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**UNITED STATES DISTRICT COURT  
CENTRAL DISTRICT OF CALIFORNIA  
WESTERN DIVISION**

NATURAL RESOURCES DEFENSE  
COUNCIL, INC., et al.,

Plaintiffs,

vs.

DONALD C. WINTER, Secretary of the  
Navy, et al.,

Defendants.

Case No. 05-cv-07513-FMC (FMOx)

**SETTLEMENT AGREEMENT**

Hon. Florence-Marie Cooper  
U.S. District Judge

For the purpose of settling the above-captioned lawsuit without further judicial proceedings, and for the purpose of settling the attorney fee dispute in Natural Resources Defense Council, Inc. v. Winter, Case No. CV06-4131 FMC (JCx) (the “RIMPAC litigation”), and for no other purposes, Defendants Donald C. Winter, Secretary of the Navy, and the United States Department of the Navy (collectively “Navy” or “Defendants”) and Plaintiffs Natural Resources Defense Council, Inc., International Fund for Animal Welfare, Cetacean Society International, League for Coastal Protection, Ocean Futures Society, and Jean-Michel Cousteau (collectively “Plaintiffs”), hereby state as follows:

WHEREAS, on August 5, 2005, the Assistant Secretary of the Navy for Installations and the Environment communicated the Navy’s comprehensive strategy for assessing the effects of its use of mid-frequency active (“MFA”) sonar on marine mammals (hereinafter “Strategy”) via letter (hereinafter “August 2005 Letter”) to the Administrator of the National Oceanic and Atmospheric Administration (“NOAA”). The Strategy, which was developed in response to the 2004 amendments to the Marine Mammal Protection Act (“MMPA”), was based upon the environmental planning requirements prescribed by the National Environmental Policy Act (“NEPA”) and Executive Order 12114, as well as the procedural and substantive legal requirements set forth in the MMPA and the Endangered Species Act (“ESA”). The August 2005 Letter described the Strategy as a three-step plan whereby the Navy would first begin the process of assessing effects associated with MFA sonar training and testing which occur within its ranges and operating areas (“OPAREAS”). The August 2005 Letter reported that the Navy had funded this first step, described as the Tactical Training Theater Assessment and Planning Program (“TAP”), in the amount of approximately \$98 million through FY 2009. The second step of the Strategy consisted of conducting effects analyses for those major fleet training exercises that occur outside ranges and OPAREAS as the details of those activities become

finalized and are scheduled. The third step, to be commenced after completion of the first two steps, consisted of collaborative efforts by the Navy and NOAA to explore additional ways to assess sonar operations that do not occur on ranges or in major exercises, but that reasonably could be analyzed on a regional or programmatic basis. The Strategy further committed that Navy activities employing MFA sonar would adhere to a number of protective measures intended to minimize exposure effects to marine mammals.

WHEREAS, on August 22, 2005, NOAA communicated via letter its concurrence with the Navy's Strategy.

WHEREAS, on multiple occasions prior to filing this lawsuit in October 2005, including in letters dated July 14, 2004, August 5, 2004, and October 26, 2004, Plaintiffs communicated to the Navy Plaintiffs' understanding that the Navy's use of MFA sonar in its ongoing training and testing exercises in biologically significant waters off the coast of the United States and around the world had caused and was continuing to cause significant adverse environmental effects on marine mammals, fish, sea turtles and other species, including endangered and threatened species. Plaintiffs further communicated to the Navy Plaintiffs' position that the Navy had failed to comply with NEPA, ESA, or the MMPA in conjunction with its ongoing worldwide training and testing exercises involving MFA sonar. Plaintiffs also expressed their desire to enter into a dialogue with the Navy to discuss potential means of mitigating the effects of the Navy's use of MFA sonar, of remedying what Plaintiffs described as past violations of law, and of preventing what Plaintiffs described as future violations and further harm to the environment.

WHEREAS, on October 19, 2005, Plaintiffs filed suit in this Court alleging that the Navy's use of MFA sonar during training and testing activities violated NEPA and the MMPA.

WHEREAS, on January 3, 2006, Plaintiffs amended their complaint (“First Amended Complaint” or “FAC”) to allege that the Navy’s non-combat use of MFA sonar also violated the ESA.

WHEREAS, on February 17, 2006, Defendants filed a Motion to Dismiss or, in the Alternative, for Summary Judgment (“Dispositive Motion”).

WHEREAS, by Order dated May 15, 2006, the Court authorized jurisdictional discovery and supplemental briefing on the Navy’s Dispositive Motion.

WHEREAS, on June 28, 2006, Plaintiffs filed a separate complaint in this Court alleging that the Navy’s use of MFA sonar during its Rim of the Pacific 2006 (“RIMPAC”) training exercise violated NEPA and the MMPA.

WHEREAS, on July 3, 2006, the Court granted Plaintiffs’ request for a Temporary Restraining Order in the RIMPAC litigation.

WHEREAS, the Navy appealed the RIMPAC TRO to the Ninth Circuit.

WHEREAS, while the RIMPAC TRO was on appeal, the Parties settled the RIMPAC litigation and filed a settlement agreement with the Court on July 7, 2006.

WHEREAS, on July 7, 2006, the Court entered an order that dismissed the RIMPAC litigation with prejudice but retained jurisdiction to resolve any applications for attorneys’ fees and costs under 28 U.S.C. § 2412(d)

WHEREAS, on October 19, 2006, the Court issued a Protective Order in the instant action which, inter alia, prohibited disclosure of the contents of documents produced by the Navy in response to Plaintiffs’ discovery requests to anyone other than the Court, the parties, and their attorneys and staff.

WHEREAS, by Order of January 4, 2007, the Court granted Plaintiffs’ motion for fees and costs in part under the Equal Access to Justice Act in the RIMPAC litigation.

WHEREAS, the Navy appealed the RIMPAC fee order to the Ninth Circuit.

WHEREAS, on April 10, 2008, Plaintiffs filed a Second Amended Complaint (“SAC”) in the instant action alleging violations of NEPA, the MMPA, and the ESA.

WHEREAS, by Order of July 17, 2008, pursuant to a stipulation of the parties, this Court stayed all proceedings in the instant action to enable the parties to discuss the possibility of settlement.

WHEREAS, the parties held settlement conferences regarding settlement of the instant action on August 12, August 22, September 10, September 23, and September 25, 2008.

WHEREAS, on September 16, 2008, the Ninth Circuit affirmed in part and reversed in part the RIMPAC fee order.

WHEREAS, the Parties held settlement negotiations with respect to the RIMPAC fee matter during the above-referenced settlement talks on September 23 and 25, 2008.

WHEREAS, Plaintiffs and Defendants, through their authorized representatives, and without any admission or final adjudication of the issues of fact or law relating to Plaintiffs' claims, have reached a settlement of the above-captioned litigation and the RIMPAC fee matter.

THEREFORE, in the best interests of the public, the Parties, and judicial economy, the Parties hereby stipulate and agree to the following terms in settlement of any and all claims relating in any way to the above-captioned litigation and the fee dispute in the RIMPAC litigation:

1. The Parties agree that all negotiations leading up to this Stipulation are and will remain confidential, and will not be discussed or disclosed except to the Parties and their representatives.
2. This Agreement is not to be construed as a concession by either party as to (a) the potential impacts on marine mammals or other animals of employing mid-frequency active sonar ("MFA sonar"); (b) the validity of any other fact or legal position concerning the claims or defenses in the above-captioned action; or (c) the

extent of measures required to comply with the NEPA, MMPA, the ESA, or other environmental laws.

3. This Agreement has no precedential value and shall not be used as evidence of such in any litigation or in representations before any forum or public setting.

