

**Chair's Summary of Program Review of Protected Species Science
Science on Marine Mammals and Turtles**

**Southwest Fisheries Science Center & Northwest Fisheries Science Center
La Jolla, CA**

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Review Panel Members:

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Objective: The objective of this review is to evaluate the Southwest Fisheries Science Center Marine Mammal and Turtle Program and the Southern Resident Killer Whale Program of the North West Fisheries Science Center. The review panel was asked to use the following overarching questions in developing their review:

- Do current and planned protected species scientific activities fulfill mandates and requirements under the ESA and MMPA, and meet the needs of the regulatory partners?
- Are there opportunities to be pursued in conducting protected species science, including shared and collaborative approaches with partners?
- Are the protected species scientific objectives adequate, and is the best suite of techniques and approaches to meet those objectives?
- Are the protected species studies being conducted properly (survey design, statistical rigor, standardization, integrity, peer review, transparency, confidentiality, etc.)?
- How are advances in protected species science and methodological approaches being communicated and applied in NMFS?

Background and Overview of Meeting

The Review Panel reviewed the activities of the Southwest Fisheries Science Center (SWFSC) Marine Mammal and Turtle Division and the Northwest Fisheries Science Center (NWFSC) Southern Resident Killer Whale program at the SWFSC laboratory in La Jolla, July 27-31. Other NOAA regional programs that include marine mammals, but fall within other larger programs, such as the California Current Ecosystem Monitoring, Environmental Chemistry and Ecotoxicology programs, were not evaluated. Science programs were described by a series of speakers over the first three days through presentations divided into five different themes, in which overviews and specific case reports were described, and laboratory tours. The panel was privileged and honored to review such a world class science program and hear first-hand from talented, productive and committed scientists recognized as leaders in their field, and was impressed by the consistent high quality not only of the science presented, but of the logistical

support, background briefing materials, laboratory tours, and professionalism of the entire staff (including research, administrative and support personnel). The materials and presentations provided to the reviewers were clear, well organized and thorough, reflecting considerable work by the staff in their preparation. The panel was especially impressed by the leadership of Dr. Lisa Ballance, who has clearly led her staff through complex financial times and maintained a world-class science program and has a clear vision for its future. Her professionalism and vision are outstanding. The scientists working in the reviewed programs are active leaders renowned in the international marine mammal and turtle science community, and are firmly connected to real world needs and emerging issues in marine mammal and turtle conservation and management. Their overall attitude and thorough approach to the review process reflects not only their dedication to marine mammal and turtle conservation, but their commitment to ensuring high quality research through the peer review process.

The major focus of the presentations was on the work of the SWFSC, with one themed session dedicated to the Southern Resident Killer Whale program of the NWFSC. A clear presentation on the SWFSC program history and the shift in program mandates over the past 30 years gave the panel good context for evaluation of the current science program, and guided the panel's thoughts on the strengths of, and challenges facing, the science program. The review was structured into a series of themes that were presented separately, but clearly interact and have important linkages that enhance overall ability to answer management needs. For example, although health assessments were presented separately from abundance estimation, they can serve as an early warning for population trends and explain linkages to stressors. The SRKW and abundance and risk assessment "themes" use tissues and technology developed by the "life history" theme. Other programs based at other NMFS offices working with marine mammals also overlap with the themes reviewed, and it will be important to bear these program missions in mind when considering future directions for the program themes reviewed here by this panel. These include the California sea lion program based at NMML (population assessments need to be integrated with stranding response in Southern California and prey assessments at SWFSC), and the Marine Mammal Health and Stranding Program (future of the genetics archive at SWFSC should be evaluated in the context of an integrated National Marine Protected Species Tissue Archive). The panel considered presentation content, background materials provided by the Center and points raised during discussions to comment on five themes

Panel Members' Major Recurrent Observations and Recommendations

The listed observations and recommendations below are not in any specific order and do not represent consensus, but represent the general views of the panel or the views of individuals.

Over the course of the three days, six issues listed below arose multiple times and were pertinent to all five themes reviewed.

1. The science presented is of extremely high standard often representing the world's best work on the topic, thus it is "good" science that is hypothesis driven, with well-designed surveys, innovative approaches, standardization and validation of methods and statistical rigor, that has been published in peer reviewed journals.

The science team is outstanding, continually showing their productivity, professionalism, expertise, ability, dedication and leadership in each area of science reviewed. The number of peer-reviewed publications produced each year is impressive, and the ability of senior scientists to perform proactive science is a result of their foresight that results from years of experience as leaders in the field and a past flexibility to be creative. Although resources have become increasingly limited, the skill, experience and dedication of science staff has resulted in innovative techniques and technologies that have maintained high quality science. These techniques and technologies are shared throughout NOAA, as well as with the marine mammal and turtle international community.

2. There have been significant scientific innovations developed by SWFSC staff that are advancing the fields of marine mammal and turtle science. Specifically the photogrammetry, endocrine research and turtle skeletocronology and isotope work will fundamentally change the abilities of scientists to produce data needed by managers.

Innovative techniques developed by the SWFSC will dramatically change the ability to perform life history and health assessments, fundamental to a plethora of management needs. The endocrine work on dolphin blubber was critical methodology to recent NRDA evaluation of dolphin health in the Gulf of Mexico post the Deep Water Horizon oil spill; photogrammetry of whales is providing individual based health assessments of Southern Resident Killer Whales that will help elucidate importance of prey in population recovery. The agency should invest in these innovative techniques and technology, as their availability allows rapid response to emerging issues. Furthermore, investment will attract good young scientists to work for the agency rather than academia, preventing lack of recruitment of world class staff in the future.

3. The volume and areas of research are limited by diminishing resources and some information needs for the agency are not being provided as scientists respond to goals of external funders. The science performed meets the mandates of the MMPA and ESA, however, some science of the “right” science specifically for NMFS Western Region is not getting done.

To maintain the high standard of science the program has been globally recognized for, experienced and dynamic program leads with strong leadership have been creative in developing partnerships and collaborations, as well as novel methodologies and temporary fixes to the challenges of declining resources. Science staff have not, however, been able to perform the full suite of science projects outlined in the current science strategic plan and the annual guidance memorandum, and some regional priorities for the management office (West Coast Regional Office) have not been directly addressed. Some stocks have not been recently assessed and thus stock assessment reports have not been updated due to limited ship based surveys, with increasing reliance on modelling and innovative quantitative techniques to overcome this issue. There has been limited opportunity to evaluate impacts of climate change on cetaceans of the western region. As science staff have garnered financial support from non-NOAA agencies and the private sector, some science efforts have been redirected at addressing these funders’ goals and objectives, rather than those of NMFS. Thus some science of high quality that has been published in peer-reviewed publications is not an immediate priority for U.S. management needs. Although the work is excellent science that promotes development of new techniques and

important international partnerships, there may be more pressing needs for protected species that occur in US waters that are not being met.

The increase in funding by external partners runs the risk of perceived conflicts of interest.

The science program leads communicate regularly and openly with the Regional Office, yet from the materials presented to the panel, there appear to be some management information needs that are not being addressed by the science programs reviewed. Some science activities do not directly address regional priorities, although they do address national or international needs. This may be due to these needs being addressed by other programs within NMFS along the west coast, but further clarity on the roles of different programs and clear lines of communication among NMFS offices and programs would be useful. Clearer guidance on the relative importance and prioritization of differing regional and national management needs would be useful in prioritizing science programs. External funding coupled with the international recognition of SWFSC abilities has resulted in scientists conducting field work on species outside the western region, although similar issues may exist locally. This concern is compounded by permitting restrictions on the use of UAS in US waters.

4. Although currently world class, the future of the quality of the reviewed science is at risk due to an unstable program structure: the majority of base funds are dedicated to salaries leaving little for annual operations and equipment maintenance; a large number of senior staff are likely to retire in the near future; and young scientists' intellectual stimulation is constrained due to limited support for travel to conferences and workshops and hence ability to network with other leaders in the field.

A staff succession plan is vital to ensuring scientific vitality of the SWFSC Marine Mammal and Turtle program. The impending retirement of several senior scientists is both an opportunity and a concern, as it can offer pathways to budget savings, yet will also result in loss of some of the expertise for which NMFS is internationally renowned. Key staff are vital for nationally important science, especially quantitative expertise. This needs to be maintained through a careful staff succession plan, to ensure quantitative ecology expertise is retained, and the innovative endocrine and life history assessment work currently performed by contractors is retained. Furthermore, as young scientists are recruited, emphasis must be placed on the need for increased integrative and ecosystem approaches, data management and interdisciplinary collaborations. Investment in travel for young scientists is needed. The ability of researchers to maintain intellectual curiosity, be familiar with cutting edge research and develop innovative research as well as collaborations and interdisciplinary projects is enhanced by travel to scientific conferences and workshops, so funding for these must be maintained.

5. The SWFSC tissue archives are assets of national and international importance, yet their quality and future are at risk due to limited financial support within the SWFSC budget line. The genetics archive must be supported by national investment.

The genetics archive is internationally recognized as a resource that is used by the global marine mammal and turtle community, and has allowed rapid response to stock delineation questions from NMFS management. However, support is maintained from the limited regional SWFSC

resources, and instead this should be supported as a component of an integrated national protected species archiving system. A comprehensive assessment of national marine protected species tissues and data is needed, and a plan developed to ensure long-term sustainability of this national resource. Support should be provided at a national level to ensure the world class genetics resource persists.

6. Several programs have high-quality time series data that are at risk, threatening ability to detect impacts of ecosystem perturbations such as climate change.

Time series are dependent not only upon long-term funding, but scientists with an understanding of the issues. The staff have done a fantastic job in developing techniques and technologies to overcome funding and logistical constraints, and have developed new methods that have great promise, such as aerial photogrammetry from UAS. The examination of stranded animals also allows detection of environmental changes impacting marine mammals, and the long-term data and sample archive (from both ship based sampling and stranded animals) at SWFSC are invaluable, and has allowed validation of novel endocrine studies as well as detection of anthropogenic impacts such as barotrauma and ship strikes. These programs that contribute to long term data series must be maintained and invested in. Increased investment in data management is recommended.

Chair's specific points on themed presentations

Theme 1. Abundance Estimation and Trends

Observations

Strengths:

- The science team working on abundance estimations and trends are of high quality, produce excellent science, and work well together as a team, with complementary skill sets.
- The science is mandate driven, meeting not only regional, but national and international needs.
- Long term data series allow detection of trends, impacts of ecosystem change and anthropogenic impacts e.g. gray whale shore based counts are cheap yet have allowed detection of ice change impact on cetaceans, an important example of impacts of climate change on high profile species
- Increasing use of acoustic methods, Bayesian and modelling approaches have overcome limited availability of ship based line transect survey data
- Habitat models are continually being refined to address management questions
- Methodology is being exported to other regions
- Information and models used by international community e.g. IWC, IUCN
- Constructive partnerships with other federal partners, e.g. BOEM, US Navy
- Publication of freely available government reports on methodology
- Software packages have been initiated and developed that are publicly available and used worldwide.
- Turtle bycatch assessment modeling to overcome logistical difficulties in turtle population assessment.

