I. Application for a Scientific Research permit Under the Marine Mammal Protection Act and for Scientific Purposes Under the Endangered Species Act

II. Date of Application: November 20, 2005

III. Applicant and Personnel

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

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B. Qualifications and Experience

The Center for Whale research has been conducting photo-identification studies of killer whales, notably the southern resident population, since 1976, pioneering research on this population. The applicant and CIs have many decades of combined experience in studying killer whales and other cetacean species. C*urriculum vitae* of PI and CI's are in Appendix I. See Appendix II for a list of publications from the Center for Whale Research.

IV. Proposal

A. Summary

Researchers with the Center for Whale Research (CWR) have been conducting individual photo-identification studies of the southern resident killer whale (SRKW) population on an annual basis since 1976. These studies have provided unprecedented information on population dynamics and demography, social structure, and individual life histories. These data have been the basis for management decisions in both Canada, under the Species at Risk Act, and the United States, under the Marine Mammal Protection Act and the Endangered Species Act. Additionally, this annual photographic inventory has provided a high quality catalogue of individual identification photographs and genealogies, which is proving to be essential for additional ecological studies of this population. This permit application is specifically to cover continued photo-identification

studies of SRKWs to support conservation and recovery plans by monitoring population size and demographics, movements and distribution, social structure, and individual health and body condition. Additionally, prey remains will be collected alongside photo-identification studies to continue a collaborative study of SRKW diet that has been ongoing for more than 30 years, to fill key data gaps on the prey preferences of individually identifiable whales. Photo-identification data will also be collected opportunistically from other killer whale populations that may be encountered, specifically from the recognized Eastern North Pacific Offshore stock, the Eastern North Pacific Northern Resident stock, and the Eastern North Pacific Transient stock. These data will be used to continue the long-term participation of CWR in collaborative studies to assess the distribution and status of these populations, to facilitate listing decisions under the MMPA / ESA.

B. Introduction

1. Status of the Species

(a) Species description

The "southern resident" population of killer whales (*Orcinus orca*) is small, with recent declines of 17% between 1995 and 2001, and currently contains 88 members (Center for Whale Research, unpublished data). During the summer and fall, southern resident killer whales (SRKWs) are primarily found in the U.S. / Canada trans-boundary waters of British Columbia and Washington State. Some members of the population typically remain in the same general area in winter and spring, but others appear to range over much greater distances, and have been reported as far south as Monterey Bay, California, and as far north as Haida Gwaii (the Queen Charlotte Islands) (Carretta et al. 2005).

Other killer whales may also be encountered opportunistically within the range of SRKWs. The "Eastern North Pacific Offshore" stock ranges off the west coast of North America between California and Alaska (Carretta et al. 2005). These offshore whales were first documented by CWR staff off the coast of Washington in the late 1980's and have been photographically documented in several occasions in WA waters by CWR over the past two decades. The "Eastern North Pacific Transient" stock occurs in the waters off Alaska through California (Angliss and Lodge, 2004). CWR has been photographically documenting transient killer whales in WA waters since 1976, and has an extensive database of individual photo-identifications from this region. The "Eastern North Pacific Northern Resident stock" occurs from British Columbia through Alaska (Angliss and Lodge, 2004), and has been documented by CWR to use the transboundary waters between British Columbia and WA on an infrequent basis.

During the course of killer whale surveys, other marine mammal species may be incidentally encountered (Table 2). For example, these may be species that are being hunted by mammal-eating transient killer whales, species that sometime associate with resident killer whales, or species that may be attracted to survey vessels.

(b) Life History and Population Status:

The size of the SRKW population has been known since the first complete photo-identification census in 1976, and was estimated for the years prior to that (CWR, unpublished data). Although the southern resident population was likely increasing in size in the early 1960s, the number of whales in the community dropped dramatically in the late 1960s and early 1970s due to live capture for aquariums. A total of 47 individuals that are known or likely to have been southern residents were captured and removed from the population. The population increased 19% (3.1% per year) from a low of 70 after the live-captures ended in 1973 to 83 whales in 1980. From 1981-1984 the population declined 11% (-2.7% per year) to 74 whales as a result of lower birth rates, higher mortality for adult females and juveniles, and lower numbers of mature animals, especially males, which was caused by selective cropping in previous years. From 1985 to 1995, the number of southern residents increased by 34% (2.9% per year) to 99 animals. A surge in the number of mature individuals, an increase in births, and a decrease in deaths contributed to the population growth. The latest decline began in 1996, with an extended period of poor survival and low fecundity resulting in a decline of 17% (-2.9% per year) to 81 whales in 2001. Since 2001, the number of southern residents has increased slightly to 88 in 2005 (CWR, unpublished data). In the U.S., the southern residents were listed as 'depleted' under the Marine Mammal Protection Act (MMPA) in 2003, and recently as "endangered" under the Endangered Species Act (ESA) in 2005. In June 2004, the Washington State Department of Fish and Wildlife added southern resident killer whales to their endangered species list. In Canada, the southern resident population was designated as endangered under the Species at Risk Act in November 2001.

Eastern North Pacific Offshores are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMA. They are therefore not classified as a "strategic" stock under the MMPA (Carretta et al. 2005). Eastern North Pacific Northern Residents are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMA. (Angliss and Lodge, 2004). In Canada, the northern resident population was designated as "threatened" under the Species at Risk Act in November 2001. Eastern North Pacific Transients are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMA. (Angliss and Lodge, 2004).

During the course of killer whale surveys, other marine mammal species may be incidentally encountered (Table 2). For example, these may be species that are being hunted by mammal-eating transient killer whales, species that sometime associate with resident killer whales, or species that may be attracted to survey vessels. These species are listed in Table 2, along with their status.

2. Background/Literature Review

The Center for Whale Research (CWR) has been conducting individual photo-identification studies of the southern resident killer whale (SRKW) population on an annual basis since 1976 (Balcomb and Goebel 1976; Balcomb and Bigg 1986; Bigg et al 1987; Ford et al 1994; Ford et al 2000). These studies have provided unprecedented baseline information on population dynamics and demography (Olesiuk et al. 1990; Brault and Caswell 1993; Durban,

2002), social structure (Heimlich-Boran 1986; Bigg et al. 1990), and individual life histories (Olesiuk et al. 1990). This detailed understanding of population status and trends has supported management decisions in both Canada and the United States. Most recently, data derived from CWR's long-term SRKW studies have been used to support listing decisions in the U.S. under the Marine Mammal Protection Act and the Endangered Species Act (Krahn et al. 2002; NMFS 2005), and listing decisions in Canada under the Species At Risk Act of 2003. Additionally, this annual photographic inventory has provided a high quality catalogue of individual identification photographs and genealogies, which is proving to be essential for additional ecological studies of this population (e.g. Barrett-Lennard 2000; Barrett-Lennard and Ellis 2001; Ross et al. 2000).

Recent conservations strategies in the US (NMFS, 2005) and recovery plans in Canada (Killer Whale Recovery Team, 2005) have identified changes in prey availability as a possible threat to SRKWs.. SRWKs are known to be dietary specialists, feeding exclusively on fish (Ford et al. 1998), and there are correlations between SRKW occurrence and salmon abundance (Heimlich-Boran, 1986; Osborne 1999; CWR, unpublished data). However, an evaluation of the extent of this threat requires more detailed data on the diet of this population. The CWR is a long-term collaborator in a study of killer whale diet that has developed effective and non-invasive methods for the collection of prey remains from free-ranging killer whales (Ford et al. 1998). This collaboration has been ongoing since 1974 these methods have been successfully implemented to collect 88 prey samples to date. The collection of prey remains from individually-recognizable whales at the same time as photo-identification studies offers the potential to examine for group or individual-specific dietary preferences.

CWR has also been conducting opportunistic photo-identification studies of other killer whale populations. The Eastern North Pacific Offshore stock was first photographically documented by CWR staff off the coast of Washington in the late 1980's (Ford et al. 1994) and have been photographically documented in several occasions in WA waters by CWR over the past two decades (CWR, unpublished data). CWR has been conducting photo-id studies of Eastern North Pacific transient killer whales in WA waters since 1976, and has an extensive database of individual photo-identifications from this region. These data are being used in collaborative studies of this population (Ford and Ellis, 1999). The Eastern North Pacific Northern Resident stock has been documented by CWR to use the transboundary waters between British Columbia and WA on an infrequent basis, and these data are being contributed to long term studies of this population (Ford et. al. 2000).

3. Hypothesis/Objectives and Justification

Since 1976, the CWR has conducted annual photo-identification studies of SRKW's. This has provided a detailed understanding of population status and trends over the last 30 years, which has been the basis for management decisions in both Canada and the United States. Assessing the success of conservation and recovery plans now requires continued population monitoring (NMFS, 2005; Killer Whale Recovery Team, 2005). We propose to continue this 30-year photo-identification study to provide this baseline data on population status.

