



**UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration**

National Marine Fisheries Service

P.O. Box 21668

Juneau, Alaska 99802-1668

November 6, 2002

Dave Sturdevant
Division of Air and Water Quality
Department of Environmental Conservation
410 Willoughby Avenue.
Juneau, Alaska 99801

Re: Review of the draft report: "Assessment of Some of the Effects of Reduced Dissolved Oxygen on the Fish and Invertebrate Resources of Ward Cove, Alaska"

Dear Mr. Sturdevant:

The National Marine Fisheries Service has reviewed and offers the following comments on the draft report, **"Assessment of Some of the Effects of Reduced Dissolved Oxygen on the Fish and Invertebrate Resources of Ward Cove, Alaska,"** written by EPA scientist Duane Karna. Several of our Habitat Conservation Division biologists (Susan Walker, Linda Shaw and Lawrence Peltz) and one fishery scientist from our Alaska Fisheries Science Center (Dr. Robert Stone) contributed to this review. In general, we believe the report is well written and the literature review on the effects of hypoxia is excellent. We offer the following comments for your consideration in improving the review draft.

Title

We believe the title needs rewording as no effects of reduced dissolved oxygen on the fish and invertebrate resources of Ward Cove were measured or identified. The paper presents results for a literature search of the effects of low dissolved oxygen on some species of fish, mostly in controlled laboratory situations, and some possible effects on the fish and invertebrate resources of Ward Cove were discussed.

Purpose

The ultimate purpose of the paper should be more clearly stated. The paper does not discuss the purpose or intent of the paper. Was the purpose to assess the effects of ongoing fish waste disposal? If so, then more detail should be



provided on that operation. Information on fish processing waste disposal is limited to mentioning that the activity occurs in July, August, and September.

Field Methodology

The paper would be improved by including an explanation of why the field methodology used was selected. Although the EPA (2002) report is referenced, it is unclear why DO measurements were not collected near the seafloor where most of the fish listed in Appendix I reside. Also, invertebrates are largely ignored, many are likely important prey items. Given the history of Ward Cove, the paper should reference all comprehensive studies on the cove's living marine resources that have been conducted.

Based on the information provided in the report, Ward Cove is clearly an impaired water body. If mid-water column waters are seasonally hypoxic, then the water column near the seafloor at 48 m (the maximum depth in the Cove) is very hypoxic. If Ward Cove is a typical Southeast Alaska estuary, the water column is strongly stratified during the summer (when waste disposal is apparently occurring) and there is essentially no thermohaline mixing. The cover letter points this out - the report does not. The cover letter also indicates that the Cove has limited water circulation - based on a quick look at the NOAA nautical chart we concur with that. Circulation is likely impaired by the partial sill blocking the Cove to Tongass Narrows. The DO values measured in Ward Cove are much lower than those measured by NMFS Auke Bay Lab scientists at 100 m depth in Fritz Cove and even 200 m depth in Taku Inlet during the same time of year.

Effects of Hypoxia on Fish Growth section

The review concentrates on laboratory studies and finfish. Important studies on the effects of naturally occurring hypoxia on some species have been left out of the review that are relevant to this study. The literature contains several such reports which should be included in this review, we can provide a partial list if requested. We believe it is inappropriate to imply that low DO effects on growth rates for juvenile rainbow trout and lake trout, which were presumably measured in freshwater, can be used to estimate the effects of low DO in Ward Cove on cutthroat trout and Dolly Varden char - which would also rear in freshwater.

Ward Cove is clearly a poor habitat for fish and invertebrates, however, the fish will move to adjacent areas and effects on growth will not occur. Fish are mobile and opportunistic, they search out the ideal habitat and will not remain in marginal or poor habitats unless population density is high, which is not the case in the waters of Tongass Narrows.

The main effect of hypoxia on fish growth is elimination of previously suitable habitat. The fish and invertebrate habitat which occurred historically in Ward Cove has been changed drastically and it is likely that fish avoid the hypoxic area and will continue to do so until the BOD demand on the bottom of the cove lessens.

Effects of Hypoxia on Fish Disease

Conclusions on the incidence of fish disease occurrence should be based on investigation of Ward Cove specifically and not for southeast Alaska in general. It is unclear if an effort to document the rate of fish disease has been made specifically for Ward Cove. Lack of specific data on fish diseases in Ward Cove should be listed in Section 6.0 with the other limitations of this assessment. Similar to comments on the effect of hypoxia on fish growth, the major effect of hypoxia on fish disease is related to habitat elimination. If fish are confined in an area and forced to endure stressful conditions such as hypoxia, they are more likely to develop disease. Although an outbreak of herring viral erythrocytic necrosis did occur in Ward Cove, it also happened at other places in southeast Alaska and cannot be attributed to DO conditions in Ward Cove.

The text refers to water quality analyses at the time of *the* fish kill in Ward Cove, yet the introduction notes periodic fish kills in the 1950s. Is this reference to a specific fish kill or is it referring to all of them?

Lethal Effects of Hypoxia

The discussion section uses the literature review to hypothesize the impacts of hypoxia on indigenous species in Ward Cove. While hypoxia is certainly lethal, fish will move if conditions get bad and will avoid the hypoxic area prior to asphyxiation. Benthic invertebrates are more sessile and less adept at avoiding the lethal effects of hypoxia. The benthic

invertebrate community of Ward Cove has undoubtedly been altered, and studies documenting this alteration should be cited. There are probably organisms that thrive in the current conditions at the bottom of Ward Cove, but the majority of indigenous species have probably been eliminated due to a total change of habitat.

The paper defines hypoxia as dissolved oxygen levels below 2 mg/l. Is this a standard? Although the author-defined hypoxia indicates that less than 4 mg/l results in reduced growth and chronic mortality, this is not classified as hypoxia. If hypoxia were defined as dissolved oxygen levels below 4 mg/l statements in the discussion would be altered from "Hypoxia occurs only as small cells within the cove in this depth range," to "Hypoxia covers almost the entire cove for July, August and September." These statements affect the weight of the conclusions and could be used to declare that "Hypoxia occurs only as small cells," when in fact the biological effect is much greater.

The conclusions regarding the ability of juvenile salmonids to avoid hypoxic waters in Section 5.1 is seemingly contradicted by the opposite conclusion in Section 5.2 for other marine and estuarine species. Juvenile salmonids appear to be most protected by the time of their emergence in early spring before hypoxic conditions develop.

General Comments

The report appears to summarize the releases from Ward Cove Packing based work by Jones and Stokes, 1989. These data need to be updated to estimate the changes which have occurred in Ward Cove in the intervening 13 years, including removal of dredged sediments, sediment capping and natural eutrophication of the wood and fish waste sediments. As a result of cumulative buildup of historic releases from all inputs, the Ward Cove Packing releases of fish processing waste are likely to be significant contributors to the Cove's BOD demand. The report would benefit from updated measurements of current BOD throughout the water column and throughout the annual cycles of thermal and salinity stratification.

Summary

In summary, this report is a nice literature search of hypoxia and its effect on fish. It doesn't specifically address problems at Ward Cove or how to fix them. While this is a much needed body of information, it would benefit greatly from: 1) a review of the methods used to collect the DO measurements (EPA, 2002), 2) expanding the review to include some of the literature on naturally occurring hypoxia, and 3) an overview of the fish waste disposal operation.

NMFS appreciates the opportunity to review and provide comments on the report. Please contact Susan Walker (907-586-7646 or susan.walker@noaa.gov) with questions or comments on this review.

Sincerely,



For Jonathan M. Kurland
Assistant Regional Administrator
for Habitat Conservation