4. The Parties agree that the above-captioned case shall be dismissed with prejudice, and that Plaintiffs shall file with the District Court a stipulation of dismissal of this action pursuant to Federal Rule of Civil Procedure 41(a)(1)(A)(ii) within 3 business days of the effective date of this Agreement. The Parties agree that they will not publicly disclose or confirm this settlement or the terms thereof until 24 hours after Plaintiffs notify Defendants that said notice of dismissal has been filed. The Parties agree that there shall be no consent decree. The Parties further agree that, pursuant to Kokkonen v. Guardian Life Ins. Co. of America, 511 U.S. 375, 380-382 (1994), the stipulation of dismissal will not incorporate any of the terms of this Agreement or refer to the Agreement in any way, and that nothing in this Agreement confers jurisdiction on the District Court to enforce any part of the Agreement.

#### **Notice and Disclosure**

5. The Navy agrees to waive the Protective Order, dated October 19, 2006, with respect to all environmental compliance documents, but not identification data, that have been entered as exhibits in either the above-captioned case or the related case, Natural Resources Defense Council, Inc. v. Winter, 07-CV-335 FMC (FMOx). The documents to which this provision applies are specifically identified by bates number in Appendix A. In the event of a discrepancy between the documents listed in Appendix A and the description of those documents in this paragraph, the information provided in Appendix A controls.

6. For each of fiscal years 2008, 2009, and 2010, the Navy agrees to provide Plaintiffs with an unclassified report that identifies the number of hours of MFA sonar used over the course of a three-month period during off-range unit-level

sonar operations within the THIRD Fleet area of responsibility ("AOR"). The report for FY 2008 will provide data on MFA sonar training and testing use during the third quarter in FY 2008. Navy will provide this report within two months of dismissal of the above-captioned case. For FY 2009, the report shall provide data on MFA sonar training and testing use during the fourth quarter, and for FY 2010, the report shall provide data on MFA sonar training and testing use during the third quarter. Navy will provide these reports within two months of the end of the applicable fiscal quarter.

7. The Navy agrees to provide Plaintiffs with a substantive briefing, by a subject matter expert (or experts if in its sole discretion the Navy determines that more than one expert is required), concerning the following subjects: (a) density estimates for use in acoustic effects modeling; and (b) propagation and exposure modeling. The Navy also agrees to provide Plaintiffs with a substantive briefing by a subject matter expert (or experts if in its sole discretion the Navy determines that more than one expert is required) concerning the following subject: synthetic training. The parties have agreed upon the subject matter for each of those briefings, and that subject matter is set out in Appendix B. In addition to Appendix B, the Parties further agree as follows:

- A. The Navy will select the location of each briefing based on the convenience and availability of the Navy's subject matter experts and program demonstration requirements.
- B. The Parties will select a mutually acceptable date and time for the briefing.
- C. To the extent travel is required, each party will be responsible for its own costs and expenses.
- D. In addition to the Navy's subject matter experts, each briefing will be attended by no more than five individuals from the Navy and five individuals representing the Plaintiffs, inclusive of legal counsel, with

each party to bear its own costs, expenses, and attorney fees. Only representatives of the Parties, including scientific experts retained by the Parties, may attend the briefings. All participants shall agree in advance to abide by the restrictions on dissemination of non-public information set forth in sub-paragraphs H and I.

- E. The briefings will address factual information applicable to the subject matter set out in Appendix B.
- F. The briefings will address only information within the Navy's knowledge and/or control.
- G. The briefings will not include any classified or proprietary information. For purposes of this Agreement, the term "classified information" is defined as "information that has been determined pursuant to Executive Order No. 12958, or any successor order, Executive Order No. 12951, or any successor order, or the Atomic Energy Act of 1954 (42 U.S.C. 2011), to require protection against unauthorized disclosure." See E.O. 12968, 60 Fed. Reg. 40,245 (August 2, 1995). For purposes of this Agreement, the term "proprietary information" is defined as "a trade secret or other confidential research, development, or commercial information that has not been released for publication to the public at large."
- H. Plaintiffs will not share any of the non-public information received through the briefings described in Paragraph 7 with any person or entity not a party to this lawsuit. Before disclosing any "non-public" information, the Navy subject matter expert shall identify his/her intent to provide "non-public" information to the audience. Plaintiffs' agreement to receipt of the "non-public" information at the briefing shall act also as an agreement not to share that information with any person or entity not a party to this lawsuit unless such information is, or subsequently becomes, publicly available through other sources. In such



instances, Plaintiffs shall give 30 days notice to the Navy of their intent to share the information.

- I. Plaintiffs will not use any of the non-public information received through the briefings described in Paragraph 7 for litigation purposes. Before disclosing any “non-public” information, the Navy subject matter expert shall identify his/her intent to provide “non-public” information to the audience. Plaintiffs’ agreement to receipt of the “non-public” information at the briefing shall act also as an agreement not to use that information for litigation purposes in this or in any other legal action unless such information is, or subsequently becomes, publicly available through other sources. In such instances, Plaintiffs shall give 30 days notice to the Navy of their intent to share the information.
- J. If within the 30-day period the Navy notifies Plaintiffs of a disagreement over whether information subject to the requirements of Sub-paragraph H and/or I is or has become “publicly available through other sources,” the Parties shall meet and confer in an attempt to resolve their differences. This meeting shall occur at a time mutually agreeable to the Parties, but need not occur within the 30-day period. This meeting shall occur prior to any public disclosure of the subject information by Plaintiffs, and each attorney shall bear its own costs, expenses, and attorney fees associated with any such meeting.
- K. The Navy’s agreement to provide a briefing on synthetic training shall not be construed as having any bearing on whether synthetic training is, can be, or will ever become an adequate substitute for at sea operational training.

### **Research Provisions**

8. The Navy agrees to spend \$14.75 million from the Navy's general research and development budget over the course of three years, from FY 2009 to FY 2011, to fund research projects relating to marine mammals within the three agreed research topic areas described in Appendix C to this agreement. Work under existing contracts or grants that has already been funded at the time this settlement agreement is executed by all parties will not be counted against the \$14.75 million, but any work funded after this settlement agreement is executed by all parties that is within the three agreed research topic areas described in Appendix C will be counted against the \$14.75 million. The Navy also reserves the right to fund ongoing and new contracts and grants using FY09, FY10 and/or FY11 funds for projects that may build on work accomplished before the settlement agreement is executed by all parties. Thus, task orders, delivery orders or contract modifications under existing contracts or grants that are funded after this settlement agreement is executed by all parties and that are within the three agreed research topics will be counted against the \$14.75 million, including options on existing contracts or ongoing grants that are funded after the settlement agreement is executed by all parties. Contracts or grants that are within the three agreed research topics and are awarded after the settlement agreement is executed by all parties will also be counted against the \$14.75 million. Consistent with Appendix C, the Navy shall provide notice to NRDC of task orders, delivery orders, or contract modifications under existing contracts or grants that are funded after this settlement agreement is executed by all parties and that are within the three agreed research topics, including options on existing contracts or ongoing grants that are funded after the settlement agreement is executed by all parties. In the event that project costs under the proposed topics do not realize \$14.75 million over three fiscal years, Navy shall, subject to the availability of appropriated funds, apply fiscal year 2012 funding towards projects in the agreed upon topics to achieve \$14.75 million over four fiscal years. A comprehensive description of the three research topics, their

objectives, and their cost estimates are provided in Appendix C. The cost estimates contained in Appendix C are estimates only and do not restrict the Navy's ability to allocate the \$14.75 million across the three agreed research topics as the Navy deems appropriate.

