SOUTHERN RESIDENT KILLER WHALE BEHAVIOR WORKSHOP
APRIL 20, 2004

NOAA NMFS NORTHWEST FISHERIES SCIENCE CENTER
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SEATTLE, WASHINGTON

FINAL REPORT

WORKSHOP OBJECTIVES

The objectives of this workshop were to bring together Southern Resident Killer Whale (SRKW) biologists involved in behavioral data collection to discuss and develop some standards for the collection of behavioral data on this population. It was a common finding of the recent NMFS SRKW workshops that additional rigor and standardization of behavioral sampling methodology was desirable to support the ongoing and upcoming research projects relating to the recovery and stabilization of the population. The intention of the workshop was to:

1) Improve understanding of the methodology required for behavioral research, and methods and techniques that have been accepted in other taxa,
2) Clarify terminology used to describe killer whale behavior,
3) Improve research design, data collection, and data storage methodology beyond improvements in coding definitions,
4) Coordinate data collection and exchange.

WORKSHOP ACHIEVEMENTS

The first goal was achieved through a series of presentations in the morning session of the workshop in which Dr. Philip Lehner (Faculty Emeritus, Colorado State University and author of the Handbook of Ethological Methods) presented a talk on "Considerations in Coding Behavioral Data" (illustrations available online soon) and Jennifer Marsh (MSc, San Diego State University and PhD student, University of Washington) presented a talk on "A Review of Behavioral Coding of Cetacean Behavior, With an Emphasis on the Behavior of Killer Whales" (illustrations available online soon). Following these two presentations, participants were invited to describe their data sets and coding procedures, and to describe their perceptions of the issues involved in quantifying killer whale behavior. This discussion extended until after lunch and provided some progress towards the fourth goal of the workshop, as participants learned a great deal about how, and why, various groups were collecting data.

We made a great deal of progress towards the second goal through a lengthy process of developing a mutually-agreeable series of behavioral dimensions and ordinal categories of behavior within these dimensions. This Concensus Coding Scheme, described in detail on the following pages, is a molecular or bottom-up approach to coding behavior, in which objective and quantifiable dimensions of behaviors are recorded in the field and functional descriptions of behavior are left for later interpretation. Our hope is that this scheme will influence the development of rigorous coding systems, provide some consistency among

systems, and provide the "Rosetta Stone" by which differing coding systems can define their codes in a common way. This achievement also addresses the fourth goal of this workshop.

Relatively little time was available to achieve the third goal of the workshop, improving research design, data collection, and data storage methodology beyond improvements in coding definitions. Future workshop efforts might address these issues, discussing experimental design and statistics, benefits and costs of using archival data sets, improved methods for acquiring and storing data (handheld PDA's, tablet PC's, voice-recognition-coded data, etc.), and methodological issues like assessment of inter- and intra-observer reliability. Future workshops could also more explicitly address data sharing and exchange from both a technological and a cultural point-of-view.

Finally, the workshop participants endorsed the value of interacting with their peers in killer whale behavior research. Future workshops should encourage exchange of information, reporting of interesting results, and the development of new technical and intellectual directions to addressing research needs of Southern Resident Killer Whales, and cetaceans in general.

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A Consensus Coding Scheme for Killer Whale Behavior

Developed by the participants in the SRKW Behavior Workshop, UW and NMFS/NWFSC, 20 April 2004

Concept

The participants agreed that future coding systems for SRKW behavior work should emphasize descriptive, quantifiable definitions of SRKW behavior, rather than the more common functional definitions currently in use. To this end, the group adopted a molecular, bottom-up approach to describing the behavior of killer whales. It was agreed that it may be difficult or impossible to force very functional existing archival data into these low-level categories, but that some attempt to re-define existing behavior coding systems using these low-level definitions might be beneficial.

