I. Title of Application

Application for a scientific research permit under the ESA and MMPA to study killer whales (*Orcinus spp.)*

II. Date of Application

November 21, 2005

III. Applicant and Personnel

A. Applicant/Permit Holder, Principal Investigator, Co-investigator(s), and other Personnel Directly Involved in Taking

Applicant/Permit Holder and Principal Investigator

Name:	Dr. David E. Bain,
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Institutional affiliation:	Global Research and Rescue, Inc.

Co-Investigators

Name:	Dr. James C. Ha
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University of Washington,
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Institutional affiliation: University of Washington

Name: Dr. J. Pete Schroeder
Address: Marine Mammal Research Associates,
620 W. Anderson Rd.,
Sequim, WA 98382
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e-mail: jpsmmra@olypen.com
Institutional affiliation: Global Research and Rescue, Inc.

Name: Dr. Laurie J. Gage
Address: 1131 Second Ave.
Napa, CA 94558
Telephone: (707) 251-5523
Fax:
e-mail: laurie.j.gage@aphis.usda.gov
Institutional affiliation: Global Research and Rescue, Inc.

Other Personnel Directly involved in taking

Mr. Robert Wood and Mr. Robert McLaughlin will regularly participate in the research and bring extensive experience in vessel operation and photography to the research team. Additional research assistants will participate in the research, and NMFS will be notified of their names and duties prior to the start of each field season.

B. Qualifications and Experience

CURRICULUM VITA OF DAVID E. BAIN

Friday Harbor Laboratories,
University of Washington,
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Friday Harbor, WA 98250
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ACADEMIC BACKGROUND

University of California at Davis (Post-Doctoral Fellow)	1989-1991
University of California at Santa Cruz (Ph.D. in Biology)	1981-1989
San Francisco State University (Master's program in Biology)	1980-1981
University of California at Santa Cruz (B.A., with majors in Biology and Physics with Psychobiology)	1978-1980
New College, University of South Florida	1977-1978
NSF Summer Science Training Program, Humboldt State University	1976
University of Maryland at College Park (summer sessions)	1974,1975

EXPERIENCE

Affiliate Assistant Professor of Psychology, **University of Washington**,	1993-Present
Contractor, **National Marine Fisheries Service,**	1990-Present
Visiting Scientist, **The Whale Museum**,	2000-Present
Killer Whale Research Director, **Marine World Foundation**,	1979-2001
NRC Research Associate at **National Marine Mammal Laboratory,**	1991-1992
Post-Doctoral Fellow, **University of California at Davis**	1989-1991
Consultant for **Active Environments**	1990-1991
Consultant for **Dolphin Research Center**	1990
Research Assistant, **University of California at Santa Cruz**	1987
Teaching Assistant, **University of California at Santa Cruz**,	1982-1986
Computer Programmer, **Satellite Business Systems**,	1980
Research Assistant, **Marine World Research Foundation**,	1978-1979

AFFILIATIONS

Charter Member**, Society for Marine Mammalogy**

AWARDS AND HONORS

National Research Council Research Associateship, 1991-1992
American Cetacean Society, Monterey Bay Chapter, Award, 1982
National Science Foundation Graduate Fellowship, 1981-1984
B.A. with Honors with Majors in Biology and Physics with Psychobiology,
University of California at Santa Cruz, 1980
New College Out-of-State Tuition Waiver, 1977
Earthwatch Scholarship, 1977
National Science Foundation Summer Science Training Program at
Humboldt State University, 1976
Johns Hopkins University **Study of Mathematically and**
Scientifically Precocious Youth, Scholarship, 1974

FUNDING HISTORY

National Marine Fisheries Service Contracts, 1990-present, $535K
Earth Island Institute, Contract 2K
Northwest Straits Commission Grants, 2001-2002 60K
Orca Relief Citizens Alliance Grant, 2001 4K
Center for Biological Diversity Contract, 2001 2K
Oiled Wildlife Care Network Grant, 2000-2001 20K
Anonymous Donation, 1999-2002 250K
Marine World Grants, 1987-2001 400K
Minerals Management Service, 1998-99 60K
The Whale Museum Contracts, 1997-2001 14K
Woods Hole Oceanographic Institution, 1997-1999 4K
United States Geological Survey 1997-1998 15K
BioRad Laboratories, 1997 9K
National Academy of Sciences COBASE Project Development Grant, 1995 2K
British Columbia Ministry of Parks Contract, 1995 2K
National Research Council Research Associateship, 1991-1992 30K
Institute of Museum Services Conservation Grant, 1991-1992 25K
National Science Foundation Doctoral Dissertation Research Improvement Grant
1985-1987 5K
National Science Foundation Graduate Fellowship, 1981-1984 20K

PAPERS

Bain, D. E., R. Williams and A. W. Trites. In preparation. Potential effects of whale watching on killer whale (*Orcinus orca*) population dynamics: insights from three models.

Bain, D. E., J. C. Smith, R. Williams and D. Lusseau. in review. Effects of vessels on behavior of southern resident killer whales (O*rcinus* spp.). NMFS Contract Report No. AB133F03SE0959 and AB133F04CN0040.

Griffin, R. M. and D. E. Bain. 2005. Sound Exposure of Southern Resident Killer Whales in the Southern Strait of Georgia. Contract Report to the National Marine Conservation Feasibility Study. Vancouver, BC. 23 pp.

Killer Whale Recovery Team. 2005. DRAFT National Recovery Strategy for Northern and Southern Resident Killer Whales (*Orcinus orca*).

Heise, K., L. G. Barrett-Lennard, E. Saulitis, C. Matkin and D. Bain. 2003. Examining the evidence for killer whale predation on Steller sea lions in British Columbia and Alaska. Aquatic Mammals 2003, 29.3, 325–334

Bain, D. E., W. Anderson, F. Felleman, M. Harris and P. Higgins. 2002. Orca Recovery Conference Report 2002. Earth Island Institute. 30 pp.

Bain, D. E. 2002. Acoustical properties of pingers and the San Juan Island commercial gillnet fishery. NMFS Contract Report No. 40ABNF701651. 14 pp.

Bain, D. E. 2002. A model linking energetic effects of whale watching to in killer whale (*Orcinus orca*) population dynamics. Contract report submitted to Orca Relief Citizens' Alliance.

Eisenhardt, E., D. E. Bain and R. W. Osborne. 2002. 2001 San Juan County Bottomfish Recovery Project Biological Assessment Final Report. Contract Report submitted to the San Juan County Marine Resources Committee.

Smith, J. C. and D. E. Bain. 2002. Theodolite study of the effects of vessel traffic on killer whales (*Orcinus orca*) in the near-shore waters of Washington State: 2001 field season summary. Unpublished report.

Williams, R., D. E. Bain, J. K. B. Ford and A. W. Trites. 2002. Behavioural responses of killer whales to a "leapfrogging" vessel. J. Cet. Res. Manage. 4:305-310.

Williams, R., A. Trites and D. E. Bain. 2002. Behavioural responses of killer whales (*Orcinus orca*) to whale-watching boats: opportunistic observations and experimental approaches. J. Zool. (Lond.). 256:255-270.

Bain, D. E. 2001. Noise-based guidelines for killer whale watching. Paper submitted to the Wildlife Viewing Workshop. Vancouver, BC.

Williams, R., A. Trites and D. Bain. 2001. Are killer whales habituating to boat traffic? IWC Scientific Committee Document SC/53/WW3.

Bain, D. E. 2000. Characteristics of the 1999 acoustic barrier at Hiram M. Chittenden Locks. Contract Report to NMFS.

Miller, P. J. and Bain, D. E. 2000. Within-pod variation in the sound production of a pod of killer whales, *Orcinus orca*. Animal Behaviour. 60:617-628.

Dahlheim, M., D. Bain, C. Sims, and D. Demaster. 2000. Southern resident killer whale workshop. AFSC Processed Rep. 2000-06, 17 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115-0070.

Trites, A. W. and D. E. Bain. 2000. Short- and long-term effects of whale watching on killer whales (*Orcinus orca*) in British Columbia. Paper presented to the IWC Workshop on the Long-Term Effects of Whale Watching. Adelaide, Australia.

Wade, P, D. Bain and K. Balcomb. 2000. Population dynamics of southern resident killer whales. SRKW11. Paper submitted to the Southern Resident Killer Whale Workshop. Seattle, WA.

Bain, D. and K. C. Balcomb. 1999. Population trends of southern resident killer whales (*Orcinus orca*) from 1960-1999. Report submitted to November, 1999 SRG Meeting, Maui, HA.

Szymanski, M. D., D. E. Bain, K. Kiehl, K. R. Henry, S. Pennington and S. Wong. 1999. Killer whale (*Orcinus orca*) hearing: auditory brainstem response and behavioral audiograms. J. Acoust. Soc. Amer. 106:1134-1141.

Calambokidis, J., D. E. Bain and S. D. Osmek. 1998. Marine mammal research and mitigation in conjunction with air gun operation for the USGS "SHIPS" seismic surveys in 1998. Contract Report submitted to the Minerals Management Service.

Moore, S. E., K. M. Stafford, M. E. Dahlheim, C. G. Fox, H. W. Braham, J. J. Polovina, and D. E. Bain. 1998. Seasonal variation in reception of fin whale calls at five geographic areas in the North Pacific. Mar. Mamm. Sci. 14:617-627.

Szymanski, M. D., A. Ya. Supin, D. E. Bain, and K. R. Henry. 1998. Killer whale (*Orcinus orca*)

auditory evoked potentials to rhythmic clicks in killer whales. Mar. Mamm. Sci. 14:676-691.

Bain, D. E. 1997. Effects of the 1997 SHIPS study on Marine Mammals in Puget Sound. Contract Report to the U.S. Geological Survey.

Bain, D. E. 1996. Sound Level Contours Produced by the 1995 Acoustic Barrier at the Hiram M. Chittenden Locks. NMFS Contract Report No. 40ABNF502019. 17 pp.

Bain, D. E. and T. Samansky. 1995. Analyzing changes in dolphin survival rates over time at Marine World Africa USA. Proc.1995 Conf. Int. Assoc. Aquatic Anim. Med. 60-64.

Szymanski, M. D., D. E. Bain and K. R. Henry. 1995. Auditory evoked potentials of a killer whale (*Orcinus orca*). In (R. A. Kastelein, J. A. Thomas, and P. E. Nachtigall, eds.) Sensory Systems of Aquatic Mammals. De Spil Publishers. The Netherlands. 1-10.

Bain, D. E. and M. E. Dahlheim. 1994. Effects of masking noise on detection thresholds of killer whales. In (T. R. Loughlin, ed.) Marine Mammals and The Exxon Valdez. Academic Press. N.Y. 243-256.

Dahlheim, M. E., D. E. Bain, and J. M. Waite. 1994. Recovery monitoring of Prince William Sound killer whales injured by the Exxon Valdez oil spill using photo-identification techniques. I.D. Number: Marine Mammals Study Project No. 93042. 12pp.

Norberg, B. and D. E. Bain. 1994. Implementation and assessment of the acoustic barrier at the Hiram M. Chittenden Locks using calibrated measurements of the sound field. National Marine Fisheries Service. Seattle, WA. 238 pp.

Bain, D. E. 1993. Research on captive killer whales--what's been accomplished and what remains to be learned. Proc. 1991 Int. Marine Animal Trainers Assoc. Conf. 1-6.

Bain, D. E. 1993. Sound production by a neonatal Dall's porpoise, *Phocoenoides dalli*. Proc. 1988 Int. Marine Animal Trainers Assoc. Conf. 62-69.

Bain, D. E., B. Kriete, and M. E. Dahlheim. 1993. Hearing abilities of killer whales (*Orcinus orca*). J. Acoust. Soc. Amer. 94:1829

Bain, D. E. 1992. Multi-scale communication by vertebrates. In (J. A. Thomas, R. A. Kastelein, and A. Ya. Supin, eds.) Marine Mammal Sensory Systems. Plenum Press. New York. 601-629.

Bain, D. E. 1992. Hearing abilities of killer whales (*Orcinus orca*). National Marine Mammal Laboratory Contract Report #43ABNF002499 and #43ABNF002500. 20 pp.

Davis, R. O., D. E. Bain, R. J. Siemers, D. M. Thal, J. B. Andrew and C. G. Gravance. 1992.

Accuracy and precision of the CellForm-Human automated sperm morphometry instrument. Fertil. Steril. 58:763-769.

Bain, D. E. 1990. Examining the validity of inferences drawn from photo-identification data, with special reference to studies of the killer whale (*Orcinus orca*) in British Columbia. In (P.S. Hammond, S. A. Mizroch and G. P. Donovan, eds.) Individual Recognition of Cetaceans: Use of Photo-identification and Other Techniques to Estimate Population Parameters. International Whaling Commission. Special Issue 12:93-100.

Bain, D. E. 1990. Conducting Research on show animals--a scientists perspective. Proc. 1989 Int. Mar. Anim. Trainers Assoc. Conf. 128-133.

Bain, D. E. 1990. The cutest whale I ever saw was sipping fish shakes through a straw. Proc. 1989 Int. Mar. Anim. Trainers Assoc. Conf. 68.

Davis, R. O., D. E. Bain, M. F. Obasaju, J. B. Andrew, and D. F. Katz. 1990. Computerized morphometric analysis and classification of human spermatazoa. J. Androl Suppl. 11:26.

Bain, D. E. 1988. An evaluation of evolutionary processes: studies of natural selection, dispersal, and cultural evolution in killer whales (*Orcinus orca*). Ph.D. Dissertation. University of California, Santa Cruz.

Bain, D. E. 1988. A journey through the NMFS Marine Mammal Inventory. Proc. 1987 Int. Mar. Anim. Trainers Assoc. Conf. 103-130.

Bain, D. E. 1986. Acoustic behavior of *Orcinus*: periodicity, sequences, correlations with behavior, and an automated technique for call classification. In (B. Kirkevold and J. Lockard, eds.) Behavioral Biology of Killer Whales. Liss. New York. 335-371.

Bain, D. and R. Smolker. 1986. Incidental takes--taken for granted? Soundings. 11(2):3.

Bain, D. E. 1985. Orca studies at the University of California, Santa Cruz. Cetus 6:18.

Bain, D. E. 1983. Concurrent rehabilitation of three stranded dolphins: implications for captive cetacean health care. Proc. Ninth Annu. Conf. IMATA. 9-17.

SELECTED UNPUBLISHED PRESENTATIONS

Bain, D. E. 2003. A quantitative estimate of the relative importance of factors in the decline of Southern Resident Killer Whales (*Orcinus orca*). Abstract submitted to the 15th Biennial Conference on the Biology of Marine Mammals. Greensboro, NC.

Bain, D. E., A. Trites and R. Williams. 2001. Energy flux as a mechanism for estimating population scale effects of "minor" disturbance from noise and other human activities. Abstract submitted to the Society for Marine Mammalogy Conference. Vancouver, BC.

Duncan, S., M. Dougherty, J. King, D. Bain and S. Hawks-Johnson. 2001. The application of an unmanned vessel to killer whale and other cetacean research. Abstract submitted the Society for Marine Mammalogy Conference. Vancouver, BC.

Wade, P. R., K. C. Balcomb, and D. E. Bain. 2001. Population dynamics of southern resident killer whales, with an examination of the recent decline. Abstract submitted the Society for Marine Mammalogy Conference. Vancouver, BC.

Dahlheim, M., H. Braham, S. Moore, K. Stafford, C. Fox and D. Bain. 1996. Acoustic detection of large whales. Abstract submitted to the Mexican Marine Mammal Conference.

Moore, S. E., K. M. Stafford, D. E. Bain, M. E. Dahlheim, C. G. Fox and H. W. Braham. 1996. Development of passive acoustic techniques to investigate large whale habitat use in the Eastern North Pacific. Abstract submitted to the IWC Climate Change Symposium.

Bain, D. E. 1995. Non-kin association patterns of killer whales (*Orcinus orca*). Paper presented to the International Ethological Conference. Honolulu, HA.

