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FINAL REPORT

National Security Issues and the North Pacific Acoustic Laboratory

ONR Contract N00014-03-M-0004

Principal Investigator

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One of the fundamental goals of the ONR-supported North Pacific Acoustic Laboratory (NPAL) project is to further our understanding of the ultimate limits of long-range sonar imposed by ocean variability and the ambient sound field. Although the NPAL project itself is unclassified, the data collected for the NPAL project using bottom-mounted receivers operated by the U.S. Navy are classified. In addition, the results of the NPAL project potentially have implications for a number of classified U. S. Navy programs. This contract provided a small amount of support to allow SIO participants in NPAL to participate in analyses of the classified data and discussions of the national security implications of NPAL. We proposed to:

1. Consult with personnel from the Applied Physics Laboratory of the University of Washington on the analysis of classified acoustic data collected for the NPAL project.
2. Consult with and provide advice to classified U. S. Navy programs as requested.

With respect to Task 1, the following peer-reviewed papers co-authored by NPAL participants at SIO and published during the period of this contract made use of data from the bottom-mounted receivers:

Worcester, P. F., and Spindel, R. C. (2005). "North Pacific Acoustic Laboratory," J. Acoust. Soc. Am. **117**, 1499–1510.

Andrew, R. K., Howe, B. M., Mercer, J. A., and The NPAL Group (J. A. Colosi, B. D. Cornuelle, B. D. Dushaw, M. A. Dzieciuch, B. M. Howe, J. A. Mercer, W. H. Munk, R. C. Spindel, and P. F. Worcester) (2005). "Transverse horizontal spatial coherence of deep arrivals at megameter ranges," J. Acoust. Soc. Am. **117**, 1511–1526.

Worcester, P. F., Munk, W. H., and Spindel, R. C. (2005). "Acoustic remote sensing of ocean gyres," Acoustics Today **1**, 11–17.

Mercer, J. A., Colosi, J. A., Howe, B. M., Dzieciuch, M. A., Stephen, R., and Worcester, P. F.

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(2009). "LOAPEX: The Long-Range Ocean Acoustic Propagation EXperiment," IEEE J. Ocean. Eng. **34**, 1–11.

Dushaw, B. D., Worcester, P. F., Munk, W. H., Spindel, R. C., Mercer, J. A., Howe, B. M., Metzger, K., Jr., Birdsall, T. G., Andrew, R. K., Dzieciuch, M. A., Cornuelle, B. D., and Menemenlis, D. (2009). "A decade of acoustic thermometry in the North Pacific Ocean," J. Geophys. Res. **114**, C07021.

Dushaw, B. D., Au, W. W. L., Beszczynska-Möller, A., Brainard, R. E., Cornuelle, B. D., Duda, T. F., Dzieciuch, M. A., Forbes, A. M. G., Freitag, L., Gascard, J.-C., Gavrilov, A. N., Gould, J., Howe, B. M., Jayne, S. R., Johannessen, O. M., Lynch, J. F., Martin, D., Menemenlis, D., Mikhalevsky, P. N., Miller, J. H., Moore, S. E., Munk, W. H., Nystuen, J., Odom, R. I., Orcutt, J. A., Rossby, T., Sagen, H., Sandven, S., Simmen, J., Skarsoulis, E., Southall, B., Stafford, K. M., Stephen, R., Vigness-Raposa, K. J., Vinogradov, S., Wong, K. B., Worcester, P. F., and Wunsch, C. (2010). "A global ocean acoustic observing network," in *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society*, edited by J. Hall, D. E. Harrison, and D. Stammer (ESA Publication WPP-306, Venice, Italy), in press.

With respect to Task 2, Worcester served as a member of the ONR Deep Water Acoustic Distributed System (DWADS) Review Team during 2005, participating in classified discussions as needed.

Finally, during the period of this contract Worcester also consulted extensively with the Naval Oceanographic Office (NAVO) at Stennis Space Center, MS, while planning for the 2009 NPAL Philippine Sea Pilot Study/Engineering Test and the 2010–2011 NPAL Philippine Sea Experiment. Having access to the classified bathymetric data held by NAVO was absolutely essential to the successful conduct of these experiments.

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