WASHINGTON STATE
Academy of Sciences
Science in the Service of Washington State

Adaptive Management of Regulations

Washington State Academy of Sciences Committee on Underwater Acoustics and Disturbance

Adaptive Management

Purpose

The purpose of this document is to provide guidance on an adaptive management approach to evaluate management actions intended to mitigate the effects of vessel noise and disturbance on Southern Resident Killer Whales (SRKW).

Management Question and General Approach

Adaptive management is a systematic approach for improving resource management by learning from management outcomes [U.S. Department of Interior Technical Guide: Adaptive Management]. In general, an adaptive management plan needs to include all relevant factors that could change and/or be manipulated based on a set of testable hypotheses.

Ample data support the findings that noise and vessel disturbance are two of several documented stressors to SRKW that affect their behavior and potentially impact their health and population. The *management question* posed here is whether adjustment in the rules aimed at reducing the vessel-related stressors will result in positive population growth. Although it is feasible to control vessel-related stressors, it is not necessarily possible to affect other important aspects of whale health. That means that, although an active manipulation can be made for one source of stress, the response to this manipulation is contextual and depends on improvement of other key factors for this population; namely, food availability. Concluding that a signal of response by the whales is explained by this single manipulation is difficult.

Thus, the adaptive management approach best suited for addressing the management question and the selected action involves both the active manipulation of vessel regulations and passive monitoring of other indicators (such as prey type abundance, ocean conditions, large commercial vessels) known to affect the whales. Taken together, data collected on selected indicators with concurrent development of data sets on indicators of whale behavior and health provide the fundamental *lines of evidence* that would be synthesized to draw inference regarding the effectiveness of the management action. This inference would address a *null hypothesis* that the new rules meant to reduce vessel-related stressors have no effect on the health of the whales and their population size.

In addition to monitoring the positive effects of vessel regulations, it will be important to monitor for unintended negative consequences of these regulations (such as more whale watch activity around whales outside of a no-go zone), in order for adaptive management to address this potential concern.

Overview

Adaptive management requires monitoring what is being managed, the response, and other interacting and cumulative factors. The adaptive management schema for Washington Department of Fish and Wildlife (WDFW) commercial whale watch licensing rules for SRKW is likely to be *passive*, meaning that measurements are obtained by observation rather than by setting up a controlled experiment.

In the case of the proposed rules developed by WDFW through a consultative process during the summer of 2020, adaptive management would consider vessel interactions (such as number of boats and distance from whales) as the factor being managed and monitor the behavior and health of the SRKW population (in *Metrics* below) as the management goal. Other lines of evidence (such as ocean and weather conditions, prey availability, etc.) can also be tracked to help tease out the cumulative effects of factors outside of the scope of proposed new regulations.

An adaptive management timescale of two years is insufficient to observe the true effects of new regulations on SRKW. Passive adaptive management must have a long timescale for monitoring; short-term metrics are often not meaningful due to the difficulty in teasing out the effects of other factors. A minimum of five years is needed to see effects on population given the reproductive timescale of SRKW.

This approach is in line with, for example, the six-year management review process associated with the European Union Habitats Directive, or the International Whaling Commission Revised Management Procedure for whaling [IWC RMP for Baleen Whales]. Cautionary tales can be derived from examples of shorter management review cycles used for other species, such as North Atlantic Right Whales, in which there was a shift in whale habitat use and migration timing such that it that no longer matched the seasonal or spatial extent of existing regulations. While management decisions require a longer maturity period, it is important to note that they still require short-term monitoring (such as annual, or shorter timescales as outlined in *Metrics* below) to inform them.

The indicators that would lead to changing the newly proposed regulations include metrics and conceptual models as described below. The committee notes that, in the near term, it is just as likely that adaptive management may point to further constraint of the rules, versus relaxing them.

Metrics

Management metrics are most useful when they are clear, simple, explicit, easy to enforce and associated with a specific assessable goal. Short-term behavioral changes, such as habitat use as measured by SRKW distribution, and foraging frequency and success, are the most direct measures of SRKW response to changes in vessel regulations. Daily foraging rates and the daily number of successful foraging events, based on tag data, could serve as proxies for orca energy balance. However, such behavioral metrics can be time intensive and expensive to measure and can be confounded by prey availability.

Body condition and other health indicators, such as physiological parameters, may be useful across longer time periods. However, suitable ranges for physiological parameters and body condition indices that represent healthy individuals are somewhat unknown in free-ranging killer whales. Population count, while a clear management goal, is an integrated target that relies on many other factors – that is, while management of vessel interactions may be successful, the SRKW population may take a very long time to, or fail to, reach a particular size. In addition, uncertainties associated with inferring significant changes in population growth rate and abundance often mean that using population count time series for management decisions is often challenging [Slooten et al 2000; Wilson et al. 1999].

Given the complexity and interconnectivity of risk factors, it would be challenging to relate positive changes in body condition, reproductive success, calf survival, or population growth rate solely to vessel regulations. Metrics of whale condition provide lines of evidence useful in evaluating the null hypothesis. The use of these metrics must be made with the scientific understanding of their benefits and limitations in mind. The benefits and drawbacks of various metrics for SRKW population recovery from

management of vessels are outlined in Table 1.

Emergency rules might use different metrics than longer-term management. The observation of animals of concern, by photos or other tangible information, would be one reason to institute more restrictive regulations. For example, when individual SRKWs are observed to be in poor condition, it would be helpful to be able to put more restrictive regulations in place to protect the population.