Challenges

- Maintenance of staff skills, innovative approaches and intellectual stimulation without support for attendance at specialized conferences and workshops
- Long term series at risk due to budget constraints, limited ship time, impending staff retirement
- Visually cryptic species hard to obtain data for
- Turtle population assessment dependent upon modelling
- Rapidly changing California current ecosystem requires increased data collection rather than reduced to understand impacts of change on species
- Stressors are increasing (ship traffic, noise, HABs)

Recommendations

- Develop an integrated nationwide plan for use vessels for marine mammal surveys, with clear vessel specifications, and adopt the rotating schedule for surveys proposed by the SWFSC.
- Develop a staff succession plan, with emphasis on a quantitative ecologist with field skills, and allow attrition through selective non replacement of retiring scientists to manage restricting budgets.
- Continue strong partnerships with academia to garner funding avenues and intellectual “freshness”
- Increase investment in acoustic monitoring tool development and technology sharing.
- Share acoustic resources and expertise agency wide
- Increase investment in computerized technology and novel skill sets for gray whale assessments.
- Increase communication across region and nationally to prioritize stocks for assessment.
- Power analysis of pinniped survey data to determine possibility of decreased survey frequency
- Increase partnerships with user groups to develop habitat-based density models, such as shipping industry.

Theme 2. Defining units to conserve

Observations

Strengths

- The genetic archive is an international resource for marine mammal and turtle genetics, essential for stock assessments and fulfillment of MMPA and ESA mandates that serves the entire agency as well as international community.
- Rapid and timely response to listing petitions and stock delineation needs have been met using genetic archive, e.g. humpback and false killer whale stock/dps characterizations
- Proactive approach to stock delineation needs such as current fin whale genetic work allows easier management decisions outside of intense scrutiny during a “crisis”

Challenges

- The genetic archive is at risk of poor curation, decreased sample recruitment and poor data management and dissemination due to limited resources, reduced ship time for biopsy, and increased time needed for data management under PARR and for CITES permit processing
- Laboratory equipment has not been upgraded in recent years, and few maintenance contracts exist
- Data generation is increasing, requiring increased data management
- Number of post-doctoral visitors in the program has decreased
- Increased proportion of scientist time spent on administration rather than research
- Decreased attendance of scientists at international academic meetings and conferences reduces intellectual innovation in an evolving field

Recommendations

- Develop an integrated agency-wide program for marine protected species sample archiving (including e.g. marine mammal and turtle genetics at SWFSC, at the SEFSC, salmon at Smithsonian, pinnipeds NIST west coast, stranded animal samples at MMHSRP partner institutions) and is supported at a national level to decrease financial burden of the genetics archive on SWFSC.
- Invest in data management and informatics.
- Develop a national prioritization of species for stock/dps characterization

Theme 3. Science to support recovery of Southern Resident Killer Whales

Observations

Strengths

- Strong collaboration with management and responsiveness to management needs
- Bibliography demonstrates productivity
- Multiple public workshops have allowed considerable input into program design
- Integrated interdisciplinary approach to science
- Detailed data on individuals enable understanding of factors affecting recovery of small mammalian populations
- Shift in focus from population level parameter correlations with environmental parameters and stressors to individual level health assessment
- Novel UAS based photogrammetry opens opportunities for understanding individual health
- Passive acoustic recorder development and deployment increases understanding of winter distribution
- Successful outreach about the novel photogrammetry techniques.

Challenges

- Small population size means stochastic effects such as a mortality due to ship strike prevent meaningful interpretation of correlations among population dynamics and potential stressors
- Multiple stressors confound interpretation of excessively focused studies

- Effects of contaminants unlikely to be understood through correlational and observational studies
- Seasonal and stock-specific distribution of prey poorly understood
- Winter movements and prey of SRKW poorly understood
- Reproductive losses poorly understood

Recommendations

- An integrated multidisciplinary approach must continue to bring multiple lines of research together
- Individual health assessment approach should be continued and integrated with population parameters, especially individual whale body condition through photogrammetry
- Photogrammetry should be continued over years of differing calf recruitment and prey availability to determine impacts of latter on survival and reproduction.
- Continue study of whale location and habitat use through tagging and passive acoustic recorders to further understand habitat use, distribution in winter, prey needs and habitat overlap with northern resident killer whales.
- Decrease focus on contaminant levels due to limitations of correlational approach
- Pursue opportunities for funding through SeaWorld Killer whale research fund
- Increase effort to examine carcasses and support diagnostics on dead killer whales to understand causes of mortality rather than expand microbiome work which only gives natural history of live whale breath flora rather than information on pathogenicity of organisms
- Increase collaboration with endocrine laboratory to use hormonal changes in blubber and or breath as health markers
- Continue quantitative fecal prey DNA assessment

Theme 4. Life history and condition

Observations

Strengths

- Strong publication record, high quality scientists, strong collaborative approach
- Long term data set on gray whales allows detection of potential effects of climate change, integrates marine mammal work with ecosystem approach.
- Innovation and shift in focus from manned aircraft and ships to photogrammetry and use of UAS is cheaper, more data on individual, and gives more refined endpoints for detection of effects.
- Integration across programs increases efficiency, allows for science innovation, facilitates technique development and answers management questions
(Cutting edge novel technology (UAS, blubber endocrinology) shared throughout NOAA; mining of sample and data archive from ETP has allowed understanding of reproductive failures in ETP; mining of stranding database sample archive allows validation of novel endocrinology techniques)

- Novel world class science and prior investment in new techniques allowed detection of effects of DWH oil spill on endocrine and reproductive health of bottlenose dolphins in the Gulf of Mexico
- Cross NOAA collaboration with MMHSRP and NRDA funding allowed cutting edge science during assessments of oil spill impacts
- Specimen based research takes advantage of previously archived material as well as samples from stranded animals
- Sample archive from stranded animals and the ETP provides basis for other research in life history, including development of novel endocrinology techniques.
- Turtle vital rate estimation using new techniques (age and growth analyses in the bone layers and hormone assays for sex ratio evaluation), and
- Turtle habitat mapping (stable isotope techniques, surveys)

Challenges

- Unstable funding with contract personnel in lead positions.
- Decreased ability to obtain tissue biopsies due to decreased ship time
- Retention of world class innovative scientists hard with restricted travel funds and ability to attend conferences and workshops to develop collaborations
- Lack of assessment of role of biotoxins in strandings, UMEs, and SRKW health assessments despite presence of massive HAB along west coast and NOS resources for investigation
- Ability to use UAS and photogrammetry in US waters is constrained by permitting restrictions.

Recommendations

- Invest in staff with quantitative ecological expertise and field experience to integrate life history data with population dynamics and risk assessment.
- Continue development of remote endocrine assessment tools through blubber and breath hormone and metabolite assessments.
- Increase collaborations with academia and NCOS to evaluate biotoxin effects in cetaceans
- Increase integration of stranding response with ecosystem programs
- Develop collaborations with other researchers on breath analysis (e.g. Davis lab, UCD) to expand breath analysis to include metabolites
- Streamline permitting for use of UAS in U.S. waters.
- Explore partnerships with California State programs, especially the Ocean Science Trust

Theme 5. Risk assessment

Observations

Strengths

- Internationally recognized science to support ESA and MMPA mandates
- Internationally recognized expertise in risk assessment demanded at IWC, IUCN and within country expert panels on marine mammal and turtle conservation

- Participation in international collaborations in conservation of critically endangered species. Specifically, the programs leadership in vaquita population assessment has been critical in supporting the Mexican government's actions to conserve this critically endangered species.

Challenges

- Travel to countries needing scientist expertise for risk assessment limited
- Critical status of the vaquita in non US waters demands immediate action

Recommendations

- Support travel for key personnel with expertise crucial to guiding conservation of critically endangered species
- Support Mexican marine mammal science program for trans-boundary issues of critical conservation importance.

Reviewer's report on the Program review of protected Species Science:
Marine Mammal and Turtle Division (MMTD), SWFSC, 27-31 July

Reviewer: #1

Dated 5 August 2015

General observations

It has been both a privilege and a pleasure to participate in the Panel review of the Marine Mammal and Turtle Division (MMTD). Although I have known many of the more senior scientific staff in the Division for many years, I am always impressed by their dedication and the exceptional quality and diversity of the science in their programs. At this meeting, I was also impressed by the leadership and mentoring offered to their junior staff, contractors and students.

The 2 fundamental questions (+1)

Members of the review panel were asked to consider two fundamental questions,

- 1) *Is the MMTG doing 'good science'?*
- 2) *Is the MMTG doing 'the right science'?*

The answer to the first question is, without exception, yes. The quality of the science and the presentation presented during the review were of high quality, consistent with the reputation of the SWFSC as a center of excellence in marine mammal (cetacean) and turtle science

The answer to the second question is more difficult to judge. Although the MMTG maintains a strong relationship with the Regional Office and is fulfilling many of its obligations under the ESA and MMPA, the direction of the science is increasingly being influenced by the priorities of other agencies, BOEM and the Navy in particular. While these partnerships have many synergies and shared responsibilities under the ESA and MMPA, there is the risk of undermining the independence and 'proactive' strengths of the MMTG through a 'client-provider' relationship with these other agencies.

To this, I will add a third question,

- 3) *Will the MMTG be able to maintain its reputation as a center of excellence and to fulfill its responsibilities under the ESA and MMPA in the face of a stagnant or declining budget?*

To date, the MMTG has maintained strengths in traditional organismal biology and has demonstrated a commendable ability to embrace and innovate with new technology. However, it is not clear that this is sustainable with the current base funding or through the increasingly competitive search for outside funding. It was encouraging to see from the presentations of Summary and Future Directions that the realities of these challenges are recognized by the current Division Chief (Ballance) but navigating these changes will, I suspect, require difficult strategic decisions about capabilities (see below, Staffing Concerns).

The five overarching questions (+1)

- 1) *Do current and planned protected species scientific activities fulfill mandates and requirements under the ESA and MMPA and meet the needs of the regulatory partner?*

>Yes, largely, although stagnant base funding has resulted in a backlog of Stock Assessment Reports (SARs) and an inability to update abundance estimates.

2) *Are there opportunities to be pursued in conducting protected species science, including shared and collaborative approaches with partners?*

>Yes, probably, but the MMTD already has a strong history of collaborative research and partnerships, including an impressive number of international collaborations.

3) *Are the protected species scientific objectives adequate and are the best suite of techniques and approaches being used to meet those objectives?*

>Yes, the MMTD has shown an impressive ability to innovate and embrace new technological and analytical methods, as well as appropriate use of more conventional or traditional methods.

4) *Are the protected species studies being conducted properly (survey design, statistical rigor, standardization, integrity, peer review, transparency etc.)?*

>Yes, the MMTD case studies demonstrated a high standard of research, with a strong analytical rigor and innovation, particularly for ‘difficult’ species (e.g., cryptic and rare) and difficult issues (e.g., predator/prey relationship of SR killer whales).

5) *How are advances in protected specie science and methodological approaches being communicated and applied in NMFS?*

>Communication and relationships between the MMTD and partners within NMFS (e.g., WC Regional Office, Office of Protected Resources, the NWFSC and NMML) seem strong and collegial.

6) *How are advances in protected specie science and methodological approaches being communicated outside the NMFS?*

The MMTD has demonstrated an exceptional record of publication in peer-reviewed journals and agency reports. The CVs of many of the senior staff are of a world-class caliber. However, the ability of MMTD staff to present at scientific conferences and to contribute to international fora, e.g., the scientific committee of the International Whaling Commission, has diminished in recent years due to travel constraints. This has a two-fold effect of slowing the diffusion of new information to the wider scientific community and of depriving MMTD staff of the ability to learn from and initiate collaborations with colleagues outside NMFS.