9. The National Marine Fisheries Service ("NMFS") has noticed its intent to conduct marine mammal survey efforts in Hawaii by 2010. Within a reasonable amount of time after NMFS has completed these survey efforts and made the survey data available, the Navy will apply the Hawaii survey data to the Spatial Decision Support System (predictive habitat model for SOCAL, U.S. West Coast, and Eastern Tropical Pacific), and will make the results of this application available to the public. The Navy commits to completing this task within 90 days of receiving the relevant data from NMFS to the extent it is reasonably possible. To the extent it is not reasonably possible to complete this task within 90 days, the Parties will meet and confer so that the Navy may describe the circumstances delaying the completion of this task.

**Navy Environmental Compliance Per August 2005 Letter**

10. The Navy is in the process of implementing the TAP component of its Strategy (as described in the August 2005 Letter, *supra*), whereby it will complete a comprehensive assessment of the effects associated with MFA sonar training and testing conducted within its ranges and OPAREAS. The Navy is also preparing assessments of the effects associated with MFA sonar testing in addition to the TAP component of its Strategy. The Navy's schedule for completion of its Environmental Impact Statements ("EIS") pursuant to NEPA and, if applicable, completion of its ESA biological assessments and submission of its MMPA incidental take authorization applications to NMFS for MFA sonar training and testing conducted within its ranges and OPAREAS is detailed in Appendix D for each of the following Range Complexes, OPAREAS, or combination thereof (collectively, "Ranges"):

A. Hawaii Range Complex ("HRC");

- B. Southern California Range Complex ("SOCAL");
- C. Atlantic Fleet Active Sonar Training Area ("AFAST");
- D. Pacific Northwest Training Range Complex ("PACNORWEST");
- E. Naval Surface Warfare Center Panama City Division Mission Activities ("NSWC PCD");
- F. Naval Undersea Warfare Center Keyport Range Complex Extension ("NUWC Keyport");
- G. Marianas Islands Range Complex ("MIRC");
- H. Gulf of Alaska ("GOA").

11. The Navy confirms its intent to adhere to its range-wide compliance schedule, as described in Paragraph 10 and Appendix D. In the event the Navy is unable to adhere to one or more of the milestones described in Paragraph 10 and Appendix D, the Navy shall promptly advise Plaintiffs, and shall further advise Plaintiffs of the new date or dates by which the Navy estimates that it can reach the milestone(s). Should Plaintiffs request, the Parties shall meet to discuss the revised schedule in an attempt to resolve any differences that may arise regarding the change in schedule, with each party to bear its own costs, expenses, and attorney fees associated with any such meeting.

12. The Navy confirms its longstanding commitment under the Strategy (as described in the August 2005 Letter, supra) to complete an assessment of the environmental effects of each major off-range training exercise within the THIRD Fleet AOR prior to conducting the exercise. A "major exercise" is a maneuver or simulated wartime operation involving planning, preparation, and execution that: (A) Is carried out pursuant to an operation order or similar tasking directive primarily designed for the purpose of training; and (B) Has substantial potential to cause a significant impact on the quality of the environment because of the number of participating units, the nature of the training activities, and the location of the exercises. Major exercises include JTFEX, FLEETEX, RIMPAC, Kernel Blitz and

exercises of similar scope and intensity as designated by the Echelon II commander or his delegate. They may be a combined, joint, or single-service exercise, depending upon participating organizations. "Major exercise" does not include unit-level training or multi-unit training that is not conducted under a dedicated training operation order.

13. The Navy confirms its longstanding commitment under the Strategy (as described in the August 2005 Letter, *supra*) to assess the environmental effects of off-range unit level MFA sonar operations within the THIRD Fleet AOR, viz., those that do not form part of a major exercise.

**"Cooling Off" Period**

14. Plaintiffs will adhere to a 120-day "cooling-off" period for judicial challenges regarding MFA sonar training and testing activities conducted on each of the Ranges identified in Paragraph 10 and Appendix D. The cooling-off period for each Range shall commence upon issuance of the Record of Decision ("ROD") for the Environmental Impact Statement addressing the effects of MFA sonar training and testing activities on that Range. During the cooling-off period, Plaintiffs agree not to commence a judicial challenge against the Navy or any other Federal Agency or official concerning any MFA sonar training and testing activities on the Range. During that time, Plaintiffs also shall not cause any person or entity not a party to this agreement to commence a judicial challenge against the Navy or any other Federal Agency or official concerning those same activities. To the extent Plaintiffs allege that they are adversely affected or aggrieved by one or more of the above-described agency actions within the meaning of a relevant environmental statute, the Parties agree to meet and confer during the 120-day period in an attempt to resolve their differences and avoid further litigation, with each party to bear its own costs, expenses, and attorney fees associated with any such meet and confer.

15. The provisions in Paragraph 14 will also apply to the HRC in the event an amended ROD is issued for that Complex no later than February 28, 2009.

16. Except as limited by this Agreement, Plaintiffs reserve the right to challenge future Navy sonar training and testing activities, and the Navy reserves the right to assert all defenses.

17. Nothing in this Agreement shall waive or foreclose the Government's ability to exercise any applicable statutory or regulatory waiver or alternative compliance provisions including, but not limited to, (a) the Navy's ability to request, and the Council on Environmental Quality's ("CEQ") ability to approve, alternative arrangements pursuant to 40 C.F.R. § 1506.11; (b) the Secretary of Defense's ability to exempt any action or category of actions undertaken by the Navy from compliance with the MMPA pursuant to 16 U.S.C. § 1371; or (c) the President's ability to exempt the Navy from compliance with the Coastal Zone Management Act pursuant to 16 U.S.C. § 1456(c)(1)(B). Nothing in this Agreement shall be construed as an admission by Plaintiffs as to the validity of any such waiver or alternative compliance provisions.

#### **Attorney Fees and Costs**

18. The Navy agrees to pay Plaintiffs a total of \$1.1 million in full and complete satisfaction of any and all claims, demands, rights, and causes of action pursuant to the Equal Access to Justice Act, 28 U.S.C. § 2412(d), the Endangered Species Act, 16 U.S.C. § 1540(g), and/or any other statute and/or common law theory, for all attorney fees and costs incurred by Plaintiffs, individually and/or severally, in the above-captioned lawsuit and in both the district court and appellate proceedings in the RIMPAC litigation. Payment is conditioned upon Plaintiffs' voluntary dismissal with prejudice of the above-captioned lawsuit and Plaintiffs' August 2, 2006 Motion for Fees and Costs in the RIMPAC litigation. Accordingly, within 3 business days of the effective date of this Agreement, Plaintiffs shall file a stipulation of dismissal with prejudice of the above-captioned case pursuant to Federal Rule of Civil Procedure

41(a)(1)(A)(ii), and a stipulation of dismissal with prejudice of Plaintiffs' August 2, 2006 Motion for Fees and Costs in the RIMPAC litigation.

19. The payment of \$1.1 million shall be made by electronic funds transfer within 120 days of the later of the following two occurrences: (a) the Plaintiffs' filing of a stipulation dismissing with prejudice the above-captioned case; and (b) the Plaintiffs' filing of a stipulation dismissing with prejudice Plaintiffs' EAJA claim in the RIMPAC litigation. Within 15 days of the effective date of this Agreement, Plaintiffs will provide Defendants with all information necessary to complete the electronic funds transfer.

20. Nothing in this Settlement Agreement relieves the Federal Defendants of any obligation to act in a manner consistent with applicable federal, state or local law. No provision of this Agreement shall be interpreted as or constitute a commitment or requirement that the Federal Defendants obligate or pay funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341, or any other law or regulation.