Table 1: Benefits and drawbacks of metrics for measuring SRKW population recovery

Metric	Length	Benefits	Limitations
Behavior, including foraging rates and success, habitat use, etc.	Short-term (immediate)	Only metric that directly measures whale response to vessel regulation changes	Intensive and can be expensive to measure Can be confounded by prey availability
Population size or percent increase	Long-term (5+ years)	Clear and easy measurement Direct link to management goal of population recovery	Needs to incorporate carrying capacity and minimum viable population Affected by multiple factors beyond vessel noise and disturbance
Body condition, particularly for juveniles or reproductive female	Medium-term (weeks to months, buffered by blubber layer)	Reflects individual health Relatively simple to measure and compare over time	Changes with growth, age, and reproductive status; additional research needed to determine "healthy" values Affected by multiple factors beyond vessel noise and disturbance
Births or calf survival	Medium-term (years)	Indicates population growth in shorter-term	Challenge to measure, particularly pregnancy; depends on observer efforts and SRKW habitat use patterns. Affected by multiple factors beyond vessel noise and disturbance
Physiology changes: stress hormone levels, bioenergetics, etc.	Short-term (possibly days, dependent on sampling)	Reflects individual health	Changes with other physiological processes such as pregnancy Affected by multiple factors beyond vessel noise and disturbance
Boater behavior, including: # of boats near whales, time with whales, etc.	Short-term (immediate)	Measures adherence to management Investigates unintended consequences of vessel regulations	Doesn't measure whale response/recovery

Conceptual Models

Conceptual models, by organizing the primary factors affecting whales, can also inform adaptive management strategies. Washington State could adopt a conceptual model of the understanding of threats and opportunities for SRKW recovery to use as a guide for management of the species across multiple axes.

A conceptual model would include the primary factors considered in the synthesis and analysis of data collected on the whales and other factors. Justification for choosing these factors should be included, and models would be updated as the scientific information changes. Numerical models could also be useful, though accurately defining linkages between different stressor effects and SRKW vital rates remains inherently challenging.

Data Needs for Management

Data to collect through the licensing program

The commercial whale watch licensing program has the potential to collect data that will inform management of the program. Collection of these data should primarily focus on operator behavior, and *would not* be a justification for additional whale watch operator presence around whales.

Informative data to collect from licensees include:

- Automatic Identification System (AIS) location of boats
- Whale identification and group size (including whether it is an adult or calf)
- Location of the whale and boat at the start and end of an encounter
- Whether the whale has injuries or other unusual characteristics
- Whether there are other boats in the area (within ½ nautical mile)
- How long each boat is present

Ideally, reporting would be done by trained naturalists who could also identify the pod and whale activity state. Trained observers/monitors on whale watch boats could also monitor the boat's interactions with whales and report compliance by recreational vessels in the vicinity. Collected data are not usable until analyzed, and we suggest that WDFW consider the agency's capacity for data analysis in formulating the data collection strategy.

An integrated monitoring system is essential to addressing the viability of the rules. The WSAS Committee is aware that the Oceans Initiative is collecting land-based observations of boat distance/number and SRKW foraging behavior to monitor effectiveness of WDFW rulemaking. This approach and the technologies for collecting data directly on several elements of whale behavior as well as on vessels appears suited for development of a dataset that directly measures aspects highly relevant to the manipulation of vessel rules. We anticipate that this current-day data on SRKW behavior in relation to vessel interactions, particularly if collected over multiple years, will help to fill a data gap of how whales are affected by vessels under current regulations, though on-water monitoring will also be useful for higher-resolution data collection.

The WSAS Committee is also aware that San Juan County and the Oceans Initiative are partnering to collect spatially explicit data on SRKW foraging locations. We anticipate that this study, which collects

new data and compares it to decades-old datasets, will highlight foraging areas identified decades ago that have persisted in recent years despite recent lower-than-typical presence, and thus inform areas particularly important for vessel restrictions (such as slow-go or no-go zones). As new data are collected, an adaptive approach to any location-based management components is logical.

Discerning a sentinel or magnet effect

In order to determine a sentinel or magnet effect of commercial whale watch vessels, studies would need to be conducted to assess if or how observed, reported, or enforced infractions change with a change in the number of whale watch vessels present.

In order to establish this relationship, additional research would need to be conducted with:

- Multiple seasons of Soundwatch observations, including previously collected data,
- In addition to observations, a controlled study with a sufficiently large sample size of randomized applications of interactions with recreational vessels, tracked over a season or more,
- Combined land-based observation (which biases sampling in the landscape of whale presence) and boat-based observation (which may bias boater behavior),
- Measurement of claims such as reduced recreational vessel interaction and speed, and
- Encounters with transient killer whales would be appropriate for this type of study because boater behavior (not whales) would be the subject of the study.

Summary

A passive adaptive management approach to evaluating management actions provides objective, evidence-based evaluation of the effectiveness of those actions.

Elements of this approach include:

- A clear statement of the goal for actions,
- A conceptual model justifying how these goals are affected by the actions,
- A null (do nothing) hypothesis that grounds the program,
- An integrated monitoring program of at least five years following a change,
- A robust synthesis of the information developed during the monitoring,
- A numerical model for further synthesis and as a predictive tool,
- Peer review of findings, and
- Evidence-based recommendations for changes in the program.

A co-management approach, in which stakeholders share in management responsibilities and goal setting, could ensure that the management scheme receives broad acceptance by the community and would subsequently require less policing effort.