Other concerns

Threats to staffing and program functions

With a staff of about 72 individuals (40 federal permanent, 32 contract) and a large cohort of senior scientists that are reaching retirement age, the MMTD needs to be strategic about future hires and advancements. At present, 98% of base funds are committed to personnel costs (the 40 federal FTE), resulting in dependency from temporary funds and external contracts for support of non-federal staff (contract staff) and project support. As discussed above, this funding constraint has the potential to erode the independence of the MMTD in setting priorities for new and ongoing research, particularly the ‘proactive’ science and innovation that is strength of the MMTD (see below). If base budgets remain stagnant, as anticipated, the only other sources for operational objectives will have to come from the salary savings from attrition of current staff. This trade-off is unfortunate but might prove necessary to restore some flexibility of the MMTD to set priorities for addressing issues that are not considered a priority by partner agencies.

Programmatic and administrative support for proactive science and innovation

A number of case studies pointed to the rapid response and innovative approaches to emerging or ongoing management issues, e.g., the rapid response to the petition for designation of a Distinct Population Segment for Hawaiian false-killer whales and application of innovative technology for life history, health assessment and genomics. This rapid response and innovation is possible, in part, because of the physical infrastructure and technical expertise of the MMTD, including the collections (e.g., the CCTA). However, it is also supported by the foresight and professional judgment of senior staff, and their leadership in long-term collaboration with university and independent scientists. This intellectual infrastructure is threatened by the loss of flexibility in operational support due to stagnant base funding (e.g., dependence on outside funding), and the loss of individual professional freedom from increasing scrutiny and restriction of a 'risk averse' administrative environment. It is also threatened by the retirement of senior staff, who have thrived in a past environment of greater support and fewer constraints than those likely to be faced by their replacements. To maintain the strengths of the MMTD, I encourage leadership to do what they can to support these 'proactive' attributes in the professional development of the upcoming scientific staff.

Threats to the cetacean and turtle archive (collections)

It was clear from a number of presentations that the cetacean and turtle tissue archive (CTTA) is an invaluable resource for the MMTG in fulfilling their ESA and MMPA obligations, as well as for contributing to international and national collaborations outside the federal government. This collection has grown over the decades, as a result of the foresight and commitment of MMTG staff, to the largest and most comprehensive collection of its kind in the world. With the move to the new building and the design of specialized facilities, the physical preservation of the collection seems assured. However, the functionality of the collection, in terms of serving the needs of the MMTG and the established collaborations (including contributors to the archive), is threatened by current constraints on budget and personnel. There is an urgent need to provide direct, 'line-item' funding in support of the continued functionality of the CTTA and recognition as a national and international resource.

Informatics and bioinformatics support

Although the data management needs of the physical collections were well articulated (and justified), I would suggest funding priority also be given to greater support for the 'information collections'. This includes the records of long-term studies, in general, and the genetics laboratories, in particular. The cetacean and turtle genetics laboratories have already generated large datasets that must be integrated with the physical collections and made public under the PARR. Although I am sure the MMTD have been diligent in submitting DNA sequences from published articles to GenBank, this is not really an adequate or even appropriate archive for much of the data generated by the cetacean and turtle group (e.g., GenBank is not really interested in 100 submissions of the identical haplotype sequence from sperm whales in the North Pacific). This problem will become much more acute with the 'data avalanche' resulting from adoption of next-generation-sequencing (NGS) protocols that members of the MMTD are helping to pioneer. A dedicated staff for bioinformatics is almost certainly a necessity for progress in analysis, data management and data archiving for NGS

The transition from ‘endangered species’ to ‘functional role in the ecosystem’

I understand that this omission may be due in part to how the reviews are being structured but I would encourage the MMTG to give greater consideration to the role of recovering populations of cetaceans in the ecosystem. With the numerical recovery of some cetacean populations in the North Pacific, particularly gray whales and the humpback whales, we have a unique, historical opportunity to understand the return of these species to their former functional role in the ecosystem.

Historical reconstruction of exploited species

I would have appreciated a greater emphasis on an historical perspective for the population dynamics of exploited populations. The International Whaling Commission has spent considerable time and effort on these models as part of the ‘comprehensive assessments’ of stocks undertaken after the moratorium on commercial whaling. This exercise has proven challenging but informative in clarifying the impact of whaling and understanding the dynamics of recovery or lack of recovery. Members of the SWFSC or their students have been active participants and innovators in these IWC assessments. Although an historical reconstruction and estimation of pre-exploitation abundance are not considered directly relevant to the ESA listing reviews, they can be useful in framing the debate for future listing decisions. For example, can we say that humpback whales or gray whales in the North Pacific are now more abundant than they were before whaling?

Theme-specific observations and comments

Theme 1: Abundance estimation and trends - Cetaceans

Strengths. The overview and case studies represented tremendous progress in the estimation of abundance and trends in cetaceans of the west coast, including the vaquita. The group provided examples from different survey methods, including line-transect, photo-identification, shore counts and passive acoustics. All demonstrated statistical rigor, ingenuity and innovation. The advances in passive acoustics and species identification of vocalizations are particularly impressive and promising for estimating cryptic and rare species.

Challenges. The loss of large ship time will limit the ability of the group to provide regular assessments of abundance in many of the 42 stocks along the US WC. These surveys have been subsidized in recent years by partnership with BOEM and the Navy. If these agencies are unable or unwilling to fund future surveys, how would the SWFSC meet its MMPA obligations?

Comments and questions

>Advances in passive acoustic density estimates and remote sensing of oceanographic conditions could replace large-ship surveys for some estimates of abundance and distribution, but what about the need to collect other biological data, e.g., biopsy samples?

>Have revised estimates of abundance been re-fitted to population dynamic models used by the IWC for the comprehensive assessment? What are the implications for pre-exploitation abundance and MSY?

>The estimates of sperm whales off the west coast seem surprisingly low – is this consistent with historical whaling records?

Theme 1: Abundance estimation and trends - Turtles

Strengths. Unlike the cetacean program, which placed emphasis on the cetacean along the west coast, the turtle program included a larger overview of the international scope needed for the assessment and protection of these species. The group leaders have shown vision and dedication in establishing the collaborations needed for success with a truly international program. The program also shows great strengths in a holistic approach, using

Challenges. How will the network of collaborations and samples collection be sustained with diminished funding for laboratory analyses and reduced travel for international meetings? How will the data management and ‘legacy’ issues of the program be sustained given reliance on graduate students and postdoctoral fellow?

Comments and questions

>Good to see the initiation of several a large-scale genotype capture-recapture projects.

Theme II Defining Units to Conserve – Cetaceans and Turtles

Strengths. This program exemplifies the strengths of the MMTD in both scholarship and empirical science, as applied to management needs and as a contribution to the larger field of conservation biology. Over the last two decades, the group leaders and their teams have helped to frame the debate over how we define units to conserve in cetaceans and turtles through conceptual advances (e.g., standards for defining subspecies, distinct population segments and stocks) and adoption of modern molecular methods, including the recent advances in genomics.

Challenges. The empirical advances made by the group have depended, in large part, on access to two resources: 1) access to the world’s most comprehensive tissue archive for cetaceans and turtles; and 2) advances in molecular genetics, now including next-generation sequencing and genomics. Both of these are threatened by stagnant funding (see general comments).

Comments and questions

>Case study on DPS of false killer whales and elaboration of new species of Baird’s beaked whales demonstrate the strength of the pro-active approach and existing infrastructure in responding to urgent management needs (e.g., petition for listing).

>The extensive reference datasets for defining DIPs and DPSs in turtles reflects a tremendous history of collaboration and represents a model for international data sharing.

Theme III – Science in support of SR killer whales

Strengths. The SR killer whale team has demonstrated an impressive interdisciplinary approach to addressing uncertainty in a challenging management context for an iconic species, while operating under considerable public scrutiny.

Challenges. The program has experienced stagnant or declining funding, threatening the ongoing research of the group. The options for direct mitigation actions are likely to be limited and difficult, particularly in regards to the interactions between killer whales, salmon and pinnipeds.

General comments

- >The satellite tagging seemed to be providing perhaps the most critical new information about the potential risk factors facing SR killer whales.
- >The next-generation sequencing of feces for diet studies (prey identification) is an important innovation and complement to the previous reliance on prey scales or tissue
- >The photogrammetric evaluation of pregnancy and body condition of known individuals seems to offer another innovative approach for understanding life history responses (see below for Theme IV, Life History and Condition).

Theme IV Life History - Cetaceans

Strengths. The cetacean life history program has a great strength in traditional specimen-based research, arising from the legacy of the ETP tuna/dolphin issue and the stranding program. The team has also made impressive advances in technological innovation, e.g., the use of unmanned aerial vehicles (UAV) for photogrammetry of individual body condition and biopsy samples for hormone (pregnancy and stress) analyses. In this, the group has been very successful with a transition from its history of large-vessel research in the ETP to small boats and new technologies for cost and efficiency.

Challenges. Much of the technical innovation and the field applications of these methods are dependent on outside funding and some are addressing management issues outside the WC Region. This reflects the success of technical advances and the collaborative spirit of the group but also represents a challenge for setting priorities and meeting mandates.

Comments

- >Great to hear about the success of the photo-ID, tagging and biopsy sampling of beaked whales and progress with integrating these results for an assessment of the population disturbance in the AUTEK operating area.

Theme IV Life History - Turtles

Strengths. As with the cetacean program, the turtle program has embraced innovation and technological advances to address fundamental life history uncertainties in turtles throughout their range. This includes the now relatively established technology in telemetry and stable isotope, and the more recent advances in skeletochronology, hormone assays and genotype capture-recapture. The group has also developed great collaborative strengths and outreach with the international turtle community, resulting in a tremendous archive of samples.

Challenges. More so than the cetacean group, the turtle group seems to be dependent on students and postdocs for both core function and technical innovation. How can the long-term databases be maintained and integrated over time with the turnover typical for students and postdocs? How can the group maintain its strong collaborative relationship with the decline in funding for international travel and the flexibility to provide quid pro quo of services and capacity building?

Theme 5 – Risk assessment – cetaceans and turtles

Strengths. The overview of the Risk Assessment team confirmed strengths in the status review of stocks and assessing the spatial and temporal risks of risk of bycatch, ship-strikes and other anthropogenic impacts. As in ‘Defining Units to Conserve’ the team has been proactive in development of standards to meet the mandates of the ESA and the MMPA and innovative in

application of quantitative approaches to spatial risks.

Challenges. As with other teams, Risk Assessment has increasingly looked to outside funding for support of personnel (contractors) and research opportunities. This has made it more difficult to meet the requirement of core mandates.

Comments

>The presentation on the 'Desperate Dozen' was an important reminder of the critical threat of bycatch to local population or subspecies of cetaceans around the world, even as this has diminished as a threat in the US, and the important contribution of the MMTD in setting priorities for international conservation.

Summary and Future Directions

This was an excellent overview of the strength and challenges of the MMTG and a roadmap for the future from the view of leadership.

Reviewer #2

**2015 PROGRAM REVIEW
SCIENCE ON MARINE MAMMALS AND TURTLES**

La Jolla, CA - 27-31 July 2015

REVIEWER #2

GENERAL COMMENTS

Introduction

I write from the perspective of the current Program Leader for cetacean assessment and ecology at the National Marine Mammal Laboratory (NMML). My own program addresses similar management issues, and faces similar challenges and obstacles to those encountered by the research groups that were part of this review; consequently, I can understand well the often difficult choices made by the leadership of the groups represented at this review.

