KITSAP
ALLIANCE
OF PROPERTY OWNERS

February 16, 2004

Chris Endresen, District #1
Jan Angel, District #2
Patty Lent, District #3
Kitsap County Board of County Commissioner
614 Division Street
Port Orchard, WA 98366

Subject: 2003 Kitsap Salmonid Refugia Report
By Dr. Christopher W. May and Ms. Gretchen Peterson

Honorable Commissioners:

When the 2003 Kitsap Salmonid Refugia Report was released last year the county indicated to KAPO that they would not seek input from the public on the report. As you may remember KAPO commissioned a scientific peer review of the original Refugia Study and the subsequent updates.

KAPO has been an active participant in the WRIA 15, Chico Watershed, Natural Resources Working Group and the Best Available Science Advisory Board. So we are most interested in whatever science the County uses on which to base land use policy or regulations. We have once again commissioned Dr. Robert Crittenden to review the "2003 Kitsap Salmonid Refugia Report." Dr. Crittenden's review has been paid for with private funds.

The County Natural Resources staff has told me that the County considers the Refugia Report to be "Best Available Science" as does the State and that the study will be used as written.

Dr. Crittenden's review is complimentary in large part of the new report; however he does raise significant questions about the study's validity and conclusions that should be considered by the county and the State. KAPO would very much appreciate concerns raised in this report be addressed.

I am enclosing copies of Dr. Crittenden's review and Dr. Crittenden's credentials.

Respectfully submitted,

Vivian Henderson

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cc: Kamuron Gurol, Director Dept. of Community Development w/attachments
Jim Bolger, Manager, Natural Resources, Kitsap County w/attachments

Robert N. Crittenden

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Education

1989 Ph.D. Fisheries, University of Washington.

1977 M.S. Marine Biology, University of the Pacific

1974 B.S. Zoology, Oregon State University

1969 Graduated Monterey High School

Positions Held

1999-Present Owner/Writer/Speaker, Hargrave Publishing, P.O. Box 157, Carlsborg WA 98324, --- Hargrave Publishing is a small publisher specializing in books on history politics and nature. It, also, does direct retail sales.

1989-Present Owner/Consultant, Crittenden Biometrical, P. O. Box 157, Carlsborg WA 98324 --- Consulting on biometrics, fisheries biology, genetics and the environment for a wide range of clients: from grass roots groups and the private sector to Agencies of State, Federal, and Foreign Governments.

1996-98 Chairman of the Board & Co-Founder, Dungeness Valley Association, Sequim WA. --- The DVA was a property owners association. Its primary focus was the management of the Dungeness River.

1994-96 Freelance Reporter, Various small papers and magazines but regularly in Citizens' News, Sequim WA --- On the average, throughout this period, I wrote about two articles per month on fisheries issues or covering politics in Olympia.

1990-1992 Post Doctoral Fellow, Department of Natural Resources Management, Simon Frazer University, Burnaby BC --- The research contract's mission was to explain year-to-year variations in the abundance of salmon in British Columbia.

1983. Research Associate, University of Alaska, Juneau, --- Symposium on hydroacoustics and a study of hydroacoustical methods.

1977-1989 Graduate Student --- PhD program, Center for Quantitative Sciences in Fisheries and Forestry, Fisheries Department, University of Washington, Seattle, WA

1976 Director of sampling and sorting teams, Smith and Associates, Sebastopol CA --- Impact statement on PG&E's Moss Landing Power Plant.

1975 Biological Field Work, later, mathematical modeling, D.W. Kelley, Aquatic Biologist, Sacramento CA --- Impact statement on a small water reservoir and the associated stream.

1974-1977 Graduate Student --- Master's degree program, Pacific Marine Station, University of the Pacific, Dillon Beach CA.

Popular Works.

Crittenden, R.N. 2000. *Politics of Change: A Brief History.* Hargrave Publishing, 352 p.

Crittenden, R.N. Several dozen newspaper articles mostly in *Citizens' News*, Sequim WA.

Crittenden, R.N. 1995. *Two Studies: Salmon at Risk and Elite Planners.* (2 edns.) Hargrave

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Scientific and Selected Technical Publications.

Crittenden, R.N. and the Groundwater Work Group 1998. *Expected Water Demand for all*

Future Domestic Wells along the Dungeness River. 10 p. Clallam County, Department of Community Development, Port Angeles WA. 12 p. Also, available on-line at www.hargravepublishing.com.