Bain, D. E. 1995. The role of communication in a predator-prey system. Paper presented to the Animal Behavior Society Conference. Lincoln, NE.

Bain, D. E. 1995. Breathing patterns and health: a place for chaos theory? Poster presented to the International Marine Animal Trainers Association Conference. Las Vegas, NV.

Bain, D. E. 1995. The use of sound to guide killer whales (*Orcinus orca*) entrapped in Barnes Lake, Alaska, to open water. Poster presented to the Society for Marine Mammalogy Conference. Orlando, FL.

Szymanski, M. D., A. Ya. Supin, D. E. Bain and K. R. Henry. 1995. The killer whale (*Orcinus orca*) auditory system assessed with evoked potentials: click rates and audiograms. Paper presented to the Society for Marine Mammalogy. Orlando, FL.

Bain, D. E., and J. Olhiser. 1994. Factors affecting food intake of killer whales and dolphins. Paper presented to the International Marine Animal Trainers Association Conference. Tacoma, WA.

Bain, D. E., M. E. Dahlheim, C. G. Fox, R. V. Miller, and H. W. Braham. 1993. North Pacific fixed hydrophone arrays: assessing temporal and spatial movements of whales. Poster presented to The Oceanography Society Conference, Seattle, WA.

Miller, P. J. and D. E. Bain. 1993. Dialect development in *Orcinus orca*. Poster presented to the Society for Marine Mammalogy. Galveston, TX.

Bain, D. E. 1991. Geometry for the informed school. Paper presented to the Society for Marine Mammalogy. Chicago, IL.

Bain, D. E. 1991. Natural history of killer whales. Paper presented to the Biology Colloquium. Sonoma State Univ.

Bain, D. E. 1991. Vocal learning in killer whales. Paper presented to the Animal Behavior Society. Wilmington, NC.

Bain, D. E. 1990. Dispersal patterns in killer whales (*Orcinus orca*). Paper presented to the Animal Behavior Society. New York.

Bain, D. E. 1990. On the design of hydrophone arrays for localizing the underwater sounds of killer whales (*Orcinus orca*). Paper presented to the Third Orca Symposium. Victoria, B. C.

Bain, D. E. 1989. Dispersal patterns in birds and mammals: insights gained through studies of the killer whale (*Orcinus orca*). Poster presented to the Society for Marine Mammalogy Conference. Pacific Grove, CA.

Kriete, B. and D. E. Bain. 1989. Why are there balloons on the whales, or how to determine food requirements of captive killer whales. Paper presented to the 1989 IMATA Conf. Amsterdam.

Bain, D. E. 1988. Socioecology of killer whales (*Orcinus orca*). Poster presented to the Evolution and Human Behavior Conference. Ann Arbor, MI.

Bain, D. E. 1988. How breathing patterns reflect health of cetaceans. Paper presented to the Western Regional Conference of the AAZPA. Monterey.

Bain, D. E. 1987. Observational methods for assessing relatedness in killer whales, *Orcinus orca*. Poster presented to the Seventh Biennial Conference on the Biology of Marine Mammals. Miami. 3.

Cranford, T. W., M. Amundin and D. E. Bain. 1987. A unified hypothesis for odontocete click production. Paper presented to the Seventh Biennial Conference on the Biology of Marine Mammals. Miami. 14.

Bain, D. E. 1987. Biology of killer whales (*Orcinus orca*) in captivity and the wild. Paper presented to the IMATA Conf. New Orleans.

Bain, D. E. 1987. The effects of incidental takes, directed takes, and habitat degradation on cetaceans. Poster presented to the IMATA Conf. New Orleans.

Bain, D. E. 1985. A method for assessing the similarity of vocalizations and morphology of killer whales (*Orcinus orca*). Presentation to the Sixth Biennial Conf. on the Biology of Marine Mammals. Vancouver. 11.

Bain, D. E. 1984. Acoustical behavior of killer whales (*Orcinus orca*). Presentation to the Pacific Division of the American Association for the Advancement of Science. San Francisco.

Bain, D. and S. Allen. 1982. Interactions of a killer whale from Iceland with one from Northern Vancouver Island. Paper Presented to IMATA Conf. Honolulu.

Ray, R. D. and D. Bain. 1981. Behavioral contributions to psychomatic health diagnostics in captive marine mammals. Presentation to the Fourth Biennial Conf. Biology of Marine Mammals. San Francisco. 97.

JAMES C. HA

CURRICULUM VITA

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Education

1980 B.A. Biology cum laude, Millersville University, Millersville, PA.

1983 M.A. Biology, Wake Forest University, Winston-Salem, NC.
Thesis title: Food Supply And Home Range In The Fox Squirrel (Sciurus niger).

Ph.D. Zoology (Behavioral Ecology), Colorado State University, Fort Collins, CO.
Dissertation title: The Effects Of Time And Metabolic Requirement On Foraging Behavior Of Captive Gray Jays.

Professional Experience

1982-1983 Research assistant, Wake Forest University.

Fall 1983-Spring 1988 Teaching assistant, Department of Zoology/Biology, Colorado State University. Courses taught: Mammalogy, Vertebrate Biology.

Summers 1984-1987 Instructor in computer science, Larimer County Vocational- Technical Center, Colorado. Courses taught: Introductory BASIC Programming, Introduction to LOTUS 1-2- 3, Computer Literacy.

Spring 1986 Instructor for Vertebrate Biology, Zoology Department, Colorado State University.

Fall 1988-Spring 1989 Instructor for Principles of Animal Biology (freshman majors/non-majors lab course), Biology Department, Colorado State University

Fall 1989-Fall 1990 Temporary Assistant Professor for Principles of Animal Biology (all semesters), Vertebrate Biology (fall), and Graduate Seminar in Behavior: Evolution of Social Systems and Behavior (spring), Biology Department, Colorado State University.

1990-1992 Research Scientist III, University of Washington Regional Primate Research Center.

1991-1992 Lecturer, Psychology Department, University of Washington, Seattle.

1992-1999 Research Assistant Professor, Department of Psychology, University of Washington.

- 1993-present Research Affiliate, Child Development and Mental Retardation Center, University of Washington.

1996, 1998 Visiting Scientist, Population Genetics Laboratory, Southwest Foundation for Biomedical Research, San Antonio TX.

- 1999-present Research Associate Professor, Department of Psychology, University of Washington.
- 2001-present Data Management Supervisor, Infant Primate Research Laboratory, University of Washington.
- 2004 Credentialed as a Certified Applied Animal Behaviorist by the Animal Behavior Society (www.animalbehavior.org)

Scientific Publications

Zegers, D.A. and J.C. Ha. 1981. Niche separation of Peromyscus leucopus and Blarina brevicauda. J. Mammal. 62:199-201.

Farley, S.D., J. Ha and P. Lehner. 1988. An inexpensive microcomputer and interface for control and data acquisition in the operant arena. Physiological Ecology Section Newsletter, Ecological Society of America. 1:4-6.

Ha, J.C., P.N. Lehner and S.D. Farley. 1990. Risk-prone foraging behavior in captive gray jays (Perisoreus canadensis). Anim. Behav. 39:91-96.

Weigl, P.D., L. Sherman-Jones, M.A. Steele, J.C. Ha and T. Sharpe. 1990. The ecology of the fox squirrel (Sciurus niger) in North Carolina: implications for survival in the southeast. Bull. Tall Timbers Res. Sta. 24:1-93.

Ha, J.C. and P.N. Lehner. 1990. Notes on gray jay demographics in Colorado. Wilson Bull. 102:698-702.

Ha, J.C. 1991. Risk-sensitive foraging: the role of ambient temperature and foraging time. Anim. Behav. 41:528-529.

Luhring, K.A., J.C. Ha and P.N. Lehner. 1992. Agonistic displays of the gray jay (Perisoreus canadensis): a comparison with other corvids. Northwestern Naturalist 73:22- 24.

Kimpo, C., J. Ha, S. Sulzbacher, and H. Ochs. 1994. The analysis of incomplete longitudinal data sets. Clinical Research 42:107A.

Ha, J.C., C. Nosbisch, J.D. Unadkat, S.H. Conrad, G.C. Ruppenthal, G.P. Sackett, and J. Abkowitz. 1994. Fetal toxicity of zidovudine (azidothymidine) in Macaca nemestrina: preliminary observations. Journal of A.I.D.S. 7:154-157.

Kimpo, C., J. Ha, G. Sackett, and H. Ochs. 1994. Developmental effects of prenatal exposure to SIV and HIV virus in infant pig-tailed macaques (Macaca nemestrina) and HIV exposure in human subjects. J. Medical Primatology 23:256.

Robinette, R., J. Ha, C. Kimpo, and G. Sackett. 1995. Gross motor development in infant Macaca nemestrina using a new climbing apparatus. Amer. J. Primatology 35:319-326.

Conrad, S., J.C. Ha, C. Lohr, and G. Sackett. 1995. Ultrasonic assessment of fetal growth in the pigtailed macaque (Macaca nemestrina). Amer. J. Primatology 36:15-35.

Ha, J.C. 1996. Microcomputers: an overview for ethologists. In: Lehner, P.N. Handbook of Ethological Methods. Cambridge University Press, NY. 512 pp.

Ha, J.C. 1996. Book review: Alpha Males: An Early History of the Regional Primate Research Centers, by W.R. Dukelow. Animal Behaviour 52:1059-1060.

Knapp, L.A., J.C. Ha, and G.P. Sackett. 1996. Parental MHC antigen sharing and pregnancy wastage in captive pigtailed macaques. J. Reproductive Immunology 32:73-88.

Ha, J.C., C.L. Kimpo and G.P. Sackett. 1997. Multiple-spell discrete-time survival analysis of

developmental data: object concept in pigtailed macaques. Developmental Psychology 33:1054-1059.

Robinette, R.L. and J.C. Ha. 1997. The significance of fishing behavior by Northwestern crows. Wilson Bulletin 109:748-749.

Unis, A.S., M.D. Roberson, R. Robinette, J.C. Ha and D.M. Dorsa. 1998. Ontogeny of human forebrain dopamine receptors: I. Differential expression of [3H]-SCH23390 and [3H]-YM09151-2 specific binding. Developmental Brain Research 106:109-117.

Ha, J.C., C. Nosbisch, J.L. Abkowitz, S.H. Conrad, N.K. Mottet, G.C. Ruppenthal, R. Robinette, G.P. Sackett, and J.D. Unadkat. 1998. Fetal, infant, and maternal toxicity of zidovudine (azidothymidine) administered throughout pregnancy in Macaca nemestrina. Journal of Acquired Immune Deficiency Syndrome and Human Retrovirology 18:27-38.

Heath-Lange, S., J.C. Ha and G.P. Sackett. 1999. Behavioral measurement of temperament in male nursery-raised infant macaques and baboons. American Journal of Primatology 47:43-50.

Ha, J.C., R.L. Robinette and G.P. Sackett. 1999. Social housing and pregnancy outcome in captive pigtailed macaques. American Journal of Primatology 47:153-163.

Ha, J.C., R.L. Robinette, and A. Davis. 2000. Survival and reproduction in the first two years following a large-scale primate colony move and social reorganization. American Journal of Primatology 50:131-138.

Robinette, R.L. and J.C. Ha. 2000. Beach-foraging behavior of Northwestern crows as a function of tide height. Northwestern Naturalist 81:18-21.

Nair, S., J.C. Ha and J. Rogers. 2000. Nineteen new microsatellite DNA polymorphisms in pigtailed macaques (Macaca nemestrina). Primates 41:343-350.

Ha, J.C., R.L. Robinette, and G.P. Sackett. 2000. A demographic analysis of the Washington Regional Primate Research Center pigtailed macaque colony, 1962-1997. American Journal of Primatology 52: 187-198.

Robinette, R.L. and J.C. Ha. 2001. Social and ecological factors influencing vigilance by Northwestern crows (Corvus caurinus). Animal Behaviour 62:447-452.

Ha, J.C., R.L. Robinette, L. Almasy, and B. Dyke. 2002. Heritability of birthweight in pigtailed macaque monkeys. American Journal of Primatology 56:207-213.

Robinette, R.L., P. Bentzen, J.L. Marsh and J.C. Ha. 2003. Kin discrimination in food stealing by Northwestern Crows (*Corvus caurinus*). Bird Behavior 15: 65-75.

Ha, R.R. and J.C. Ha. 2003. Effects of ecology and prey characteristics on the use of alternative social foraging tactics in crow. Animal Behaviour 66: 309-316.

Papers Submitted

Publications in Preparation: These are papers for which complete manuscripts are undergoing in-house editorial revision before submission. This list does not include data for which no manuscript has been prepared.

Hinde, K., J.C. Ha, and L. Newell-Morris. Spontaneous abortion as a reproductive strategy in captive macaques of compromised maternal condition.

Gray, J. and J.C. Ha. Black-White Discrimination and Hamilton Search Learning in Infant Pigtailed Macaque Monkeys.

Marsh, J.A. and J.C. Ha. Historical analysis of association patterns in southern resident killer whales (Orcinus orca).

Ha, S.J. and J.C. Ha. Geographic differences in call structure among Pacific Northwest crow populations.

Books

Ha, R.L. and J.C. Ha. In preparation. Integrative Statistics for Behavior Science. McGraw-Hill, Inc.

Scientific Presentations: Invited Paper Presentations

Ha, J.C. Preliminary Analysis of the WaRPRC Nemestrina Colony. AAAG/SFBR Workshop on Anthropological and Primate Genetics, Southwest Foundation for Biomedical Research, San Antonio TX, November 1998.

Ha, J.C., B. Dyke, and G.P. Sackett. Heritability of behavioral milestones in infant pigtailed macaque monkeys. Annual meeting of the Behavior Genetics Association, Vancouver Canada, July 4-7, 1999.

Scientific Presentations: Contributed Meeting Presentations

Zegers, D.A. and J.C. Ha. 1980. Niche separation of Peromyscus leucopus and Blarina brevicauda. Annual meeting of the American Society of Mammalogists, June 8-12, 1980.

Ha, J.C. and P.D. Weigl. 1981. The southeastern fox squirrel - unknown and endangered? Annual meeting of the American Society of Mammalogists, June 7- 11, 1981.

Weigl, P.D., P. Williams and J.C. Ha. 1981. Body size as an adaptive strategy in the fox squirrel (Sciurus niger). Annual meeting of the American Society of Mammalogists, June 7-11, 1981.

Weigl, P.D. and J.C. Ha. 1982. Comparative ecology of eastern and western populations of the fox squirrel (Sciurus niger). Annual meeting of the Ecological Society of America, August 8-12, 1982.

Ha, J.C., P.D. Weigl and T. Sharpe. 1983. Food availability and home range in the fox squirrel (Sciurus niger). Annual meeting of the American Society of Mammalogists, June 19-23, 1983.

Ha, J.C., S.D. Farley and P.N. Lehner. 1987. Gray jay (Perisoreus canadensis) responses to changes in food density within a closed economy laboratory simulation: temporal patterns and risk sensitivity. Annual meeting of the Animal Behavior Society, June 21-26, 1987.

Arguello, S.H. and J.C. Ha. 1987. EVENT: Inexpensive microcomputer recording of rapidly changing, simultaneous observation data. Annual meeting of the Animal Behavior Society, June 21-26, 1987.

Ha, J.C. 1988. Foraging behavior in captive gray jays (Perisoreus canadensis): response to altered foraging time and metabolic requirements. Annual meeting of the Animal Behavior Society, August 7-12, 1988.

Luhring, K.A., P.N. Lehner and J.C. Ha. 1988. Agonistic behavior in gray jays (Perisoreus canadensis): a comparison to other corvids. Annual meeting of the Animal Behavior Society, August 7-12, 1988.

Ha, J.C. and P.N. Lehner. 1990. Survivorship, movements, and group composition of gray jays in Colorado. Annual meeting of the Animal Behavior Society, June 11- 15, 1990.

