questionnaire design, were apparent with the first EDR submissions in 2006. To date, extensive efforts have been taken to investigate and validate the quality of the information reported in the EDR forms. Several informal focus groups have been held with EDR submitters and more formal review has been conducted as follows:

- the contractor collecting the data in conjunction with the AFSC has prepared annual reports documenting questions raised by submitters and known or potential flaws in questionnaire design
- a certified public accountant has been contracted to conduct annual records-check validation by means of random and for-cause audits on subsets of the submitted EDRs and supporting financial records
- a formal industry committee established by the Council has conducted two reviews of the EDR forms and audit findings and provided data quality and reporting burden assessments
- statistical and qualitative results of audit findings and industry assessments have been incorporated into a detailed metadata document and distributed for public review
- the Council's Scientific and Statistical Committee has reviewed the metadata
- and the Council has received a staff discussion paper on EDR data quality limitations and endorsed constraints on use of a substantial subset of EDR data.

The EDR is a census of all crab fishery participants in the harvest and processing sectors and compliance is a mandatory condition of annual permit renewal. As such, data quality limitations do not arise from sampling design or unit nonresponse error. Rather, data quality limitations arise principally from error sources associated with availability and accuracy of records maintained by submitters, flaws in questionnaire design (including specification errors, excessive computations required of the submitter, and incompatibility with standard industry recordkeeping conventions), and coverage and measurement error due to frame design and changes in industry structure. Revisions to EDR forms were incorporated in 2006 and 2007 to address some identified data quality concerns; however, revisions are limited by specifications set forth in the CFR. Further measures to improve data quality and utility, and reduce submitter burden, will require substantial redesign of the EDR program and associated regulatory specifications. The Council has initiated a process to review the analytical objectives of the EDR program and develop revised regulations and reporting requirements. This process is currently ongoing, with decisions regarding objectives and data reporting requirements expected in December of 2011.

The objective of the CIE review is to identify appropriate methodological best practices and standards for survey design, evaluation, and testing, and to define data quality assurance and data quality control QA/QC procedures to be employed in the EDR program redesign and subsequent administration. The program falls within the class of statistical data collection referred to in the scientific literature as an establishment survey, for which the existing methodological literature is limited and exists largely in government statistical agency documents, conference proceedings, and institutional knowledge. As an agency, NOAA Fisheries is relatively inexperienced with regard to conducting establishment surveys, particularly with respect to industry financial

information, although it does conduct a number of administrative record reporting systems that include financial information. NOAA largely lacks specialized staff expertise and institutional knowledge of relevant methodologies and scientific standards for establishment survey methods for financial information and data QA/QC methods and standards appropriate for different data uses (e.g., administrative, research, or policy/management program evaluation). As such, a broader objective of the CIE review is to identify institutional gaps in appropriate managerial and scientific expertise to carry out statistical social and economic data collection as mandated by the Magnuson-Stevens Act in the context of regulated fishing business establishments.

The CIE panel members will be selected on the basis of their expertise in establishment survey design methodology and implementation in regulated industries, survey data QA/QC, and analysis of economic performance of business establishments in commercial fisheries or similar statistical and/or regulatory and industry settings. Panel members are expected to review the documented record of the analytical objectives and process of crab EDR design, evaluation, testing, and data QA/QC employed to date in order to identify process and technical/scientific shortcomings, develop recommended best practices, objective standards, and evaluative criteria in these areas as applicable to the program setting and objectives. To the extent that the scope of the CIE review does not permit the specification of methodological best practices and standards in sufficient detail to be implemented directly in EDR program redesign, the panel is expected to provide recommendations for process improvements and development of appropriate institutional capacity to enable further methodological development and defensible standards in establishment survey design, evaluation, testing, and data QA/QC in this and other fishery economic data collection programs.

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an independent peer review during the panel Review Committee (RC) meeting scheduled in Seattle during 23-25 August 2011. The CIE reviewers shall have the requested expertise necessary to complete an impartial peer review and produce the deliverables in accordance with the SoW and ToR and as stated below:

<u>CIE Reviewer 1</u> shall have working knowledge and recent experience in the application of fishery economics. This reviewer must be an expert in applied economic research and policy/management analysis in commercial fisheries, and must have a well-established record of publication that includes the results of applied analyses in commercial fisheries management. It is also desirable to have familiarity with financial accounting practices in fishing/seafood processing and comparable industries and experience in US federal fisheries management would be beneficial.