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the sine of the half-angle of the effective conical volume sampled. *Fish. Res.* 14:197-208.

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Crittenden, R.N. and V.F. Gallucci 1990. *An exploratory Analysis of Length Frequency Data for the Indian Oil Sardine from the Coastal Waters of Oman.* Report to the Omani-American Joint Comm., Ruwi, Oman. 50 p.

Gallucci, V.F. L. Anderson, and R.N. Crittenden 1990. *Evaluation of the Stock Assessment Parts of a Program in the Sultanate of Oman Under Direction of the Omani-American Joint Commission.* U.S. Embassy, Ruwi, Oman. 50 p.

Crittenden, R.N. 1989. *Variance estimation for steelhead sport catch estimates based on creel census data.* Report to Washington Department of Wildlife. Olympia, WA 35 p.

Crittenden, R.N. 1989. *Abundance Estimation Based on Echo Counts.* Dissertation, University of Washington, 169 p.

Crittenden, R.N. and G.L. Thomas 1989. A conditional generalized least squares estimator for the size of a closed population. *Can. J. Fish. Aquat. Sci.* 46: 818-823.

Crittenden, R.N. et al. 1988. A weighted duration-in-beam estimator of the volume sampled by a quantitative echo sounder. *Can. J. Fish. Aquat. Sci.* 45: 1241-1256.

Thomas, G.L.,R.E. Thorne, D.A Marino, J. McClain, and R.N. Crittenden 1986. *Hydroacoustic Measurements of the Density and Distribution of Juvenile Sockeye in Tustumina Lake, Alaska, during 1986.* Second Annual Report. U.S. Fish. Wildlf. Serv. Contr., Washington Cooperative Fisheries Unit. 1 p.

Crittenden, R.N. 1984. *A Regression Analysis of chinook and Coho Salmon Runs in the Duwamish-Green River System, Investigating Possible Relationships Between the Sizes of these Runs and Available Data on Conditions in the Riverine and Saltwater Environments.* Report to U.S. Fish and Wildlife Service, Olympia WA. 42 p.

Crittenden, R.N. and O.A. Mathisen 1983. *The Estimation of Fish Biomass and its Associated Variance with Application to Hydroacoustic Survey Data and to Tower-Count Survey Data.* Final Report, University of Alaska, Juneau. 401 p.

Crittenden, R.N. 1983. An evaluation of the Leslie-DeLury method and of a new weighted

method for estimating the size of a closed population. *Fish. Res.* 2: 141-158.

Crittenden, R.N. 1981. Morphological characteristics and dimensions of the filter structures from three species of Daphnia (Cladocera) *Crustaceana* 41: 23?-248.

Crittenden, R.N. 1978. Sensitivity analysis of a theoretical energy balance model for water temperatures in small streams. *Ecological Modelling* 5: 207-224.

Crittenden, R.N. 1977. *The Prediction of Water Temperature in Small Clear Streams. Thesis. University of the Pacific*. Stockton CA 74 p.

Review of the "2003 Kitsap Salmonid Refugia Report"

By Dr. Robert N. Crittenden

Prepared for the Kitsap Alliance of Property Owners.

The "2003 Kitsap Salmonid Refugia Report," by Dr. Christopher W. May and Ms. Gretchen Peterson appears to be based on a scientifically valid approach and, also, to meet the criteria for "Best Available Science," except for one criterion. That is statistical tests and measures of dispersion. The authors do not analytically compute those measures and without them, tests can not be conducted nor confidence intervals computed. Thus, it is, at present, impossible to determine whether their results are significant nor what their level of accuracy may be. The needed measures of dispersion can be readily obtained from the various scores they developed. Unfortunately, they did not present the data necessary to do those computations. Nevertheless, they did present enough information about the dispersion of their estimates, in graphical form, to provide a visual impression of the level of accuracy: Based on that, it appears that their estimates may be significant but that their scores are of relatively low accuracy. The authors need to compute the estimates of dispersion. Until they have done so, their report does not meet the standards for Best Available Science, nor can it be said to be scientifically valid, as they have not yet demonstrated the statistical significance of their results. In addition, until they have done so, their study should not be used to made management decisions, as the decision-makers need to know, at what level of difference the scores for the refuges are statistically significant. Satisfying the criteria for Best Available Science is a due process issue, and violations of due process are actionable as civil rights violations. For this reason, I advise that the study not be accepted until the authors have provided the necessary tests and measures of dispersion. But, once they have done so, provided that their results are statistically significant at the conventional scientific level, of 95%, I recommend that their report be accepted and used in decision-making, as it is otherwise acceptable.