21. Nothing in this Settlement Agreement shall be interpreted as imposing obligations on any federal agency that is not a signatory to the Agreement.

22. The effective date of this Agreement shall be the date on which the final party signs the Agreement.

IT IS HEREBY AGREED.

Dated: December 26, 2008

IRELL & MANELLA LLP  
Richard B. Kendall  
Gregory A. Fayer  
Josh B. Gordon  
Holly L. Gershow

By: Richard B. Kendall /hg  
Richard B. Kendall

ATTORNEYS FOR PLAINTIFF NATURAL  
RESOURCES DEFENSE COUNCIL

Dated: December 26, 2008

NATURAL RESOURCES DEFENSE  
COUNCIL, INC.  
Joel R. Reynolds  
Stephen Zak Smith

By: Joel R. Reynolds/hg  
Joel R. Reynolds  
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FOR COASTAL PROTECTION, OCEAN  
FUTURES SOCIETY, AND JEAN-MICHEL  
COUSTEAU

Dated: December 24, 2008

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DONALD C. WINTER, Secretary of the  
Navy, AND UNITED STATES  
DEPARTMENT OF THE NAVY

Appendix A

<u>Bates Number</u>	<u>Title/ Brief Description of Document</u>
PMFA0000209-0000211	Finding of No Significant Harm for Proposed Major Atlantic Fleet Training Exercises and USS Enterprise Carrier Strike Group Composite Training Unit Exercise
PMFA0000445-0000446	Finding of No Significant Harm for Anti-Submarine Warfare (ASW) Exercise Pioneer V Integrated Fleet Testing and Training Event in VACAPES OPAREA Spring 2005
PMFA0001401-0001402	Marine Mammal Density Estimate Methods for JTFEX and the SOCAL OPAREA
PMFA0002048-0002053	Marine Mammal Compliance For TF ASW Experiments 06-1/5
PMFA0002252-0002258	Marine Mammal Take Results for 4 MK-54's with 5 Ranging Pings from a 53C Surface Ship Sonar
PMFA0002352-0002354	Executive Summary of Overseas Environmental Assessment (TF ASW RWT Okinawa, Japan, 9/2006)
PMFA0002914-0002916	Email chain with subject "Next JTFEX" dated 02/27/2003
PMFA0002924-0002925	Email from Joan Heath to Elizabeth Nashold and Harrison Eacho with subject "AT-SEA ENVIRONMENTAL MITIGATION FOR APR MULTI-NATIONAL MARTIME EXERCISE 03-1: OPERATION BLACK SHOE" dated 04/26/2003
PMFA0003505-0003506	Email from Elizabeth Nashold to James Seyler, Joel Bell, and Deanna Rees with subject "JFK C2X Planning Meeting, 12 Jan at 1000" dated 01/06/2004
PMFA0005349-0005377	Email chain with subject "Sonar info week of 2 Feb" dated 02/04/2004
PMFA0005548-0005549	OEA for Anti-Submarine Warfare Exercise (ASWEX) Portion of JTFEX in SOCAL OPAREA, Jan. 2005
PMFA0005550-0005552	Email chain with subject "LMRISAccountRequest.doc" dated 12/16/2004
PMFA0005566-0005567	Email chain with subject "SOCAL ASW Exercise Info" dated 12/17/2004 and attachment.
PMFA0005569-	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise

0005590	Southern California Range Complex January 2005
PMFA0005618-0005628	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex January 2005
PMFA0005664-0005676	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex January 2005
PMFA0005977-0005978	Message from COMPACFLT with subject "Major Fleet Exercise Environmental Documentation"
PMFA0006114-0006124	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex March 2005
PMFA0006156-0006166	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex March 2005
PMFA0006230-0006250	Overseas Environmental Assessment for Anti-Submarine (ASW) Exercise Smart Search '05/ Ship ASW Readiness Effectiveness Measuring (SHAREM) – 150
PMFA0008702-0008713	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise in the Southern California Range Complex Associated with COMPUTEX November 2005
PMFA0009445-0009455	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex December 2005
PMFA0010398-0010403	Report with heading "Verification of South Eastern ASW Training Initiative (SEASWITI) Events"
PMFA0010935-0010951	Email chain with subject "Environmental Protection Measures for ESGEX" dated 03/22/2006
PMFA0022703	Email from Steve Leathery to Frank Stone with subject "Conf Call – RIMPAC" dated 02/16/2006
PMFA0031768-0031777	Atlantic Fleet Mitigation Chart
PMFA0031831-0001841	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Southern California Range Complex December 2005
PMFA0033715-0033720	CPF Draft Response to NOAA Request for Additional Mitigation Measures on 7 Jun 06
PMFA0035251-0035255	Email chain with subject "Feb C2X Ops Matrix" dated 02/08/2006

PMFA0035637-0035641	Conference Call Between CNO (N45) and NMFS (Initiated by NMFS) 16 February 2006
PMFA0036896-0036917	Environmental Planning Documentation for IWO JIMA ESGEX 06-1
PMFA0037165-0037174	Statement of Technical Review for NEPA/EO 12114 Documents
PMFA0054140-0054142	Finding of No Significant Harm for Proposed USS Eisenhower Carrier Strike Group (CSG) Composite Training Exercise (COMPTUEX) 06-2
PMFA0056062-0056065	Memo listing topics for discussion concerning incidental take permits for sonar activities
PMFA0058312-0058319	Discussion Draft: Mitigation Measures for 2007-08 Major Exercises
PMFA0062923	Pacific Fleet Commander's Position on Mitigation Measures Proposed by NRDC
PMFA0111502-0111504	Conrad Erkelens' Comments on EA/OEA for Northern Edge 2004
PMFA0122716-0122720	Overseas Environmental Assessment (OEA) for Proposed ASW Exercises in SOCAL OPAREA, January 2005 (Internal Pre-Decisional Document)
PMFA0128648	Letter from Commander, U.S. Pacific Fleet to Chief of Naval Operations (N45) re: Overseas Environmental Assessment for Anti-Submarine Warfare Exercise Carrier Strike Group Exercise March 2005
PMFA0128649-0128659	Overseas Environmental Assessment: Anti-Submarine Warfare Exercise Carrier Strike Group Exercise March 2005
PMFA0133983-0134078	Overseas Environmental Assessment: Combined Composite Training Unit Exercise 05-1 and Joint Task Force Exercise 05-2 At-Sea Activities June 2005
PMFA0138840-0138849	Email from Thomas Callahan to Lonny Cousins, Bruce Strissel, Nicholas Gural, and Jenny Son with subject " R171420Z Jun 05 COMFLTFORCOM NORFOLK VA ENVIRONMENTAL PROTECTIVE MEASURES FOR COMPTUEX 05-1 AND JTFEX UNCLAS" dated 06/21/2005
PMFA0141468-0141469	Training Objectives Affected by Sonar Mitigations
PMFA0149072-	Information on Compliance Documentation for Exercises Since Sept.