To begin with, I would note that I and other Panel members found the set-up of this particular review somewhat puzzling, in that it was characterized as a “West Coast” review, but excluded some rather obvious components. In particular, it was not clear why the decision was made to exclude the California Current Ecosystem Program at NMML, as well as to not present information on other marine mammal work (e.g. Puget Sound harbor porpoise) conducted at the Northwest Fisheries Science Center (NWFSC). I at least could see no obvious reason why this additional work should be reviewed separately, and effectively out of context, at another time.

That aside, with the exception of the Southern Resident Killer Whale study (the only component of work from NWFSC that was presented here), the review was dominated by a broad overview of the Southwest Fisheries Science Center’s Protected Species Division (SWFSC, PRD). Consequently, most of my review relates to the work of that entity.

As a general comment on the former, the NWFSC killer whale work is based upon sound science (including some innovative approaches to the study of this endangered population), although as noted below I believe there are one or two avenues that could be pursued (or de-emphasized) in the future.

SWFSC

In three long days of presentations by SWFSC staff, it became increasingly apparent that the work of the PRD is consistently outstanding in virtually every respect. The Division contains multiple world-class scientists, and is characterized by consistent leading-edge innovation in both methodological and analytical approaches, a remarkably strong publication record, and more than anything by a broad, sophisticated and long-term scientific vision. This vision, and the many senior (and not-so-senior) staff who have developed and consistently advanced it over the years, has allowed SWFSC to create a division that is an extraordinary asset to NOAA, and one which is perhaps under-appreciated in some respects.

Dr Lisa Ballance should be commended for her scientific vision and strong leadership of this group, which contains numerous high performers and a strong cadre of internationally recognized scientists.

In short, this place is a gem, and try as I might there was little I could find to criticize in the work presented to the Panel. PRD is an institution that has led the way internationally in a number of areas, and which consistently brings innovation and precision to management-driven research. This is all the more so because of the considerable constraints imposed upon its work by the present (and likely future) funding environment, which is increasingly bleak and which inevitably forces the Division to triage and focus on the most critical needs or high-visibility management issues. One potential casualty of this is erosion of one of the Division’s greatest assets, which is its long-term datasets and its extraordinary tissue archive. The value of these entities has become increasingly apparent today: long-term data and samples provide

a unique baseline with which to address burgeoning issues arising from global climate change, and the breadth of the sample collection represents a unique resource with which to address important conservation issues, notably as increasingly sophisticated new analytical techniques become available. The existence of these things owes much to the long-term vision of senior staff who have created and maintained these assets over decades; this is obviously not something that can be recreated elsewhere *de novo*.

The scientific vision at PRD has always incorporated an unequivocal commitment to broad data sharing and collaboration; this features extensive multi-disciplinary research as well as a wide network of international collaborators. This is a model for science generally: do what you need to do, share (widely) as you need to share, and bring in everyone necessary to make the most of your work and apply the most productive approaches to addressing questions and issues.

Strengths

- Strong scientific vision, maintained over decades.
- World-class science and scientists in both the marine mammal and marine turtle fields.
- Exceptional commitment to dissemination of information through regular and timely peer-reviewed publications, for both marine mammals and turtles.
- Consistent openness and commitment to national and international collaboration.
- Creation and curation of invaluable long-term datasets and of a unique marine mammal and marine turtle tissue archive.
- Strong capacity building through international collaborations, as well as career development through support of numerous graduate students and young scientists.
- Strong linkages between research and management needs of the West Coast Region, as well as international conservation issues.

Challenges

- Inadequate funding: base funding is almost entirely eaten up by salaries, thus forcing leadership to rely almost entirely on soft money for operational support. This runs the risk of an institution being responsive to external funders' needs rather than primary legislative mandates; while these almost always overlap with agency management needs, perceived conflict of interest may be an issue.
- Travel restricted by lack of funding or by travel ceilings, resulting in staff being unable to attend key scientific meetings; given that such events foster the networking that leads to many of the most productive collaborations, the negative impacts of this constraint cannot be overstated.
- Inability to convert contract positions that perform essential functions into permanent hires; without this, the ability of this Division to maintain its unique assets (both personnel and scientific) will be degraded.
- A compressed spending calendar, with money sometimes arriving too late in the year to use effectively or to permit adequate planning.
- Sometimes intractable bureaucracy within NOAA, imposing increasing obstacles to essential functions such as contracting and hiring, with negative effects on morale, planning and operations.
- An increasingly "risk-averse" culture within government that promulgates obstructive rules and regulations according to the lowest common denominator, and thus creates unnecessary barriers to the great majority of individuals (who aren't idiots).
- Lack of support to fulfill some basic legislative mandates; for example, many marine mammal Stock Assessment Reports have not been updated because of lack of funding for abundance surveys.

Key general recommendations

- NOAA leadership should recognize the great value of SWFSC PRD and give serious consideration to supporting its critical needs with additional base or other funding to support permanent hires in key positions.

- PRD should develop a staffing plan to replace key senior individuals who will retire in the near future, and also create or fill - with Headquarters support - existing critical needs. (My impression is that these might include a hormone analysis specialist, a quantitative ecologist with strong field skills, and a database manager; but that should be left to the Division Director to determine).
- Provide additional funding for travel of key personnel to important scientific meetings.
- Given the reality that base funding is unlikely to increase, develop a systematic approach to applying for external funds, including mentoring younger scientists in how to write and target proposals.

OVERARCHING QUESTIONS

1. Do current and planned activities fulfill mandates and meet the need of regulatory partners?

Largely yes, though dependence upon soft money from external sources may divert some resources to fulfilling the research needs of those funders. Inadequate funding has resulted in gaps in coverage regarding mandates; for example, many marine mammal Stock Assessment Reports suffer from lack of new data because of no support for surveys.

2. Are there opportunities to be pursued in conducting protected species science?

Both SWFSC and NWFSC are conducting innovative work at high levels of excellence, and both engage in extensive collaborations both nationally and internationally.

3. Are the scientific objectives adequate, and are the approaches and techniques adequate?

Absolutely. SWFSC in particular is a leader in development of robust and innovative methods, both in the field and in analytical work.

4. Are studies being conducted properly?

Yes, to the highest standards.

5. How are advances being communicated and applied?

For the most part (with the notable exception of a couple of key individuals), both SWFSC and NWFSC have an exemplary publication record, and as noted above both centers are characterized by extensive openness, data sharing, capacity building and collaboration.

KEY SPECIFIC FINDINGS AND RECOMMENDATIONS (AS REVIEWER HAS COMMENTS ON)

THEME I. ABUNDANCE ESTIMATION

Observations

SWFSC PRD is internationally known for its development of numerous innovative methods to address the problems inherent in marine mammal abundance estimation. These include (among others) acoustics-based surveys and associated software/hardware; Beaufort-specific $g(0)$ estimates; habitat-based density models identifying persistent relationships between cetacean species and habitat variables to predict future distribution; new approaches to treating abundance data; and night counts using infra-red cameras. PRD has over the years developed increasingly robust survey methodology, resulting in improved precision and reliability in abundance estimates. Much of this expertise has been exported to other institutions and is now used in many locations worldwide.

The PRD's annual gray whale calf surveys are cheap to conduct, and extend a decades-long time series of data. Although eastern gray whales are abundant today and are no longer considered endangered, these surveys are worth continuing because they extend the long-term data set and thus provide an opportunity to examine environmental influences on reproduction and other demographic parameters. This is particularly important in view of a rapidly changing Arctic, where much of this population feeds in summer.

Strengths

- Innovative field and analytical techniques to estimate abundance, including development of acoustic detection methods.
- Line-transect and other surveys make the most use of ship time with multi-disciplinary sampling (at least as budget permits).
- Habitat-based modeling to predict the distribution of species for use in survey design and critical habitat assessments.
- Extensive long-term datasets on abundance and distribution of various species.

Challenges

- Lack of consistently scheduled ship time for conducting surveys, resulting in outdated abundance estimates and lack of other key data.
- Inadequate funding to adequately staff cruises and meet operational costs.
- Analysis of acoustic data remains very labor-intensive; based upon the experience of my own acoustics group at NMML, I am not convinced that the optimism expressed by PRD staff regarding the development of automated species identification systems is warranted.

Recommendations

- NOAA should allocate ship time two or three years ahead and ensure that sufficient funding is available for operational costs associated with key surveys.
- Although I recognize the importance of maintaining some aspects of the gray whale work (e.g. calf surveys), I am not convinced that the very small potential Makah hunt and the corresponding questions regarding the identity (as a possibly separate unit) of the Pacific Coast Feeding Group are sufficient to justify continued focus and expense on this species. Hopefully the current *Lasker* survey will resolve this issue and allow PRD to focus its limited resources elsewhere in future years.

As a trivial side note, I am also not convinced that climate change will have a negative impact on gray whales by significantly extending their range and thus migration time, as was suggested in one of the presentations; a gray whale shifting its range north by 300-500 miles would add only a few days to its migration time, which is unlikely to represent a significant energetic cost.

THEME II. UNITS TO CONSERVE

Observations

As with abundance estimation, PRD staff in La Jolla are recognized internationally as leaders in the development of innovative methods for defining populations and management units, and many of the current approaches to this issue in marine mammal conservation biology have originated here. Similarly, the marine turtle program is characterized by broad outreach and international collaboration, which has permitted a multi-national overview of, and approach to, various key species and issues.

Although it has utility well beyond the topic of Units To Conserve, the lab's marine mammal and turtle tissue archive was described under this Theme. **This archive represents a world-class resource.** In a very real sense, the collection is directly comparable to one of the great national natural history museums that in Victorian times were established in large part to provide scholars with access to numerous specimens, with which to describe the variety of taxa and thus establish species and population designations. Regardless of the existence of other tissue collections, the La Jolla archive is clearly the primary reference archive for marine mammals (especially cetaceans) and marine turtles. Despite its

evolution into this primacy, the archive is not adequately recognized for what it is; perhaps because it originated as a regional and locally-funded entity, it effectively still has that perceived lower-level status within NOAA. It is time for NOAA to recognize the tremendous value and national status of this archive, and provide commensurate support for its maintenance and continued expansion.

Although geneticists have been the principal users of the archive, the samples curated there have broad utility for other studies, including contaminants, physiology, endocrinology and general health. The temporal and geographic breadth of the sample set in the archive offers unique opportunities to provide immediate solutions to important management questions; a good example is the recent study of *Pseudorca* in Hawai'i, where PRD's ability to establish management units was due entirely to the availability within the archive of geographically diverse samples of this species.

Indeed, the issue of defining management units is so central to so many issues in marine mammal and marine turtle management that this aspect of PRD's work must be considered a priority by NOAA. The La Jolla lab (with or without involvement of the archive) frequently addresses national and international needs.

The program's pro-active approach to assignment of priorities is particularly useful, and the recent La Jolla-led exercise on using Lines of Evidence to establish criteria for designating management units is a further example of the way in which this group leads the field.

Despite the critical importance of the La Jolla archive and the continual receipt of increasing amounts of data and samples, there is inadequate support for maintenance and expansion of this resource. I note that most staff responsible for the archive, including some key individuals, are contractors.

Strengths

- World-class marine mammal and turtle archive featuring broad temporal, geographic and taxonomic depth, with extensive utility for addressing numerous scientific questions relating to the management of species and populations.
- World-class science that has been instrumental in developing novel approaches to determination of population structure and management units.
- Analytical depth within the research program.

Challenges

- Increasing data and samples, fewer staff and resources.
- Inadequate funding for staff and even for essential equipment maintenance contracts. The archive continues to be supported out of base funds or temporary monies despite its national and international importance.