Ha, J.C. and A. Cepaitis. 1991. The role of harmonic and arithmetic means in risk- sensitive foraging by gray jays (Perisoreus canadensis). Annual meeting of the Animal Behavior Society, June 1-6, 1991.

Ha, J.C. and G.P. Sackett. 1992. Paternal and nonpaternal male influences on pregnancy outcome in captive pigtail macaque monkeys (Macaca nemestrina). Annual meeting of the Animal Behavior Society, June 13-18, 1992.

Ha, J., R. Robinette, C. Kimpo, and G. Sackett. 1992. The climbing tube: a new measure of motor control in infant pig-tailed macaques. Annual meeting of the American Society of Primatologists, June 19-21, 1992.

Nosbisch, C., J.D. Unadkat, J.C. Ha, S.H. Conrad, G.C. Ruppenthal, and G.P. Sackett. 1992. Fetal toxicity of zidovudine. VIII International Conference on AIDS, July 19-24, 1992.

Bowden, D., M. Agy, D. Anderson, C. Kimpo, J. Ha, G. Sackett *et al*. 1993. Neurobehavioral AIDS induced by SIV_{Mne} or HIV-1 in infant pig-tailed macaques (Macaca nemestrina). IX International Conference on AIDS, June 7-11, 1993.

Novak, M.F.S.X., J.C. Ha, and G.P. Sackett. 1993. Heritability and captive breeding effects on physical and psychological traits of infant pigtailed macaques. Annual meeting of the Animal Behavior Society, July 25-29, 1993.

Kimpo, C.L. and J.C. Ha. 1993. The effects of nursery-rearing on the social behavior of immature captive baboons. Annual meeting of the Animal Behavior Society, July 25-29, 1993.

Heath, S., J. Lockard, J. Ha, and R. Farrow. 1993. Puzzle solving abilities in captive long-tailed macaques: pregnancy and drug treatment effects. Annual meeting of the American Society of Primatologists, August 18-22, 1993.

Novak, M.F.S.X., J.C. Ha, G.C. Ruppenthal, G.P. Sackett. 1994. Rearing infant monkeys in pairs: rotating partners. Annual meeting of the Animal Behavior Society, July 23-28, 1994.

Heath, S. and J.C. Ha. 1994. Behavioral measurement of temperment in nursery-raised infant macaques and baboons. Annual meeting of the Animal Behavior Society, July 23-28, 1994.

Lange, S.K., C. Kimpo, J. Kimpo, K. Morris, and J.C. Ha. 1994. Habitat selection and home range of mountain beaver (Aplodontia rufa). Annual meeting of the Animal Behavior Society, July 23-28, 1994.

Robinette, R., J.C. Ha, and G.P Sackett. 1994. Social contact with pregnant females affects pregnancy outcome in captive pigtail macaque monkeys. Annual meeting of the Animal Behavior Society, July 23-28, 1994.

Sackett, G.P. and J.C. Ha. 1994. Life span ponderal growth in captive M. nemestrina. XVth Congress of the International Primatological Society, August 3-8 1994.

Morris, K., C. Kimpo, G. Morris, and J.C. Ha. 1995. The influence of proximity to humans on population density and home range size of mountain beaver (Aplodontia rufa). Annual meeting of the Society for Northwestern Vertebrate Biology, March 1995.

Ha, J.C. and S.J. Ha. 1995. Significant differences in call structure among Pacific Northwest crow

populations. Annual meeting of the Animal Behavior Society, July 8-13, 1995.

Robinette, R. and J.C. Ha. 1995. Beach foraging behavior of American crows as a function of tide height. Annual meeting of the Animal Behavior Society, July 8-13, 1995.

Kimpo, C., J.C. Ha and G. Sackett. 1995. Object concept in pigtailed macaques. Annual meeting of the Animal Behavior Society, July 8-13, 1995.

Robinette, R. and J.C. Ha. 1996. The relationship between tide height, prey density, foraging efficiency in beach-foraging American crows. Annual meeting of the Animal Behavior Society, August 3-9, 1996.

Sackett, G.P. and J.C. Ha. 1996. Multiple spell survival analysis as a method for studying low rate behaviors over sessions. Int'l Conference on Measuring Behavior, Netherlands, October 14-18, 1996.

Kroeker, R., J.C. Ha, and G.P. Sackett. 1997. Analysis of neurobehavioral assessments in pig-tailed macaques using survival methods. Society for Research in Child Development, Washington D.C., April 1997.

Ha, J.C. and R.L. Robinette. 1997. Beach foraging crows I: Ecological and behavioral determinants of patch departure. Annual meeting of the Animal Behavior Society, June 21-26, 1997.

Robinette, R.L. and J.C. Ha. 1997. Beach foraging crows II: Social foraging. Annual meeting of the Animal Behavior Society, June 21-26, 1997.

Robinette, R.L. and J.C. Ha. 1998. Evidence for multiple factors influencing vigilance. Annual meeting of the Animal Behavior Society, July 18-22, 1998.

Robinette, R.L. and J.C. Ha. 1998. Successful scrounging by beach-foraging Northwestern Crows (Corvus caurinus). Foraging/98: Nervous Systems to Ecosystems, July 21-24, 1998.

Ha, J.C. and R. Jacobs. 1999. Visitor effects on the behavior of two captive jaguars. Annual meeting of the Animal Behavior Society, June 26-30, 1999.

Nicholson, T.M., J.S. Lockard, J.C. Ha, C.G. Walker-Gelatt, and M.F.S.X. Novak. 1999. Initation and reciprocation as a function of group composition in laboratory-reared infant Macaca nemestrina. Annual meeting of the American Society of Primatologists, August 12-16, 1999.

Ha, J.C., R. Robinette Ha, and B. Dyke. 2002. Heritability of physical, cognitive, and social development in infant pigtailed macque monkeys. Annual meeting of the Animal Behavior Society, July 13-17, 2002.

Marsh, J.A. and J.C. Ha. 2003. Historical analysis of association patterns in southern resident killer whales (Orcinus orca). Annual meeting of the Animal Behavior Society, July 19-23, 2003.

Skypeck, V.K., L. Newell-Morris, and J.C. Ha. 2003. Epidemiology of high birth weight in the pigtailed macaque (Macaca nemestrina). Annual meeting of the American Society of Primatologists, July 31-Aug 3, 2003.

Bentson, K.L., C.M. Crockett, and J.C. Ha. 2003. A rapid home cage procedure for assessing individual and group differences in behavioral reactivity of monkeys. Annual meeting of the American Society of Primatologists, July 31-Aug 3, 2003.

Bentson, K.L., C.M. Crockett, H.B. Montgomery, and J.C. Ha. 2004. Cage level has little effect on behavior of macaques (M. fascicularis, M. nemestrina, and M. mulatta). Annual meeting of the American Society of Primatologists, June 8-12, 2004.

Scientific Presentations: Seminars and Invited Lectures

Why Mice Climb Trees, or Niche separation of Peromyscus leucopus and Blarina brevicauda. Departmental seminar, Biology Dept., Millersville University. November 1979.

Home Range and Food Supply in the Southeastern Fox Squirrel. Departmental seminar, Biology Dept., Wake Forest University. Spring 1983.

Searching Biological Literature by Computer: A Workshop. Departmental seminar, Zoology Dept., Colorado State University. December 1986.

How to Search 19 Years of Literature in 10 Minutes. Departmental seminar, Fisheries and Wildlife Biology Dept., Colorado State University. March 1988.

Measurement of Physiological Stress in Free-Ranging Animals. Workshop on Aircraft/Wildlife Interactions. U.S. Fish and Wildlife Service and U.S. Air Force, Estes Park, CO 12 April 1988.

The Effects of Foraging Time and Metabolic Requirements on Foraging Behavior and Metabolic Rate of Captive Gray Jays (Perisoreus canadensis). Departmental seminar, Biology Dept., Colorado State University. April 1989.

Gray Jays: Field Biology and Animal Behavior. Public lecture: Colorado Department of Parks and Recreation, Colorado State Forest. 14 July 1990.

Guest lecturer, Animal Behavior Course. Biology Dept., Colorado State University. 1987, 1988, 1989.

Guest lecturer, Ethological Methods Course. Biology Dept., Colorado State University. 1988, 1990.

Thermoregulation and Behavior of Gray Jays: Past, Present, and Future Studies. Guest lecture, Comparative Physiology Course. Biology Dept., Colorado State University. September 1989.

Guest lecturer, Vertebrate Biology Course. Biology Dept., Colorado State University. February 1990.

Guest lecturer, Psychology as a Natural Science Course. Psychology Dept., University of Washington. 1992, 1993.

Guest lecturer, Developmental Psychology Seminar. Psychology Dept., University of Washington. 1991, 1992, 1993, 1994, 1995, 1996, 1998, 2000.

Guest lecturer, Methods of Data Analysis Workshop Series. Child Development and Mental Retardation Center, University of Washington. 1992.

Guest lecturer, Statistical Methods in Longitudinal Research Course. Psychology Dept., University of Washington. 1993, 1994, 1995, 1997, 1999, 2000, 2002.

Ecology of the Gray Jay in the Rockies. Invited Seminar, Biology Department, Millersville University, Fall 1993.

Infant Primate Research Laboratory: Ethology and Psychology. Invited Seminar, Biology Department, Millersville University, Fall 1993.

Invited workshop participant: Methods in Genetic Epidemiological Analysis, Southwest Foundation for Biomedical Research, San Antonio TX, October 1995.

Guest lecturer, Comparative Animal Behavior. Psychology Department, University of Washington. Summer 1996.

Social Housing and Pregnancy Outcome in Captive Pigtailed Macaques. Invited seminar, UW Regional Primate Research Center, August 1998.

Social Housing and Pregnancy Outcome in Captive Pigtailed Macaques. Invited seminar, UW Psychology Department, August 1998.

Recent Research on the Northwestern(?) Crow: Foraging, Acoustics, and DNA. Meeting of the

Washington Ornithological Society, March 1999.

The Social Behavior of Highly Cognitive Animals: Examples from Crows, Monkeys, and Orca Whales. Invited seminar, Laboratory of Ornithology, Cornell University, Ithaca NY, 30 October 2000.

Invited Workshop Participant: Colony Records Analysis. Southwest Regional Primate Research Center and National Institutes of Health (NCRR), Jan 12, 2001.

Invited Workshop Participant: Colony Records Analysis II. Jackson Laboratories and National Institutes of Health (NCRR), Jun, 2001

Heritability of Cognitive and Reflex Development in Infant Pigtailed Macaques: Preliminary Results and Future Directions. Invited seminar, Oregon National Primate Research Center, Beaverton OR, 24 September 2001.

Invited Workshop Participant: Ethoinformatics. Indiana University's Center for the Integrative Study of Animal Behavior and National Science Foundation, April, 2002.

The Social Behavior of Highly Cognitive Animals: Examples from Crows, Monkeys, and Orca Whales. Invited seminar, Department of Biology, Boise State University, Boise ID, 19 October 2002.

Chair of Workshop: Colony Records Analysis III. NIH-National Center for Research Resources, San Antonio, TX November 2002.

The Social Behavior of Highly Cognitive Animals: Examples from Crows, Monkeys, and Orca Whales. Invited seminar, Behavioral Ecology Institute, National University of Mexico, Mexico City Mexico, 14 December 2002.

Invited Workshop Participant: Ethoinformatics II. Cornell University's Laboratory of Ornithology and National Science Foundation, Feb 2003.

The Social Behavior of Highly Cognitive Animals: Examples from Crows, Monkeys, and Orca Whales. Invited course lecture, Animal Behavior course, North Seattle Community College, Seattle WA, 13 Mar 2003.

Invited Workshop Participant: National Marine Fisheries Service Review of Research Needs for Southern Resident Killer Whales: I, Whale-watching and II, Food Supply. Northwest Fisheries Research Center, May 2003.

Invited Workshop Participant: National Marine Fisheries Service Review of Research Needs for Southern Resident Killer Whales 2004. Northwest Fisheries Research Center, Jan 2004.

Social Behavior of Resident Inshore Killer Whales in the Pacific Northwest: Natural and Human Influences, Invited seminar, Psychology Department, New College of the University of South Florida, 17 Mar 2004.

Organizer and Chair of National Marine Fisheries Service workshop on Behavior Coding of Killer Whales, 20 April 2004.

Colony Records Analyses of the WaNPRC Pigtailed Macaque Colony, Invited lecture, Oregon National Primate Research Center, 5 May 2004.

The Sensory Systems of Sharks. Invited course lecture, Animal Behavior course, North Seattle Community College, Seattle WA, 9 Jun 2004.

The Social Behavior of Highly Cognitive Animals: Examples from Crows, Monkeys, and Orca Whales. Invited seminar, Biology Department, Millersville University of Pennsylvania, 21 Sep 2004.

Social Behavior of Resident Inshore Killer Whales in the Pacific Northwest: Natural and Human Influences, Invited seminar, Biology Department, Millersville University of Pennsylvania, 22 Sep 2004.

Co-Chair of Workshop: Colony Records Data-sharing Initiative. NIH-National Center for Research Resources, San Antonio, TX 1-4 November 2004.

Cat Behavior and Misbehavior, Invited talk, Seattle-King County Humane Society, 16 Nov 2004.

A Quick Introduction to the U.W. Infant Primate Research Laboratory, Invited lecture, Oregon National Primate Research Center, Animal Model of Gestational Diabetes Workshop, 6 December 2004.

The Sensory Systems of Sharks. Invited course lecture, Animal Behavior course, North Seattle Community College, Seattle WA, 11 Feb 2005.

Research Grants

1979 Research grant from Millersville University Alumni Foundation's Niemeyer Student Research Fund.

1980 Grant for travel expenses from Millersville University Alumni Foundation's Niemeyer Student Research Fund.

1984 Research grant: Harris and Eliza Kempner Foundation (with S.D. Farley) for "Risk-sensitive foraging by gray jays in a closed economy."

1987 Colorado Mountain Club Foundation Research Fellowship for "Foraging behavior in free-ranging gray jays."

1992, 1997, 2002 Active contributor to budget, drafting, submission, and review process for 5-year Regional Primate Research Center Core Grants, including development of new programs in both Basic and Colony Health-Related Research categories.

1997, 1998 Supervised grant-writing and award process for graduate student grants awarded to Renee Robinette from the Animal Behavior Society Research Grants Program and Sigma Xi.

2003 Active contributor to budget, drafting, submission, and review process for 5-year Center for Human Development and Disability Core Grant.

2003 Contract from Northwest Fisheries Research Center, NMFS: Proposal to the National Marine Fisheries Service, Northwest Fisheries Research Center: Social Behavior and Affiliation Patterns in Southern Resident Orca (Orcinus orca), $16,000.

2004 Contract from Northwest Fisheries Research Center, NMFS: Proposal to the National Marine Fisheries Service, Northwest Fisheries Research Center: Social Behavior and Affiliation Patterns in Southern Resident Orca (Orcinus orca): Year 2, $35,000.

2005 Co-PI, with Dr. Linda Jones (Northwest Fisheries Research Center, NOAA), Proposal to the National Marine Fisheries Service, Northwest Fisheries Research Center: Social Behavior and Affiliation Patterns in Southern Resident Orca (Orcinus orca): Year 3, $50,000.

2005 Co-PI, with Dr. Renee Ha, Contract from Division of Wildlife, Commonwealth of the Northern Mariana Islands, Proposal to Study the Decline of the Mariana Crow (*Corvus kubaryi*) and the Rota Bridled White-eye (*Zosterops rotensis*) on the Pacific Island of Rota, $271,000.

Honors and Awards

1980 Awarded undergraduate departmental honors. Thesis title: "Application of radiotelemetry to the study of the southern flying squirrel (Glaucomys volans).

1980 A.G. Breidenstine Award for excellence in undergraduate research, Millersville U.

1980-1982 Graduate academic scholarship: Wake Forest University.