0149075	2005 to June 2006
PMFA0177001-0177084	Appendix A – 2002 and 2004 Findings of No Significant Impact
PMFA0179545-0179746	Final Comprehensive Environmental Assessment for Major Atlantic Fleet Training Exercises February 2006
PMFA0185916-0186082	Final Comprehensive Environmental Assessment for Major Atlantic Fleet Training Exercises February 2006
PMFA0324685-0324697	CORE Navy 25-26 July 2006 Meeting Highlights
PMFA0348902-0348916	Composite Training Unit Exercises and Joint Task Force Exercises (SOCAL): Addendum to Endangered Species Consultation Package.
PMFA0354688-0354692	Email chain with subject “Updated mitigations lists” dated 11/08/2006
PMFA0357672-0357673	Email chain with subject “Urgent – Need CSFTL_C2F feedback on 2007 exercise locations” dated 11/16/06
PMFA0366463-0366465	Email chain with subject “Additional info required for ES and new chapt 7 of RIMPAC EA” dated 12/06/06
PMFA0367968-0367988	Email chain with subject “End of the day (for DC)” dated 12/06/2006
PMFA0376882	Email chain with subject “Right Whale concerns for SEASWITI 07-2” dated 12/12/2006
PMFA0377335-0377341	Preparation for CCC Hearing JTFEX/COMPTUEX Dec 15, 2006
PMFA0377361-0377363	Email chain with subject “Right Whale concerns for SEASWITI 07-2” dated 12/13/2006
PMFA0388177-0388190	PowerPoint presentation with title “Sonar Update” dated 7/12/2006
PMFA0398129-0398135	Background Information on Marine Mammal Effects and Compliance Timelines
PMFA0400495-0400496	Recommendation on mitigation options for PACNORWEST in light of Shoup inquiry
PMFA0403962-	Response to NOAA Comments on JTFEX/COMPTUEX

0403980	
PMFA0462254-0462280	U.S. Navy Pacific Fleet Marine Mammal Exercise Monitoring Plan For Composite Training Unit Exercise (COMPTUEX) and Joint Task Force Exercises (JTFEX) Within the Southern California Range Complex

**Appendix B: Briefing Topics**

**I. Density estimates for use in acoustic effects modeling:**

1. Describe all data sources principally used in developing the density surfaces. (Are data from platforms of opportunity included in addition to line-transect survey data? Are other opportunistically collected datasets included (e.g., whaling records, fisheries bycatch, stranding data? Does environmental data include data collected in situ in addition to remotely sensed data? Where remotely sensed data are used, are temporal and spatial scales of data compatible with cetacean datasets?)
2. Provide detail on resolution of temporal and spatial scales of data availability and the scales used in models. (What methods are used to interpolate habitat data (e.g., inverse distance weighting, kriging?)
3. Clarify how seasonality (for both oceanographic and biological factors) is included in the model.
4. Describe the statistical methods used to infer species distributions (e.g., generalized linear model, additive model, etc).
5. Provide detail on oceanographic, bathymetric, and any other parameters used in predicting where species would occur, and on how these parameters are utilized in models.
6. Please elaborate on any assumptions made regarding the association of specific species with environmental data, particularly in cases where data for a given species are unavailable.
7. Describe how uncertainty in either habitat features (e.g., oceanographic and bathymetric elements) or species distributions is incorporated into models.
8. Explain how the predictive accuracy of models will be assessed, and how models will be improved as new data become available. (Are iterative/adaptive aspects built in?)
9. Clarify whether efforts have been made to incorporate a broad range of environmental data in predictive models.
10. Explain how autocorrelation in cetacean datasets is handled (e.g., rarefaction, permutation tests).

**II. Propagation and exposure modeling:**

1. Identify oceanographic, bathymetric, or other parameters included in the propagation model and explain how they are utilized in the model. (E.g., are models able to predict surface ducting conditions?)
2. Describe data sources for all environmental parameters in sound propagation models, including bottom characteristics, depth of thermocline, sound speed, shear sound speed, attenuation. (E.g., Where do data for bottom characteristics come from and how are data

- interpolated?)
3. Provide explanation of (and rationale for) specific noise propagation models used (e.g., ray trace models, parabolic equation models, normal mode models or geometric spreading models) and describe efforts to ensure that propagation models work in the environment of interest and at the frequency range of interest.
  4. Discuss any efforts to test alternative models for sound propagation, and their results.
  5. Characterize the level of knowledge regarding oceanographic data in specific training areas (e.g., how well characterized are bottom types and sound-speed profiles?).
  6. Provide results of any comparisons of predicted versus actual measured transmission loss in environments comparable to that of relevant training areas.
  7. Describe the process involved in calculating the probability of exposing an individual to various noise levels (e.g., using density of animals and acoustic propagation loss).
  8. Explain how the "exposure zone" (size, intensity, and shape) from an acoustic event is estimated; provide examples of how this zone would differ under different oceanographic conditions (e.g., under which scenarios might the relationship between distance and exposure be nonlinear?).
  9. Elaborate on whether species-specific data on TTS and PTS are used to calculate exposures in take models. (E.g., are different sensitivities of various species taken into account in take levels?) Given the lack of species-specific acoustic data and known sensitivities of some species (harbor porpoise) versus others (bottlenose dolphin), please describe how thresholds were determined for each species of interest.
  10. Explain how intra-seasonal and interannual variation are accounted for in propagation and take models. (E.g., Are oceanographic variables and marine mammal population data available for the season of interest in which training will take place? What is the temporal scale over which data are averaged (season, year, etc)?)
  11. Describe methods for calculating densities for various marine mammal species. (E.g., What level of likelihood (or function) is used to determine the numbers that will "likely be present"?)
  12. Elaborate on methods used to determine the range of each species and whether all habitat is treated equally (versus a separate treatment for important habitat including migratory routes, calving grounds, etc.). (How was occurrence modeled for species for which no survey data are available?)
  13. Please describe the sensitivity of the model, providing examples of how take estimates would differ under varying assumptions about the dose response curves.
  14. Please provide further description of any efforts to account for uncertainty in propagation and take models, including the range of parameter values used, different transform functions attempted, etc.
  15. Please describe how you have ensured that models are improved and updated in a timely matter as new data and techniques become available.



### **III. Synthetic training**

1. Please describe current uses of synthetic training within the training, certification, and maintenance cycle for sonar proficiency (e.g., purposes of synthetic training at each stage, how synthetic training works, locations of synthetic training, number of hours required for technicians).
2. Describe the role of synthetic training as defined in the Required Capabilities Document (product of the TAP program) and in any range-specific planning documents, both for current use and for longer-term planning horizons. Describe the extent to which synthetic training has displaced historic levels of in-field training with sonar.
3. Please describe the budget for acquiring/maintaining existing systems or programs for synthetic training and for research and development of new synthetic training techniques. Explain the role played by the various Navy agencies (e.g., fleet commands, NUWC) in the present use of synthetic training, in the budgeting for synthetic training, and in research and development for new synthetic techniques.
4. Please identify and describe the major technical impediments to the expansion of synthetic training as a (partial) substitute for in-field training, and describe current and potential research needed to resolve those impediments and the probable budget for that research.
5. Please explain the extent to which synthetic or simulation techniques (e.g., simulated geography) can allow operators to modify the conditions of in-field training, and describe how these techniques have been used in prior training activities.