Recommendations

- NOAA should recognize the La Jolla collection as a *national* archive with international reach, and support it accordingly (i.e. with funding that is separate from current SWFSC base funds). This might occur within a broader discussion of integrating the various existing marine mammal and turtles sample collections into a single national system, including samples held at NIST, at regional labs, and by various members of the Stranding Network. However, I feel strongly that the central component of any such system should be the La Jolla archive, which dwarfs the others in its temporal, geographic and taxonomic extent.
- In this regard, I recommend that the La Jolla archive be renamed to something that includes "National" in the title, to reflect its status (simple suggestion: National Marine Mammal and Turtle Archive, NAMMTA).

THEME III. SCIENCE TO SUPPORT RECOVERY OF SOUTHERN RESIDENT KILLER WHALES

Observations

Southern Resident Killer Whales (SRKW) were heavily impacted by captures for public display between 1962 and the late 1970's, with substantial effects on age structure within the population. They were listed as Endangered in 2005, which status reflected a virtually flat trend in the population since 1980, and evidence of decline in more recent years. Survival and birth rates both correlate strongly with the abundance of their apparently preferred prey, Chinook salmon. Suggested causes of this population's failure to recover include nutritional stress relating to food limitation, disturbance from vessel traffic, contaminants, and possible small-population effects.

The NWFSC has conducted some excellent work on SRKW, some of it in collaboration with SWFSC and independent research groups (Center for Whale Research, Vancouver Aquarium, et cetera). This has included distribution studies, abundance estimation, contaminant and prey studies, vessel impact research and (more recently) investigations of body condition and health.

Food limitation seems to be the most plausible explanation for the lack of recovery and poor reproductive output of SRKW, although it is possible that multiple factors are responsible. However, it emerged during the presentations that the contaminant burden of SRKW is significantly lower than that of studied transient-type (mammal-eating) killer whales, which are reproducing well despite this. In light of this, it seems to me unlikely that contaminants are a significant factor in the failure of SRKW to recover.

Strengths

- Multi-disciplinary approach to the issue of SRKW recovery.
- Strong ties with salmon fisheries biology.
- Leaders in cetacean contaminant studies.

Challenges

- The usual inadequate resources, with salary consuming most of base funding.

Recommendations

- Additional support for staff and operations.
- Given the plausibility of nutritional stress as a/the leading cause of reproductive and recovery problems in SRKW, it is essential that the NWFSC's work on health and body condition be continued. This should involve visual assessments using the new Hexacopter system employed on SRKW by Durban and colleagues, together with physiological markers of health, stress and pregnancy using hormonal analysis.
- The above work should be paired with continued involvement of studies of prey abundance and distribution.
- Give serious consideration to suspending the contaminant studies. Samples that continue to be collected can be archived for future use if needed. However, given the comparison to higher contaminant burdens and higher reproductive output of transient-type killer whales noted above, this does not seem likely to be a major factor in the failure of SRKW to recover, and the program's limited resources should be expended elsewhere.
- The SRKW presentations included reference to captive killer whale work with regard to contaminants; irrespective of the recommendation above, I see little justification in supporting this aspect of the work given the many differences and potential effectors between captive killer whales and wild populations.
- Given: a) the non-recovering and possibly declining status of this population, b) the studies by NWFSC showing the waters off the southwestern coast of San Juan Island are a foraging ground, and c) their studies demonstrating behavioral impacts of whalewatching vessels; the Region should consider the risk-averse

approach of imposing further restrictions on whalewatching vessels in this area. This could include increasing the minimum approach distance, or banning whalewatching from the area altogether. Regular enforcement presence is key to the success of any regulations.

THEME IV. LIFE HISTORY

Observations

The Life History program at SWFSC PRD exemplifies the kind of innovation that characterizes much of the institution's work. Long a leader aerial photogrammetry, PRD has in recent years taken this to a new level with the introduction of hexacopters for use in measurement, body condition assessment and even breath sampling of cetaceans. Other innovations within this program include specimen-based research integrating photogrammetry, toxins and other topics; hormone analysis; and tagging.

I commented during the meeting that there are times within marine mammal research when the field leaps forward; an example was the widespread introduction of genetic analysis in the 1980's. The use of hexacopters for photography and sampling, and the development of reliable hormone analysis for investigating everything from stress to reproductive and maturational condition, represents another such advance; and PRD is at the forefront of this new world of technological possibility. It is the next revolution in marine mammal science.

Hormone analysis and body condition work has opened the door to clarification or resolution of many long-standing questions. Examples of this from the review included: pregnancy testing to show reduced odontocete reproductive rates tied to oil spills, tuna purse seining and naval sonar activity; and body condition assessments (including pregnancy) in SRKW and baleen whales. Similarly, tagging to examine movements and dive profiles of beaked whales have yielded major insights into the likely serious consequences of disturbance by naval sonar.

Some of this work has also been applied at PRD to marine turtles, where development of testosterone assays to sex animals represents a major breakthrough that has provided key information that has previously hampered many studies of this taxon. Similarly, age determination and habitat shifts have been assessed at PRD using skeleto-chronology and stable isotope research. These represent major advances in the field.

Finally, I would note that a major breakthrough in the study of hawksbill turtles - discovery of previously unknown habitat in mangroves and the development of conservation strategies that resulted from this finding - would likely not have happened had a PRD staff member (Alex Gaos) not attended a sea turtle conference and networked with other researchers there. This example is one of many that underscores the need for travel support for staff to attend such meetings to share information and develop productive and important collaborations.

Strengths

- World-class innovation in development of field and analytical methods to study life history.
- Extensive international collaboration, allowing broad overviews of species and issues, and development of multinational research and conservation strategies.

Challenges

- As usual, insufficient support for operational work to continue existing studies or develop needed new research.

Recommendations

- General support for staffing and operational costs, as noted repeatedly above.

THEME V. RISK ASSESSMENT

Observations

PRD staff are recognized for their world-class expertise in conservation issues, and have consulted extensively on national and international panels and other groups. This has included the critically endangered vaquita in Mexico, where collaborations with Mexican partners has been central to efforts to avoid the extinction of this species. The point made by Bob Brownell during the review that effort should be focused now on populations that are not in imminent danger of extinction, but may be in the foreseeable future if action is not taken now, was of considerable importance.

PRD staff have also been responsible for development of key quantitative approaches to conservation problems, such as listing criteria; these often have broad applicability across taxa, not just to marine mammals. Staff have also developed innovative models to predict, with much success, the distribution of species from analysis of environmental variables such as sea surface temperature. This allows for more effective design of surveys, as well as assessments of the overlap between marine mammals or turtles and anthropogenic risk factors. These models can also be applied to explaining year-to-year differences in local abundance.

I was surprised at the absence of presentations on the tuna-dolphin “problem” under this or another theme, given the long involvement of this lab in that issue and the high visibility which it once enjoyed. Evidently large numbers of dolphins continue to be involved in chase and encirclement, and the findings by SWFSC that pregnancy rates and stress and strongly correlated with this activity makes it doubly surprising that the issue seems to have fallen off the metaphorical map. Irrespective of whether Congress and the public considers this problem solved or forgotten, it clearly persists.

Strengths

- World class expertise and leadership in the conservation field.
- Development of novel techniques for assessing distribution of marine mammals.

Challenges

- As usual, inadequate support for personnel and travel.

Recommendations

- Additional support for staff and meeting travel. Networking and information exchange at meetings is particularly important for the advancement of conservation issues and strategies.
- With regard to bycatch reduction issues, consider whether gear research conducted elsewhere (e.g. New England or the southeastern U.S.) has applicability to bycatch issues within the West Coast Region.
- Develop predictive distribution models for many species, including those outside the West Coast range, for use in assisting survey design and assessing anthropogenic risk.
- Provide support for development of a strategy to conserve marine mammal and turtle populations that are not yet in imminent danger of extinction, but may be if not protected soon.
- Provide additional information updating the status of the tuna-dolphin issue, including summaries of current work on abundance and recovery of dolphin populations, and recent work on the impacts of chase and encirclement on stress and reproduction.

CONCLUSIONS

Overall, it was a pleasure and a privilege to hear the scope and quality of the many presentations at this review. The overall standard of science is outstanding, and the ingenuity and innovation with which staff pursue management-related conservation issues is often remarkable. The marine mammal and tissue archive in La Jolla is a unique national and international resource, and should be recognized as such.

Reviewer#3

Reviewer #3 Report on Program Review of Protected Species Science**Southwest Fisheries Science Center (mammals, turtles) and Northwest Fisheries Science Center (Southern Resident Killer Whales, SRKW)**

SWFSC La Jolla

July 27-31, 2015

General Observations

This is an excellent group of researchers dedicated to management-relevant, highly innovative science for marine mammals and sea turtles. The quality and rigor of the science presented by all of the project leaders was uniformly excellent, and the publication record for the programs is excellent. The SW Center programs have a long history of strong science that integrates across biological systems. The NW Center killer whale program benefits from strong research partnerships and a unique set of data on the history and relatedness of individual animals, enabling an in-depth evaluation of population dynamics. Both programs benefit from highly dedicated scientists, students and volunteers with a passion for their work and commitment to strong science for conservation. The SW Center Program needs more base funding to continue providing the scientific support and innovation needed to address protected species issues on the west coast, and maintain its position as a world leader in marine mammal and sea turtle genetics and population biology.

Based on the presentations and bibliography we were provided, SWFSC and NWFSC have been very **responsive to management** needs, both in terms of issue-driven science and more general question-driven science that contributes to our understanding of population dynamics and threats to protected species. In particular, accumulation and analysis of long time series data on abundance, distribution, condition factors collected by the Centers and their partners are essential resources for evaluation of change and impact. There is a strong line of **communication and cooperation with the Western Regional Office**, and collaborations across Centers. What is less clear is if the current funding model will allow rapid response to emerging protected species management issues if long term data sets and human capital cannot be maintained.

The science conducted in the programs we reviewed benefits greatly from an emphasis on **rigorous hypothesis-testing, objective and integrative analytical tool development, and practicality for management applications**. The latter is particularly important for exporting the research to other science centers and the greater natural resource management community. However, the innovative problem solving and research advances that are currently hallmarks of both Centers is hampered by too much reliance on external funding for new research and a lack of support for travel to scientific meetings.

The most exciting new research efforts at SWFSC are in two major areas: 1) **development of technologies to enhance cost-effective data collection** for marine mammals, and 2) **innovations directed at vital rate estimation** for mammals and turtles. The latter includes reproductive rates, sex ratios, growth rates and age at maturation, and annual survival rates and survivorship to maturity. Marine mammals and turtles are hard to observe, travel vast distances across international borders, and most are long-lived. This makes it extremely difficult to detect a change in abundance with statistical rigor or diagnose the causes of population change with census counts alone. As marine mammals and turtles are increasingly affected by climate change, fisheries management, and coastal development, evaluating the impacts of these stressors will require both regular monitoring and the creative assessment tools that the SW Center is providing.

Continued support of data collection for **long time series** of marine mammal and turtle abundance and distribution is essential for evaluation of climate change impacts and management effectiveness. Rapid response to emerging issues, such as protected species interactions with fisheries, is possible because of the accumulated knowledge and time series data maintained by the Center. However, the cost of ship-based surveys is very high, and some surveys, such as the Eastern Tropical Pacific marine mammal cruises, have not been conducted for several years. There are a number of ways to approach this issue, most of which are employed by the Centers now:

- o Conduct analyses to determine the optimal and minimal frequency and extent of surveys to identify trends and changes in abundance or distribution;
- o Combine mammal and turtle survey efforts with environmental and fisheries-related surveys when possible;

- Utilize new platforms for data collection, including smaller vessels, unmanned vehicles, and acoustics where feasible;
- Partner with other agencies, industries (e.g., energy development, fisheries), and universities to gather marine mammal and turtle data on surveys designed for other purposes; and
- Create opportunities for “citizen science” contributions to sightings information for monitoring mammal and turtle distributions in coastal areas.

