Response to Council of Economic Advisors' (CEA) Analysis of Vessel Speed vs. Whale Ship Strikes

NOAA Fisheries, 31 July 2007

Background

A meeting at the Council on Environmental Quality with representatives from NOAA, DOC, OMB, OSTP, the Office of the Vice President, and Council of Economic Advisers (CEA) was held on July 10, 2007 to discuss the right whale ship speed rule, but the issue of appropriate speed for the rule was not resolved. Following the meeting, CEA said it would investigate the reliability of analysis in the published literature on which NOAA is basing its position. With NOAA's assistance, CEA reconstructed the data base. Then, on its own, CEA produced additional analyses in which CEA changed the coding of a few data points to observe how the model responded. CEA confirms relationship between speed and injury but concludes it is sensitive to interpretation of a few data points and may not be as strong of a relationship as is suggested in published papers. CEA also suggests there is not a statistically significant difference in probability of mortality between 14 and 10 knots. NOAA has reviewed CEA's analysis and finds it is a biased sensitivity analysis because it only explored changing serious injury to minor or no injury (i.e., CEA selection of data points for their analysis was not random) -- whereas analysis in the literature confirms that the models conform to "goodness of fit" statistical tests.

NOAA's response to the CEA analysis

Analysis conducted by CEA involved choosing five particular ship strike records (from a total of 53 records contained in the scientific literature (Pace and Silber, 2005), and running simulations by changing the "fate" code (i.e., from a "serious" to "non-serious" injury) of these records in various permutations. The "logit" functions resulting from these models show variation around the Pace and Silber curve.

NOAA biometricians reviewed the CEA analysis and have concerns. First, it is unclear how or why these five records were chosen for re-coding, and why CEA would consider recoding these records as a sensitivity analysis. All 5 of the cases were considered serious injuries by NMFS, due to the nature of the injury or the whale's subsequent behavior. Furthermore, this analysis is unlike any formal sensitivity analysis NMFS biometricians are familiar with; usually either simulated datasets or random draws from an existing dataset are used to explore the robustness of a model to perturbation. Ultimately though, one would hope that a model is sensitive to changes in values of the dependent variates (as the Pace and Silber logit model is). Where there should be concern is when the sensitivity analysis of the model shows conflicting trends (e.g., a declining probability of mortality as speed increases); the Pace and Silber analyses did not show that.

Second, NOAA was asked to conduct a test for statistical significance between, for example, 10 and 14 knots. However, this is neither a relevant nor appropriate test. Some of the issues include the triviality of the null hypothesis (the size of the effect is more important), lack of an *a priori* experimental design, and lack of any form of a control. Moreover, the number of individual observations at any single speed is sufficiently small

that the power of any significance testing is extremely low. The general lack of relevance of post-hoc tests of significance, such as that proposed, is addressed in a number of published papers (see, for example, Anderson and Burnham, 2007). The appropriate tests for this type of analysis are either "Goodness of Fit" tests on the model, or contingency table tests of the original data (though contingency table tests cannot be conducted on individual speeds due to small sample size). These tests all indicate that: (a) the logit models in the published reports provided statistically significant fits to the data, (b) all probability curves, including those generated by CEA, indicate strong and direct relationship between vessel speed and mortality/serious injury, and (c) as speed increases, so does the likelihood of death/serious injury. Finally, the Pace and Silber model predicts that requiring the fleet to reduce speed from 14.3 knots (the median speed of vessels entering the U.S. Mandatory Ship Reporting Areas in the NE and SE) to 10 knots will result in an estimated >40% reduction in mortality risk.

Finally, CEA questioned the use of 10 knots as an appropriate threshold for conservation purposes (suggesting that perhaps lower speeds were necessary for increased conservation value). The data, models, and best available science indicate that as vessel speed increases so does the probability of death or serious injury in a ship strike. Therefore, NOAA's use of 10 knots provides high conservation value while also allowing for adequate ship steerage.

In sum, although some data were re-coded by CEA (contrary to NOAA determinations regarding the severity of the injury), the resulting curves were generally similar to the previous peer-reviewed analysis, and show a strong relationship between vessel speed and the severity of a ship strike. And, the basic facts remain that (1) there is a direct relationship between speed and death/serious injury, and (2) at vessel speeds at or below 10 knots the probability of death/serious injury is greatly reduced.