## APPENDIX C

### **Confidential Settlement Communication Not for Use in Any Other Context**

#### **Proposed Research Topics List**

December 5, 2008

This document details the research topics, objectives under those topics, cost estimates, and projections on funding discussed by the Navy and NRDC. The following general points apply across all proposed topics:

- **Research Project Notification.** Navy will provide written, post-award notice to NRDC of the projects funded under the agreed upon research topics, with the following data elements: date of contract/grant; number of contract/grant; contractor's name; Principal Investigator's (PI's) name; title of project (work being done); amount of contract/grant; and performance period.
- **Progress Reviews.** Navy will provide NRDC with progress reviews in the form of peer-reviewed publications or annual reports on the research projects funded under the agreed upon research topics. In addition, Navy will provide an annual information brief at a mutually agreed location to NRDC on the research projects funded under this agreement with opportunity for dialog that does not infringe on selection and oversight duties of the Navy offices responsible for research.
- **Time Frame.** Navy will stress to grant applicants that obtaining and disseminating relevant results in a timely manner will be a priority. Annual reports will provide preliminary results and a section explaining how those results are relevant to management and Navy operations.
- **Availability of Appropriations:** Projects funded pursuant to the agreed upon topic list will be funded through general appropriations for Navy research, if made available by Congress, beginning in fiscal year 2009. Navy agreement to fund projects under the topic list will be subject to the availability of appropriated funds. The Navy agrees to seek sufficient funding through its budgetary process to fulfill its obligations under this agreement. Any requirement for the payment or obligation of funds by the Navy, however, shall be subject to the availability of appropriated funds, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. Section 1341.
- **Cost Estimates.** The costs provided below are the Navy's best estimates of all projected research costs for projects under each topic, and total \$14.75M in expenditures over three fiscal years. In the unanticipated event that project costs under the proposed topics do not realize \$14.75M over three fiscal years, Navy shall, subject to the availability of appropriated funds, apply fiscal year 2012 funding towards projects in the agreed upon topics to achieve \$14.75M over four fiscal years. As represented in the parties' negotiations, the Navy will not expend future funding on redundant projects. However, the Navy reserves the right to fund ongoing and new contracts and grants using FY09, FY10 and/or FY11 funds for projects that may build on work accomplished in a previous project or projects.

- **Welfare considerations.** NRDC and co-plaintiffs recognize that invasive techniques such as biopsy and tagging can yield important information that cannot be obtained by other means. However, the benefit of the information obtained must be weighed against the potential risk to animals, and thus invasive techniques are only to be used as part of a well-defined research program, the ultimate objective of which is to provide data that will assist the Navy in mitigating more effectively the potential effects of midfrequency sonar on marine mammals. The Navy's research efforts will continue to be part of such a well-defined research program, approved by the host institution Institutional Animal Care and Use Committee (IACUC), consistent with the approved Department of Defense Animal Use Protocol, and where applicable, covered by a scientific research permit issued pursuant to the Marine Mammal Protection Act by the National Marine Fisheries Service (NMFS) or the United States Fish and Wildlife Service (USFWS).

## **1) MAP KEY HABITAT PREDOMINANTLY FOR BEAKED AND OTHER WHALES IN AREAS USED FOR MFA SONAR TESTING AND TRAINING**

### **Background**

There has been recognition that atypical mass strandings of beaked and other whales may be associated with naval exercises that use mid-frequency active (MFA) sonar (Evans and England 2001, Cox et al. 2006). A variety of hypotheses have been proposed to explain the causal chain of events from sound exposure to stranding. These include hypotheses that whales may be physically affected by MFA sonar signals, MFA sonar may trigger behavioral reactions that cause beaked whales to panic and swim to shore, and then die from injuries associated with stranding, or that MFA sonar exposure may trigger a behavioral reaction in beaked whales that could injure them independent of stranding, and that either the reaction or the subsequent injury leads some of the whales to strand; the last of these is considered "a plausible pathologic mechanism" (Cox et al. 2006). It is clear that each of these different hypotheses would require very different approaches for reducing the risk to whales from MFA sonar exercises, and a fundamental understanding of the reasons behind strandings is required.

To understand the mechanisms underlying strandings and to reduce risks to whales, a number of reviews (e.g. National Research Council 2003 & 2005, MMC 2004) over the past few years have identified the need for additional research in a number of areas, including to measure the distribution and abundance of beaked whales (e.g. Evans and England 2001, Cox et al. 2006). Research into the best methods for acquiring such knowledge is important both to plaintiffs and to the Navy as it seeks to enhance its environmental assessment capabilities.

MacLeod and Mitchell (2006) list several areas in US waters as beaked whale habitat based on sightings and stranding records that include the following: 1) northeastern North America continental shelf margins (from Cape Hatteras to southern Nova Scotia and east to the start of the abyssal plain), 2) California shelf margins (from the coast west to 125°W), 3) Hawaii 18.5-22.5°N, 154.4-160.25°W, and 4) Northern Gulf of Mexico (North of the US-Mexico border, east to 84.87°W, south to the western end of Cuba, east to 81.34°W and North to Florida).

Areas used for Navy MFA sonar testing and training overlap with the four areas likely to represent beaked whale habitat as described above; however, relatively little is known about species diversity, abundance and habitat use in these areas. The locations where Navy tests and trains with MFA sonar include the Hawaii Range Complex, the Southern California Range

Complex, the Atlantic Undersea Test and Evaluation Center (AUTEK) in the Bahamas, and the Atlantic Fleet Active Sonar Training (AFASST) area.

The continental shelf off the northeastern coast of North America likely represents habitat for beaked whales based on sightings or strandings, including at least six species from three genera (MacLeod and Mitchell 2006). Previous work suggests that beaked whales are broadly distributed across the continental shelf and over the continental slope and rise, and may be particularly concentrated around Cape Hatteras and Georges Bank (CeTAP 1982, Waring et al. 1993, Waring et al. 2001) The deep waters off the California coast are also likely habitat for a diversity of beaked whales: seven species have been recorded, including Perrin's beaked whale (*Mesoplodon perrini*) which is only known from California waters at present (Dalebout et al. 2002). Density may be highest around the southern California Bight (MacLeod and Mitchell 2006). In the waters surrounding Hawaii, three species of beaked whales are known to occur: Blainville's beaked whale (*Mesoplodon densirostris*), Cuvier's beaked whale (*Ziphius cavirostris*), and Longman's beaked whale (*Indopacetus pacificus*). Although few dedicated surveys have been undertaken to determine densities, recorded sightings suggest the regular occurrence of at least the first two species around the Hawaiian Islands. Density of beaked whales may be particularly high around seamounts near the Hawaiian archipelago (Johnston et al. 2008). Although only 10 beaked whale strandings have been recorded in the Hawaiian Islands through 2005 (Maldini et al. 2005) and no mass strandings have been recorded, Faerber and Baird (submitted) suggest that the near shore bathymetry, coastal topography and demographics of the Hawaiian Islands are such that the probability of observing strandings, should they occur, is a great deal lower than for other island chains such as the Canary Islands. Finally, in the northern Gulf of Mexico, four species of beaked whales occur (Sowerby's beaked whale, Blainville's beaked whale, Gervais's beaked whale, and Cuvier's beaked whale), but little is known about abundance of these species.

In addition to the potential effects of Navy sonar operations on beaked whales, the Navy also has interest in examining the potential effects of sonar on other related species. For example, the Navy is interested in the general behavior of baleen whales in regions of possible Navy influence, primarily to establish a background to measure trends, particularly those that can be correlated with changes in the ocean environment.

### **Research Topic #1**

- Use existing survey data<sup>1</sup> to estimate presence/absence, and abundance of beaked whale species in areas used for MFA sonar testing and training in proximity to the beaked whale habitat areas as described above.
- Obtain/add to environmental and oceanographic data for areas used for MFA sonar testing and training in proximity to the beaked whale habitat areas as described above.
- Develop, augment and update habitat models for beaked whale species, including species presence and abundance in areas used for MFA sonar testing and training.

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<sup>1</sup> Emphasis should be placed on estimating density and abundance from existing survey data. The highest priority should be given to the analysis of existing survey data for the estimation of marine mammal abundance in the SOCAL Range Complex. These include the analysis of the 2005-08 CalCOFI ship surveys collected by SIO and Cascadia Research, the analysis of SWFSC at-sea pinniped sightings, the analysis of SWFSC cetacean survey data off northern Baja California, Mexico, and the analysis of the 2001-03 aerial survey data from the San Clemente range collected by SIO.

- Undertake fine-scale surveys to include focal animal follows (including monitoring animal movements via satellite tagging), passive arrays, floating instrument platform (FLIP) within Southern California Offshore Range (SCORE) in order to improve habitat mapping.