<u>CIE Reviewer 2</u> shall have working knowledge and recent experience in the application of survey research. This reviewer must be an expert in the use and methodology of survey design and administration as they apply to data collection for research, management analysis, and regulatory compliance in the context of regulated industries. The review must also have a well-established record of publication that includes the results from studies of survey research

methodology in the context of business establishments. In addition, the reviewer must be engaged (currently or in the very recent past) in research that addresses theoretical or methodological advances related to the use of establishment survey methods and institutional best practices for economic survey design and administration.

CIE Reviewer 3 shall have working knowledge and recent experience in the application of data validation and data QA/QC methodology. This reviewer must be an expert in practical and statistical data quality assessment and data validation in the context of recordkeeping and monitoring of regulated industries. Experience with financial accounting practices in small to medium scale business enterprises and application of US Federal Information Quality Act requirements to collection of financial and business data from regulated industries by federal agencies. Experience with records-check validation methods would be useful.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting in Seattle, Washington during the 23-25 August 2011 as specified in the Schedule of Milestones and deliverables herein.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review

documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

The following background documents will be provided in preparation for the peer review.

1. Annual Catcher/Processor Crab Economic Data Report (EDR), Calendar Year 2009. 2010. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
2. Annual Catcher Vessel Crab Economic Data Report (EDR), Calendar Year 2009. 2010. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
3. Annual Shoreside Processor Crab Economic Data Report (EDR), Calendar Year 2009. 2010. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
4. Historical Catcher/Processor Crab Economic Data Report (EDR), Calendar Year 2004. 2006. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
5. Historical Catcher Vessel Crab Economic Data Report (EDR), Calendar Year 2004. 2006. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
6. Historical Shoreside Processor Crab Economic Data Report (EDR), Calendar Year 2004. 2006. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
7. Five-Year Review of the Crab Rationalization Management Program for Bering Sea and Aleutian Islands Crab Fisheries. 2010. North Pacific Fishery Management Council, Anchorage, AK. December 28, 2010
8. Discussion paper on crab economic data collection. 2010. North Pacific Fishery Management Council, Anchorage, AK. October 2010.
9. Discussion paper on economic data collection. 2010. North Pacific Fishery Management Council, Anchorage, AK. February 2010.
10. Final EIS for BSAI King and Tanner Crab Fisheries. NOAA Fisheries. August 2004.
11. Garber-Yonts, B. and J. Lee. 2010. Stock Assessment and Fishery Evaluation Report for King and Tanner Crab Fisheries of the Bering Sea and Aleutian Islands Regions: 2010 Economic Status Report. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
12. Alaska Crab Economic Data Report Data Validation: Report Prepared for Pacific States Marine Fisheries Commission, 2009 Calendar Year Data. 2010. AKT, LLP, Portland, OR. November 2010.
13. 2006 Economic Data Report (EDR) Data Collection Difficulties. 2007. Pacific States Marine Fisheries Commission, 205 SE Spokane Street, Suite 100 Portland, OR. July 2007.
14. BSAI Crab Economic Data Report Database: Metadata. 2010. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.
15. BSAI Crab EDR Database: Data Quality Summary. Updated January 30, 2008. NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA.

This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report. CIE reviewers are not required to reach a consensus, and should instead provide a brief summary of their views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting in the Seattle during 23-25 August 2011 as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than REPORT SUBMISSION DATE each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts" and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to Dr. David Die ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

July 19, 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
August 8, 2011	NMFS Project Contact sends the CIE Reviewers the pre-review documents
August 23-25, 2011	Each reviewer participates and conducts an independent peer review during the panel review meeting.
September 9, 2011	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
September 23, 2011	CIE submits CIE independent peer review reports to the COTR
September 30, 2011	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) each CIE report shall have the format and content in accordance with Annex 1, (2) each CIE report shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

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APPENDIX 4: REVIEW PANEL

The review panel consisted of four persons:

Dr Chris Anderson (Chair)
Associate Professor, Department of Environmental and Natural Resource Economics
University of Rhode Island, Kingston, RI

Dr Susan Hanna
Professor Emeritus of Marine Economics
Oregon State University Corvallis, OR

Dr Danna Moore
Associate Director, Social & Economic Sciences Research Center
Washington State University, Pullman, WA

Dr Richard Wang
Director, MIT Information Quality Program
Massachusetts Institute of Technology, Cambridge, MA