Conservation plans for SRKWs highlight the possible threat of reduced prey availability (NMFS, 2005; Killer Whale Recovery Team, 2005). However, there are key data gaps that currently constrain an understanding of the feeding ecology of southern resident killer whales,

and prevent us from determining the extent and magnitude of this threat. Notably, there is a lack of data on the year-round distribution, diet and nutritional status of these whales (Killer Whale Recovery Team, 2005). For long-lived marine mammals, data on body condition and individual growth provide important indications of both individual health and population status (e.g. Perryman and Lynn 2002). We propose to use photographic methods for obtaining morphometric and body condition measurements of identified individuals. Specifically, we have developed and tested a novel approach for obtaining morphometric measurements from the photographic documentation of projected laser-dots that can be routinely implemented alongside photo-identification studies (Durban and Parsons, submitted). Additionally, we propose to continue a 30+ year study of SRKW diet by collecting prey remains (Ford et al. 1998) from individually indentified whales on an opportunistic basis at the same time as photo-identification sampling.

1. Continue the long-term photo-identification study of SRKW's with vessel surveys within the core range of this population throughout the year.
2. Monitor the wider distribution of SRKWs using boat-based and aerial surveys, along with photo-identification, to document individual whales throughout their range.
3. Use the photo-identification studies to provide quantitative data on the morphometrics and body condition of individual whales.
4. Combine individual photo-id studies with the collection of prey remains (e.g. scale samples) to provide information on individual-based dietary preferences.

Over the past three decades, CWR has also been conducting opportunistic photo-identification studies of other killer whale populations, specifically the Eastern North Pacific Offshores, the eastern North Pacific Transients and eastern North Pacific Northern Residents. These studies have provided unprecedented baseline data on patterns of individual occurrence and distribution (e.g. Ford et al. 1994; Ford and Ellis, 1999; Ford et al 2000). However none of these populations are currently listed under the MMPA or ESA, due in part to a lack of detailed data about population status, particularly for the offshores and transients (Carretta et al. 2005; Angliss and Lodge, 2004). We therefore propose to continue photo-identification monitoring of these populations when opportunities arise, in order to contribute to ongoing studies of population size, trends, demography and distribution that are necessary for assessing population status.

SRKWs will be differentiated from other killer whale populations using the established methods of individual recognition through natural markings (e.g. Ford et al. 2000). CWR has been compiling photographic catalogues of individuals from each of the four different killer whale stocks for the last three decades. Staff at CWR are uniquely qualified to recognize individuals and thus distinguish populations in the field. Digital photography and real-time comparison to existing photo identification catalogues will be used to confirm visual identifications.

SRKWs and other killer whale populations will be studied using the same methodologies (below).

C. Methods

1. Duration of the Project and Locations of Taking

Duration: This monitoring project will be repeated on an annual basis, consisting of studies throughout the year. Because survey effort will be constrained by weather conditions, it is expected that the majority of this effort will occur in spring, summer and fall. However, winter data is valuable for monitoring distribution and mortality patterns, and we would like the authority to conduct studies throughout the year.

Location: The known range of SRKWs extends from Monterey Bay, California to the northern Queen Charlotte Islands, Canada, and we would like to have the authority to take them throughout this range. Additionally, we would like the authority to extend survey effort into the waters off SE Alaska, to investigate if the SRKWs are ranging into this area (which is in close proximity to the northern extent of their currently recognized range). It is likely that the majority of survey effort will occur within the core range of this population in the waters of Washington State.

Killer whale vessel surveys

Killer whales will be studied using a variety of vessel surveys. These will primarily involve small-boat surveys launched from shore stations within the core range of this population in Washington State. However, to study the wider distribution patters of these whales, we will also use small-boats launched from shore in other areas. To cover more remote waters, larger boats of up to 72ft will be used for multi-day trips, and smaller boats may be launched from these platforms. Photo-identification will be conducted in the same manner as in each of the last 30 years. To cover the wider distributional range of SRKWs more effectively, we may also use aerial surveys and aerial photography to document the individual identity of sighted whales.

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

We request the authority to harass Southern Resident killer whales (*Orcinus orca*) for the purpose of collecting photo-identification data. Based on our experience, we anticipate that the majority of photo-identification approaches will NOT elicit a behavioral response from the whales, and therefore will not constitute takes. However, we are requesting a potential of 500 photo-identification takes per "species" (i.e. Southern Resident killer whales) per year. For the same purpose, we are also requesting 500 photo-identification takes per year for non-southern resident killer whales that may be encountered. The takes we have requested are also listed in Table 1.

The types of taking involve (1) Level B harassment (i.e., no potential to injure). Individuals may be subject to take by harassment more than one time.

Although we anticipate that the majority of photo-identification approaches will NOT elicit a behavioral response from the whales, and therefore will not constitute takes, we are requesting a potential of 500 takes because of the resolution required for our photo identification studies. These studies need to occur regularly and throughout the year in order to address key issues that

have been identified by conservation and management plans (NMFS 2005; Killer Whale Recovery Team, 2005). For example, obtaining data on the year-round distribution at the level of individual pods and matrilines is necessary for documenting critical habitat. Reliably documenting the presence of individuals and matrilines can only be accomplished through photo-identification methods. Additionally, understanding the factors driving population dynamics requires close monitoring of the population for birth and mortality patterns (particularly neonatal mortalities). This requires regular photographic inventories of the population to document the timings of births and deaths, in order to correlate these with possible environmental covariates. Neonatal mortality is a key parameter that needs to be quantified in order to interpret population dynamics. However, neonatal mortality events can only be detected if there is regular monitoring of the population in order to document new calves before the die. Maintaining cultural diversity has been identified as a key recovery goal (Killer Whale Recovery Team 2005). Killer whales have a unique social structure, which is important for maintaining cultural traditions. Therefore it is important to monitor individual co-occurrence on a regular basis in order to quantify social structure and monitor changes over time (Killer Whale Recovery Team 2005).

There are currently 88 animals in the population. If we plan to document each of them once every two weeks, then this will involve 2288 animal documentations per year. Therefore, our cautiously conservative level of 500 takes (which we do not anticipate reaching) would still only involve minor behavioral reactions from the whales in less than 25% of animal documentations. To ensure that the number of takes is actually much lower than this, we will carefully control our survey behavior when approaching whales. During boat approaches, we will attempt to limit close approach to the whales for photo-identification purposes, but anticipate that this will require approaches to within approximately 15-25m in order to obtain reliable individual documentations, depending on sighting conditions. Boat approaches will be gradual and experienced vessel operators will be used at all times. Based on our experience, we anticipate that the majority of photo-identification approaches will not elicit a behavioral response from the whales. If there is evidence of avoidance, a maximum of three approaches will be attempted before the encounter with the group is terminated. This level of three takes is potentially less than 4% of the group, if the whole population is encountered, and no greater than 15% of the group of they are encountered in individual pods (the smallest pod, k pod = 20 whales). Aerial surveys will generally be flown at around 750ft altitude, and we anticipate that this will not elicit a behavioral response from the whales. If animals appear to respond to the presence of an aircraft, the aircraft will leave the vicinity immediately.

Collection of prey remains will be conducted in conjunction with photo-identification surveys form boat platforms. No additional takes will be associated with this activity, as this involves inspection of the water that has been disturbed by surfacing whales *after* they have moved on from the vicinity. Similarly, collection of photographs for morphometric analysis will occur simultaneously with photo-identification studies from boat and aerial platforms, involving no additional takes.

We anticipate that the majority of photo-identification approaches will NOT involve incidental encounters with other marine mammal species. If they do occur (e.g. killer whale prey), we will

endeavor to avoid approaching these species. However it is possible that such species may be incidentally approached during killer whale photo-identification surveys, and this may occasionally cause minor behavioral reactions from individuals, constituting incidental level B takes.

Aerial and boat surveys:

Boat surveys

Whales will be approached and then photographed from small boats launched from shore, or from larger vessels. All individual whales will be photographed for identification, if possible. The approaches will be gradual and will be designed to minimize or avoid any behavioral response. All sex and age groups will be approached for photo-identification studies. We will attempt to limit close approaches to the whales for photo-identification purposes, but anticipate that this will require approaches to within approximately 15-25 m in order to obtain reliable individual documentations, depending on sighting conditions. Based on our experience, we anticipate that the majority of photo-identification approaches will NOT elicit a behavioral response from the whales. If there is evidence of avoidance, a maximum of three approaches will be attempted before the encounter is terminated. We will try and limit the amount of time that it takes to document all the individuals in a group that is encountered, but this may take up to a maximum of 8 hours during vessel surveys. Digital SLR cameras and digital video will be used to document individual whales, and identifications will later be confirmed by comparison to an existing catalogue of individual whales (Ford et al. 2000; CWR unpublished data). SRKWs will be differentiated from other killer whale populations using the established methods of individual recognition through natural markings (e.g. Ford et al. 2000). CWR has been compiling photographic catalogues of individuals from each of the four different killer whale stocks for the last three decades. Staff at CWR are uniquely qualified to recognize individuals and thus distinguish populations in the field. Digital photography and real-time comparison to existing photo identification catalogues will be used to confirm visual identifications.For distributional studies, GPS units will be used to document the location of encounters, and vessel tracks will be stored in GPS memory and later databased.