The goals of this research topic are to document species occurrence, population densities, spatial patterns and fine-scale habitat utilization by beaked whales and other species using dedicated line-transect survey and acoustic data, particularly in the deep waters in areas used for MFA sonar testing and training. Initial habitat modeling for beaked whales should be carried out (or assessed/augmented if it has already been completed for these areas) based on all available previously collected NOAA survey datasets.

Habitat modeling techniques have been described extensively for beaked whales and other cetaceans (Ferguson et al. 2006, Hamazaki 2002). For example, Generalized Linear Models (GLMs) with a logistic link function have been used to model beaked whale habitat off the northeastern coast of the US (Waring et al. 2001, Hamazaki 2002). Ecological niche factor analysis has also been used to model beaked whale habitat in the North Atlantic based on water depth, slope and orientation (MacLeod 2005). MacLeod and Zuur (2005) used generalized additive models (GAMs) to model beaked whale habitat association in the Bahamas. Variables that have been investigated in these past studies include depth, slope, distance offshore, seabed topography, sea surface temperature, salinity, chlorophyll concentration, thermocline depth, and thermocline strength. The proposed research topic should build upon these methods (GLMs, GAMs, and others) in order to model beaked whale habitat in areas used for MFA sonar testing and/or training.

#### **ONR Estimated Costs**

- FY10 - \$600K

#### **N45 Estimated Costs**

- FY09 - \$850K
- FY 10/11 - \$1.5M

## **2) IMPROVING METHODS IN CETACEAN DETECTION**

### **Background**

Marine mammal calls cover the frequency range from 10 Hz – 150 kHz (Richardson et al. 1995). Mysticetes (baleen whales) generally produce low frequency sounds (10 – 2000 Hz) which are a tonal or modulated-tonal quality. Odontocete (toothed whale) sounds are divided into three general categories: echolocation clicks, burst-pulsed calls, and whistles. Echolocation clicks are broadband, impulsive sounds with typical frequencies between 5 - 150 kHz, burstpulsed calls are rapid series of broadband clicks, and whistles are frequency modulated narrowband calls that occur between 2-35 kHz.

Detection of bioacoustic sounds, classification by species, and localization (DCL) of calling animals as a function of time (tracking) are key steps in processing passive acoustic monitoring data. Recent advances in acoustic recording capabilities allow remote autonomous recordings with multiple-terabyte data storage (Wiggins and Hildebrand 2007). Manual analyses of these large datasets are prohibitive, based on time and expense. A variety of methods have

been tested detecting and classifying beaked whale sounds. Many of these methods were presented at the Third International Workshop on Detection and Classification of Marine Mammals using Passive Acoustics (Boston, July 2007). These methods have variously relied on a support vector machine (Jarvis et al. 2007, Roch et al. 2007), a statistical classifier (Gillespie and Caillat 2007), the Teager-Kaiser energy operator (Kandia and Stylianou 2007, Roch et al. 2007), a noise-adaptive band-limited thresholding (Theriault and Hood 2007), matched filtering (Morrissey et al. 2007, Mellinger 2007a), and a neural network (Mellinger 2007a). Among the best of these was a support vector machine (Roch et al. 2007); the neural network also performed well. Other detection methods are being explored in the analysis of several datasets of beaked whale sounds (Mellinger and Clark 2006).

Buoyancy-driven autonomous underwater gliders provide unique platforms to support the development of real-time algorithms for marine mammal detection and classification. The current generation of gliders (Spray, Seaglider, and Slocum) are severely limited in payload and battery capabilities since they were originally designed as 2-person-deployable platforms for vertically profiling slowly-varying ocean properties such as temperature and salinity. These design parameters limit their ability to conduct marine mammal monitoring missions. Two developments improve this situation significantly. First is the development of low-power, small (in weight and volume) hardware for marine mammal passive acoustic monitoring (PAM), reducing the demands on the glider platform. Second is the expanded platform capability provided by a glider specifically designed for real-time, persistent, and passive acoustic monitoring missions. This combination of attributes ultimately will result in an operational system that provides timely information on marine mammal presence to support Naval mitigation efforts.

Determining the density and distribution of cetacean species is fundamental to understanding their basic biology, and also to monitoring and mitigating the effect of man-made impacts on their populations. Currently, the main method of achieving this is using visual line transect surveys. Another fruitful avenue of recent research has been the use of towed passive acoustic arrays either in place of a single visual platform or as a secondary observation platform. With an array of two or more hydrophones towed in a known configuration it is possible to estimate the bearing to a sound received at multiple hydrophones and, if the ship is moving fast relative to the animal, a sequence of these bearings can be used to estimate the perpendicular distance of the animal from the transect line. Fixed passive acoustic devices have enormous potential for cetacean monitoring, because they enable large amounts of data to be collected over long time periods, or potentially processed in real time for select outputs, at low to moderate cost. In areas where fixed arrays already exist, there would be very little additional expenditure required to extract and analyze the data, were suitable methods available. Where fixed arrays do not exist at an appropriate scale, but where short to medium term monitoring is required, temporary deployments of devices such as sonobuoys or various pop-up (i.e., anchored, retrievable) buoys could provide the required data.

It is an important goal to estimate absolute density using PAM data as opposed to some index of density such as received call rates, because indices often have only a weak relationship with population size (e.g., Anderson 2001 and 2003, Pollock et al. 2002). For example, if we find that the number of calls of a species of interest received per unit time are different between two areas or two seasons then this could be because of variation in calling frequency or in probability of detecting calls caused by differences in sound propagation in the water, average depth of the animals, call strength, etc. These potential sources of bias focus mainly on the application of

distance sampling methods to the fixed passive acoustic scenario, which is a specific research need addressed under this research topic.

## **Research Topic #2**

- Explore multiple avenues of detection and species classification from PAM data.
- Develop automated detection and classification of marine mammals for mobile underwater gliders.
- Develop methods for estimating the density of cetacean species from fixed passive acoustic devices. Methods should be applicable to a wide range of scenarios, including dense and sparse arrays of permanent, bottom-mounted sensors and single bottom mounted or floating sensors.
- Demonstrate the utility and generality of the density estimation methods by implementing them in a set of key test case studies to ensure their relevance to real-world applications.
- As feasible, use case studies to cross-validate passive acoustic species identification by enabling visual monitoring effort in combination with acoustic data collection.
- Utilize photo-identification and biopsy data that confirm species identification and provide information about stock structure and sex of animals (as well as reproductive status and contaminant load).
- Promote adoption of the new density estimation methods in the marine mammal research community by (a) publishing results in the peer-reviewed literature, (b) archiving data and results in publicly available electronic storehouses (e.g., the Ocean Biogeographic Information System, OBIS), (c) holding start-up and wrap-up workshops open to all interested researchers.

The principal goal of this research topic is to improve our ability to infer cetacean presence, abundance, and behavior using acoustic data. In order to accomplish this, we propose a research topic with the goal of 1) improved ability to detect, classify, and localize animals, and 2) application of distance sampling methods to determine density from fixed passive acoustic sensors. This will enable the integration of acoustic data with information from visual surveys and other sources (such as photo-identification and biopsies). Once these methods are developed researchers will be able to capitalize on existing sources of data including a number of moored recording stations already collecting acoustic data in U.S. waters, including passive acoustic sensors in military ranges such as SCORE, AUTEK and PMRF ranges, Autonomous Underwater Listening Stations (AULS), which are deployed in each of the 14 National Marine Sanctuaries, and oceanographic acoustic moorings deployed by IOOS (Integrated Ocean Observing System). As necessary, additional acoustic equipment could be deployed in order to capture information along an anthropogenic noise gradient. In addition, it will also be important to ensure that continuous oceanographic data are available for the same areas, and that as much as possible of the full acoustic bandwidth is being measured in order to detect vocalizations by any species as well as any anthropogenic noise.