1987 Teaching Fellowship Award for Excellence in Undergraduate Teaching: Colorado State University.

1997 Alpha Phi Sorority Faculty of the Year Award: University of Washington.

1998 Founders' Memorial Poster Award for "Evidence For Multiple Factors Influencing Vigilance." With R.L. Robinette, annual meeting of the Animal Behavior Society, July 18-22, 1998.

Societies

Animal Behavior Society
American Society of Primatologists
Association of Field Ornithologists
Sigma Xi (National Research Honor Society)

Service to Department

1982-83 Graduate student representative to faculty: Biology Dept., Wake Forest U.

1984-86 Member (1984), Chairman (1985): Colloquium in Life Sciences Committee, Zoology Department, Colorado State University.

1986-Spring 1989 Graduate student liaison to C.S.U. Morgan Libraries: Zoology/Biology Department, Colorado State University.

1987-1990 Implemented and maintained departmental account for computer bibliographical database access (BRS AfterDark, primarily Biological Abstracts), including presenting training seminars and workshops for faculty and students.

1989-1990 Computer and Statistics Consultant, Biology Department, Colorado State University. Resource person for microcomputer users in department. Statistics resource person for graduate students in Biology, Fisheries and Wildlife, and Psychology Departments.

1991-present Serve on various National Primate Research Center committees: Colony Modeling Committee, Animal Records System Committee, Breeding Colony Advisory Group, and IPRL New Computing Resources Committee. Currently serve on Animal Record System Advisory Committee.

1998-99 Served on annual review and renewal committee for Laura Little, Lecturer, Psychology Department

2000-2003 Appointed as Animal Behavior Area Representative, Graduate Training Committee, Psychology Department.
2000-2006 Elected Faculty Senator from Psychology Department

Service to Profession

1988-1996 Developed, maintained ABSnet, a professional electronic mail network.

- 1989-present Ad-hoc reviewer for Animal Behaviour

1990-1996 Appointed to Public Affairs Committee, Animal Behavior Society.

- 1991-present Ad-hoc reviewer for American Journal of Primatology

1991-1994 Appointed to Education Committee, American Society of Primatologists.
1992-1994 Local Host for 1994 Animal Behavior Society meeting at the University of Washington.
1995 Appointed to chair ad-hoc Conservation Committee, Animal Behavior Society.
1996-1997 Statistics advisor to Editorial Board of Animal Behaviour.
1996-1998 Appointed as first chair of Conservation Committee, Animal Behavior Society

- 1996-present Appointed as Internet/Web Site (ABSnet) Manager, Animal Behavior Society

1998-2001 Elected Member-at-Large, Executive Committee, Animal Behavior Society
1999 Ad-hoc reviewer (twice) for Natural Sciences and Engineering Research Council of Canada research proposals
2000 Ad-hoc reviewer for National Science Foundation
2001-2003 Elected Senior Program Officer, Executive Committee, Animal Behavior Society
2002 Member, National Science Foundation/Animal Behavior Program Doctoral Dissertation Improvement Grant Review Panel

- 2002-present Co-Chair National Institutes of Health/National Center for Research Resources Colony Records Analysis Working Group
- Local Host for 2005 Animal Behavior Society meeting: Snowbird Ski Resort, Utah.

2003 Member of four-person Animal Behavior Society Central Office site visit team

- Director of Animal Behavior Society's Central Office

Also occasional reviewer for International Journal of Primatology; Zoo Biology; Institute for Laboratory Animal Research; Behavioral Research Methods, Instruments, and Computers; Journal of Comparative Psychology

Other Professionally-related Activities

Author of EVENT-PC software for recording behavioral data by computer. EVENT-PC is currently being used at over 35 research facilities. Also authored SEQ-PC for sequential analysis of behavioral data. Author of several custom software packages for researchers in North and South America. In 2003, I developed a Palm PDA-based program for collecting behavioral data, now in use in 5 labs at the University of Washington, as well as 2 labs at Indiana University and at a Kenyan baboon research field site for UCLA.

Operate Animal Behavior Associates of Washington, a private clinical practice in applied animal behavior and the treatment of companion animal behavior problems. 1999-present.

Co-Founder of Companion Animal Behavior Connection, a local organization of accredited professional pet behavior specialists with the goal of providing educational resources and professional access to both local veterinarians and the public.

Collaborators

Publications with U Washington collaborators: Kimpo, C; Sackett, GP; Robinette, RL; Unis, AS; Roberson, MD; Dorsa, DM; Nosbisch, C; Abkowitz, JL; Conrad, SH; Mottet, NK; Ruppenthal, GC; Unadkat, JD; Heath-Lange, S; Davis, A; Novak, MFSX; Walker-Gelatt, CG; Bentzen, P; Kroeker, R; Jacobs, R; Nicholson, T; Lockard, JS.

Publications with Southwest Foundation for Biomedical Research collaborators: Nair, S; Rogers, J; Almasy, L; Dyke, B.

Graduate Advisors: Weigl, PD (Wake Forest U); Wunder, BA & Lehner, PN (Colorado State U)

Advisees: Kimpo, C; Robinette, RL; Hawks-Johnson, S; Marsh, JL; Skiver Thompson, R; Alloway, H

Jennifer A. Marsh

Department of Psychology
University of Washington
Box 351525
Seattle, WA 98195-1525

e-mail: jam3@u.washington.edu

ACADEMIC BACKGROUND

2001-present	Enrolled in Ph.D. program, Animal Behavior Area, Department of Psychology, University of Washington.
1997 – 2000	Master of Science, Interdisciplinary Studies, Animal Behavior, San Diego State University. Title: School characteristics and social affiliation patterns of California bottlenose dolphins (*Tursiops truncatus)*
1988–1992	Bachelor of Science, Biology, California Lutheran University

PROFESSIONAL EXPERIENCE

Fall 2001-Fall 2002	Teaching Assistant, Department of Psychology, University of Washington Courses: Fundamentals of Psychological Research (Psych 209), Animal Behavior (Psych 200)
Fall 2003	Teaching Assistant, Department of Psychology, University of Washington Course: Fundamentals of Psychological Research (Psych 209)
Fall 2004	Teaching Assistant, Department of Psychology, University of Washington Course: Fundamentals of Psychological Research (Psych 209)

RESEARCH SKILLS

1997-2000	Photo-identification of bottlenose dolphins, land-based behavioral data collection, boat driving/handling, research team management
2002-2004	Photo-identification of killer whales, boat-based behavioral data collection using Palm III *xe*, boat driving/handling, research team management

HONORS, GRANTS AND AWARDS

1988 Presidential Scholarship, California Lutheran University
1990 Thouren Biological Scholarship, California Lutheran University
2001 Humane Society of the United States Research Grant ($500)
2002 Cetacean Society International Research Grant ($500)
2002 Ford Foundation Predoctoral Fellowship for Minorities ($48,000)
2003 Bolles Fund University of Washington ($800)
2003 National Marine Fisheries Service grant for "Social Behavior and Affiliation Patterns in Southern Resident Killer Whales (*Orcinus orca*)" ($16,000) Total award period covered: 07/17/03 – 06/30/03
2004 National Marine Fisheries Service grant for "Social Behavior and Affiliation Patterns in Southern Resident Killer Whales (*Orcinus orca*)": Year 2, Competitive Renewal ($35,000)
2004 Sigma Xi Grants in Aid of Research, University of Washington ($500)

PAPERS

Ha, R. R., P. Bentzen, J. Marsh and J. C. Ha. (2002). Kinship and association in social foraging Northwest crows (*Corvus caurinus*). Bird Behavior 15: 65-75.

Marsh, J. A., D. W. Weller and R. H. Defran. In prep. Social affiliation patterns of Pacific Coast bottlenose dolphins (*Tursiops truncatus*).

UNPUBLISHED PRESENTATIONS

Marsh, J.A., D. W. Weller and R. H. Defran. 1999. School size, school composition, and social affiliation patterns in Pacific Coast bottlenose dolphins (*Tursiops truncatus*). Abstract submitted to the Society for Marine Mammalogy Conference. Maui, HI.

Marsh, J. A., and J. C. Ha. 2003. Historical patterns of affiliation in southern resident killer whales (*Orcinus orca*). Abstract submitted to the Animal Behavior Society Conference. Boise, ID.

AFFILIATIONS

Member, Animal Behavior Society
Member, American Cetacean Society

Member, Sigma Xi
Member, Society for Marine Mammalogy

J. Pete Schroeder, DVM
Marine Mammal Research Associates

E-mail jpsmmra@olypen.com

Education:
BS in Animal Husbandry, 1957, Iowa State University, Ames, Iowa
DVM, 1966, Iowa State University, Ames, Iowa

Personal Information:
Currently an active member of the Conservation Breeding Specialist Group of the Species Survival Commission of the World Conservation Union (IUCN) and has active contracts with NOAA Fisheries as a technical writer and consultant for The Southern Resident Killer Whale Conservation/Recovery Plan and the US Navy for necropsies related to strandings and possible sonar damage tostranded marine mammals.

Professional Memberships:
Charter Member, Society for Marine Mammalogy
American Association for Zoological Parks and Aquariums
Conservation Breeding Specialist Group, Species Survival Commission, IUCN
International Association for Aquatic Animal Medicine, President, 1989-1990

Community Service:
Olympic Coast National Marine Sanctuary Advisory Council, '96 – ' 01, Chair, 1998-2000
North Olympic Regional Fisheries Enhancement Group, board member, '92 – 03, Vice Chair, 1996-2003
Commissioner, Washington Department of Fish and Wildlife Commission, 2004 to 2005
Global Research and Rescue, www.grrescue.org, board member, 2003 to present
Washington Wildlife and Recreation Coalition, board member, 2005 to present

Professional Publications and Presentations:

- Author or co-author of 28 peer reviewed publications, (numerous citations)
- 13 reviewed proceedings papers
- 48 Abstracts
- 14 Scientific Sessions Chairperson
- 61 Scientific Presentations; many presentations to school and community groups
- Six book chapters
- The North American Regional Bottlenose Dolphin Stud Book, 1993

Complete list available upon request

Editorial service to Scientific Journals:

- Diseases of Aquatic Organisms
- Marine Mammal Science
- Marine Mammals: Public Display and Research

Selected Research Programs, Original Studies and Publications:

Marine Mammal diving physiology studies using a Weddell Seal in a diving chamber at UCLA Medical Center to study the pinniped diving response, exposing X-rays while simulating a deep dive.

- 1970, Kooyman, GL, JP Schroeder, DD Hammond, Bronchograms and tracheograms of seals under pressure, Science 169:82-84

United States Antarctic Research Program, National Science Foundation project at Palmer Station, Antarctica, 1971, reviewed in National Geographic, Vol 140. No. 5

- 1971, Kooyman, GL, JP Schroeder and DG Greene, Effects of deep dives on penguins and blue-eyed shags. Antarctic Jnl of the US, p 95

- 1972, Kooyman, GL, JP Schroeder and DG Greene, Blood gas tensions in penguins during simulated deep dives, American Jnl of Physiology, 222(6):1467-1470

Laboratory Animal Medicine:

- Obtained American Association for Laboratory Animal Science (AALAS) accreditation for the research facility at the Veterans Administration Medical Center, San Diego.

- Member of Animal Research Committee at the Veterans Administration Medical Center, San Diego '76-81, and Queens Medical Center, Honolulu Hawaii, '83-91.

- 1982, Dueck, R, JP Schroeder, *et al*., Carotid exteriorization for percutaneous catheterization in sheep and dogs. American Jnl of Veterinary Research, Vol 43, No. 5

- Diagnostic Pathology Laboratory Set-Up and Operation, Valdez Oil Spill, Sea Otter Recovery Center. March, April, 1989.

Marine Mammal Reproductive Physiology. Dr. Schroeder developed the first artificial insemination protocol for bottlenose dolphins.

- 1989, Schroeder, JP and KV Keller, Seasonality of serum testosterone levels and sperm density in *Tursiops truncatus*, Jnl of Experimental Zoology, 249:316-321

- 1990, Schroeder, JP, Breeding Bottlenose Dolphins in Captivity, in The Bottlenose Dolphin: Eds. S Leatherwood and R Reeves, Academic Press Inc.,

Pp. 435-446

- 1990, Schroeder, JP, Artificial Insemination of bottlenose dolphins, in The Bottlenose Dolphin: Eds. S Leatherwood and R Reeves, Academic Press, Inc.
  Pp. 447-460

Dr. Schroeder's Laboratory at Naval Ocean Systems Center, Kaneohe Marine Corp Air Station, Kaneohe Bay, HI, was the site of his Marine Mammal Health Research Program jointly funded by the Office Of Naval Research and SPAWARS. As program manager and principal investigator he managed an annual budget of $1,500,000. for research programs in marine mammal reproductive physiology and stress physiology from 1981 to 1991. Preventive medicine was highly emphasized and though he managed the largest herd of captive marine mammals in one place in the world, 66 animals, there was zero death loss from 1986 to 1991. His preventive medicine program, including training paradigms for complete physical examinations while the marine mammals remained in the water, was adopted as a regular training protocol for all US Navy marine mammals.

- 1985, Schroeder, *et al*., A Vibrio alginolyticus tissue infection in *Tursiops truncatus,* Jnl of Wildlife Diseases, 21(4):437-438

- 1991. Palmer, CJ, JP Schroeder, *et al*., Staphylococcus aureus in newly captured Pacific Bottlenose dolphins, *Tursiops truncatus, spp gilli.* Jnl of Zoo and Wildlife Medicine, 22(3): 330-338

Dr. Schroeder was a co-investigator in marine mammal ophthalmology achieving the first photographs of the inside of the bottlenose dolphin and grampus dolphin eye:

- 1987, Dawson, WW, and JP Schroeder, The ocular fundus of two cetaceans, Marine Mammal Science, 3(1): 1-13.

Dr. Schroeder was involved as consultant veterinarian for the capture of an orphaned baby Killer Whale (A73, Springer) in Puget sound during the summer of 2002, he was the lead veterinarian in charge of the 30 day rehabilitation period and consulting veterinarian on the release of A73 back to her pod in Johnstone Strait, BC, 400 miles north of her capture site. Her pod adopted her, confirmed by several sightings one and two years later. This is the only capture and reintroduction case of this type ever completed successfully and involved cooperation between the governments of the US and Canada.

- This project was reported to the International Association for Aquatic Animal Medicine Conference, 2003 Abstract, Rescue, Rehabilitation and Release of a Wild Orphaned Killer Whale (*Orcinus orca)* Calf in the Pacific Northwest.

- Dr. Schroeder has been involved in establishing stranding networks and performing rescues of stranded marine mammals throughout his career.

- 2004, Norman, S.A., R.C. Hobbs, J. Foster, J.P. Schroeder and F.I. Townsend, A review of animal and human health concerns during capture-release, handling and tagging of odontocetes. J. Cetacean Res. Management, 6(1):53-6

From 1987 to 1993, Dr Schroeder established a research and diagnostic laboratory for marine mammal health, an artificial insemination program and a Marine Mammal Conservation Program at Ocean Park in Hong Kong. Through this program he became involved with the Peoples Republic of China's attempt to prevent extinction of the baiji, a fresh water dolphin living in the Yangzi River. Dr Schroeder initiated a CBSG
Baiji Population and Habitat Viability Assessment Workshop at Nanjing Normal University in 1993. Efforts continue, but the Three Gorges Dam will mark baiji's end.

Dr Schroeder is currently involved in the Southern Resident Killer Whale Population Conservation/Recovery Plan as a Contract Technical Writer for NOAA Fisheries. He produced a scientific workshop on the effects of pollution and contamination on that population October 24, 2003, at the Seattle Aquarium. Continuing efforts include producing a literature review and paper on the issue of pollution and contamination in Puget Sound/Georgia Basin for the Conservation Plan, which has gone through NOAA Fisheries internal review. The draft will soon be out to the public for review, www.nwr.noaa.gov.