Data on individual morphometrics and body condition will be obtained from photographic images taken at the same time as photo-identification approaches. Laser-dots of fixed separation will be photographed to provide a calibration scale of known size, allowing actual size measurements to be obtained (Durban and Parsons, submitted). This simple approach has been shown to be an effective and non-invasive way for obtaining useful morphometric measurements, and can be routinely implemented alongside photo-identification studies (Durban and Parsons, submitted). Prey remains will be collected in conjunction with photo-identification surveys form boat platforms, and remains will be linked to individual whale identifications where possible. Samples will be labeled with the whale identification, encounter number and location, and preserved in alcohol within sterile containers.

Aerial surveys

A key knowledge gap for SRKWs is the wider distributional range of the whales, particularly beyond the core inshore waters and outside of the summer months (Killer Whale

Recovery Team 2005; NMFS 2005). We propose to collect data on wider distributional patterns, at the level of individual pods and matrilines, using aerial survey platforms. Fixed wing, amphibious aircraft will be used on an opportunistic basis and as part of a routine survey plan to study distributional and movement patterns. These surveys may cover any part of the range of this population, however they will primarily be used to extend survey effort beyond the inshore waters of WA, or to cover this area more fully during winter months. When killer whales are sighted, Digital SLR cameras and digital video will be used to obtain overhead images of killer whale saddle patches that can be matched to the high quality CWR catalogue of individual whales to determine the composition of located groups. Additionally, high quality photographs will be used for photogrammetric measurements (e.g. Perryman and Lynn, 2002). In order to provide the opportunity to obtain high quality images, multiple passes may be made over a group of whales. However, groups will be circled only enough to obtain a good photograph, and no more. Aerial surveys will generally be flown at around 750ft altitude, and we anticipate that this will not elicit a behavioral response from the whales. If animals appear to respond to the presence of an aircraft, the aircraft will leave the vicinity immediately.

Capture:

No animals will be captured**.**

Handling/Restraint:

No animals will be restrained.

***Sample collection and analysis*:**

Non marine mammal (i.e. fish) prey remains will be collected in conjunction with photo-identification surveys form boat platforms, and remains will be linked to individual whale identifications where possible. Samples will be labeled with the whale identification, encounter number and location, and preserved in alcohol within sterile containers. Samples will later be analyzed as part of a long-term collaboration with Canadian scientists at Fisheries Oceans Canada (e.g. Ford et al. 1998), using genetic approaches to allow an assignment to species and stock (particularly for salmon), where possible. These opportunistic collections will be conducted in conjunction with photo-identification surveys. No additional takes will be associated with these activity, as this involves inspection of the water that has been disturbed by surfacing whales after they have moved from the vicinity.

***Scientific instruments*:**

No scientific instruments will be placed as part of this research.

Marking:

No animals will be marked during the course of these surveys.

Acoustics

No active acoustic studies will be conducted as a part of this research.

The following has been added to this application at the request of the applicant. In an email dated January 4, 2006, John Durban wrote:

"CWR will continue to routinely use passive acoustics to facilitate the detection of vocalizing killer whales; to use acoustic calls to identify killer whales to ecotype, population and acoustic clan; and to monitor the predation behavior of transient killer whales that are typically vocally active only after a kill. Passive acoustic data will be collected using single fixed hydrophones that will be mounted below the water line at strategic shore stations (e.g. at CWR, San Juan Island). Where the use of fixed hydrophones is not feasible, modified sonobuoys may be attached to moorings that will transfer acoustic data to shore stations using VHF signals. Acoustic data will also be collected opportunistically from boat platforms that will be stationary with engines turned off. Boat-based passive acoustic data will therefore be collected at distances that will not cause disturbance to the whales and therefore will not involve any additional takes."

3. Import/Export of Marine Mammals/Marine Mammal Parts

No samples will be imported or exported under this permit.

4. Removing Animals from the Wild into Captivity/ Research or Enhancement on Captive or Rehabilitating Animals

No animals will be removed from the wild and no research on captive animals will be done.

5. Lethal Take

No marine mammals will be lethally taken as a part of these studies.

D. Resources needed to accomplish objectives

CWR have been conducting photo-id studies of SRKWs since 1976. This proposal is to continue this ongoing project.

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

Effects

We do not expect any lasting effects of vessel approaches, and in most cases no response at all. However, it is possible that the whales may show short-term avoidance to approaching vessels, such as subtle changes in direction.

Alternatives

Vessel surveys are necessary to document all the individuals in the population to continue this 30+ year annual photographic inventory. Limited photo-identification studies could be conducted from shore, but this would not provide sufficient resolution for monitoring this population. Additionally, vessel and aerial surveys for photo-identification are necessary to survey widely throughout the range of this population in order to document the movement and distribution patterns of individual whales.

Incidental effects

Killer whales travel in stable, social groupings, and therefore all individuals encountered will be subject to vessel and aerial approaches for photo-identification.

Aerial and boat surveys

We do not expect any lasting effects of approaches, and in most cases no response at all. However, it is possible that the whales may show short-term avoidance to approaching vessels, such as subtle changes in direction.

Aerial surveys will generally be flown at around 750ft altitude, and we anticipate that this will not elicit a behavioral response from the whales. If animals appear to respond to the presence of an aircraft, the aircraft will leave the vicinity immediately.

During boat approaches, we will attempt to limit close approach to the whales for photo-identification purposes, but anticipate that this will require approaches to within approximately 15-25m in order to obtain reliable individual documentations, depending on sighting conditions. Based on our experience, we anticipate that the majority of photo-identification approaches will not elicit a behavioral response from the whales. If there is evidence of avoidance, a maximum of three approaches will be attempted before the encounter is terminated.

Capture

No marine mammals will be captured as a part of these studies.

Handling/Restraint

No marine mammals will be handled or restrained as a part of these studies.

Sample collection

Non-marine mammal (i.e. fish) prey samples (e.g. salmon scales) will be collected opportunistically in conjunction with photo-identification surveys. No additional takes will be associated with this activity, as this involves inspection of the water that has been disturbed by surfacing whales after they have moved from the vicinity.

Scientific Instruments

No instruments will be places on marine mammals as a part of these studies.

Marking

No marine mammals will be marked as a part of these studies.

Acoustics

Active acoustic devices will not be used as part of this study.

Incidental Harassment

Because killer whales travel in stable groupings, all individuals encountered will be subject to vessel approaches for photo-identifications.

Measures to minimize effects

During aerial surveys, if animals appear to respond to the presence of an aircraft, the aircraft will leave the vicinity immediately.

Vessel surveys will always involve boat pilots experienced in approaching whales. The approaches will be gradual and will be designed to minimize or avoid any sort of startle

response. If there is evidence of avoidance, a maximum of three approaches will be attempted before the encounter is terminated.

Monitoring effects of activities

The behavior of whales will be monitored during encounters, and any avoidance to vessels will be documented. During aerial surveys, if animals appear to respond to the presence of an aircraft, the aircraft will leave the vicinity immediately. If there is evidence of avoidance to boat approaches, a maximum of three approaches will be attempted before the encounter is terminated.

F. Publication of Results

CWR will continue to produce an annual catalogue of individual whales photographically identified from the SRKW population. Each year, this catalogue will be circulated to specific members of the respective community, environmentalists, research scientists, and managers as appropriate. Results from this long-term research project will continue to be published in scientific peer-reviewed journals, books and popular articles. See Appendix II for a list of publications from the Center for Whale Research.

V. National Environmental Policy Act (NEPA) 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?*

No new, innovative or experimental equipment or techniques will be applied. CWR has used photo-identification as the primary method for studying the status of the SRKW population since 1976 (e.g. Ford et al 2000; Ford et al. 1994; Bigg et al. 1987). These photo-identification catalogues are widely used by both the scientific community and public.

(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.

No. The research does not involve the collection of potentially infectious agents or pathogens.

(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.)?

Some opportunistic research encounters may be conducted near or in National Marine Sanctuaries (with prior approval and appropriate permits), or near or in Marine Protected Areas. Although some research may be conducted near National Marine Sanctuaries or Marine Protected areas, the research would not impact the physical environment.

(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?

No.

Photo-identification studies have been used since the 1970's to monitor this population in an annual photographic inventory.

(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. The research does not involve any land-based techniques, nor would it affect species used for subsistence purposes.

(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.

No. The research does not involve transport of any tissues that could result in the introduction of microbes or other biological agents. Prey samples will be preserved immediately with a chemical preservative.

VI. Previous and Other Permits

A. Previous Permits

The applicant has been issued NMFS Permits in the distant past, eg: #56 and #437

B. Other Permits

The applicant has conducted research in the recent past as agent under permits issued to NOAA Northwest Fisheries Science Center and NOAA National Marine Mammal Laboratory, most recently under MMPA Permits No. 782-1510-02 and 781-1725-00. The applicant has also studied marine mammals under License #MML-2004-005 from DFO Canada, and more recently as agent for Dr. John Ford, DFO, Canada.

Dr. Durban is a current CI authorized on MMPA permit no. 782-1719 issued to the NOAA National Marine Mammal Laboratory. Both Dr Durban and Dr Parsons are current CIs on MMPA permit 774-1714 issued to the NOAA Southwest Fisheries Science Center. These authorizations are related to their status when acting as contractors to NOAA.