In order to fulfill the primary goal of accurate species identification from passive acoustic data, it may be useful to cross-validate information from acoustic sources with visual monitoring efforts. To this end, the key case studies mentioned above could compare inferences from acoustic data to data collected using visual monitoring or focal animal follows. For these studies, visual monitoring effort could be undertaken in areas where acoustic data are being collected,

focusing on areas of potential anthropogenic acoustic effects. Data from acoustic and visual monitoring efforts could then be integrated across different spatial and temporal scales in order to derive best estimates of species diversity and these data could be used to add to our understanding of factors influencing encounters that are missed acoustically but sighted, and vice versa.

#### **ONR Estimated Costs**

- PAM DCL development FY09/10 – \$1.5M
- PAM with gliders FY09/10 – \$4.3M

#### **N45 Estimated Costs**

- FY09 - \$2M
- FY10/11 - \$2.15M

### **3) EFFECTS OF STRESS ON MARINE MAMMALS EXPOSED TO MFA SONAR**

#### **Background**

Marine mammals are exposed to a variety of anthropogenic effects that may be a source of stress, including noise, pollutants, threatening stimuli, and habitat disruption. The stress response in captive marine mammals has been shown to include cardiac (heart rate) and neuroendocrinological responses (catecholamine and cortisol concentrations) (Mykiss-Olds et al. 2001, Fair and Becker 2000). Little is known, however, about long-term effects of stress on individuals and populations (Wright and Kuczaj 2007). Prolonged exposure to stress may result in effects including immune system suppression, reproductive failure, accelerated aging, and slowed growth (Wright et al. 2007). Biomedical research on human stress provides a theoretical framework that can assist in conceptualizing and ultimately measuring the cumulative effects of multiple stressors on individual animals (NRC 2005).

Recent promising advances in the marine mammal field include the detection of stress hormones such as catecholamine and glucocorticoidsteroid hormones via non-invasive means such as fecal sampling (Rolland et al. 2006), sloughed skin or collection of exhaled mucus (Hogg et al. 2005). However, research needs in this area include validation and calibration of assays, improved detection capabilities, characterization of the relationship between hormone levels and time since exposure to the stressor, and determination of the levels of variability among individuals (ie. Buchanan and Goldsmith 2004).

Heart rate is a valuable parameter to measure for addressing a number of questions in biology because it is a function of the autonomic nervous system that provides information on the individual's behavioral state, sensory abilities, and response to stimuli (Mykiss-Olds et al. 2001). However, as the technologies used to measure heart rate (e.g. those that sample blood serum) are potentially invasive, great care must be taken to weigh the research benefits against the potential risk to the welfare of animal subjects as required by the Navy and approved by the host institution Institutional Animal Care and Use Committee (IACUC), consistent with the approved Department of Defense Animal Use Protocol, and, if applicable, a scientific research permit issued pursuant to the Marine Mammal Protection Act by NOAA Fisheries or United States Fish & Wildlife Service (USF&WS). One potential physiological change in a marine mammal following exposure to noise is an acute stress response that would include an increase in heart rate. During diving, marine mammals exhibit what has been termed the 'dive response'



that includes redistribution of blood flow and reduced heart rate. Marine mammals maintain tight active control over heart and respiration rates for regulating blood gas homeostasis while diving.

Under normal conditions the intensity of the dive response depends upon the type of dive (e.g. foraging or traveling), dive depth and the planned duration of the dive. Diving mammals demonstrate a level of active control over the intensity of the dive response and modify it according to the demands of the particular dive type. A startle reaction may cause an animal to react to threats with a general discharge of the sympathetic nervous system, priming the animal for fighting or fleeing. Introduction of a novel stressor that startles an animal during a dive could potentially result in a suite of physiological conflicts; e.g., increased heart rate instead of suppressed heart-rate, increased oxygen requirements of muscles for flight, vasodilation at depth, etc. It is hypothesized that unexpected exposures to loud noises could produce a startle response and cause a temporary lapse in active control of physiological functions. When coupled with potential rapid ascents or descents, exposures could hypothetically affect normal diving patterns (dive duration, depth) potentially making animals more susceptible to diving related traumas.

### **Research Topic #3**

- Conduct a workshop with internationally recognized researchers to identify the state of the field in stress physiology, focusing on identifying and evaluating available or developing technologies for measuring neuroendocrinological and cardiological indicators and other biomarkers, taking into consideration non-invasive techniques. The desired outcomes from this workshop would include:
  - Examine the utility and validity of recently developed non-invasive means of measuring hormones such as catecholamine and glucocorticoidsteroid hormones via fecal sampling, sloughed skin, or collection of exhaled mucus for application in marine mammal investigations.
  - Identify key cardiological and/or neuroendocrinological indicators that have promise in investigating the effects of stress on marine mammals exposed to MFA sonar
  - Identify technological needs related to sampling cardiological and/or neuroendocrinological indicators in free-ranging marine mammals. This may include more sophisticated data logger tags that sample blood serum and cardiac parameters, and/or other biomarkers for measuring cardiological and/or neuroendocrinological indicators. In particular, workshop participants should attempt to identify available technologies that are minimally invasive.
  - Identify existing research protocols in the marine mammal field that would facilitate development and testing of devices (data logger and/or biomarkers) to measure stress response in marine mammals.

Understanding of the long-term effects of stress on marine mammal individuals and populations requires the conceptual integration of short-term stress responses, energy budgets, and life history events. Stress responses, however, are only one of several concepts that require integration of energy budgets, and life history events if population level impacts of MFA sonar are to be considered. To date, little conceptual, empirical, experimental, or field work has been conducted in this area and it is well beyond the topic of the effects of stress on marine mammals exposed to MFA sonar.

### **ONR Estimated costs**

- FY09 - \$100K

- FY10 - \$750K
- FY11 - \$1.00M

#### **N45 Estimated Costs**

- n/a

The Navy agrees that the central management of cetacean acoustic and survey data would be an important tool. The Navy agrees to propose the development of a data management system for marine mammal data to the Federal Interagency Coordinating Group (ICG), which is composed of agency representatives that support or conduct research on the effects of sound on marine mammals. We believe the ICG is the appropriate interagency facilitator for this project.

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# Environmental Documentation POA&M

Range	NEPA NOI	NEPA FEIS	NEPA ROD	MMPA Permit Application Submitted	ESA BA
Hawaii Range Complex	29 Aug 06	9 May 08	26 Jun 08	18 Jul 07	27 Sep 07
Atlantic Fleet Sonar Training	29 Sep 06	12 Dec 08	Jan 09	1 Feb 08	1 Feb 08
SOCAL Range Complex	21 Dec 06	5 Dec 08	Jan 09	26 Mar 08	20 May 08
NW Range Complex	1 Aug 07	Aug 09	Sep 09	3 Sep 08	14 Nov 08

# Environmental Documentation POA&M

Range	NEPA NOI	NEPA FEIS	NEPA ROD	MMPA Permit Application Submission	ESA BA
Panama City	19 Aug 04	May 09	Jul 09	31 Mar 08	
Keyport	11 Sep 03	Aug 09	Sep 09	16 May 08	14 Nov 08
Marianas	1 Jun 07	Oct 09	Nov 09	11 Aug 08	May 09
Gulf of Alaska	17 Mar 08	31 Oct 10	31 Dec 10	31 Apr 09	31 Sep 09