Their report presents a model for ranking or prioritizing various small regions in Kitsap and Jefferson Counties according to their value as salmonid refuges. This is a difficult estimation problem, as both the raw data and our understanding of the relevant processes which act within each of the refuges are sometimes of poor or limited quality. Nevertheless, the authors appear to have provided a solution to this estimation problem.

It also appears to meet the standards for "Best Available Science:" --- Those standards vary according to the type of study. Their study is "modeling." As such, it must meet all of the criteria, described in the Washington Administrative Code for best available science. It does meet them, with one exception. To be more specific, their methodology appears to be scientifically valid, their methods are adequately described and repeatable, they appropriately cite the relevant scientific literature, and their conclusions follow reasonably from their results.

The criterion their study fails to meet, is the requirement for appropriate statistical tests and measures of dispersion. Such tests and measures are a necessary part of science as they are what demonstrate that the results of a study are meaningful. --- The authors provide, as a measure of dispersion, only the description found on page 85 of their report. It describes the level of difference in their scores for refuge value which they consider to be "ecologically significant and measurable."

However, Figure 43, on page 202, provides a far clearer impression of the relative accuracy of their estimates. --- They appear to be significant, in the sense that some of them are significantly different from 0 or 100 at the 95% confidence level.

However, the more relevant question is whether any of the estimated scores for the individual refuges are significantly different from each other. Unfortunately, the dispersion is large enough that they can probably only distinguish the best refuges from the worst ones, at the 95% confidence level.

Although, at first, this low level of accuracy may appear to conflict with the level of difference which the authors describe as being "ecologically significant and measurable;" the two statements are really in full agreement. This is because, the authors were probably referring not to the level of difference which is significant at the 95% confidence level, but to a difference at slightly above the 50% confidence level. The first is the scientific standard and is rather conservative, whereas the second is the level where the model's predictions first noticeably out-perform chance. Specifically, the usual question is, "Is refuge A better or worse than refuge B?" That is a binary choice, and one could make that decision either by using the model or by flipping a coin. The 50% confidence level is where the model first begins to out-perform the coin-flip. So, it is at only a slightly higher confidence level than 50%, that one begins to first notice the difference. That is the level which they were probably referring to as, "ecologically significant and measurable."

What is needed, is an estimate of the standard error of their scores for refuge-value. Fortunately, an estimate can almost certainly be obtained by analyzing the data diagrammed in their figure 43, together with the riparian scores.[1] The computation of this measure of dispersion would allow the computation of confidence intervals for the refuges' final scores and rank-orders. This will make it possible to demonstrate the statistical significance of the study's results. It will also provide whoever may use those results in making management decisions about the refuges, with an understanding of their accuracy, or inaccuracy, as the case may be. That will be invaluable to their making good management decisions.

I am inclined to recommend that the study be accepted as meeting the criteria for Best Available Science, *conditional* upon the authors obtaining a measure of dispersion and demonstrating that their results are statistically significant. The reasons are: 1) Their study appears to be otherwise acceptable; 2) Even if it has a relatively low level of accuracy, it may still provide a useful tool in those cases where its predictions have statistical significance, and its use may be otherwise avoided; and 3) If it is used, it may be hoped that additional research will be done, to improve its accuracy.

Models with lower levels of accuracy are sometimes used more aggressively, based on a risk-minimization argument. --- I raise this issue to show its defects and to put the issue of statistical significance into context. --- This approach might be applied, in this case, because the risk or cost associated with not making decisions for creating and protecting a coordinated system of refuges is likely to be relatively high. The reason for this is that the cost of creating those refuges is currently low, compared to what it will be, once the land has been fully developed. In contrast, the cost of mis-assigning the rank-order of the various possible refuges may be relatively low. The reason for this is that the mandate to protect those natural resources does not require the best decisions, only that some action be taken, and often, also, that it be based it on the best information available, if any. Therefore, under a risk-minimizing approach, decisions might be made at a lower confidence level than 95%. Perhaps, at 90% or even 80%. That would allow those decisions which must be made, to still be made. In addition, they could be based on the study, which would be better than making them purely arbitrarily. [2]

The disadvantage of this approach is that decisions based on reduced confidence levels will have substantially higher error rates. In particular, the rate doubles when you move from the 95% to 90% confidence levels, and doubles again in moving from there to 80% . Only one more doubling moves you to 60%, which is close to the level at which the decisions become demonstrably arbitrary. In this regard, the 80% level is closer to being arbitrary than scientific. It follows that the 90% level is probably as low as one should ever go. But, that does not decrease the width of the confidence interval very much. Consequently there will be little improvement in terms of the ability to make decisions. --- Furthermore, a reduced level of accuracy, not only will make it more difficult to justify a decision to the public, but as the decisions get closer to being arbitrary than being scientific, the issue of liability arises, because arbitrary management violates due process.