VII. Literature Cited

Angliss R. P. and K. L. Lodge. 2004. Alaska marine mammal stock assessments, 2002. US Dept. of Commerce, NOAA Tech. Memo. NOAA-TM-NMFS-AFSC-144, 230 p.

Balcomb, K.C. and Goebel, C.A. 1976. A killer whale study in Puget Sound. Final report, Contract No. NASO-6-35330. Marine Mammal Division, National Marine Fisheries Service, Seattle, WA, 11p.

Balcomb, K.C. III and Bigg, M.A. 1986. Population biology of three resident killer whale pods in Puget Sound and off southern Vancouver Island. *In* B.C. Kerkevold and J.S. Lockard (eds.), Behavioural biology of killer whales, p85-95. Alan R. Liss, Inc., New York.

Barrett-Lennard, L.G. 2000. Population structure and mating patterns of killer whales as revealed by DNA analysis. Ph.D. thesis, Univeristy of British Columbia, Vancouver, B.C.

Barrett-Lennard, L.G. and Ellis, G.M. 2001. Population structure and genetic variability in northeastern Pacific killer whales: Towards and assessment of population viability. Research document 2001/065, Department of Fisheries and Oceans Canada, Nanaimo, B.C. 35p.

Bigg, M.A. et al. 1987. Killer Whales: A Study of Their Identification, Genealogy and Natural History in British Columbia and Washington State. Phantom Press, Nanaimo. 79p.

Bigg, M.A. et al. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Reports of the International Whaling Commission, Special Issue 12: 383-405.

Brault, S. and Caswell, H. 1993. Pod-specific demography of killer whales (*Orcinus orca*). Ecology 74(5): 1444-1454.

Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M.S. Lowry 2005. U.S. Pacific marine mammal stock assessments: 2004. US Dept. of Commerce, NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-375, 322 p.

Durban, J.W. 2002. Bayesian methods for marine mammal population assessment. Pd.D. thesis, University of Aberdeen, Aberdeen, U.K.

Durban, J. and Parsons, K. submitted. Size matters: laser-metrics of free-ranging killer whales.

Ford, J,K,B and Ellis, G.M. 1999. Transients: mammal-hunting killer whales of British Columbia, Washington, and Southeastern Alaska. UBC Press, Vancouver, Canada.

Ford, J.K.B. et al. 1994. Killer Whales: The natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. UBC Press, Vancouver.

Ford, J.K.B. et al. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76(8): 1456-1471.

Ford, J.K.B. et al.. 2000. Killer Whales: The natural history and genealogy of Orcinus orca in British Columbia and Washington State, Second Edition. UBC Press, Vancouver.

Heimlich-Boran, J.R. 1986. Behavioural ecology of killer whales (Orcinus orca) in the Pacific Northwest. Canadian Journal of Zoology 66: 565-578.

Killer Whale Recovery Team. 2005., DRAFT National Recovery Strategy for Northern and Southern Resident Killer Whales (*Orcinus orca*). Prepared for Public Consultations, Spring 2005, for Fisheries and Oceans Canada, on behalf of the Resident Killer Whale Recovery 6Team. 70 pp.

Krahn, M.M. et al. 2002. Status review of southern resident killer whales (Orcinus orca) under the Endangered Species Act. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-54, 133p.

National Marine Fisheries Service, 2005. Proposed Conservation Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington. 183pp.

Olesiuk, P.F. et al. 1990. Life history and population dynamics of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Reports of the International Whaling Commission 12: 209-244.

Osborne, R.W. 1999. A historical ecology of Salish Sea "resident" killer whales (O*rcinus orca*): with implications for management. Ph.D. Thesis, University of Victoria, Victoria, British Columbia.

Parsons, K., Durban, J. and Balcomb, K.C. In Prep. Quantifying the social dynamics of southern resident killer whales.

Perryman, W.L. and Lynn, M.S. 2002. Evaluation of nutritive condition and reproductive status of migrating gray whales (Eschrichtius robustus) based on analysis of photogrammetric data. Journal of Cetacean Research and Management 4: 155-164

Ross, P.S. et al. 2000. High PCB concentrations in free-ranging Pacific killer whales, Orcinus orca: Effects of age, sex and dietary preference. Marine Pollution Bulletin 40(6): 504-515.

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

The Fur Seal Act of 1966 (16 U.S.C. 1151-1175).

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.

Signed and Dated

_____ _____

Kenneth C Balcomb III — Date
Director
Center for Whale Research
355 Smuggler's Cove Rd.
Friday Harbor, WA 98250

ATTACHMENTS:

Table 1. Takes of killer whales.						
Activity	Species	Age	Sex	Location	Takes per animal per year	Takes per species per year
Unintentional harassment from aerial surveys	Southern Resident killer whale, *Orcinus orca*	All ages	Both sexes	North Pacific Ocean, particularly California to SE Alaska	30	500
Unintentional harassment from vessel surveys	Southern Resident killer whale, *Orcinus orca*	All ages	Both sexes	Same as above	30	500
Photo-identification	Southern Resident killer whale, *Orcinus orca*	All ages	Both sexes	Same as above	30	500
Unintentional harassment from aerial surveys	killer whale, *Orcinus orca*, NOT southern resident	All ages	Both sexes	Same as above	30	500
Unintentional harassment from vessel surveys	killer whale, *Orcinus orca*, NOT southern resident	All ages	Both sexes	Same as above	30	500
Photo-identification	killer whale, *Orcinus orca*, NOT southern resident	All ages	Both sexes	Same as above	30	500

Table 2: Species that may be incidentally taken during the course of killer whale surveys		
Species	Status	Type of Incidental Encounter
Dall's Porpoise *Phocoenoides dalli*	Not listed ESA Not depleted MMPA	Occasionally associate with killer whales; attracted to survey vessels; transient killer whale prey
Pacific White-sided dolphin *Lagenorhynchus obliquidens*	Not listed ESA Not depleted MMPA	Occasionally associate with killer whales; attracted to survey vessels; transient killer whale prey
Harbor Porpoise *Phocoena phocoena*	Not listed ESA Not depleted MMPA	transient killer whale prey
Minke Whale *Balaenoptera acutorostrata*	Not listed ESA Not depleted MMPA	transient killer whale prey
Humpback Whale *Megaptera novaengliae*	Endangered ESA Depleted MMPA	transient killer whale prey
Gray Whale (eastern North Pacific) *Eschrichtius robustus*	Not Listed ESA Not Depleted MMPA	transient killer whale prey
Harbor Seal *Phoca vitulina richardsi*	Not listed ESA Not depleted MMPA	transient killer whale prey
California Sea Lion *Zalophus californianus californianus*	Not listed ESA Not depleted MMPA	transient killer whale prey
Steller Sea Lion (eastern U.S. stock) *Eumetopias jubatus*	Threatened ESA Depleted MMPA	transient killer whale prey
Elephant Seal *Mirounga augustirostris*	Not listed ESA Not depleted MMPA	transient killer whale prey
Northern Fur Seal *Callorhinus ursinus*	Not listed ESA Not depleted MMPA	transient killer whale prey
Sea Otter (CA) *Enhydra lutris nereis*	Threatened ESA Depleted MMPA	transient killer whale prey
Sea Otter (SE Alaska, WA) *Enhydra lutris nereis*	Not Listed ESA Not Depleted MMPA	transient killer whale prey

List of Appendices

355 Smuggler's Cove
Friday Harbor, WA 98250

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Fax 360 378-5954
E-mail orcasurv@rockisland.com

Kenneth C. Balcomb, III

Objective

Curriculum Vitae

Work experience

1985 – Present Center for Whale Research Friday Harbor, WA

Executive Director and Senior Scientist

- Found and direct a non-profit organization for the purpose of promoting and conducting benign scientific research on whales, dolphins and porpoises. Specialty in photo-identification studies of killer whales, humpback whales and beaked whales.

1976 – 1985 Ocean Research and Education Society Gloucester, MA

Whale Research Biologist

- Plan research vessel itinerary for scientific research program on the ecology, distribution and population dynamics of humpback whales and other cetaceans in the North Atlantic and North Pacific Oceans.
- Prepare curriculum and instruct college-level courses in biological oceanography, bioacoustics, marine mammal biology, and physical oceanography.

1973 – 1975 United States Navy

Lieutenant

- Officer in Charge (OINC) oceanographic detachment in Commander US Naval Forces, Japan. Conduct military oceanographic research in North Pacific Ocean.

1972 (summer) Fisheries Research Board of Canada Quebec

Biologist

- Collect data and specimen materials from whales taken in commercial whaling from land stations in Newfoundland and Nova Scotia.
- Conduct oceanographic surveys and whale marking expeditions in the Western North Atlantic Ocean.

1967 – 1972 United States Navy

Ensign and Lieutenant jg

- Officer and Oceanographer. Duty stations in Florida, Texas, Virginia, Washington and Midway Island. Carrier-qualified aviator with Oceanographic specialty in Sound Surveillance System (SOSUS).

1966 US National Museum (Smithsonian Institution), Washington, DC

Field Curator

- Conduct research on the distribution of seabirds in the Central Pacific Ocean for the Pacific Ocean Biological Survey Program.