The latter two opportunities require some planning to determine how best to utilize the data provided, but can also serve as outreach opportunities to make the public more aware of what the Centers are doing. The sea turtle reporting effort aimed at local fishermen and boat operators is a good example of this, but there would need to be some effort put into quality control of the reports to make the data more than simply informational. In general, it appears that the Centers recognize the need to **make research cruises as cost-effective as possible** and the need to prioritize a more limited number of survey opportunities. Contribution to long term data sets should not be underestimated, particularly in this time of ocean change.

The marine mammal and turtle programs could benefit from more **interaction with the Fisheries Divisions**. Sharing quantitative tools and analytical methods, in particular, could benefit all Divisions at each Center. My impression from working with fisheries scientists on the Pacific Fisheries Management Council is that marine mammal and turtle research is viewed as less rigorous, less quantitative; they might be surprised to see the quality of research and assessment tools that are being developed to resolve protected species issues at these two Centers.

There is a growing need for research on the **ecosystem role** played by marine mammals in the California Current. Pinnipeds, which were not part of this review, will be a major focus of fisheries assessments and management strategy evaluations in upcoming years. Shifts in the distributions of prey species and marine mammal populations need to be monitored to anticipate future interactions with fisheries, shipping, energy development, and other ocean uses. New predictive tools for marine mammal occurrence on the West Coast are exciting and will need to be supplemented with regular surveys. Increasing connections between SWFSC expertise and Integrated Ecosystem Assessment Teams at NWFSC and SWFSC should be supported.

SWFSC MMTP clearly benefits from **strong leadership** and dedicated people who love what they do. Every presentation mentioned the value of **collaborative teams**, supportive program leaders, and volunteers. There are great **opportunities for students**. However, far too much important work is completely reliant on contractors and post-docs; some of the most innovative research on new technologies, in particular, is conducted by PhD scientists without permanent jobs. While it may not be too surprising that there are many people willing to devote long hours to research on highly charismatic species, it is a testament to the Center leadership that morale is so high in the face of difficult budget constraints, reduced ship time, and senescing equipment. If much of the good work done at the Center continues to depend on volunteers and students, leadership should continue to find inexpensive ways to reward those folks for their dedication. Likewise, **minimizing administrative burdens** on the scientific staff is essential; risk management paperwork and red tape can inhibit research and drag moral down significantly.

Finally, the Centers should receive **more support for outreach and engagement**. There is Discovery Channel stuff going on in these programs, yet the public, and our policy makers, do not seem to know or value it. These are highly charismatic species that Americans cherish. Couple that with drones, satellite telemetry, acoustics and DNA sampling, and you've got a terrific opportunity to garner more public support and resources. Web pages are not enough – active engagement through a variety of media is needed. Press releases for exciting discoveries and new technologies are a must. But the scientists and support staff are stretched thin – new resources are needed to make outreach a core component of the Science Centers.

Key (Specific) Findings and Recommendations

Theme 1: Trends and Abundance

Marine mammals

Strengths:

- Strong link to management needs (assessments)
- Multiple platforms for censuses; exploring efficiencies for surveys
- Rigorous, innovative analytical tools for abundance and trend estimation, habitat modeling
- Scientists are international leaders – IWC, IUCN
 - Vaquita monitoring and recovery efforts
 - Recognized by industry (tuna commission) as center of excellence for marine mammal abundance monitoring

Innovation:

- acoustic sampling tools – passive and towed
- automated detection from shore (FLIR infra-red)

Challenge:

- Long time series are essential, at risk due to funding restrictions

Sea Turtles

Strengths:

- Critical research for management: ESA status reviews for Pacific, Section 7 consultations
 - Example: Recent efforts to re-evaluate habitat use for areas closed to fishing
- Integration of life history information and nesting beach data (requires international collaborations)
 - Monitoring local green turtles – urban turtle population
 - Leatherback and loggerhead tracking – highly endangered populations

Challenges:

- Difficult program to run because international travel, small vessel time, aircraft time, and tags are costly, but funding only covers salaries so lots of external funds needed.
- Difficult to respond quickly to emerging issues e.g., appearance of juvenile loggerheads near San Diego this week.
- Quantitative assessment tools are still needed, particularly tools that take better advantage of available data
- Some assessment needs may not be being met due to lack of time, resources

Recommendations:

- more funding,
- evaluation of critical research needs or species evaluations that are not getting done due to lack of funding and personnel

Theme 2: Defining Units to Conserve

Marine Mammals

Strengths:

- One of the largest genetic sample collections in the world; scientific leaders in marine mammal population genetics
- Critical for management: what stock(s) are affected?
 - Example: False killer whale bycatch in Hawaii – genetic database able to quickly identify population management units
- Projects have rigorous criteria determine a priori, avoid subjective evaluation when data are incomplete
- Exciting discoveries and international collaborations
- Innovation:
 - Rigorous meta-analysis of methods for stock delineation to determine best methods for identification of management units.

Sea Turtles

Strengths:

- Only comprehensive sea turtle genetics bank in the world; SWFSC is absolute authority
 - Primary source of information to delineate management units. Comprehensive international data set.
 - Essential for turtles due to natal homing and nest site fidelity but mixed stock foraging grounds. Turtles in fisheries bycatch come from multiple stocks.
- Examples: leatherback stocks – our turtles are from Indonesia, not Central America. Longlining in American Samoa = multiple stocks
- Hawksbills – “rediscovered”
- Many international partners. Data sharing agreements difficult but critical, have led to library growth.

Challenges:

- Many samples to analyze, some key bycatch work may be getting left behind.
- Unable to attend international meetings.

Recommendations:

- More funding for collection maintenance, management.

- Less reliance on external funding, which is driving prioritization of analyses; focus more on foraging ground stock composition and bycatch.
- Allow regular meeting attendance to promote international collaborations and innovations.

Theme 3: Science to Support Recovery of Southern Resident Killer Whales (SRKW)

Strengths:

- Management driven issue, multi-disciplinary, integrative problem solving
- Multiple hypotheses, drivers = example of complexity of management problems that arise today
- Long term data on individual animals = unprecedented opportunity for analysis of a small, well-studied population
- SW Center contributing to photogrammetry, why no funding even though this was a recommendation of the external review panel?
- Thinking outside the box for analysis and modeling.

Innovations:

- sample collection, drone photogrammetry. These are valuable new techniques for marine mammal surveys, need to be fully developed and validated; perfect population for that because history of every individual is known.

Challenges:

- not enough data on fish distributions to fully evaluate food depletion hypotheses
- need more tracking information to understand coastal habitat use (especially important for possible designation of outer coast as critical habitat!), funding needed for health evaluation and vital rate estimation.
- No obvious way to link stress to vital rates, may be a red herring if adaptability is highly variable.

Recommendations:

- Focus on analysis of new information on variation in health, reproductive status for incorporation into demographic models
- Relative impacts of noise, contaminants, caloric intake, demographic inertia on vital rates (esp. reproduction) should be compared to prioritize future research.
- Year of death and age at death correlations with salmon runs may be interesting to examine.

Theme 4: Life History and Condition

For all programs, this is an exciting change of emphasis to measureable factors that influence population dynamics and may be easier to monitor than abundance for some species.

Marine Mammals

Strengths:

- Response to management = direct (navy sonar evaluation) or indirect (changes in condition factors associated with stress)
- Opportunity to integrate with life history modeling efforts.
- Only lab that uses blubber hormones as indicators of health and condition

Innovations:

- hormone sampling,
- photogrammetry (drones),
- evaluation of condition indices and potential for long term monitoring

Challenges:

- no funding for field work,
- piggy-backing on other projects.
- Old lab equipment.

Sea Turtles

Strengths:

- Long time emphasis on in-water research rather than nesting beach work.
Biotelemetry – best practices
- Now cutting edge research that utilizes tissues from dead animals (which are abundant) to evaluate age and growth, habitat use, diet.
 - Residency time estimates using age/length estimation of stranded loggerheads in Baja.
 - Testosterone assays for sexing that utilize safer ELISA methods.
 - Isotope analysis of bone layers to determine habitat use over turtle's lifetime.
- Innovations:
 - microsatellites > mtDNA for mixed stock analysis.

- genetic library development for St. Croix leatherbacks will allow estimation of vital rates (adult survival, age at maturity, fecundity, sex ratio)
- improved techniques for stable isotope analysis, aging validation, ELISA for testosterone

Challenges:

- Critical for this work to be shared with other scientists at scientific meetings, not just publications;
- Extremely valuable new methods that will help meet management needs are being developed on shoestring budgets by post docs and contractors.
- Material from strandings needs to be collected more systematically and properly cataloged, stored.

Recommendations:

- Support innovative strategies for sampling, which will save money in the long run and improve assessments
- Need more work on correlations of condition factors and vital rates
- Focus on integration results with life history and assessment modeling efforts – Stock Assessment Improvement Plans. Support the coordinated collection of aging structures, reproductive status information, and tissues for toxicology assays from strandings.
- Consider natural mortality changes more holistically – food availability, harmful algal blooms, etc.

Theme 5: Risk Assessment

Marine Mammals

Strengths:

- Long time work on innovative assessment tools and reference points that utilize available data and provide direct answers and objective criteria to management questions.
- Example: “Rules of thumb” minimum population size based on meta analysis of threatened and endangered marine species = 250 mature individuals
- Ongoing research into analytical techniques to work with “rare events” – bycatch reports of marine mammals;
- Focus on spatial overlap potential with fisheries using long term survey data, habitat mapping

Innovations:

- spatially explicit risk assessment techniques

Challenges:

- management tool development and testing requires recruitment and retention of staff with strong analytical and programming skills
- species distribution mapping requires surveys that are no longer supported internally

Sea Turtles

Strengths:

- Highly responsive to management needs
- sea turtle bycatch risk modeling,
- Contributions to the Assessment Toolbox are promoting cross-center integration.

Innovations:

- PBR-like methods, life history-based reference points
- Risk analysis methods for fisheries interactions

Challenges:

- staff is stretched thin, especially with active field research as well as analytical work;

Recommendations:

- identify and support key research cruises needed to provide distribution mapping for predictive models;
- integrate quantitative skills personnel across divisions (fisheries, protected species);
- provide continuing education support for existing staff to learn new analytical techniques

Overall Conclusions and Recommendations

1. SWFSC Marine Mammal and Turtle Program conducts excellent science that is critical to the mission of NMFS for continuing protection and monitoring of these species. Dr. Ballance and her team should be commended for their remarkable and innovative research.