Due process violations are serious offenses. They are prosecuted under the Civil Rights Act: Title 42 section 1983, of the US Code. Not only does this involve a potential liability for the County, but it has been established in case law that County employees can acquire criminal and civil liability, as individuals, if they apply laws, ordinances, or policies in violation of due process. According to *Washington Practice*,[3] the standard is that one must prove that the action was, "irrational or arbitrary... or invidious <that is, unrelated to the purpose of the regulation or out of proportion to it.>" --- Notice that arbitrary[4] decisions are grounds for action. Thus, statistical significance is an issue in due process. It also has a place, because decisions which are based on predictions which are not statistically significant do not have the sanction of science nor can they be regarded as being Best Available Science.[5] --- For these reasons, decision-making at lower than the scientific standard of 95% should be avoided.

Fortunately, reducing the confidence level should not be necessary, as development in Kitsap County probably will not occur so rapidly that there will not be adequate time to improve the model and its associated data set, so that more accurate

predictions can be obtained. That is probably the preferred course.... The obvious approach towards improving the model's accuracy is to improve the realism with which it models the processes which connect the variables in the data set to the functions and values of the refugia. As very little realistic modeling has occurred, yet, in the study, it may be fairly easy to make substantial improvements. Appropriate additions to the data set would probably also help.

In closing, I would like to remark, that the general direction towards realistic modeling, which the authors took in their discussion of the relationships between the measured variables and the processes and values of the refugia, represents a movement towards greater social justice. This can be seen in the light of the due process requirement.[6] Due process requires that laws, ordinances and their application be reasonable, directly related to the impact or process they seek to regulate, based on a legitimate government objective, and the regulation or penalty must be proportionate to the problem. The use of valid science in the studies upon which laws, ordinances, and management decisions are based, meets the due process requirement, because science is based on reason. It is consummately "reasonable." But, the ideal approach towards meeting that requirement is, usually, to use realistic modeling, because that establishes a direct correspondence between the model and the processes and impacts modeled. Thus, of all the possible scientific approaches, it usually most clearly meets the due process requirement. If, in addition, there is a real and true need for the regulation, the due process requirement is usually, thus, truly met. That is just. --- For these reasons, I compliment the authors for having adopted this orientation, in their research, and I look forward to further developments along these same lines.

1 It appears that their final score for each refuge is based on three scores: Specifically, the fish, riparian, and landscape scores. Except, for arbitrary scaling factors, these appear to be three independent measures of refuge quality, and the final score for each refuge is the mean of these three scores. Therefore, the relevant measure of dispersion is the standard error of that mean. This can be computed for each refuge from its three scores. Those standard errors of the mean can, then, be averaged over all the refuges to provide a measure of the average dispersion of their final scores and this can be used to compute the tests and confidence intervals which are needed in making comparisons among the scores from various different refuges.

2It would be useful for the users to know what the 50% confidence level is, as that is the level at which the model will not out-perform purely arbitrary decisions, such as those made made by flipping a coin. Clearly, the results of the study should not be used except at confidence levels higher than this.

3Washington Practice, Volume 24 , Environmental Law, Chapter 21.11. pages 265-266.

4The legal definition of "arbitrary", according to Black's Law Dictionary, is to govern without an underling principle. There is little difference between that and its statistical definition. Adopting the nihilist stance, that it is impossible to define principles in an ecological context, because the complexity of ecological systems exceeds human understanding, such as was enunciated by Noss and Coperrider, and was cited indirectly by the authors of this study, constitutes a declaration of an intention to make arbitrary decisions. Fortunately, although they state that their principles are the principles upon which their study is based on, its orientation and substance are overtly scientific, instead.

5 "Best Available Science" is the State's standards for scientific studies to meet the Federal due process requirement.

6 The due process requirement comes from the fifth amendment to the US Constitution.