Coding Scheme

It would be most desirable for future SRKW behavioral work to explicitly record the following information, and then to use post-data-collection analysis techniques to examine the data for common clusters or sequences of these behavioral dimensions. In lieu of this approach, we encourage future coding systems to explicitly use these dimensions to define short-hand behavioral codes for commonly observed "behaviors" consisting of clusters of these dimensions. Examples are provided below.

Primary Behavioral Dimensions

Orientation/Formation
- Flank: side-to-side-to-side
- Linear: head-to-tail
- Non-linear: no particular orientation within group

Directionality
- Directional: less than or equal to 90deg from previous direction of travel
- Non-directional: deviation of greater than 90deg from previous direction of travel

Distance (generally estimated as average distance of group members)
- Contact: physical contact
- Tight: 0 to 10m from another animal

- Loose: 10 to 100m
- Spread: Greater than 100m

Speed
- Motionless: 0 knots, "hanging", "logging"
- Slow: less than 2 knots, less smooth or "jerky" surfacing
- Medium: 2-6 knots, slow roll, "normal"
- Fast: 6-10 knots, fast roll
- Porpoising: greater than 10 knots, large portion of body out of water

Additional Behavioral Dimensions

Behavioral Events
- Generally well defined: good summaries are found in Jacobsen (1986, pgs 135-185, Kirkevold and Lockard, eds., Alan Liss, Inc.) and at the Center of Whale Research website (www.rockisland.com/~orcasurv/behavior.htm)

Synchronicity
- The degree to which events, or to a lesser extent states, occur together; a potential measure of social bonding
- If recorded, an explicit definition of the time window for defining synchronicity should be provided

Respirations
- Possibly recorded under Behavioral Events, this information is important to bioenergetic-based studies, and is therefore frequently a separate focus of data collection

Acoustics
- A potentially important part of the behavioral repertoire, difficult to collect simultaneously, and therefore frequently a separate focus of behavioral data collection

Time
- A component of the all of the dimensions above: we have attempted to minimize (but were unable to eliminate) the need for history of the behavior of an animal in order to code the current behavior, e.g., to code directionality, the observer needs to know the direction of the animal's movement on the previous surfacing
- Time recording as a dimension should be clearly defined: lengths of observation periods, units for coding sequences of behavior, intervals for sampling behavior

Examples of Historical Functional Behaviors Defined in Behavioral Dimensions

There was considerable debate about the ability to force past functional definitions into the new, and admittedly better, coding dimensions, and the usefulness of doing so. However, the following rough adaptations of classic functional definitions may help in clarifying this new approach.

Rest: flank or non-linear orientation; directional; contact or tight distance; slow speed; high synchronicity; lack of percussive events

Travel: any orientation; directional; any distance; slow, medium or fast speed

Forage: flank or non-linear orientation; directional or nondirectional; tight, loose or spread distance; slow, medium or fast speed; lunge or chase events. Also possibly a pattern of alternating "milling" and "traveling". Note: No consensus was reached by the participants on how to define this functional behavior because there were concerns that this behavior was too difficult to verify with observations from the water surface. Specifically, foraging is hard to define, as there is a spectrum of behaviors that can occur during the act of foraging. Furthermore, depending on one's definition of foraging [1) the acts of searching for prey, handling prey, and consuming prey (if successfully caught) or 2) only the acts of handling and consuming prey], identifying the occurrence of this behavior and/or quantifying how long killer whales are engaged in this behavior will have critical ramifications. These include erroneous estimates of total prey consumption, incorrect calculations of energy budgets, etc. Some thought that ground-truthing the definition for foraging with prey and behavior studies conducted in unison was necessary.

Play: Any combination of categories of behavioral dimensions, i.e., any distance, any orientation, and any speed. There are also specific categories of play:
1. Object play (kelp, floats)
2. Social interactive play (touching, breaching, percussive behaviors)
3. Solitary play

Milling: repeated, non-linear orientation; nondirectional; any distance; slow or medium speed