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Washington State University, work on post doctoral degree in comparative anatomy; Internship in Equine Medicine and Surgery 1979-1980

University of California, Davis, School of Veterinary Medicine, Doctor of Veterinary Medicine 1979, ranked in first quartile

University of California, San Diego, non-degree graduate school, teaching assistant in zoology and biology 1974-75

University of California, San Diego, Revelle College, Bachelor of Arts, in Biology (with emphasis on Biochemistry and Molecular Biology) 1974 with Honors

Dartmouth College, Hanover New Hampshire 1972-73

PROFESSIONAL EXPERIENCE:
November 2003 – March 2004, Part-time veterinarian, Los Angeles Zoo, Los Angeles, California

April 1997 – May 2003, Chief Staff Veterinarian, Six Flags Marine World, Vallejo, California

October 1980 - April 1997, Director of Veterinary Services, Marine World Africa USA (now Six Flags Marine World), Vallejo, California

January 1981 - December 1994, Director of Veterinary Services, The Marine Mammal Center, Sausalito, Calif.

Present Employment and Consulting Contracts

March 2004 – Present, Large Felid Specialist and Marine Mammal Advisor, United States Department of Agriculture

Sept 1981 – Present, Guest Lecturer at the UC Davis School of Veterinary Medicine

Sept 1998 – Present, Veterinary Consultant to Veterinary Information Network (vin.com)

August 2003 – Present, Contract with the Marine Mammal Conservation Division (Department of Commerce, NOAA, NMFS) to write the "NMFS Rehabilitation Facility Guidelines"

Past Employment and Consulting Experience
July 1990 – March 2004, Veterinarian for the Coyote Point Museum, San Mateo, CA

August 2003 – March 2004, Veterinary consultant to Safari West, Santa Rosa, CA

June 1982-March 2004, Northern California Veterinary Consultant to Circus Vargus

January 1995- 1999, Veterinary Consultant, The Marine Mammal Center, Sausalito, CA

February 1993 - August 1995, Veterinary Consultant to Safari World, Bangkok, Thailand

March 1985- 2001, Relief veterinarian, San Francisco Zoo

November 1990- 2001, Veterinary Consultant to The Duffey Company, San Francisco, CA.
November 1989 - 1995, Veterinary Consultant to Steinhart Aquarium, San Francisco, CA

March 1985- 2001, Veterinary Consultant to The Gorilla Foundation, Woodside, CA.

February 1986-June 1994, Veterinary Consultant to Marine Animal Productions, Gulfport, Mississippi

November 1988-1993, Veterinary Consultant to Environmental Science Associates, San Francisco, California

July 1980 - October 1980, Associate Veterinarian,
Dinnes Memorial Veterinary Hospital, Newhall, California.

June 1979 - June 1980, Internship in Equine Medicine and Surgery,
Washington State University, Pullman, Washington

INSTRUCTOR EXPERIENCE:
Supervised the externship program at Six Flags Marine World since 1981, offered to veterinary

students each year to gain experience working with captive exotic animals

Give multiple lectures each year to the students at the U.C. Davis School of Veterinary Medicine
"Captive Wild Animal Medicine" class lectures on marine mammal, elephant, and carnivore medicine and surgery to senior veterinary students
“Management of Captive Marine Mammals”, “Management of Captive Carnivores” and “Management of Captive Elephants” to the sophomore veterinary students and
“Form and Function” course lectures on marine mammals, elephants, and carnivores to the freshman veterinary students.

Give lectures every year to every other year on marine mammal medicine to Oregon State University School of Veterinary Medicine students, Corvallis, Oregon

PROFESSIONAL ORGANIZATIONS:
International Association of Aquatic Animal Medicine (IAAAM) President 2004 - 2005
American Veterinary Medical Association (AVMA)
American Association of Zoo Veterinarians (AAZV)
European Association for Aquatic Mammals (EAAM)

HONORS:
Phi Zeta Society

CURRENT VETERINARY LICENSE:
California

CONSTRUCTION RELATED EXPERIENCE:
- Developed design of Veterinary Clinic for Marine World Africa USA, 1984-85 and again in 1997-98
- Consultant on design of marine mammal and land animal facilities for Marine World Africa USA, 1984-85
- Served as the Consultant Veterinarian for the Environmental Science Associates to monitor the behavior of the animals at the San Francisco Zoo as a part of the compliance monitoring during the construction of the Oceanside Water Pollution Control Plant 1988 to 1992.
- Consultant to The Duffey Company and The San Francisco Zoo for the design and development of the San Francisco Zoo Infrastructure Replacement Project 1994 – Present

PAPERS PRESENTED TO PROFESSIONAL ORGANIZATIONS:

- Restraint and Anesthesia in Pinnipeds
- Care and Rehabilitation of a Beached Neonatal Harbor Porpoise

- Hand Rearing Pinniped Pups
- Hematological Values in Clinically Normal Rehabilitated Pinnipeds
- Common Medical Problems Encountered in Pinnipeds Admitted to the California Marine Mammal Center
- Cetacean Medicine
- Rescue and Rehabilitation of Stranded Cetaceans
- Skin Problems in Pinnipeds
- Moving Marine World Africa USA, How a Very Diverse Group of Land and Marine Mammals were Moved Successfully
- Dental Procedures in Exotic Animals
- Leptospirosis in California Sea Lions
- Training Medical Behaviors as an Aid to Medical Management of Captive Exotic Animals
- Convulsing Sea Lions off the Northern California Coast
- Rehabilitation Efforts for Two Neonatal Beaked Whales (Mesoplodon spp.)
- Methods of Moving a Stranded Humpback Whale (IAAAM, Marineland, FL, 1991)
- Treatment of Liver Disease in a Bottlenosed Dolphin (Tursiops truncatus) (IAAAM, Marineland, FL, 1991)
- Rehabilitation and Treatment Success Rate of California Sea Lions (Zalophus californianus) Stranded Along the Central and Northern California Coast, 1984-1990
- Advances in Anesthesia of Pinnipeds (IAAAM, Hong Kong, 1992)
- Common Medical Problems and Treatments of California Sea Lions Stranded in Northern California (IAAAM, Hong Kong, 1992)
- Transfusion of a Guadalupe Fur Seal (Arctocephalus townsendi) with California Sea Lion (Zalophus californianus) Blood
- Handrearing Northern Elephant Seal Pups (Mirounga angustirostris) (AAZV, Pittsburgh, PA, 1994)
- Removal of Infected Phalanges from an Asian Elephant (Elephus maximus) (AAZV, East Lansing, MI, 1995)
- Handrearing and Medical Management of Walrus Pups (AAZV, Puerto Vallarta, Mexico, 1996)
- Hydrocephalus in a California Sea Lion (Zalophus californianus) (EAAM, Algarve, Portugal, 1996)
- Minimizing Animal Problems Related to Constrution Projects In Or Adjacent To The Zoo (AZA, Monterey CA, 1997)
- Radiographic Techniques for the Elephant Foot and Carpus (AAZV, Houston, Texas, 1997)
- Instructor for the “Elephant Foot Care Workshop” at AAZV, Houston, Texas, 1997
- Cetacean Rescue and Rehabilitation (International Wildlife Rehabilitation Council 20th Annual Conference, Concord, CA, 1997)
- Aberrant Pox Lesions in Dolphins (IAAAM, Harderwijk, The Netherlands, 1997)

- Neoplasia in Aged Captive Pinnipeds (EAAM, Paris, France, 1999)
- Geriatric Medicine in Aged Captive Pinnipeds (IAAAM, Boston, MA, 1999)
- Diagnostics and Treatment of Severe Swelling of the Pharyngeal Tissues of an African Elephant (Loxodonta africana) (AAZV, Columbus, Ohio, 1999)
- Husbandry and Medical Considerations for Foot Care of Older Elephants (N. Amer. Conference on Elephant Foot Care, Portland, OR, 2000)
- Medical and Behavioral Management of Chronic Regurgitation in a Walrus (Odobenus rosmarus) (AAZV/IAAAM combined conference, New Orleans, LA, 2000)
- Prevention of Walrus Tusk Wear with Chromium Alloy Caps (IAAAM, Albufeira, Portugal, 2002)
- Serial Corneal Debridement for the Treatment of a Persistent Corneal Non-Healing Ulcer in a Trained California Sea Lion (Zalophus californianus) (IAAAM, Waikoloa, Hawaii, 2003)
- Dystocia in an African Elephant (Loxodonta africana) (AAZV, Minneapolis, MN 2003)
- Use of Buspirone to Manage Undesirable Behavior in Three Species of Carnivores (AAZV, Omaha, NE 2005)
- Best Practices – Ideas for Improving Big Cat Care (AAZV, Omaha, NE 2005)
- USDA Inspections of Commissaries and a Guide to Best Practices (AAZV, Omaha, NE 2005)

PUBLICATIONS:

Rantanen, N.W., Gage, L., and Paradis, M.R.: Ultrasonography as a diagnostic aid in pleural effusion of horses. Vet. Radiol., 1981

Dierauf, L.A., Vandenbroek, D., Koski, M., and Gage, L.J.: An epizootic of leptospirosis in California sea lions. J. Am.Vet. Med. Assoc. 187: 1145-1148, 1985

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Gage, L.J., Vandenabeele, S.I.J., and White, S.D.: Use of Hyposensitization Injections to Control Seasonal Pruritus in a Bactrian Camel (Camelus bactrianus) , J. Zoo and Wildlife Medicine 36(1) : 88-94, 2005

Gage, L.J. Use of Buspirone and Behavior to Manage Abberent Behavior in an American Badger (Taxidea taxus), J Zoo and Wildlife Medicine (in Press) 2005.

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IV. Proposal

A. Summary

This is an application to take killer whales (*Orcinus*) by harassment during five years of observational scientific research, for incidental takes of nearby marine mammals and endangered sea birds, and collection of remains of endangered species following killer whale predation. We will address several of the needs identified in the proposed Conservation Plan for Southern Resident Killer Whales, including effects of noise and other anthropogenic disturbances, distribution and movement patterns, diet and energetic requirements, reproduction and mortality patterns, health and disease, and social structure. Vessel-based and aerial observation, still and video photography (both in air and underwater), and culture of micro-organisms in exhalations will be employed. Work will be centered in the inland waters of Washington, and comparative data will be collected from Central California to Central Alaska. Takes of Southern Resident Killer Whales are estimated at 300 / yr. Takes of killer whales from non-listed populations are estimated at 100 / population / year. Other species likely to be taken incidentally include harbor, elephant, and northern fur seals, California and Steller sealions, Dall's and harbor porpoises, white-sided dolphins, minke, gray, fin and humpback whales, sea otters, and marbeled murrelets. Parts of endangered salmonids and marine mammals may be collected.

B. Introduction

1. Status of the Species

(50 CFR 216.34 (a), 216.36 (a), 222.308 (b))
(a) *Species Description*: List the species (common and scientific names) and, where applicable, the subspecies or population group(s) that may be taken.

The stocks to be taken are shown in Table 1.

Killer whales are the study species, and will be taken by Level B Harassment only. Other species shown in the table may be taken incidentally by Level B Harassment.

The species consist of the following unlisted species: Dall's porpoises (Phocoenoides dalli), harbor porpoises (Phocoena phocoena), minke whales (Balaenoptera acutorostrata), gray whales (Eschrichtius robustus), white-sided dolphins (Lagenorhynchus obliquidens), California sea lions (Zalophus californianus), elephant seals (Mirounga angustirostris) and harbor seals (Phoca vitulina). These species are found in proximity to killer whales and may be briefly disturbed as the research vessel passes them. Dall's porpoises and white-sided dolphins may bow-ride resulting in slightly longer behavioral changes.

The following species are listed under the Endangered Species Act: humpback whale (Megaptera novaeangliae), Steller sea lion (Eumetopias jubatus), and Southern sea otter

(Enhydra lutris nereis). Marbled murrelets (*Brachyramphus marmoratus*), a sea bird, and these species are found in proximity to killer whales and may be briefly disturbed as the research vessel passes them.

Fin whales (Balaenoptera physalus), which are listed under the Endangered Species Act, and northern fur seals, which are listed as depleted under the Marine Mammal Protection Act in Alaskan waters, are rarely found in proximity to killer whales, but do overlap in range sufficiently that it is likely that small numbers may be disturbed while the vessel is transiting the study area.

Other marine mammal species and listed birds occupy the study area, but we do not expect to take them incidentally to our work.

Species / Stock	ESA	MMPA	CITES	SARA	IUCN	Best	Min	Trend	Takes/yr
Killer Whale *Orcinus orca*									
ENPARS			II			>1123	1123	UNK	100
ENPNRS			II	T		216	216	UNK	100
ENPSRS	E	DS	II	E		83	83	DEC	300
GoAAIBSTS			II			>249	314	UNK	20
AT1		DS	II			8	8	DEC	0
WCT			II	T		>314	314	UNK	50
ENPOS			II	SC		466	361	UNK	50
Dall's Porpoise *Phocoenoides dalli*									
CA-OR-WA			II		LR	99,517	75,915	UNK	700
AK			II		LR	83,400	76,874	UNK	100
Porpoise *Phocoena phocoena*									
Morro Bay			II	SC	VU	1,656	1,206	INC	10
Monterey Bay			II	SC	VU	1,613	1,149	STA	10
SF-Russian R.			II	SC	VU	8,521	6,254	STA	10
No.CA-So.OR			II	SC	VU	17,763	12,940	STA	10
OR-WA Coast			II	SC	VU	39,586	28,967	UNK	10
WA Inland			II	SC	VU	3,509	2,545	UNK	10
SE AK			II	SC	VU	10,947	8,954	UNK	10
GoA			II	SC	VU	30,506	25,536	UNK	10
Minke Whale									

Balaenoptera acutorostrata									
CA-OR-WA			I		LR	1,015	585	UNK	10
AK			I		LR	UNK	UNK	UNK	10
Gray Whale *Eschrichtius robustus*									
ENP			I	SC	LR	18,178	17,752	DEC	10
White-sided Dolphin *Lagenorhynchus obliquidens*									
CA-OR-WA			II			59,274	39,822	UNK	700
NP		S	II			UNK	26,880	UNK	500
California Sea Lion *Zalophus californianus*									
US						237,000	138,881	INC	100
Harbor seal *Phoca vitulina*									
CA						27,863	25,720	STA	50
OR-WA						24,732	22,380	STA	50
WA Inland						14,612	12,844	STA	50
SE AK						37,450	35,266	STA?	50
GoA						29,175	28,917	DEC	50
Elephant seal *Mirounga angustirostris*									
CA						101,000	60,547	INC	10
Northern Fur Seal *Callorhinus ursinus*									
San Miguel Is.					VU	7,784	4,190	STA	10
EP		DS			VU	888,120	751,754	DEC	10
Humpback Whale (*Megaptera novaeangliae*									
ENP	E	DS	I		VU	1,034	943	INC	10

CNP	E	DS	I		VU	4,005	3698	INC	10
Fin Whale *Balaenoptera physalus*									
CA-OR-WA	E	DS	I		EN	3,279	2,541	STA?	10
NP	E	DS	I	T	EN	UNK	UNK	UNK	10
Steller Sea Lion *Eumetopias jubatus*									
Western	E	DS			EN	UNK	34,779	DEC	50
Eastern	T	DS		SC	EN	31,028	31,028	INC	50
Sea Otter *Enhydra lutris*									
CA	T	DS	I		EN	UNK	2,376	INC	10
WA			II		EN	UNK	360	INC	10
SE AK			II	T	EN	12,632	9,266	UNK	10
SC AK			II		EN	16,552	13,955	STA	10
Marbled murrelet *Brachyramphus marmoratus*	T			T	EN	UNK	18,050	DEC	500

Key:
DS = Depleted and Strategic
DEC = Declining
E,EN = Endangered
I = Increasing
LR = Low Risk
S = Strategic
SC = Special Concern
STA = Stable
T = Threatened
UNK = Unknown
VU = Vulnerable

Table 1. Status of populations that may be involved in takes during the course of this research. The table is based on Carretta *et al*. 2005, Angliss and Lodge 2004, www.speciesatrisk.gc.ca/Q1_e.cfm, www.cites.org, www.iucn.org, and www.fws.gov/endangered/wildlife.html#Species. Gray whale data are from Angliss and Outlaw (in prep.) because the draft incorporates data on a significant change in population status not incorporated

in the latest final stock assessment report. Killer whale data also are from Angliss and Outlaw (in prep.) because it incorporates a change in stock structure since the last final report. The number of takes by Level B Harassment per year requested is shown in the final column.