1964 – 1966 US Fish and Wildlife Service, NMML (now NMFS), Seattle, WA

Biological Technician

- Collect data and specimen materials from whales taken in commercial fisheries from land stations in Richmond California.
- Conduct at-sea surveys and whale-marking expeditions in the Eastern North Pacific Ocean.

1963 – 1964 Anatomy Department, University of California Veterinary School, Davis, CA

Laboratory Technician

- Prepare specimen materials for histological examination. Special qualifications in comparative anatomy of lung tissues and adaptations of terrestrial and diving mammals.

Education

1972 - 1973 University of California Santa Cruz, CA

Marine Biology Graduate Studies

- Coursework in Biochemistry, Marine Mammal Biology, and Statistics.
- Fieldwork in Marine Mammal Biology with Dr. Ken Norris.

1963 University of California Davis, CA

Bachelor of Arts, Zoology

- Coursework in Chemistry, Philosophy, Physics, and Zoology,
- Specimen preparation work with Dr. Milton Hildebrand.

Professional memberships

Charter Member, Society for Marine Mammalogy; Member, American Society of Mammalogists; Charter Member, Sociedad Mexicana para Estudio de Mammiferos Marinos; Member, IUCN/SSC Whale Specialist Group; Invited Specialist, Scientific Committee, International Whaling Commission (IWC).

Publications

Appended.

John William Durban B.Sc., Ph.D.

Research Scientist
Center for Whale Research
Friday Harbor, WA 98250

Research Associate
Alaska Fisheries Science Center, NOAA
7600 Sand Point Way NE, Seattle WA 98115

Tel. (206) 526-4539, Email: John.Durban@noaa.gov

RESEARCH SUMMARY:

- Population ecology of marine mammals
- Field research: photo-id, line-transect surveys, remote biopsy sampling, photogrammetry
- Bayesian statistical methods for population assessment and decision analysis.

QUALIFICATIONS:

1998 **B.Sc.** Zoology-Animal Ecology (First Class Honours), University of Aberdeen, U.K.
2002 **Ph.D.** Zoology, *"Bayesian Methods for Marine Mammal Population Assessment"*, University of Aberdeen, Aberdeen, U.K.

CURRENT POST-DOCTORAL RESEARCH POSITION:

January 2003 – December 2005

- National Research Council (U.S.) Research Associateship hosted by NOAA, Seattle, WA.
- Bayesian approaches for estimating population parameters for cetaceans
- Killer whale population assessment in the western Gulf of Alaska, Bering Sea and Aleutian Islands.

SKILLS SUMMARY

Field-work skills

- Survey design for marine mammal population monitoring
- Photo-id techniques and line-transect surveys
- Remote biopsy tissue sampling from free-ranging cetaceans
- Photogrammetric techniques for morphometric measurements of free-ranging cetaceans
- Boat piloting (Commercially endorsed advanced Powerboat License, Royal Yaughting Association).
- Licensed VHF radio operator, experienced with GPS Navigation.
- Working as part of research teams in remote locations (Alaska, Scotland, Bahamas)
- NOAA cruise-leader experience (2003, 2004, 2005)
- Supervision of eco-tourism projects; running a research station

Data analysis and statistical modeling:

- Bayesian statistical methods
- MCMC computer intensive simulation
- Mark-recapture, state-space, time-series, and generalized linear modeling
- Programming in S-Plus, BUGS and WinBUGS.
- Database design (MS Access)

PUBLICATIONS:

Parsons, K.M., **Durban, J.W.,** Claridge, D.E. Herzing, D.L., Balcomb, K.C. and Noble, L.N. (2006) Population genetic structure of coastal bottlenose dolphins (*Tursiops truncatus*) in the northern Bahamas. In press *Marine Mammal Science.*

Lusseau, D, Wilson, B, Hammond, P.S., Grellier, K, **Durban, J.W**, Parsons, Barton, T.B, and & Thompson, P.M. (2006) Quantifying the influence of sociality on population structure in bottlenose dolphins. In press *Journal of Animal Ecology*.

Durban, J.W. and Elston, D. A. (2005) Mark-recapture with occasion and individual effects: abundance estimation through Bayesian model selection. In press *Journal of Agricultural, Biological and Environmental Statistics*.

Durban, J.W., Elston, D.A., Ellifrit, D.K., Dickson, E., Hammond, P.S. and Thompson, P.M. (2005) Multi-site mark-recapture for cetaceans: population estimates with Bayesian model averaging. *Marine Mammal Science* 21(1): 80-92.

Durban, J.W. (2005) Clustered mark-recapture for analysis of social populations. In review *Ecology*.

Herman, D.P. , D.G. Burrows, P. R. Wade, **J.W. Durban**, R.G. LeDuc, C.O. Matkin, L. Barrett-Lennard. and M.M. Krahn. (2005). Ecotype classification and prey preferences of eastern North Pacific killer whale populations from fatty acid, stable isotope, and organochlorine analyses of blubber biopsies. In press *Marine Ecology Progress Series*.

Urian, K.W., **Durban, J.W**., Waples, D., Barco, S., Bowles, N., Mallon-Day, R., Rittmaster, K., Rountree, G., Sayigh, L., Schofield, D., Thayer, V., Young, R. and Read, A.J. (2004) Abundance and stock identity of bottlenose dolphins along the Outer Banks of North Carolina. In review *Journal of Cetacean Research and Management*.

Parsons, K.P., **Durban, J.W.** and Claridge, D.E. (2004) Male-male aggression renders dolphin unconscious. In press, *Aquatic Mammals*, 29.3: 360-362.

Durban, J.W. (2002) *Bayesian methods for marine mammal population assessment*. PhD Thesis, University of Aberdeen, U.K.

Parsons, K.M., **Durban, J.W**. and Claridge, D.E. (2002) Comparing two alternative methods for sampling small cetaceans for molecular analysis. *Marine Mammal Science*, 19(1):224-231.

Parsons, K.M., **Durban, J.W**., Claridge, D.E., Balcomb, K.C., Noble, L.R. and Thompson, P.M. (2002). Kinship as a basis for alliance formation between male bottlenose dolphins, *Tursiops truncatus*, in the Bahamas. *Animal Behaviour* 66: 186-194.

Durban, J.W., Thompson, P.M., Elston, D.A. and Lambin, X (2000) A role for Bayesian inference in cetacean population assessment and management decisions. *Journal for Cetacean Management and Conservation* 2(2), 117-123.

Durban, J.W., Parsons, K.M., Claridge, D.E. and Balcomb, K.C. (2000) Quantifying dolphin occupancy patterns. *Marine Mammal Science* 16(4): 825-828.

Parsons, K.M., Dallas, J.F., Claridge, D.E., **Durban, J.W**., Balcomb, K.C., Thompson, P.M., and Noble, L.R. (1999). Amplifying dolphin mitochondrial DNA from faecal plumes. *Molecular Ecology* 8: 1766-1768.

CONFERENCE PRESENTATIONS:

Durban, J.W, Balcomb, K.C., Ellifrit, D.E. and Wade, P.R. (2004) Does mark-recapture work for cetaceans? Talk presentation, 15th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada.

Mackey, B., **Durban, J,** Middlemass, S. and Thompson, P. (2004) Estimating survival of harbour seals from sparse photo-id data. Talk presentation, 15th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada.

Durban, J. (2002) Bayesian models and model selection for marine mammal population assessment. Seminar, Royal Statistical Society, Highland Group Meeting, Aberdeen

Durban, J., Middlemass, S., Elston, D., Wilson, B, Grellier, K., Hammond, P.S., Thompson, P.M. (2001). Assessing the role of environmental variability on dolphin abundance trends. Talk presentation, 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada.

Durban, J., Claridge, D.E., Parsons, K.M., Ellifrit, D.K., Balcomb, K.C. (2001). Quantifying turnover in a population of dense beaked whales. Talk presentation, Beaked Whale Workshop, 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada.

Middlemass, S.J., **Durban, J.W.**, Mackey, B.L., Armstrong, J.D., Hiby, L., Thompson, P.M. (2001). Combining regular counts and photo-identification to assess harbour seal abundance on a small scale. Poster presentation, 14th Biennial Conference on the Biology of Marine Mammals, Vancouver, Canada.

Durban, J.W., Thompson, P.M. (2000) Bayesian trend analysis of a vulnerable dolphin population. Poster presentation, Student Conference for Conservation Science, Cambridge, U.K.

Durban, J.W., Elston, D.A., Thompson, P.M (2000) Bayesian trend analysis for marine mammal populations. Talk presentation, European Cetacean Society Conference, Cork, Ireland.

Durban, J.W., Elston, D.A., Thompson, P.M (2000) Marine mammal population assessment: linking observations to population processes. Talk presentation, Annual Meeting of Biomathematics and Statistics Scotland, Aberdeen, U.K.

Durban, J.W., Parsons, K.M. (1997). Aspects of the social structure of bottlenose dolphins in the Sea of Abaco, NE Bahamas. Poster presentation, Mammal Society Conference, St. Andrews, U.K.