2. NWFSC Killer Whale Program is approaching the problem of southern resident killer whale recovery rigorously and comprehensively; this endangered species research is contributing to our understanding of long-lived whale population dynamics and response to environmental and anthropogenic stressors that can be applied to other threatened marine mammal populations. However, a clear diagnosis for the lack of recovery may not be tenable; focus on vital rates is likely to be the most fruitful path.
3. Integration of information, from genes and physiology to abundance and distribution to food webs and ecosystems, is emphasized across these Center programs. Tools that link field data to predictive modeling are a strong example of the value of such integration for management, and should continue to be emphasized.
4. Rapid response to emerging issues, such as scientific advice needed for protected species interactions with fisheries, is possible because of the accumulated knowledge and time series data maintained by the SW Center. However, the current funding model does not allow the flexibility needed to respond to new opportunities and management challenges.
5. Both Centers are testing innovative new technologies that can provide protected species data more cost-effectively but require support for equipment, personnel, and data management.
6. Some new analyses and techniques are leading to very large data sets, and data management is going to be a critical need.
7. There should be increased emphasis and support for research and monitoring related to body condition, reproduction, growth and survival of turtles and marine mammals, which provides the information needed to determine the causes of population change, an essential need for species recovery planning.
8. Allow all scientists to attend at least one scientific meeting per year, and provide some funding to support travel for post-docs and students.
9. Currently, the SWFSC is considered an international leader in marine mammal and sea turtle genetics. NMFS leaders should pursue line item funding for support of highly valuable and unique tissue collections that can cover costs of personnel, storage, data sharing, and enablement of collaborative research efforts.
10. The Centers should receive more support for outreach and engagement.

Reviewer #4

**Southwest and Northwest Fisheries Science Center
Marine Mammal and Sea Turtle Science Peer Review
27-31 July, 2015**

Background

Peer review is a cornerstone of a strong science program, and recognition of that, the peer review panel was charged with conducting a high-level review of the marine mammal and sea turtle science enterprise at the Southwest and Northwest Fisheries Science Centers. The focus of the review boils down to two questions: 1) are they doing good science; and 2) are they doing that science right. This report reflects on the wealth of information provided and introduces some observations and recommendations for consideration to strengthen the Centers' programs.

General Observations and Recommendations

The protected species staff and leadership of the Southwest and Northwest Fisheries Science Centers and their leadership are to be commended on the orchestration of this review. It is no small feat to encapsulate the history, present day operations and vision for the future of so broad and complex a program over the course of three, scant days. The overview presentations, case studies and background materials prepared for this review provided a window into operations, strategies and long-range vision for these programs. They also illustrated the group's commitment to scientific integrity and to providing sound science for management decisions.

Presenters included an accounting of strengths in their presentation materials and almost without exception, first on those lists were the scientists. After reviewing the materials, hearing the talks, and touring the labs it is clear this is most certainly true. The Center is populated with a cadre of innovative and productive scientists who understand their mission and are dedicating to carrying it out. An atmosphere of pride in the work being done is pervasive and well founded.

Some observations and recommendations include:

Tissue Collections

Observation: The tissue collections at the SWFSC are an invaluable asset to the scientific community at the Center, as well as nationally and internationally. Resources to maintain the archive and end to the accompanying database have diminished over time, jeopardizing the long-term stability of this work and hampering access to this invaluable resource. In some cases, space has become a limiting factor. Revised protocols that made smaller sample sizes the new standard will mitigate the space issue for a time, but additional planning will be required.

Recommendation: NOAA should conduct a thorough analysis of current protected species tissue banks and develop comprehensive strategy, including the long-term maintenance of the tissues and data management to strengthen the utility of the data.

A Right-sized Program

Observation: Currently, base funding covers FTE salaries with about a 5% surplus for scientific operations. Core mission activities are being carried out via contract labor, post-docs, graduate students and volunteers funded via federal, temporary funds and extramural reimbursable funds. While this is reasonable strategy for dealing with a short-term, acute funding shortfall, it inserts a level of risk when the shortfalls are chronic.

Recommendation: Certainly, obtaining additional base funding would solve this challenge in a way that protects the integrity of the program as it is currently structured. Unfortunately, an increase of that level appears to be unlikely. From a strictly budget standpoint, one approach to deal with this is to deliberately resize the program to map to the level of base resources anticipated. A decision would be made on the ideal proportion of a healthy program of this ilk is appropriately allocated to labor costs versus the proportion that should be allocated for operational costs. That breakdown could be used to reset programmatic priorities and scale or cut programs over time to achieve that configuration. Temporary and reimbursable funds could then be used to conduct short-term projects, and the core activities would not be jeopardized when those projects came to a close and the funding stream ended. Programmatically, this is extremely challenging exercise. It would be particularly challenging in this case because the current work is of such high priority. I would, however, be one approach to managing the risk of a perturbation to the budget (an unexpected cut) or to operations (e.g., an unexpected phenomenon in the ecosystem that demands attention) driving the program into the red.

Reliance on Non-base Funding

Observation: Similar to the issue above, a high reliance on temporary federal funds or extramural reimbursable funds creates some challenges, in addition to the obvious benefit of having more resources. The Center is doing a good job of targeting projects that contribute to the highest priorities. The quality of the work being done makes the Center even more competitive in their pursuit of extramural funds. That said, this funding approach can lead to mission creep, can deter progress in meeting the demands for the primary clients of the science, slow progress toward achieving long-range goals and also has a much higher administrative burden than does base funding.

Recommendation: The ideal setting for pursuing extramural funds is in the context of a right sized program. In that setting it is advantageous to aggressively seek extramural funds in a way that compliments ongoing, core work creating more discretion in the amount and programmatic areas for which the funds are sought.

Succession Planning

Observation: One of the Protected Species Program's greatest strengths is the talented collection of scientists it houses. A good deal of discussion focused on capacity shortfalls for critical skill sets. An additional issue for consideration is succession planning. Loss of a staff member can easily be both a crisis and an opportunity. Good planning can mitigate the crises and position the Center to capitalize on the opportunity.

Recommendation: Continue to invest in succession planning, including:

- investment in the professional development of early and mid-career scientists in the form of training, participation in professional meetings and mentoring.
- continue staff planning to use natural attrition to reshape the Division to the evolving demands of a dynamic ecosystem and equally dynamic management needs.
- ensure that the portfolios of your research scientists include an appropriate blend of operational science and question-based research.

Relevance

Observation: A great deal of care is invested in operating a program that provides the highest impact science advice and products to tackle the most pressing management demands. Linking decisions about operations to past peer review reports, strategic plans and annual guidance from throughout the hierarchy is having the desired effect. The annual Go-Hold-No Go exercise is an excellent means of translating that to an annual operations plan. This commitment to tailoring the program plans to ensure the relevance of the work is commendable.

Recommendation: Continue this or a similar approach, as it appears to be serving the Center well, especially when there is representation from the NOAA Fisheries management side to reflect their highest science priorities as well.

Data Management

Observation: Insufficient data management capacity was a repeating theme throughout the review. This issue was particularly pressing relative to the tissue collections.

Recommendation: Investing in the backfilling the current vacancy will be important to keep pace with the ingest rate of new samples, maintain the utility of the data and

enable compliance with the Administration's Public Access to Research Results policy.

Innovation

Observation: The SWFSC is commended for their investments in innovation, which have led to new technologies and analyses that will improve operational science within the SWFSC and well beyond. Advances in visual observations for marine mammals (e.g. migration monitoring via infra-red imaging; ID and condition factor observations using the hexacopter) represent significant advances in marine mammal monitoring and life history studies. Advances like these have the double benefit of improving the quality of the data/understanding and the efficiency of data acquisition. Those results are being disseminated via the peer-reviewed literature.

Recommendation: This is a very logical focus area for which to secure competitive funding, including temporary funds from NOAA RFPs and extramural funds in the form of reimbursables. Development of new technologies and analyses via short-term projects provide much desired research opportunities for staff in collaboration with post-docs or graduate students who may also be funded via the project. Technology transfer to other science centers can magnify the benefits of these innovations, bringing an even higher return on investment.

Ecosystem Approaches

Observation: Considering the fiscal constraints the Center is under, some good progress on ecosystem approaches has been made. Cross-taxa cruises that collect oceanographic data are more efficient and can be invaluable to understanding patterns in habitat preferences and trophic dynamics.

Recommendation: Collaborating with the fisheries division on some question-based research could forge new partnerships and shed additional light on relationships across taxonomic groups and correlated biological responses to physical drivers.

Equipment Maintenance

Observation: Equipment breakdowns or the threat of such was a recurring theme in the laboratory tours. Impacts of breakdowns can range from an inconvenience, e.g., temporarily slowed throughput to potentially catastrophic, e.g., outage of a -80 freezer.

Recommendation: One possible solution would be to establish a routine maintenance plan for the full inventory of mission-critical instruments and to hold resources in reserve to execute it and cover repairs in the event of a breakdown. Funds remaining in the reserve could be poached as the fiscal year wanes.

Key Findings and Recommendations

1. Do current and planned protected species scientific activities fulfill mandates and requirements under the ESA and MMPA, and meet the needs of the regulatory partners?

The intent to meet the requirements under the ESA and MMPA, and meet the needs of the regulatory partners within the Center is strong. Care is taken to align programs with strategic plans throughout the hierarchy and operating plans are developed with the agency and Center's highest priorities in mind. With operational funding at such a critically low level, the incentive to seek extramural funds is also strong. Guiding the search for these funds to focus predominantly on work that targets ESA and MMPA mandates and the needs of regulatory partners is a way to avoid mission creep.

2. Are there opportunities to be pursued in conducting protected species science, including shared and collaborative approaches with partners?

The programs have done an excellent job of leveraging their own resources to extend the reach of their programs with a broad suite of partners. Continuing to nurture those partnerships is good, provided the work is focused and productive.

Strong partnerships have been developed within NOAA Fisheries as well. Examples were given of multi-purpose research cruises that were modified to work across jurisdictions to gain efficiencies. While each of the three Pacific coastal science centers have specialized expertise by taxa and scientific discipline, exploring additional collaborations among these three pools of talent and assets may yield even greater efficiencies and productivity. If advantages of these collaborations are sufficiently strong over the long term, consideration may be given to restructuring activities across the Centers to more fully capitalize on them.

Within the SWFSC, opportunities may arise from stronger networking among the divisions, in particular with the Environmental Research Division and the Fisheries Ecology Division. Such collaborations could facilitate the programs' evolution toward ecosystem approaches by exploring areas such predator-prey relationships, and modeling changes in abundance, distribution and vital rates relative to changes in environmental conditions.

Working with social scientists would better prepare the program (science and management) to understand the new challenges they will face when management measures yield the desired outcome and populations climb to meet management targets. Social challenges of managing a depleted population can be very different than those of managing a population that has recovered.

3. Are the protected species scientific objectives adequate, and is the best suite of techniques and approaches to meet those objectives?

4. Are the protected species studies being conducted properly (survey design, statistical rigor, standardization, integrity, peer review, transparency, confidentiality, etc.)?

Re-phrased as the Director's opening question, "are we doing the science right?" the response is yes. The experiences from the highly controversial work in the Eastern Tropical Pacific demanded "bullet-proof science" and that standard of science does, indeed persist. The science being conducted at the Centers is sound and serves as a reliable basis for management and policy decisions. Several examples were given of innovations that improved the quality and the efficiency of the science at the Centers and advanced the state of the discipline.

Perhaps one of the greatest assets of this science enterprise, beyond the scientists themselves, are the long-term at-sea data series. Standardized collections are an invaluable tool for detecting and understanding changes and the mechanisms that contribute to them.

5. How are advances in protected species science and methodological approaches being communicated and applied in NMFS?

The publication record of the SWFSC's Marine Mammal and Sea Turtle Division is extremely impressive and is strong evidence of a commitment to communication scientific results to the scientific community. Evidence was given of innovations born of this program being adapted or adopted by other scientists via these communications.

Looking for opportunities to take these successes to a broader audience via articles in the popular literature or social media could contribute to a more ocean science-literate constituency.