Factors affecting the status of the stocks mentioned above are generally poorly understood. For some species like humpback and fin whales, fur seals, and sea otters, status is based on failure to recover from historical harvests, although gray whales and elephant seals did recover from harvests, and gray whales declined again for unknown reasons. For others like white-sided dolphins, entanglement incidental to fisheries is a factor. For killer whales and Steller sea lions, factors affecting status are active research areas. For some like minke whales, status is unknown because recent population estimates are not available. Marbled murrelets declined due to destruction of nesting habitat, but marine factors are not adequately understood. It is not clear why elephant seals, California sea lions, and most harbor seal stocks are doing well, but one harbor seal stock is not.

All marine species are at risk from oil and other toxic chemicals, entanglement, restructuring of ecosystems due to fishing and other harvest pressures, and climate change. Odontocetes are vulnerable to increasing noise levels, and mysticetes are at increasing risk for vessel collisions as vessel traffic increases. Loud sound sources such as airguns pose some threat to all marine species, though some are believed to be more vulnerable than others (see Carretta *et al*. 2005 and Angliss and Lodge 2004).

2. Background/Literature Review

The taxonomic status of killer whales (*Orcinus spp*.) is undergoing review (Perrin 2004). Although many species have been described (Heyning and Dahlheim 1988), there is not a consensus on appropriate nomenclature, and new names may be needed if old descriptions cannot be linked with certainty to newly elucidated taxa (Perrin 2004). *Orcinus orca* is a North Atlantic, marine mammal-eating species described by Linneaus in 1758.

There are several approaches available for determining taxonomic relatedness. External morphology (Evans *et al*. 1982, Bain 1988, Baird and Stacey 1988), skeletal morphology Berzin and Vladimirov (1983), DNA sequences (Hoelzel and Dover 1991, Hoelzel *et al*. 1998, 2002, Hoelzel 2004, Barrett-Lennard 2000, Stevens *et al*. 1989) and acoustic behavior (Awbrey *et al*. 1982, Jehl *et al*. 1980, Bain 1988, Yurk *et al*. 2002, Yurk 2005), can all shed light, although rarely is information from all these sources available. For example, Mikhalev *et al*. (1981) and Berzin and Vladimirov (1983) described what they believed was a new species of killer whale based on external and skeletal morphology. Pitman and Ensor (2003) and LeDuc and Pitman (2004) supported the existence of other species based on genetic data, although they analyzed individuals for which they lacked skeletal data.

NMFS still refers to all killer whales under *Orcinus orca*, and has recognized different stocks in our study area (Carretta *et al*. 2005, Angliss and Lodge 2004, Angliss and Outlaw in prep.). Three of these stocks were described as *O. ater* by Cope (in Scammon, 1869, 1874). The Eastern North Pacific Transient Stock is being divided into three stocks. Transients are almost certainly a different species than *O. orca*, and the different stocks may be subspecies of this other species of *Orcinus*. The Eastern North Pacific Northern Resident Stock and The Eastern North Pacific Southern Resident Stock are more closely related to some North Atlantic killer whales than to transients, but are probably two subspecies of a third species (though they have been proposed to be two Distinct Population Segments of the same subspecies). The Eastern North Pacific Offshore Stock also has closer genetic ties to some North Atlantic killer whales than to transients and residents, and may represent a third North Pacific species. That is, Residents, Transients, and Offshore killer whales probably derive from three independent invasions of the North Pacific. Cope also described *O. rectipinna* in the Eastern Tropical Pacific, which is not found in our study area.

With the recent recognition of the degree of divergence of the stocks (Krahn *et al*. 2002, 2004), along with the end of a period of steady growth following collections for public display (Olesiuk *et al*. 1990) their conservation status is changing. Southern Residents were listed as endangered under the Endangered Species Act (NMFS 2004a, NMFS 2005a). Southern Residents are recognized as "endangered" under the Species at Risk Act (SARA) in Canada (see Baird 2001). Northern Residents and Transients have been listed as "threatened" under SARA. Offshores are recognized as a Species of Special Concern under SARA (Killer Whale Recovery Team 2005). The State of Washington recognizes all killer whales in state waters as "endangered" (see Wiles 2004).

Southern Residents were recognized as depleted under the Marine Mammal Protection Act in 2003 (NMFS 2003). As a result, NMFS has been developing a Conservation Plan. The proposed plan has been released for public comment (NMFS 2005b), and a more extensive discussion of the proposed research under this permit can be found there. Due to the conservation status of Southern Residents, a great deal of research needs to be conducted on them. However, comparisons with other killer whale populations will be valuable, and novel techniques can be perfected on less threatened populations before being applied to Southern Residents.

A range of problems will be addressed in the research to be conducted under this permit. Most of the work will be the result of directed effort, although we propose to collect some data of conservation value incidental to our primary research.

The problems we hope to address are: distribution and movements, energetics, health, social evolution, and acoustic behavior. We hope to provide incidental information on diet.

The use of inshore waters is well documented (Heimlich-Boran 1988, Bigg *et al*. 1990, Osborne 1999). However, sightings outside the inshore waters of Washington and British

Columbia are sparse (Wiles 2004, Krahn *et al*. 2004, Killer Whale Recovery Team 2005). Thus a portion of our program will address behavior in offshore waters.

Energetics has several components. One focus is energy expenditure. Kriete (1995) explored several approaches to determining energy expenditure. One was to monitor breathing rates, and estimate energy expenditure based on oxygen consumption measured in captive whales. A second was to monitor swimming speed, and estimate drag. The third was to monitor food intake, although this is difficult in the wild. Kriete made a number of simplifying assumptions which need to be tested with additional data, and depending on their validity, may require modification of her estimates. These simplifying assumptions included: tidal volume is constant; a correction factor based on an estimated dive profile could be applied; killer whales could be modeled as a rigid ellipsoid with appendages; and swimming gait was uniform.

Baird (1994, Baird *et al*. 2003, 2005) has obtained data on dive behavior, some of which was available to Kriete and some of which is new since she completed her work.

Ford *et al*. (2005) have proposed that food availability is currently limiting growth of killer whale populations, and J. Heimlich-Boran (1986) and Nichol and Shackleton (1996) have suggested food availability influences whale movements in the Eastern Pacific, and Similä *et al*. (1996) made a similar suggestion for the North Atlantic.

Disturbance may modify energy balance. Williams et al. (2002ab) and Kruse (1991) found vessel traffic affected behavior in ways that might increase energy expenditure. Bain (2002a and Bain et al. in prep.) suggested noise from vessels might reduce foraging efficiency by masking echolocation, and in turn reducing foraging behavior (Williams and Ashe 2005 and Bain et al. in review, see also Au et al. 2004, Bain and Dahlheim 1994, Erbe 2002, Barrett-Lennard et al. 1996, and Gordon and Moscrop 1996). Due to the popularity of whale watching, killer whales can be exposed to a great deal of vessel traffic (Duffus and Dearden 1993, Osborne et al. 2002), so even if the effects of a single vessel at a given time are small, there is potential for cumulative effects to be important.

Few data are available on the health of free-swimming killer whales. A number of pathogens have been documented in stranded and captive killer whales (Gaydos et al. 2004), along with other cetaceans (Greco et al. 1985 and 1986, Fujioka et al. 1988), and some infections can be fatal (see Palmer et al. 1991). While pathogens have not been identified as a direct cause of the recent decline in Southern Resident Killer Whales, they may impede recovery (Dazak et al. 2001). Causes of mortality for most individuals are unknown. Which individuals are pregnant is unknown, although gestation lasts approximately 17 months (Walker *et al*. 1988, and see Anderson 1982). Bain (1990) developed a method to infer neonate mortality from calving intervals, but direct observation should prove more reliable, as well as revealing which females' calves experience perinatal mortality. Photogrammetry can be used to measure growth rates, which can be compared to growth rates from other sources (Bigg 1982, Christensen 1984, Clark and Odell 1999).

Resident killer whales are unusual in the degree that societies are matrilocal (resulting in recurring social units known as pods, Bigg *et al*. 1987, 1990, Bain 1988, Baird and Whitehead 2000). However, non-kin factors are important in structuring schools (ephemeral social units that last hours or perhaps days, Waite 1988, Rose 1992). Prey availability is one factor likely to influence school structure (Hoelzel 1993, Baird and Dill 1996, Baird 2000, Bisther 2002). Alloparental care is another likely factor (Waite 1988). Anthropogenic disturbance (e.g., vessel traffic, sonar) is another candidate (Bain *et al*. in review). More data are needed to interpret changes in social organization (compare S. Heimlich-Boran 1986 with Ford and Ellis 2002).

Although call structure can change within the lifetime of an individual (Deecke *et al*. 2000), acoustic behavior evolves on a number of time scales, and thus may have value in identifying taxonomic units (Ford 1989, 1991, Bain 1988, Miller and Bain 2000, Miller 2002, Miller *et al*. 2004, Yurk *et al*. 2002, Yurk 2005, Awbrey *et al*. 1982). Further, it may change due to noise, suggesting it can be used as a measure of disturbance (Foote *et al*. 2004).

Southern Residents spend most of their time outside of the inshore waters of British Columbia and Washington, yet little is known of what happens when they are in outer waters. Thus anecdotal accounts of basic biological events would represent significant advances. For example, one might observe feeding behavior (Baird and Dill 1995, Estes *et al*. 1998, Felleman *et al*. 1991, Ford *et al*. 1998, Fertl *et al*. 1996, Heise *et al*. 2003, Jefferson *et al*. 1991, Pitman *et al*. 2001, 2003, Pitman and Dutton 2004).

New information on offshore distribution and feeding behavior of Southern Residents would help interpret the role toxins have played in the status of Southern Residents (Ross *et al*. 2000, Ylitalo *et al*. 2001, Rayne *et al*. 2004, and see Ridgway and Reddy 1995, Reddy *et al*. 2001).

One might observe exposure to dangerous noise levels (e.g., Balcomb and Claridge 2001, Morton and Symonds 2002, Olesiuk *et al*. 2002, Petras 2003, U. S. Department of Commerce and Secretary of the Navy 2001, NMFS 2004b, US Navy 2004, McCauley *et al*. 2003, and see Richardson *et al*. 1995). One might observe fishery interactions (Carretta *et al*. 2005, Angliss and Lodge 2004).

Although anthropogenic factors are a primary concern, natural factors may continue to be important in regulating populations. Mantua *et al*. (1997), Francis *et al*. (1998) and Beamish *et al*. (1999) described relationships between climate and salmon abundance, which in turn may be important to regulating populations of killer whales.

3. Hypothesis/Objectives and Justification

This section is organized in accordance with the proposed Conservation Plan for Southern Resident Killer Whales. For more detailed explanations of the justification for this research, please see

that document (NMFS 2005b). Section numbers from that document are included here to facilitate locating more information.

B1.1 Determine distribution and movements in outer coastal water. While movements of Southern Residents in inshore waters are well known, there are only a handful of sightings from outer coastal waters. We will test the hypothesis that these whales spend the majority of their time in the outer waters. Since few data exist on use of outer waters, there is a need to develop information on basic biology, exposure to risk factors, and critical habitat. The population will directly benefit from identification of critical habitat and NMFS' ability to address risk factors in outer waters. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B1.3 Determine the effects of prey abundance, distribution, and availability and other factors on whale distribution and movements. We will test the hypothesis that killer whale distribution is determined in part by the distribution of preferred prey species. An association between prey and whales would allow prioritizing habitat enhancement projects in a way that optimizes whale recovery. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B2.1 Determine the diet of the southern residents. We will contribute to understanding the basic biology of killer whales by adding to knowledge of diet outside the summer months when most data are available. As this information is needed for Southern Residents in particular, it is not possible to conduct this work on other populations or species.

B3.1 Determine causes of mortality. By spending more time on the water, we hope to locate a higher fraction of carcasses than have been recovered in the past. This will add to knowledge of basic biology. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B3.3 Evaluate reproductive patterns. Southern Residents exhibited below normal recruitment during their decline in the 1990's. However, it is unknown whether this is due to a reduced pregnancy rate, reduced survival rate, or both. We will attempt to determine which females are pregnant, and what proportion of these females are subsequently sighted with calves, to obtain a better estimate of pregnancy rates and perinatal survival. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B3.5 Evaluate changes in social structure. Social structure may reflect population health. We will test whether population structure is stable through time, and if it changes, whether the changes are correlated with risk factors such as prey availability or disturbance. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B4.1 Assess the health of population members. We hope to add to knowledge of the basic biology

of killer whales by monitoring health of free-ranging killer whales. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B4.3 Determine metabolic rates and energy requirements. We will test a number of hypotheses: 1) blows are roughly equal in tidal volume; 2) blow rates are correlated with energy expenditure as estimated from drag calculations; 3) different swimming gaits are used at different swimming speeds; 4) blow rates are correlated with activity state. If all hypotheses are supported, it would be possible to estimate energy expenditures from activity budgets. This would be important, since activity state data can be collected by observing occasional surfacings of unidentified individuals, while measurement of all blows in a series by an identified individual is technically much more challenging. Understanding of energy requirements is an important component of understanding the role prey availability plays in conservation. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B5 Investigate the behavior of the southern residents. By monitoring behavior throughout the year and in geographically diverse areas, we hope to identify correlations between environmental conditions and behavior. If such correlations are found, historical records of behavior (Marsh and Ha 2003) could be used to assess historical environmental quality. In turn, this would allow testing environmental variables for correlation with environmental quality. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.1.3 Determine whether the southern residents are limited by critical periods of scarce food resources. We will test the hypotheses that behavior varies with prey availability, and that during portions of the year killer whales expend more energy than they acquire. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.2.1 Determine vessel characteristics that affect the southern residents. We will test whether vessel characteristics such as size, propulsion system, and operating practices are correlated with behavioral responses to vessel traffic. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.2.2 Determine the extent that vessels disturb or harm the southern residents. We will estimate the duration that killer whales are exposed to different magnitudes of vessel disturbance. Further, we will attempt to develop a "transfer function" relating cumulative exposure to population scale effects. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.2.3 Determine the extent that other sources of sound disturb or harm the southern residents. We will attempt to map sound sources other than engine noise in the marine environment. Such sources include acoustic harassment devices, airguns, mid-frequency sonar, and

Doppler current meters. These maps will consist of both geographic locations and times of exposure. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.2.4 Determine the acoustic environment of the southern residents. We will provide information on the basic biology of killer whales by monitoring the acoustic environment both in close proximity to killer whales, and in nearby habitat that is not occupied at the time. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.2.5 Determine the hearing capabilities and vocalization behavior of the southern residents near sound sources. We will test for correlations between noise levels and call selection, rates, and structure. We will add to knowledge of the basic biology of killer whales by weighting noise measurements in accordance with killer whale hearing ability. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.4 Determine risks from other human-related activities. We will attempt to determine whether killer whales are exposed to risk factors not presently considered important (e.g., entanglement). This will be particularly important when killer whales are not in inshore waters, and add to knowledge of basic biology. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B6.5 Evaluate the potential for disease. We will add to knowledge of basic biology by monitoring the environment for potential pathogens, as well as determining which organisms are normally present in healthy animals. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B7 Identify important habitats for the southern residents. By monitoring movement patterns in poorly known parts of the range, we hope to add to knowledge of basic biology and identify additional habitat that is important to killer whales. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B8 Determine the effects of variable oceanographic conditions on the southern residents and their prey. We hope to add to knowledge of basic biology by monitoring oceanographic conditions in proximity to killer whales and in nearby unoccupied habitat. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

B9.4 Determine genetic relationships among populations. We hope to add to knowledge of basic biology by analyzing photographs showing external morphology to identify heritable characters and the frequency of these characters in different populations. As this information is needed for Southern Residents in particular, it is not possible to conduct this work exclusively with other populations or species.