UNPUBLISHED REPORTS:

Thompson, P.M., Tufft, L., Spencer, N., Grellier, K and **Durban, J.** (2000). *Evaluation of techniques* for monitoring the abundance and behaviour of bottlenose dolphins - the Kessock Channel as a case study. Scottish Natural Heritage Commissioned Report F99LE01.

Claridge, D.E., Balcomb, K.C and **Durban, J.W.** (2000) Preliminary Report on the Occurrence, Distribution and Occupancy of Ziphiids and Balaenopteriids in the northern Bahamas 1997-1999. *Report to the U.S. National Marine Fisheries Service.*

Claridge, D.E., Balcomb, K.C., Parsons, K.M. and **Durban, J.W**. (1999, 2000, 2001) Bahamas Marine Mammal Survey field report. *Report to Bahamas Department of Fisheries*.

FIELD RESEARCH EXPERIENCE:

- **Cruise Leader, National Marine Mammal Laboratory (NOAA), (2003, 2004, 2005)**

Project: Cetacean surveys in the Gulf of Alaska, Bering Sea and Aleutian Islands, with focus on the distribution, abundance and diet of killer whales.
Involvement: Chief Scientist on large-vessel line-transect surveys for assessing cetacean distribution and abundance; small boat approaches for individual photo-identification and biopsy tissue sampling of killer whales, humpback whales, N. Pacific right whales, fin whales, sperm whales and beaked whales.

- **Research staff, Bahamas Marine Mammal Survey (1995 - current)**

Project: Surveying the occurrence, distribution and abundance of marine mammals in Bahamian waters. Focussed population studies of bottlenose dolphins and dense-beaked whales in the NE Bahamas.
Involvement: Co-Principal Investigator of *Earthwatch* field project, design and execution of small-boat photo-identification surveys, remote biopsy tissue collection from cetaceans, photographic analysis for individual recognition of cetaceans, running of a remote field research station, supervision of eco-tourism project.

- **Postgraduate research student, University of Aberdeen (1999-2002)**

Project: Monitoring the abundance and status of bottlenose dolphins around NE Scotland.
Involvement: Project steering, design and execution of photo-identification surveys, analysis of photo-id data, small boat piloting, supervision of undergraduate student projects.

- **Volunteer research assistant, Center for whale Research, W.A. (summer 1993-1995)**

Project: Long-term study of killer whale population ecology.
Involvement: Photo-identification techniques, small boat piloting.

COMMITTEE MEMBERSHIP

2000 - Member of the Special Area of Conservation monitoring group for bottlenose dolphins in the Moray Firth, NE Scotland. Convened by Scottish Natural Heritage and the Moray Firth Partnership.

2004 - Member of the Species at Risk recovery team for northern and southern resident killer whales, convened by the Department of Fisheries and Oceans Canada.

AWARDS:

- Postgraduate Scholarship from the Carnegie Trust for the Universities of Scotland, 1998 – 2002.
- City of Aberdeen Quincentenary Medal, 1998.
- MacGillivray Prize in Zoology, University of Aberdeen, 1997.

PERSONAL DETAILS

Date of Birth: 1st July 1976 | Place of Birth: Aylesbury, Buckinghamshire, U.K.
Nationality: British | Marital Status: Married

REFEREES

Dr Paul M. Thompson
University of Aberdeen, Lighthouse Field Station, George Street, Cromarty, Ross-Shire IV11 8YJ
Tel. and Fax (01381) 600 548. Email: lighthouse@aberdeen.ac.uk

Dr. David A. Elston
Biomathematics and Statistics Scotland, Environmental Modelling Unit, Macaulay Land Use Research Institute, Aberdeen AB15 8QH, UK. Tel. (01224) 318611, Fax (01224) 312147. Email: d.elston@macaulay.ac.uk

Dr. Paul R. Wade
Alaska Fisheries Science Center, NOAA Fisheries, 7600 Sand Point Way NE, Seattle WA 98115-6349, USA. Tel. (206) 526-4021, Fax: (206) 526-6615, Email: Paul.Wade@noaa.gov

Curriculum vitae

Kim Michelle Parsons, B.Sc., Ph.D.

Research Scientist - Center for Whale Research, Friday Harbor, WA 98250

Research Associate - Northwest Fisheries Science Center, NOAA, 2725 Montlake Blvd. E, Seattle, WA 98112

Phone: (206) 860 6782 email: Kim.Parsons@noaa.gov

Personal profile

My research interests are primarily focused on the social ecology of vertebrates, and the integral role that an understanding of social organisation and population structuring plays in conservation and management objectives. My work often incorporates the integration of individual-based observational data and molecular genetic data to address questions of population structuring, ecology and conservation. The integration of these direct and indirect data facilitates clustering methods to be applied at the level of an individual and can prove valuable in the assessment of population processes.

Education

- *University of Aberdeen, UK, 1997 – 2002*
  PhD in Zoology
  Thesis: The use of molecular and observational data to infer the structuring of bottlenose dolphin populations.
  (Supervisors: Dr. Paul M. Thompson, Dr. Les R. Noble)

- *University of Victoria, Canada, 1989 – 1994*
  BSc in Biology (First class)

Career Summary

NRC Postdoctoral Research Fellow, NOAA, NWFSC, Seattle, WA Social dynamics of fish-eating killer whales in the northeast Pacific.	03/04	To	12/05
Contract Biologist, NOAA, National Marine Mammal Laboratory, WA Photo-identification and biopsy sampling of killer whales in central and western Alaska (DART 2003 survey).	07/03	To	08/03
Research Contract, University of Aberdeen, Lighthouse Field Station (UK) Photographic matching and identification of bottlenose dolphins encountered in NE Scotland during 2002.	05/03	To	09/03
Research Contract, Joint Nature Conservancy Council (UK) Developed a procedural guideline for the use of photo-identification to monitor changes in the abundance of bottlenose dolphins in SAC's.	01/03	To	03/03
Postdoctoral Research Fellow, University of Aberdeen, Zoology Dept. Developed a molecular genetic assay to identify salmonid prey species from the seal scat matrix using a PCR-RFLP approach.	10/02	To	12/02
Postdoctoral Teaching Fellow, University of Aberdeen, Zoology Dept. Lecturer, BSc undergraduates and MSc Marine & Fisheries; Supervisor of honours' and MSc student research projects; Organiser of undergraduate & postgraduate residential field courses.	01/02	To	10/02

NSERC funded PhD research student, Zoology, University of Aberdeen	10/97	To	12/01
Co-Principal Investigator: Bahamas Marine Mammal Survey (a Center for Whale Research project)	01/97	To	Current
Teaching assistant for undergraduate practicals (level 1-3): Zoology Dept., University of Aberdeen	10/97	To	05/00
Research Assistant: Zoology Dept., University of Aberdeen	04/97	To	06/97
Hon. Research Assistant: Experimental Taxonomy Lab, Zoology Dept., University of Aberdeen	10/96	To	03/97
Co-Coordinator: Student marine mammal research internship program, Abaco, Bahamas	06/96	To	09/96
Research Assistant: Bahamas Marine Mammal Survey	10/94	To	04/95
Boat captain and naturalist: Seacoast Expeditions, Victoria, B.C.	05/92	To	09/95
Research Assistant, B.C. (Canada): Marine Mammal Research Group & Cetacean Stranding Network	06/91	To	06/95

Scientific publications

.

[1] Durban, JW and **Parsons, KM** (Submitted) Quantifying clusters in social populations. *Animal Behaviour.*

[2] Durban, JW and **Parsons, KM** (Submitted) Size matters: Laser-metrics of free-ranging killer whales. *Marine Mammal Science.*

[3] Corkrey, R., Brooks, S., Lusseau, D., **Parsons, K**., Durban, J.W., Hammond, P.S. & Thompson, P.M. (Submitted) A Bayesian capture-recapture population model with simultaneous estimation of heterogeneity. *Journal of the American Statistical Association.*

[4] Lusseau, D, Wilson, B, Hammond, PS, Grellier, K, Durban, JW, **Parsons, KM**, Barton, TR, Thompson, PM (In Press) Quantifying the influence of sociality on population structure in bottlenose dolphins. *Journal of Animal Ecology*.

[5] **Parsons, KM**, Durban, JW, Claridge, DE, Herzing, DL, Balcomb, KC, Noble, LR (In Press) Population genetic structure of coastal bottlenose dolphins (*Tursiops truncatus*) in the northern Bahamas. *Marine Mammal Science.*

[6] **Parsons, KM**, Piertney, SB, Middlemas, SJ, Hammond, PS, Armstrong, JD (2005) DNA-based identification of salmonid prey species in seal faeces. *Journal of Zoology* **266**:1-7.

[7] Hastie, GD, Wilson, B, Wilson, LJ, **Parsons, KM**, Thompson, PM (2004) Functional mechanisms underlying cetacean distribution patterns: hotspots for bottlenose dolphins are linked to foraging. *Marine Biology* **144**:397-403.

[8] **Parsons, KM**, Durban, JW, Claridge, DE (2003) Male-male aggression renders bottlenose dolphin (*Tursiops truncatus*) unconscious. *Aquatic Mammals* **29**(3):360-362.