Reviewer #5

2015 PROGRAM REVIEW**SCIENCE ON MARINE MAMMALS AND TURTLES**

La Jolla, CA - 27-31 July 2015

REVIEWER # 5**Observations**

Two words that define the science done at the MMTD: excellence and innovation. This is a world-class research center known for developing innovative analytical methods and technologies that change or inspire other researchers on how marine mammal and turtle science is done in the rest of the world. We heard this week of new non-invasive methods that will help us understand, in a more complete way, the life cycles, interactions and habitat use of marine mammals and turtles, providing critical scientific data of excellent quality. These ground-breaking presentations, and those of the entire review, highlight five over-arching observations:

First, Mention should be made that a key aspect of the success of this research team is thanks to the strong expertise, great foresight and excellent leadership qualities of the Division Director, Lisa Balance, and Deputy Director, Jeremy Rusin.

Second, the science that is done in this center fulfills mandates and requirements under ESA and MMPA. From the presentation we have listened during this week it is also clear that most of the work by the Programs of the Division anticipates the needs and was noted for strong collaboration between science and management

The methods and techniques developed by the Mammal and Turtle Research Division are derived from the management objectives in response to mandates, both legislative (e.g. ESA, MMPA) and regulatory mandates (NMFS). In the first presentation of the review process the answer to the questions "Are we doing the correct science" is: YES the Division does excellent science in terms of survey design, statistical rigor, and transparency. I cannot tell about confidentiality. And the second question of doing "the right science" despite the difficult multiple mandates and competing for limited staff time, restrictive and constraints in budget is, as well, YES. Citing Lisa Balance the science is bullet proof.

Third, in my opinion, scientists working for government agencies have a disadvantage compared to scientists working in universities and the private sector when it comes to periods of restricted funding. While university and private sector scientist have the option (and are encouraged) to secure external support, such as funds from government (e.g., National Science Foundation) and foundations (e.g. NSF, Pew Charitable Trust, Packard Foundation, etc.) this is almost impossible to do for government scientist. The challenge is how to find mechanisms for government scientists to access external support. While beyond the scope of this review, it is clear that MMTD is a leader in seeking external funding support from partners. MMTD staff have been extremely resourceful and successful in obtaining significant outside funding, and while there are many benefits of

gaining outside support (including increasing collaboration), such efforts come at a high cost in terms of staff time and heavy administrative burden, as well as hinders long-term strategic planning.

Fourth, Regarding how are the advances and methodologies approaches being communicated and applied at NMFS I think this was not clearly presented and discussed.

Fifth unparalleled generosity of the SWFSC marine mammal and sea turtles researchers in sharing their wisdom and experience with students and researchers from around the world. Their research and academic influence extends well beyond US borders through scientific publications, conference presentations, international joint research programs and tutoring students.

I would like to congratulate the scientists and the organizing committee for the time and efforts spent, probably many months, planning the review -it showed. All the presentations were relevant and structured in a very helpful way for the reviewers. Many thanks.

THEME I: Abundance estimation & trends

Strengths

- World-Class scientific leaders in conducting surveys and analyzing data to estimate population abundance and trends and stock assessments.
- The science developed here, as in the other programs, is well targeted at fulfilling and addressing management requirements in accordance with ESA and MMPA.
- Strong EEZ Mammals and Acoustics program, innovative in developing quantitative methods and technologies that change or inspire other researchers on how marine mammal science is done in the rest of the world.
- Clear goals and deadlines to achieve research objectives
- Strong consideration to developing hardware and software that is publicly available and to estimate abundance of hard-to-survey species (cryptic, low population sizes, etc.)
- Strong multidisciplinary approach and development of new methodologies combining acoustics and visual surveys to assess population status.
- Strong development of passive acoustics for cetaceans – really innovative and global leader – and now expanding into assessment of ocean noise, especially powerful coupled with technologies that can simultaneously monitor marine mammals
- Impressive, long-term research and data set for gray whales (since the end of the 1960's) that supports the management of the species, has revealed surprising population structure and linkages, and uncovered connections with Arctic sea ice, but also serves as a model for understanding large whale population biology and the recovery of populations.
- Vaquita: a strong international component of the MMTD is the partnership between the SWFSC and researchers in Mexico's Instituto Nacional de Ecología y Cambio Climático .

- Vaquita is the most critically endangered marine mammal species in the world and the vast majority of what we know in terms of its population biology and status is thanks to the strong collaborative nature of the research between the two nations.
The Center has played a key role in assessing vaquita population size and trends over the past 20 years. The Center is a strong participant in CIRVA (write out acronym) the international recovery team that has setting the recommendations that the Government of Mexico is following to prevent the extinction of this species. The Center has also played a key role in developing the acoustic monitoring program and difficult data analysis with world-wide experts, and developing the 2015 vaquita survey with fully funded by the Mexican Government.
- An important strength of the Center is their development of habitat models of cetacean distribution with an outstanding group of high-power quantitative researchers. This work is possible thanks to a very important strength of the Center: an extensive survey data set, of marine mammal sighting data with habitat data derived from oceanographic surveys (and digital image processing) covering vast areas of the Eastern Pacific Ocean (California Current, eastern tropical Pacific, central Pacific and parts of the north Pacific).
- Marine turtle program. The Center has world-class excellence in marine turtle research. The biology of these animals makes them difficult to assess because of complex migration patterns, long lives and long generation times, and the logistic challenges of studying them at sea. . However, the multi-pronged approach by the Center has proven tremendously successful. The integration of technology with long-term and international collaboration has moved the field forward significantly.

Challenges and Recommendations

Below, are a list of challenges and recommendations. They are not exclusive to Theme 1 but were mentioned in almost all the presentations, and serve as my comments on the later themes as well.

- **Maintaining long-time series.** In her closing remarks, MMTD Director, Lisa balance, emphasized that it is critical to maintain time series. This has to be an important priority for the Center under very restricted budget conditions. The high-powered, quantitative scientists at the Center have proven successful time after time in addressing current and emerging issues due to the impeccable analysis of these sets of long time series. The challenge is how the center will maintain its relevance under current circumstances (financial and staff).
- **Attending scientific meetings.** It is critically important that the Center maintain its ability to present and clearly communicate scientific ideas and the results to the scientific community. Science is not done in isolation but rather in a lively, evolving environment where communication is of utmost importance. Meetings help foster collaborations and might help in finding funding options. This also has to be an important priority for the Center under restricted budget conditions
- **Meeting stock assessment requirements.** Another challenge under the current budget condition, is meeting the MMPA and ESA requirements of stock assessments, including

estimating human caused mortalities. The challenge is how to find mechanisms for government scientists to receive external funds (science foundations, charitable trusts) through collaboration with other institutions, with a more administrative efficiency.

- **Developing cetacean habitat models.** The development of habitat models of cetacean distribution is a strong component of the Center's work. It is clearly related with climate change. I would have liked to have had the presenters explain to the audience how these models can lead to an improved understanding of the consequences of climate change for cetaceans. For example, how can we use these models to predict an alteration of habitat use, changes in population ranges in response to a changed environment, or the potential of altered population trajectory through changes in environmental carrying capacity or altered population-scale resilience, etc. It seems that the Center can better elucidate the importance of their work with respect to climate change and their vision of how to apply their methods and models to understanding the response of top predators to climate change. Part of this was presented later (Theme V by Becker).

Theme II: Defining Units to Conserve

Strengths

- The Genetic Group is one of the pioneers and flagship on population genetics world-wide for both marine mammals and sea turtles
- Of special mention is the world-class Genetic Archive. Directly accessible to the marine mammal and sea turtle genetic group in a state-of-the art facility that allows researchers to compare genetic material between individuals, populations and species in a timely manner which provides the critical basis for advice to managers as well as taxonomists. .
- Increased value of this archive through time. The importance of this archive is growing rapidly as habitats of marine mammals and sea turtles (and other organisms) face the impact of changes in their environment due to human activities.
- Strong collaboration at the national and international level (multilateral bodies and researchers all over the world) to better delineate stocks and to refine our understanding of taxonomy in globally distributed species.
- Define units to conserve at scales relevant to management.
- Research well targeted to addressing management needs (e.g. units to conserve in accordance with the MMPA and ESA as well as international management needs). A prime example of timely response to management needs is that of false killer whales in the Hawaiian Archipelago
- Strong laboratory and analytical skills; innovation in laboratory methods
- Strong proactive group a step ahead of potential management requirements or needs.
- Important multidisciplinary approach to define units to conserve for marine mammals and sea turtles, leadership in bridging the gap between multiple lines of evidence (e.g., acoustics, genetics, photo-identification, etc.).

Challenges and Recommendations

- **Maintaining the genetic archive.** No doubt a key action is maintaining the function, upkeep and accessibility of the genetic archive for in house, regional, national and international researchers. The Center has to make every effort to maintain the archive as this is one of the Center's greatest assets. Weighing the pros and cons of elevating it to a national level and funding it with collaborative resources outside the Division (e.g. Fisheries Science Centers) are recommended. This would also allow the MMTD to optimize resources towards other research work.
- **Keeping up with rapidly changing technologies.** The Center's genetic program is critical for managers and decision makers who rely on accurate determine of stock structure. The biotechnology field develops rapidly and needs that managers and genetic scientists, from SWFSC and other NMFS centers, to maintain a strategic and collaborative process to prioritize research and the acquisition of the new and more efficient technologies.

THEME III: Science to support Recovery of Southern Resident Whales

Strengths

- Strong group of scientists with different expertise working to assess different risk factors (prey composition, effect of vessels and noise, and the link between contaminants and health).

Challenges and Recommendations

- **Strengthen the interdisciplinary approach.** Although the authors mention that one of their strengths is an interdisciplinary approach, the message received was not clear. Interdisciplinary involves the combining of two or more academic disciplines into one activity. There is an opportunity to better articulate and coordinate among the research groups to integrate the results.

Strengthen coordination. There is an opportunity for enhanced coordination between the two Centers (NWFSC and SWFSC) with the resident killer whale population.

THEME IV: Life History and Condition

Strengths

- I was breathless. The Cetacean Health and Life History Program is producing groundbreaking achievements by innovating technologies, bringing new methods into operation and providing an integrative approach to the study of marine mammals and sea turtles from an individual-based research.
- Solid and clear strategies for their work and the cost of adopting new technologies.
- Integrating different disciplines to understand better population health (e.g. contaminants, hormones, and photogrammetry).
- Very important that this group provided a road map for moving from studies that assess short-to medium-term behavioral changes to population level effects.
- Strong development and validation of methods in the field and the lab (turtles).

- Skeletochronology – this is innovative work, despite some skepticism, that is a major plus and will improve our knowledge and management of sea turtles.

Challenges and Recommendations

- **Advancing an interdisciplinary approach.** The group has a big challenge. Continue along the correct track of advancing to full interdisciplinary research by creating something new and thinking across boundaries. This will allow investigators to transcend their own disciplines and capture the complexity of the population under study.

THEME V: Risk Assessment Strengths

- Strong team of quantitative analysts developing methodologies and successfully applying methods to increasingly large and long term data-sets.
- Strong capacity to apply different modelling approaches (spatial and habitat modelling) to identifying areas of potential importance for whales and predict changes in cetacean densities.
- Novel approaches to estimate bycatch in marine mammals and sea turtles.
- Clear goals and how to achieve them in accordance with management mandates.

Challenges and Recommendations

- **Prioritizing risk assessment and funding streams.** This is excellent work with strong demand at the national and international level. The Center must look ahead to identify funding opportunities to continue to develop this work through a prioritization process.
- **Supporting permanent positions for staff.** Critical staff in this and other cases (Hormone Lab, Health and Life History Program), doing novel and state-of-the-art research are not permanent and efforts should be made to keep them.