The following two points will not result in takes, but are important components of our research program, so are mentioned here.

B10 Improve research techniques and technology. We hope to develop and employ novel techniques and technology that allow collection of data with less impact than commonly used techniques or allow collection of novel types of data without increasing impact. Further, we hope to continue working with our colleagues to make data collection more systematic and comparable among different research programs.

B11 Research support and coordination. We would like to point out our commitment to coordination as evidenced by the principal investigator being a co-organizer of the Orca Recovery Conference, which provided the initial framework for NMFS Conservation planning process, and service on Canada's Killer Whale Recovery Team organized under the Species at Risk Act, whose functions include coordinating recovery planning between the US and Canada. Two of the co-investigators organized a workshop to help standardize behavioral data collection methods.

C. Methods

1. Duration of the Project and Locations of Taking

The proposed work will be conducted over the next five years. Operationally, it will consist of three programs.

The first program will focus on Southern Resident killer whales in the inshore part of their range. This work will involve takes by harassment in the inshore waters of Washington State from roughly April through November.

The second program will also focus on Southern Resident killer whales, but while they are in the Pacific Ocean part of their range (the California, Oregon, and Washington coasts). This work will be conducted from roughly December through March. This program will not start until December of 2006.

Since Southern Residents spend some time inshore year-round, and may spend some time offshore year-round as well, there will be exceptions to the field seasons described. Further, we will not be in the field throughout the entire field season.

The third program will be conducted with killer whales in Alaskan waters (primarily with Northern and Alaska Residents in Southeast Alaska, but with some time with Alaska Residents in Prince William Sound and adjacent waters as well). Work in Alaska will be conducted in April through September.

2. Types of Taking, Methodology Involved, and Numbers of Animals that would be Taken

Killer whales will be taken by harassment due to operating a vessel in close proximity to them, as described below. The same individual may be taken more than once. In general, our operating practices do not result in takes, but some individuals are more likely to change their behavior than others and may be taken unexpectedly. On other occasions, an unseen whale will be accidentally taken. There are also times when changes in spatial arrangement of a group results in the vessel approaching non-focal individuals while operating in a manner that does not take the focal individual. The total number of behavioral changes expected to be caused is shown in Table 1 above, and the cumulative effect of the research on the southern resident population is estimated below. Due to lower efforts, impacts on other stocks will be lower than that estimated for Southern residents.

Our effort is intended to be uniform across age and sex classes, and independent of reproductive condition. Thus the distribution of takes should be reflective of the distribution of these characteristics in the population (which is expected to vary over the course of the study).

Global Research and Rescue has access to a variety of observation platforms. The "Nomad" is 44' catamaran with water jet propulsion. The "Shelmar" is a 44' monohull with water jet propulsion. We also have access to propeller-driven catamarans ranging in length from 22'-34'. We hope to obtain smaller propeller driven vessels for work that requires close approaches (described below), and a larger vessel for work in offshore waters.

Large Vessel Work.

For the outer coast work, the research team will travel aboard a large vessel, such as a converted crab boat. In rough seas, the team will remain aboard this vessel. However, when sea conditions permit, a smaller vessel will be launched from the large vessel and work will be conducted as described under Small Vessel Work. This approach will allow collection of data on identified individuals, in contrast to work from the air (e.g., Shelden *et al*. 2000) or the large vessel alone.

Data to be collected from the large vessel include: Date, time, geographic location, sonar images of the water column (to determine relative density of potential prey), ambient noise, potential risk factors (vessels present, nets, marine debris, etc.), degree of dispersion of killer whales, scan sampling of activity states, and acoustic behavior.

This approach is planned only for work with Southern Resident Killer Whales in the Pacific Ocean portion of their range.

Small Vessel Work

A variety of methods will be employed from a small boat.

Health assessment. A health assessment of each Southern Resident will be conducted once per year. The assessment will consist of: 1) exposing a culture plate to exhaled air; 2) obtaining an underwater photograph for photogrammetric assessment of body condition (including injuries) and reproductive status of females; 3) acoustic properties of blows; and 4) infrared images of blows and the dorsal portion of the body. Additional health assessments may be conducted if an individual exhibits abnormal behavior or is reported to have been injured if requested by the regional Marine Mammal Health and Stranding Response Program. A second underwater photograph of females 10 years of age and above may be taken if it has been over 4 months since the previous one.

Culture plates will be placed on a lightweight, telescoping pole 6-10 meters in length. Whales will be approached in a small boat. When a whale surfaces near the boat, the culture plate will be swept through the exhaled air. The culture plate will be sealed and then transported to a laboratory for analysis. These data will provide baseline information on microbes residing in the upper respiratory tract. Control plates exposed to ambient air and sea water will be processed to identify organisms in the environment. These data will complement data collected by stranding programs (Raverty and Gaydos 2004).

Underwater photography will be accomplished with an underwater video camera attached to a pole. The pole will be braced against the hull of the boat. It will be necessary to approach within 6 meters of a whale to obtain an adequate photograph. Photographs of females will be measured to determine whether they are pregnant. Births are rarely observed (Stacey and Baird 1997), so this method will be considered reliable if roughly half of females classified as pregnant are later sighted with a calf. Photographs of all whales will be evaluated for body girth.

All such close approaches are likely to result in takes by harassment. To minimize the consequences of such close approaches, we will conduct them during descent into resting behavior. During periods of activity, whales often become widely dispersed, and during periods of rest they often congregate into tight groups and breathe synchronously. Descent into rest is characterized by reduction in activity and congregation into subgroups which further congregate into larger groups. Whales that are traveling quickly would require operating the engine at high RPM, producing high levels of noise. Milling and socializing whales move unpredictably, making it difficult to approach closely. Whales that are already resting are easily disturbed, and tend to be in large groups which would result in unnecessary takes of non-focal individuals.

Acoustic properties of blows will be recorded using a directional microphone and parabolic reflector. Output from the microphone will be recorded on a digital recorder.

A thermal imaging camera will be used to measure spatial characteristics of blows.

A laser rangefinder will be used to measure the distance to the whale. This will allow calibrating the image, and standardizing received levels in the audio recordings of blows. Infrared images of blows will be measured for absolute size and relative temperature. The duration and power spectrum of individual blows will be measured. These will be analyzed to determine within and between individual variability and for variability with swimming speed and behavior state.

Thermal imaging of the in-air portion of the body may allow identification of abscesses and damage to the blubber layer that impairs insulation (e.g., bullet wounds, see Dahlheim and Matkin 1994; propeller scars, see Visser 1999; and natural wounds, Scheffer 1969).

Body size of juveniles will be measured from photographs to determine growth rates. Photographs will also be used to document potentially genetic morphological characteristics (Bain 1988, Baird and Stacey 1988, Visser and Mäkeläinen 2000).

Diet. Prey may be visible in the mouth (Fertl *et al*. 1996), and remains are sometimes left in the water (Ford *et al*. 1998, Ford and Ellis 2005). Remains will be collected from a small boat using a fine-mesh dip net. In order to collect samples before they sink out of reach, we will need to approach within 20-30 meters of whales. In addition to revealing prey species, scale samples can provide information on prey size, which is an important aspect of food availability (Bigler *et al*. 1996). Samples will be submitted to the Alaska Fisheries Science Center for identification.

On occasion, prey will also be monitored using sonar and a towed camera. We will use two types of sonar. One is a conventional fishfinder. These devices emit pulses in a narrow-beam directed downward. By using a center frequency of 200 kHz, whales will be unlikely to be aware of its use, as this is roughly one octave above the highest frequency whales can hear (Szymanski *et al*. 1999) and the strength of the pulse is substantially lower outside the beam, resulting in a weak signal reaching the whales unless the transducer is directly above them.

The Shelmar currently has a Raymarine L1250RC (Fishfinder & Chartplotter) with a Raymarine M260 1000W Transducer mounted "in-hull" using a E6050 Raymarine mounting kit. This system is capable of producing both 50 kHz and 200 kHz pulses with beam angles of 19° @ 50kHz and 6° @ 200kHz. The 50 kHz pulses can be disabled for use near whales, but enabled for improved monitoring of ambient prey distribution. The Shelmar also uses a Raymarine Tridata System ST60 which incorporates a 50W transducer that produces a beam angle of 11° @ 200kHz for navigational purposes.

The other type of sonar we have used is a multi-beam scanning sonar. We (Hawks-Johnson 2003) have used the Interphase PC-View which sweeps a 12^{o} beam @ 200 kHz with 420W of power through a 90^{o} angle. In contrast to standard fishfinders, sonar pulses are directed in a wide range of directions. As a result, whales are likely to be exposed to direct beams. We

have generally used this system at a distance of about 100-150 meters from whales, as increasing distance increases field of view and reduces noise levels received by whales, but we need to be close enough to receive echoes with sufficient strength to analyze in the area around the whales.

The towed camera will be a Splashcam (www.splashcam.com), which is approximately 6 cm in diameter and 12 cm long, deployed in the upper 10 meters of the water column. As it will be towed behind the research vessel, it will be used to monitor potential prey rather than whales (although whales may approach it to investigate). Observations of focal individuals are typically conducted at distances of 100-200 meters. However, as spatial arrangements of individuals change, we may become closer to non-focal individuals than the primary study animal.

The equipment described above is what we have used in the past. We may use similar equipment (in terms of frequency and power) that provides better data (e.g., higher resolution) in the future.

These methods will be applied in all study areas. However, since other researchers have already done significant work on this issue in the inshore waters of Washington during the summer season, our collections in this area will be incidental to other aspects of our work from May through September (this would be expected to result in less than 1 sample per month, so this work would only be scientifically significant if novel prey were found). In contrast, this will be a relatively high priority when Southern Resident Killer Whales are in the offshore portion of their range and sea conditions permit use of a small boat, where knowledge of prey is a high priority in conservation planning.

Social Structure. Individuals will be identified using photo-identification. In cases where good photographs are not obtained, visual recognition may also be used. Group composition, spatial arrangement and dispersion, and behavior will be recorded using a computer and/or data sheets. In addition, video will be used for some sessions to allow more detailed data collection or review to check accuracy of data recorded in real time. Two approaches will be used to quantify social structure. One is to continuously record behavior of a focal individual (e.g., Waite 1988). The other is to scan sample (e.g., Bain *et al*. in review). Continuous observations will be conducted in 30 minute blocks, and scan samples will be conducted at 15 minute intervals. Behavioral definitions to be used can be found in Bain *et al*. (in review).

This approach will be applied in all study areas.

Energetics. In conjunction with aerial work, location and time of surfacings, sounds and infrared images of blows, and behavior will be recorded. Aerial observation will be used to monitor dive patterns and gait (if whales remain near enough to the surface to be seen throughout the dive).

Location of the observation vessel will be recorded at each surfacing. While efforts will be made to maintain constant relative positions, deviations in the position of the whale relative to the boat will be recorded. Blows will be recorded using a microphone in a parabolic dish. Blow size will also be recorded using a thermal imaging camera. Activity states will be recorded, and behavioral events noted. An aerial platform will be used when possible to observe behavior in the upper 6 meters of the water column. This will allow observation of locomotive behavior (stroke frequency, glides), orientation, and whether speed measured at the surface is a good approximation of speed through the water (i.e., are significant distances covered due to changes in depth or lateral deviation from a straight path).

Fifty, 30 minute samples will be collected for adult males, adult females, and juveniles. Since aerial observation time is likely to be limited, we will focus on one age-sex class each year.

These data will be used to test hypotheses as follows. The uniformity of blows will be determined by measuring the acoustic and thermal properties of blows. The data on swimming gait will be used to determine when to employ rigid- and flexible-body drag models (see Lang 1966). The goodness-of-fit of energy expenditure based on blows and based on drag (see Kriete 1995) will test how well breathing patterns reflect energy expenditure. Further, distributions of energy expenditure within activity states will be assessed to test how well energy expenditure can be estimated from activity budget data (e.g., Osborne 1986, Waite 1988, Bain *et al*. in review).

This approach will be applied in the inshore waters of Washington and in Alaska.

Unmanned Vessels

We have been developing unmanned vessels as data collection platforms (Hawks-Johnson 2003). Without the weight of research personnel, nor the need to provide life-support, such vessels can be lighter and quieter than comparable manned vessels. The reduction in noise reduces impact, and allows operation closer to the whales without their even being aware of its presence. We will use such vessels when possible to carry instrumentation as an alternative to use of a small vessel.

The vessel Hawks-Johnson (2003) used was less than 2 meters in length, powered by small, radio-controlled, electric motors, and carried a small sonar system (see Figure 1). Sonar images were transmitted to a manned vessel. Due to the limited speed (1.5 m/s) of this vessel, we hope to build a larger, faster version capable of carrying a variety of instrumentation (e.g., in-air and under-water video and infrared cameras, in-air and underwater acoustic recording gear, and air and water quality monitors, as well as sonar).

Figure 1. Autoboat with echosounder (from Hawks-Johnson 2003).
This approach will be applied in the inshore waters of Washington and Alaska.

Aerial work.

Aerial work will be conducted from a lighter than air craft. We expect to use manned aircraft to a limited degree, but hope to work primarily with unmanned aircraft.

Due to FAA regulations, operating altitudes will be different depending on whether the platform is manned. For manned observations, we hope to use standard commercial blimps (e.g., the Goodyear blimp) at an altitude of 1000'-1500'. Such blimps are typically 50-60 meters in length, 15-20 meters in diameter, and powered by twin engines at 70-250 HP each.

Remote controlled blimps must be operated below 400', and manufacturers recommend operation at 200'-250'. They are typically 10-15 meters in length, roughly 3 meters in diameter, and powered by twin 5 HP motors. The movement of the blimp is radio-controlled from a vessel operating up to 1 km away. It will not be tethered to a boat.

A video camera will be pointed at a focal individual. The video record will allow determination of whether the focal individual remains near the surface, how straight its direction of travel is, whether it is swimming or gliding, and whether it engages in prey pursuit near the surface. We will attempt to obtain 50, 30 minute samples each year. Video will be recorded on-board the manned blimp, and transmitted with a 2.4 GHz transmitter from the unmanned blimp to the observation vessel.

Our intent is to operate the craft at sufficient altitude that it does not cause takes. However, some takes may occur while we are determining what constitutes sufficient altitude.

This approach will be applied in the inshore waters of Washington, and the unmanned blimp may be used in inshore Alaskan waters.

Passive Underwater Acoustics.

Calibrated broadband hydrophones will be towed behind a vessel. An array will be developed so that sounds can be localized. Two configurations will be used.

Miller and Bain (2000) used a tetrahedral array. While that particular array was not towed, the framework could be modified for towing, and the geometry was suitable for three-dimensional localization using arrival-time differences. The tetrahedron will be 3 meters on a side.

The other configuration is a linear array with directionality determined using beam-forming (Miller 2002). The length of that array will be about 2.5 meters.

In addition to the geometry of the receiving elements, cabling of the hydrophones to the boat and the number of arrays will effect the size. The distance to the boat will depend on the noise generated by the boat. For quieter vessels, the array can be towed 20-50m behind the vessel (less for the unmanned vessel). For noisier vessels, the array would be towed 100 m behind the vessel. Hydrophones will be towed at a depth of 5-10 m.

We may also tow two arrays at once. E.g., Miller (2002) towed two linear arrays approximately 100 meters apart to get accurate distances to vocalizing whales. Towing linear arrays side-by-side would eliminate left-right ambiguity, and this would be particularly helpful when working in offshore waters or at night.

In contrast to single hydrophone recordings, localization will allow determination of which subgroup or individual made vocalizations, as well as providing some ability to measure anthropegenic noise from separate sources. Acoustic data will be useful for a range of the objectives described above under large and small vessel work.