[9] **Parsons, KM**, Durban, JW, Claridge, DE, Balcomb, KC, Noble, LR, Thompson, PM (2003) Kinship as a basis for alliance formation among male bottlenose dolphins (*Tursiops truncatus*) in the Bahamas. *Animal Behaviour* **66**:185-194.

[10] **Parsons, KM**, Durban, JW, Claridge, DE (2003) Comparing two alternative methods for sampling small cetaceans for molecular analysis. *Marine Mammal Science.* **19**(1):224-231.

[11] Berrow, SD, McHugh, B, Glynn, D, McGovern, E, **Parsons, KM**, Baird, RW, Hooker, SK (2002) Organochlorine concentrations in resident bottlenose dolphins *Tursiops truncatus* sampled by biopsy darts in the Shannon Estuary, Ireland. *Marine Pollution Bulletin*. **44**:1294-1301.

[12] **Parsons, KM**, Noble, LR, Reid, RJ, Thompson, PM (2002) Mitochondrial genetic diversity and population structuring of UK bottlenose dolphins (*Tursiops truncatus*): is the NE Scotland population demographically and geographically isolated? *Biological Conservation*.**108**:175-182.

[13] **Parsons, KM** (2001) Reliable microsatellite genotyping of dolphin DNA from faeces. *Molecular Ecology Notes*. **100**:341-344.

[14] Durban, JW, **Parsons, KM**, Claridge, DE, Balcomb, KC (2000) Quantifying dolphin occupancy patterns. *Marine Mammal Science.* **16**(4):825-828.

[15] **Parsons, KM**, Dallas, JF, Claridge, DE, Durban, JW, Balcomb, KC, Thompson, PM, Noble, LR (1999) Amplifying dolphin mitochondrial DNA from faecal plumes. *Molecular Ecology.* **8**:1766 – 1768.

Scholarships & Awards

1997 through 2000	Overseas Research Studentship Granted by the Committee of Vice-chancellors & Principals of UK universities (CVCP)
1998 through 1999	British Council Chevening Postgraduate Scholarship
1998 through 2000	Natural Sciences & Engineering Research Council of Canada Postgraduate (PGS A) Scholarship
2000 through 2002	Natural Sciences & Engineering Research Council of Canada Postgraduate (PGS B) Scholarship
2000	European Cetacean Society Conference - Oral presentation award.

Grants

2002 Atlantic Salmon Trust (£2000)
Research grant to fund a collaborative project (2001-2002) with the Freshwater Fisheries Laboratory on the molecular genetic identification of salmonid prey species from seal faeces.

2000 Aberdeen University Principal's Fund (£200)
Grant to attend European Cetacean Society conference in Cork, April 2000

2000 British Ecological Society Student Grant (£100)
Grant to attend Ecological Genetics Group conference, April 2000.

1998 – 1999 Friends of the Environment – Abaco (Bahamas) regional division
Grant and grant-in-kind for costs to continue research on the bottlenose dolphins inhabiting the inshore waters of the Sea of Abaco.

1992 – 2002 Center for field research, USA (Earthwatch)
Annual grant to fund long-term research project *Bahamas Whales & Dolphins* that is supported through the participation of *Earthcorps* volunteers.

Other publications

[1] **Parsons, KM** (2003) Procedural guideline on using photographic identification techniques for assessing bottlenose dolphin (*Tursiops truncatus*) abundance and behaviour. *Joint Nature Conservation Committee Procedural Guideline* for the *Complete Marine Monitoring Handbook (http://www.jncc.gov.uk).*

[2] **Parsons, KM**, Piertney, SB, Middlemas, S, Thompson, PM, Armstrong, J (2002) The use of DNA to identify and distinguish between salmon and sea trout in seal faeces. *Report to the Atlantic Salmon Trust.*

[3] Claridge, DE, Balcomb, KC, **Parsons, KM** (1999) Bahamas Whales and Dolphins. *Annual Field Report to Earthwatch Institute.*

[4] Claridge, DE, **Parsons, KM**, Balcomb, KC, Durban, JW (1999) Dolphin occurrence in the Pelican Cays land and sea park. *Report to the Bahamas National Trust.*

[5] **Parsons, KM**, Noble, LR & Thompson, PM (1997) Evaluation of genetic diversity in a population of bottlenose dolphins in NE Scotland. *Report to the Whale and Dolphin Conservation Society.*

[6] **Parsons, KM** & Durban, JW (1997) Dolphin research continues in the Sea of Abaco. *Report to the Abaco chapter of Friends of the Environment in fulfilment of the terms of a research grant issued for work conducted in August 1997.*

[7] Durban, JW & **Parsons, KM** (1997) Aspects of the social structure of bottlenose dolphins in the Sea of Abaco, north-eastern Bahamas. *Funding report to the UK Mammal Society.*

[8] Claridge, DE, Durban, JW, **Parsons, KM**, Balcomb, KC (1995) Atlantic bottlenose dolphins of the Bahamas: A catalogue of individuals photo-identified in the Sea of Abaco 1991 – 1995. Centre for Whale Research, Friday Harbour, WA, USA.

Book Reviews

Parsons, KM (2002) *Molecular and Cell Biology of Marine Mammals,* Carl J. Pfeiffer (ed.). Krieger Publishing Company. 427 pp. *Aquatic Mammals*, **29**(3): 417-418.

Referee For

Aquatic Mammals, Behavioural Processes, Biology Letters, Journal of Zoology.

Scientific Presentations & Media Programmes

Long-term social dynamics of fish-eating killer whales.
(Seminar) Northwest Fisheries Science Center, Conservation Biology Division. 2005.
(Conference talk) Society for Marine Mammalogy conference, San Diego. 2005.

From photos to feces: studying dolphin population structure.
(Seminar) Northwest Fisheries Science Center, Seminar Series. 2004.

A genetic and environmental basis for social affiliations among bottlenose dolphins.
(Conference talk) Society for Marine Mammalogy conference, Greensboro. 2003.

Bottlenose dolphins: From the Bahamas to the Moray Firth.
(Public lecture) Cromarty, Scotland (UK). 2002.

Bottlenose dolphins in the Moray Firth.
(Documentary) Nature series. BBC Radio 4. 2002.

Male bottlenose dolphins form alliances with kin.
(Conference talk) Society for Marine Mammalogy conference, Vancouver. 2001.

Population structure of bottlenose dolphins in British & Irish waters.
(Conference talk) European Cetacean Society conference, Ireland. 2000.

Whale and dolphin research.
(Documentary) Discovery channel (Japan).1999.

The dolphin: Born to be wild.
(Documentary) Discovery channel (Canada).1996.

Marine Mammals of British Columbia: Seminar & slide show.
(Public lecture) Victoria, Canada. 1995.

The vocal repertoire of the Bewick's wren: Departmental seminar of the results of an independant research project. Biology dept., University of Victoria, Canada. 1994.

Conference poster presentations

Harem society identified in dense-beaked whales (*Mesoplodon densirostris*). D.E. Claridge, **K.M. Parsons**, J.W. Durban, K.C. Balcomb, D.K. Ellifrit. Marine Mammal Conference. Vancouver, Canada 2001.

Inferring dolphin phylogeography from mtDNA. **K.M. Parsons**, P.M. Thompson, L.R. Noble. Student Conference on Conservation. Cambridge, UK 2000.

Inferring dolphin phylogeography from mtDNA. **K.M. Parsons**, P.M. Thompson, L.R. Noble. Ecological Genetics Group Conference. Ormskirk, UK 2000.

Undescribed and described large squids in the North Atlantic. M. Clarke and **K. Parsons**. CIAC 2000: Millenium Cephalopod Conference. Aberdeen, UK 2000.

Aspects of the social structure of bottlenose dolphins in the Sea of Abaco, Bahamas. J.W. Durban and **K.M. Parsons**. Mammal Society Conference. St Andrews, UK 1997.

Qualifications

NOAA sponsored Washington State Powerboating Course – March 2005
American Red Cross; Adult CPR & AED – March 2005
American Red Cross; Standard First Aid – March 2004
Commercial endorsement (MSA-UK) of Advanced Powerboat Certificate – May 2001
Emergency First Aid Certification – May 2001
Royal Yachting Association (UK) Advanced Powerboat Certificate – March 2001
University of Aberdeen radiation worker certification – 1997
VHF radio operator certification (Canadian coast guard certified) – 1992

Computational Tools

Software – Microsoft office; SPSS; Matlab; ArcView; Splus; Statistica; Endnote

Genetic data analysis software – Phylip; Chromas; Clustal; Genepop; Fstat; Rstcalc; Delrious; Arlequin; Mega; Structure; Cervus; Puzzle; Oligo

Personal Details

Date of Birth:	20 May 1971
Citizenship:	Canadian
Residency:	United Kingdom (permanent resident); USA (J-2 visa)

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David K. Ellifrit

Experience

Center for Whale Research, Inc., Friday Harbor, WA

Senior Staff Assistant, Orca Survey project, 1990-present.

- Responsible for curation of the photographic library at CWR, participation in all aspects of research including photo-identification of killer whales, boat captaining, photo-analysis, and training Earthwatch volunteers.

Staff Assistant, Bahamas Marine Mammal Survey, 1996-2002.

- Participation in all parts of research, including photo-identification of and photo-analysis of Atlantic bottlenose dolphins.

National Marine Mammal Laboratory, NOAA, Seattle, WA

Contract researcher, 1993-present.

- Participant in seven NMML killer whale cruises to Southeast Alaska and three NMML killer whale cruises in the Gulf of Alaska and the southeastern Bering Sea. Conducted photo-analysis of NMML's killer whale photo-identification film from Southeast Alaska for years 1989-2001. Responsible for the curation of NMML's Gulf of Alaska and Bering Sea killer whale catalogue.

Cascadia Research Collective, Olympia, WA

Contract researcher and two time intern, 1995-2001.

- Participant in five cruises off the coast of Washington, Oregon, and California to take identification photographs of humpback, blue, gray, fin, and killer whales. Conducted photo-analysis of blue, humpback, gray, and killer whales.

University of Aberdeen, Scotland

Research Assistant, Department of Zoology, 2001-2002.

- Conducted photo-analysis of the bottlenose dolphins of the Moray Firth and surrounding areas from the 2001 field season at the Lighthouse Field Station in Cromarty, Scotland.

North Gulf Oceanic Society, Homer, AK

Contract researcher, 2002-present.

- Conducted field research in the southeastern Bering Sea. Duties included taking identification photographs of killer whales and humpback whales and logging all marine mammal sightings. Conducted photo-analysis of NGOS's killer whale photo-identification

film from the southeastern Bering Sea. Responsible for curation of NGOS's resident and transient killer whale catalogues from the Bering Sea.

Education

1995-1997 The Evergreen State College Olympia, WA

- B.A.., Environmental Studies

Publications

Dahlheim, M.E., **Ellifrit, D.K.**, and J.D. Swenson, 1997. Killer Whale (Orcinus Orca) of Southeast Alaska: A Catalogue of Photo-Identified Individuals. National Marine Mammal Laboratory, National Marine Fisheries Service, Seattle, WA.

van Ginneken, A.M., **Ellifrit, D.K.**, and R.W. Baird, 1998. Official Orca Survey Field Guide to Transients of the Haro Strait area. Center for Whale Research, Friday Harbor, WA.

van Ginneken, A.M., **Ellifrit, D.K.**, and K.C. Balcomb, 1999. Official Orca Survey All Whale Catalogue of Killer Whales (Orcinus orca) of the Pacific Northwest Southern Resident Community, 1976-1999. Center for Whale Research, Friday Harbor, WA.

Appendix II: List of publications from Center for Whale Research

Books

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 2000. Killer Whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State, second edition. UBC Press, Vancouver, British Columbia.

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 1994. Killer Whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. UBC Press, Vancouver, British Columbia.

Bigg, M.A., G.M. Ellis, J.K.B. Ford, and K.C. Balcomb. 1987. Killer whales: a study of their identification, genealogy, and natural history in British Columbia and Washington State. Phantom Press, Nanaimo, British Columbia.

Balcomb, K.C. 1987. The Whales of Hawaii. Marine Mammal Fund, Fort Mason Center, San Francisco, CA.

Journal Articles

Ford, JKB; Ellis, GM; Matkin, DR; Balcomb, KC; Briggs D; Morton, AB. 2005. Killer whale attacks on minke whales: Prey capture and antipredator tactics. Marine Mammal Science 21: 603-618.

Parsons, KM; Durban, JW; Claridge, DE; Herzing DL; Balcomb, KC; Noble, LN. 2006. Population genetic structure of coastal bottlenose dolphins (*Tursiops truncatus*) in the northern Bahamas. In press Marine Mammal Science.

Durban, JW; Elston, DA; Ellifrit, DK; Dickson, E; Hammond, PS; Thompson, PM. 2005 Multi-site mark-recapture for cetaceans: population estimates with Bayesian model averaging. Marine Mammal Science 21: 80-92.

Gaydos, JK; Balcomb, KC; Osborne, RW; Dierauf, L. 2004. Evaluating potential infectious disease threats for southern resident killer whales, Orcinus orca: a model for endangered species. Biological Conservation 117 (3) 253- 262.

Parsons, KM; Durban, JW; Claridge, DE; Balcomb, KC; Noble, LR; Thompson, PM. 2003. Kinship as a basis for alliance formation between male bottlenose dolphins, Tursiops truncatus, in the Bahamas. Animal Behaviour 66: 185-194.

Balcomb, K.C. and D.E. Claridge. 2001. Mass strandings of cetaceans in the Bahamas caused by naval sonar. Bahamas Journal of Science 8, 2-12.

Calambokidis, J; Steiger, GH; Straley, JM; Herman, LM; Cerchio, S; Salden, DR; Urban, J; Jacobsen, JK; von Ziegesar, O; Balcomb, KC; Gabriele, CM; Dahlheim, ME; Uchida, S; Ellis, G; Miyamura, Y; de Guevara, PL; Yamaguchi, M; Sato, F; Mizroch, SA; Schlender, L; Rasmussen, K; Barlow, J; Quinn, TJ. 2001. Movements and population

structure of humpback whales in the North Pacific. Marine Mammal Science 17: 769-794.

Durban, JW; Parsons, KM; Claridge, DE; Balcomb, KC. 2000. Quantifying dolphin occupancy patterns. Marine Mammal Science 16: 825-828.

Calambokidis, J; Steiger, GH; Rasmussen, K; Urban, J; Balcomb, KC; de Guevara, PL; Salinas, M; Jacobsen, JK; Baker, CS; Herman, LM; Cerchio, S; Darling, JD. 2000. Migratory destinations of humpback whales that feed off California, Oregon and Washington. Marine Ecology Progress Series 192: 295- 304.

Urban, J; Alvarez, C; Salinas, M; Jacobsen, J; Balcomb, KC; Jaramillo, A; de Guevara, PL; Aguayo, A. 1999. Population size of humpback whale, Megaptera novaeangliae, in waters off the Pacific coast of Mexico. Fishery Bulletin 97: 1017- 1024.

Parsons, KM; Dallas, JF; Claridge, DE; Durban, JW; Balcomb, KC; Thompson, PM; Noble, LR. 1999. Amplifying dolphin mitochondrial DNA from faecal plumes. Molecular Ecology 8: 1766- 1768.

Ford, JKB; Ellis, GM; Barrett-Lennard, LG; Morton, AB; Palm, RS; Balcomb, KC. 1998. Dietary specialization in two sympatric populations of killer whales (Orcinus orca) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76: 1456-1471.

Pitman, RL; Palacios, DM; Brennan, PLR; Brennan, BJ; Balcomb, KC; Miyashita, T. 1999. Sightings and possible identity of a bottlenose whale in the tropical Indo-Pacific: Indopacetus pacificus? Marine Mammal Science 15: 531- 549.

Calambokidis, J; Steiger, GH; Evenson, JR; Flynn, KR; Balcomb, KC; Claridge, DE; Bloedel, P; Straley, JM; Baker, CS; von Ziegesar, O; Dahlheim, ME; Waite, JM; Darling, JD; Ellis, G; Green, GA. 1996. Interchange and isolation of humpback whales off California and other North Pacific feeding grounds. Marine Mammal Science 2:215-226.

Darling, JD; Calambokidis, J; Balcomb, KC; Bloedel, P; Flynn, K; Mochizuki, A; Mori, K; Sato, F; Suganuma, H; Yamaguchi, M. 1996. Movement of a humpback whale (Megaptera novaeangliae) from Japan to British Columbia and return. Marine Mammal Science 12: 281-287.

Claridge, D.E. 1994. Photo-identification study to assess the population size of Atlantic bottlenose dolphins in central Abaco. Bahamas Journal of Science 1: 12-16.

Steiger, GH; Calambokidis, J; Sears, R; Balcomb, KC; Cubbage, JC. 1991. Movement of humpback whales between California and Costa Rica. Marine Mammal Science 7: 306-310.

Calambokidis, J; Cubbage, JC; Steiger, GH; Balcomb, KC; Bloedel, P. 1990. Population estimates of humpback whales in the Gulf of the Farralones, California. Report of the International Whaling Commission Special Issue 12.

Calambokidis, J; Steiger, GH; Cubbage, JC; Balcomb, KC; Ewald, C; Kruse, S: Wells, R; Sears, R. 1990. Sightings and movements of blue whales off central California 1986-1988 from photo-identification of individuals. Report of the International Whaling Commission Special Issue 12.

Bigg, M.A., P.F. Olesiuk, G.M. Ellis, J.K.B. Ford, and K.C. Balcomb. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission Special Issue 12: 383-405.

Balcomb, K.C. and Goebel, C.A. 1976. A killer whale study in Puget Sound. Final report, Contract No. NASO-6-35330. Marine Mammal Division, National Marine Fisheries Service, Seattle, WA, 11p.

Balcomb, K.C. III and Bigg, M.A. 1986. Population biology of three resident killer whale pods in Puget Sound and off southern Vancouver Island. *In* B.C. Kerkevold and J.S. Lockard (eds.), Behavioural biology of killer whales, p85-95. Alan R. Liss, Inc., New York.