The distance from the whales at which the array will be towed will depend on the objectives. One objective will be to determine noise experienced by whales during whale-watching relative to ambient noise (see Bain 2002b and Griffin and Bain 2005). In this case, we would use the unmanned vessel and try to keep the hydrophones between 30 and 50 meters from a focal individual. When determining the use of sound by individuals in social interactions, we will attempt to be approximately 200 m away. When using the array simply to track movements, we will attempt to be 400 m away. As with other focal animal work, due to changing spatial arrangements of whales, we may end up closer to non-focal individuals, and unexpected movements may result in closer approaches than intended.

This approach will be applied in all study areas.

Sample collection and analysis: No marine mammal parts will be collected from living marine mammals. However, killer whales feed on a variety of marine mammals (Jefferson *et al*. 1991), so we may collect parts of marine mammals killed but not consumed. Culture plates exposed to exhaled air will be sealed to prevent contamination and exposure of handlers to potentially zoonotic diseases. These will then be transported to a veterinary pathology lab for incubation and identification of species.

The following laboratories are currently in use and are the most likely choices for collaboration to perform or our bacteriology, serology, virology, parasitology analysis and health assessment protocols:

Wildlife Health Center, 1 Shield Ave. UC Davis, CA, 96616, Dr. Jonna Mazet, jmazet@udcdavis.edu

Dept. of Medicine, Division of Allergy and Infectious Diseases, University of Washington, Box 357185-1959 NE Pacific Ave, Seattle, WA, 98195, Dr. Caroline E. Cameron, caroc@u.washington.edu

Alaska Veterinary Pathology Services, 23834 The Clearing Drive, Eagle River, AK, 99577, Dr Kathy Burek, fnkab1@uaf.edu.

Unconsumed prey and feces will be stored in Ziploc bags until they can be transported to a laboratory (probably the Alaska Fisheries Science Center) for analysis.

Capture: No animals will be captured.

Handling/Restraint: No animals will be handled or restrained.

Scientific Instruments: No scientific instruments will be attached or implanted.

Marking: No animals will be marked.

Acoustics: No sounds will be projected. Typical received level from our engines should be less than 110 dB RMS re 1 µPa. Maximum received levels (during close approaches) will remain below 135 dB re 1 µPa and exposure to maximum levels will be limited to 5 minutes at a time.

3. Import/Export of Marine Mammals, Endangered species, or any parts thereof: No marine mammals or marine mammal parts will be imported or exported.

4. Removing Animals from the Wild into Captivity/ Research or Enhancement on Captive or Rehabilitating Animals: No animals will be removed from the wild.

5. Lethal Take: No lethal takes are planned, nor do we believe mortality or serious injury is possible as a result of the proposed activities.

D. Resources needed to accomplish objectives

We do not currently have the financial resources available to conduct and the complete the proposed activities. However, we do have a history of successful fundraising, and some funding agencies we plan to approach require that we have a permit to conduct the work before awarding funds.

E. Effects of the Research and Measures to Minimize Stress, Pain, Suffering, and/or Harassment

Effects

The effects of takes by harassment can be thought of in two ways. One, they are events that cause short-term changes in the life of individuals. Two, cumulatively, they change the habitat quality for the population. By comparing disturbed to undisturbed behavior, the nature of the take can be observed. Except in extraordinary circumstances (e.g., a distracted marine mammal becomes prey), the effects of harassment end when the vessel moves away, so the number of occurrences can be simply be counted.

In contrast, the change in habitat quality depends on the magnitude of takes and their duration. Whether the change in habitat quality matters depends on the magnitude of the overall change in quality and where the population stands in relation to the carrying capacity of that habitat (Bain *et al*. in prep.). Thus it is important not only to count takes by harassment, but also to consider the impact on the population. (In the case of lethal takes, the count of takes and the impact on the population would be roughly equal.)

Observations from small boats when carefully conducted rarely result in noticeable changes in behavior. However, shore-based observations suggest that vessel presence may result in increases in energy expenditure on the order of 10-15% (Bain *et al*. in review, Williams *et al*. 2002ab). Further, noise may result in masking of echolocation signals, reducing foraging efficiency by perhaps a similar percentage (Bain 2002a and Bain *et al*. in prep., but see Au *et al*. 2004). Bain *et al*. (in prep.) suggested multiplying the total percentage of impact by the fraction of the population impacted and the fraction of the year exposure takes place. That is, if the combined impact of increased energy expenditure and decreased energy acquisition is 25%, this would be multiplied by the fraction of the population close enough to be affected (typically 5% for Southern Residents) and the fraction of the year (10% for about 900 hours with whales) for a total impact of 0.125% of carrying capacity for a single vessel. This would be well below the PBR for Southern Residents of 0.8, so the research will have negligible impact on the population or any individual within the population. (However, one could see that a fleet of boats could collectively cause takes that cumulatively exceed PBR).

To mitigate this effect further, several steps will be taken. First, vessels will be operated as far away as possible consistent with collecting accurate data. Behavioral impacts decrease with distance, as do effects of noise. Operating vessels at low speed when near whales, as well as keeping vessels to the side of whales, may minimize impact.

Noise from aircraft flying overhead can have similar effects to vessels (Richardson *et al*. 1995). The other potential mechanism for impact is the shadow of the aircraft passing overhead. However, with the low angle of the sun at high latitudes, this is unlikely to be a problem.

By using 200 kHz sonar to monitor potential prey in the water column, it is unlikely that killer whales will be able to hear the signals (Szymanski *et al*. 1999), and hence it is unlikely they will be impacted.

Activities that require close approaches (culture of bacteria and fungus in exhaled air, underwater photography) will be limited to once or twice a year, whereas activities that require large samples (collection of focal individual behavior data) will be conducted at distances of 100-200m. Some activities, such as identification of individuals, may require brief approaches within 100m, a few times a day. Observation at 100-200m does not cause qualitative changes in behavior (a noticeable take), although statistical analysis suggests this may cause slight changes in behavior on average (Wiliams *et al*. 2002a). Approaches within 100m sometimes

cause noticeable changes in behavior, and when such changes occur they can be counted as a take. The same individuals will be approached repeatedly over the course of the study. However, we will make an effort to sample individuals as evenly as possible so that we don't spend too much time with one individual.

Alternatives

We have designed the research to have minimal impact, so we are not aware of any alternative approaches to obtain the data that might have less impact.

In contrast, approaches with greater impact have been used to address similar questions in the past, such as lethal takes to address questions like diet (e.g., Rice 1968) and growth (Christensen 1984). By using a lighter than air craft capable of traveling slowly, we can hold noise to a minimum. We eliminate disturbance due to rapid changes in acoustic exposure resulting from changes in distance and direction required of fixed-wing heavier than air craft traveling at high speed but trying to match net progress to slowly moving whales. The power required (and hence noise produced) for a helicopter to hover above whales is significantly greater than a lighter than air craft.

Nowacek *et al*. (2001) have used a tethered aerostat slightly smaller than the unmanned one we propose to use to float a camera above marine mammals. In general they found no behavioral response, but did notice changes in behavior when dolphins passed through the shadow of the aerostat. They noted it was useful for work with Southern Resident Killer Whales in a pilot study, but had trouble in winds > 15. The remote controlled aerostat will be noisier (it has small engines in contrast to no engines), but can operate at a higher altitude to mitigate the noise, will cast a more diffuse shadow due to the greater operating height, and should perform better in the moderate winds common in inshore waters. The remote controlled aerostat allows vessel operation at greater distances than would be possible if it were tethered.

Further, since the data are necessary for recovering an endangered species, not proceeding with the research is not a desirable alternative.

Incidental effects

Capture: n/a

Handling/Restraint: n/a

Sample collection: No samples will be collected invasively. Close approaches to expose a culture plate to exhaled air may result in avoidance, fluke slaps or other percussive behavior, an orienting response, changes in swimming speed, or no response.

Scientific instruments: n/a

Marking: n/a

Acoustics: The only anticipated acoustic effect is that masking may occur while the vessel's engine is running.

Incidental Harassment*:* Incidental effects on conspecific will be similar in quality but of smaller magnitude than direct effects on focal individuals.

Dall's porpoises and white-sided dolphins may respond to a vessel's presence by diverting course to bow ride. While this typically has minimal long-term consequences, it may increase risk of predation (Dahlheim and Towell 1994). Maintaining course and speed is typically the best way to minimize disturbance.

Harbor porpoises are easily disturbed. Similarly, Steller sea lions are easily disturbed. They can also be difficult to sight at a distance. Takes can be minimized by avoiding areas where these species concentrate.

Harbor seals, California sea lions, fur seals, sea otters, and marbled murrelets typically respond to a passing vessel with an orienting response. If these species are spotted in front of the vessel, the vessel can be turned away to avoid a dive response in addition. If they are sufficiently off to the side, effects can be minimized by maintaining course and speed.

Humpback and gray whales can generally be detected far enough away to avoid harassing them.

The movements of minke whales are difficult to predict, so it will be difficult to avoid them. However, since their population density is low, accidental takes incidental to this work are expected to be rare.

Impacts on pinnipeds can be minimized by avoiding haul-outs.

Responses to vessels are likely to be brief, lasting no more than a few minutes if individuals are not followed. The effect of the presence of killer whales on other species may be greater than the effect of the vessel in many cases.

We do not believe there is any potential for immediate injury or death to any individual under our protocols.

Measures to minimize effects

Due to the minimal effects of these observational studies expected under these protocols, IACUC review is not required.

To mitigate any effects further, several steps will be taken. First, vessels will be operated as far away as possible consistent with collecting accurate data. Behavioral impacts decrease with distance, as do effects of noise (Bain *et al*. in review). Operating vessels at low speed when near whales, as well as keeping vessels to the side of whales, may minimize impact (Bain *et al*. in prep.).

We have been developing unmanned vessels as data collection platforms (Hawks-Johnson 2003). Without the weight of research personnel, nor the need to provide life-support, such vessels can be lighter and quieter than comparable manned vessels. The reduction in noise reduces impact, and allows operation closer to the whales without their even being aware of its presence. We will use such vessels when possible.

Activities that require close approaches (culture of bacteria and fungus in exhaled air, underwater photography) will be limited to once or twice a year, whereas activities that require large samples (collection of focal individual behavior data) will be conducted at distances of 100-200m. Some activities, such as identification of individuals, may require brief approaches within 100m, a few times a day.

Monitoring effects of activities

Individually identified whales will be observed repeatedly. This will allow monitoring the effects of close approaches and aerial observation. Shore-based monitoring has been conducted to observe the effects of basic behavioral monitoring (Bain *et al*. in review).

F. Publication of Results

Results will be published in the scientific literature as soon as possible after completion of publishable components of the work. See our CV's for examples of journals we have published in and conferences we have attended to present our work.

V. National Environmental Policy Act Considerations

1. Will your research or enhancement activity involve equipment (*e.g.*, scientific instruments) or techniques that are new, or may be considered innovative or experimental? If yes, are they likely to be adopted by other researchers in the future?

Two aspects of our work may be considered innovative. One is the use of remote operated vessels as data collection platforms. If this approach is adopted by other researchers in the future, it could result in a reduction of harassment. The other is our effort to culture flora from exhaled air. If successful, our technique may be applied elsewhere, resulting in an increase in disturbance.

2. Does your activity involve the collection, handling, or transport of potentially infectious agents or pathogens (e.g., biological specimens such as blood), and/or does your activity involve the use or transport of hazardous substances (e.g., toxic chemicals)? If so, provide a description of protocols to be used for safe specimen and/or chemical handling, storage, and shipment to ensure human safety from injury or zoonotic disease transmission. Does your proposed research involve animal handling or dangerous work conditions? If so, explain and provide protocols that would be followed to ensure human safety.

This research involves handling potentially infectious agents inhabiting the airway of killer whales. Mazet *et al*. (2004) reviewed risks associated with close proximity to marine mammals, and made suggestions for protective measures that can be taken to limit risk. Sterile technique (gloves and mask) will be worn when handling culture plates. Plates will be sealed immediately after collection to prevent contamination of the sample and to protect humans who subsequently handle the plate. The plate will be unsealed in a pathology lab properly equipped to handle disease-causing organisms. Our protocol should be adequate to ensure the safety of all involved (Buck and Schroeder 1990, see also Hunt *et al*. 2004) and zoonotic pathogens may be treatable with antibiotics (Nachtigall *et al*. 1990) should precautions fail.

The manned blimp will meet all FAA safety regulations.

3. Would any of your activities occur in or near unique geographic area such as wetlands, National Marine Sanctuaries, Marine Protected Areas, State National Parks or wilderness areas, wildlife refuges, wild and scenic rivers, designated critical habitat for endangered species, essential fish habitat, etc.? If so, would any aspect of your activities impact the physical environment, such as by direct alteration of substrate (e.g., bottom trawling, net setting, anchoring vessels or buoys, erecting blinds or other structures, disrupting nesting bird habitat, etc.)?

Our study area includes areas proposed for designation as critical habitat for salmon, and one objective of our work is to identify critical habitat for southern resident killer whales, so that work will be conducted in areas likely to become critical habitat. Our activities will not result in any permanent modification of habitat, nor disruption of bird nesting sites or pinniped haul-outs.

4. Are you aware if the types of research or enhancement techniques to be employed could be perceived to be controversial by the public in any way? If so, to what degree would it be considered controversial and why?

Collection of expired air and underwater video may be controversial in that they require close approaches to whales. However, public concern can be mitigated by assuring them that the techniques will not result in any contact with the whales, close approaches are being kept to a minimum, and the

data collected have direct conservation applications. That is, members of the public who know why these close approaches are occurring are not likely to be concerned, but uninformed observers may angrily ask, "Why is that boat so close to the whales?".

5. Could your proposed actions affect entities listed in or eligible for listing in the National Register of Historic Places, or cause loss or destruction of scientific, cultural, or historic resources (e.g., archeological resources, species used for subsistence purposes, etc.)? Explain.

No historic places will be affected, and nothing will be destroyed in the course of this work.

6. Would any of your proposed activities include actions (e.g., transport of animals or tissues, ballast water discharge, working in sensitive remote areas, etc.) that could result in the introduction or spread of non-indigenous or invasive species (including plants, animals, microbes, or other biological agents)? If so, explain the types of activities and indicate any measure you would take to prevent or limit such spread or introduction.

We do not anticipate that any of our actions pose a risk of spreading microbes or non-indigenous or invasive species.

VI. Previous and Other Permits

A. Previous Permits

Three of us (Bain, Ha, and Marsh) have been working under the General Authorization for Scientific Research, File No. 965-1632, issued June 18, 2002 and scheduled to expire on June 15, 2007. Prior to that, Bain worked under General Authorization No. 16 (File No. 24). This application is being filed in anticipation of the listing of Southern Resident Killer Whales under the Endangered Species Act, which precludes continued work with that population under the GA.

B. Other Permits

Dr. Bain holds a permit from the National Park Service for shore-based studies of killer whales from San Juan Island National Historic Park.

Permits from National Marine Sanctuaries will be necessary for some of the large vessel work. However, since such work is more than a year away, we have not yet applied for such permits.

A Coastal Zone Consistency determination will be required for work in Washington State Waters. We have not yet applied for this determination, but will do so shortly.

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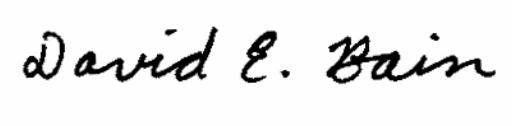
VIII. Certification and Signature

"I hereby certify that the foregoing information is complete, true, and correct to the best of my knowledge and belief. I understand that this information is submitted for the purpose of obtaining a permit under one or more of the following statutes and the regulations promulgated thereunder, as indicated in Section I of this application:

The Endangered Species Act of 1973 (16 U.S.C. 1531-1543) and regulations (50 CFR 222.23(b)); and/or

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407) and regulations (50 CFR Part 216); and/or

I also understand that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or to penalties provided under the Endangered Species Act of 1973, the Marine Mammal Protection Act of 1972, or the Fur Seal Act of 1966, whichever are applicable."



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