DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
REGION 1

FY13 - ENVIRONMENTAL CONTAMINANTS PROGRAM
OFF-REFUGE INVESTIGATIONS SUB-ACTIVITY

FINAL REPORT
WA - Impacts of Non-point Source Pollution on the Health of Salmonids in Urban and Urbanizing Watersheds

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Final Published Report References:

Feist, B.E., Buhle, E.R., Arnold, P., Davis, J.W., and Scholz, N.L. (2011). Landscape ecotoxicology of salmon spawner mortality in urban streams. *Public Library of Science ONE*, 6(8): e23424. doi:10.1371/journal.pone.0023424.

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Management Recommendations:

The Services-led off-refuge EC investigation has yielded extensive insights into the nature of the coho spawner die-off phenomenon, as well as predictive modeling for unmonitored watersheds based on a close correlation between the observed severity of the phenomenon and land cover characteristics corresponding to a gradation of urbanization. Both studies were published in the influential, peer-reviewed, open-access scientific journal PLoS ONE. The forensic analysis (Scholz et al., 2011) has been viewed 1,987 times since Dec. 14th, 2011, with 417 pdf and xml downloads (accessed July 19th, 2012). The predictive modeling paper (Feist et al., 2011) has been viewed 1,481 times since Aug. 17th, 2011, with 443 pdf and xml downloads (accessed July 19th, 2012). Major findings have also been presented widely at regional and national scientific meetings, at regional workshops, and related fora.

The key results of the off-refuge EC investigation are thus reaching a broad end-user audience in the Pacific Northwest and beyond (e.g., northern California) comprised of federal, state, and local natural resource managers, academic scientists, K-12 educators, non-governmental organizations, tribal organizations, and the general public. Most of the feedback to the FWS-NOAA Team has come from stream habitat restoration practitioners, particularly those working in urban or urbanizing watersheds. The FWS-NOAA Team has developed educational materials and stream survey protocols and distributed these widely; as of the fall of 2011, the survey protocols have been adopted by King County, the Stillaguamish and Suquamish Tribes, and others.

An extensive weight-of-evidence approach points to toxic runoff from streets, parking lots, and other impervious surfaces as the cause of recurring coho spawner fish kills. As expected, the forensic evidence indicates exposure to mixtures of metals and petroleum hydrocarbons in affected spawners, albeit at levels lower than those expected to cause acute lethality based on the conventional toxicology literature. More work is needed to identify the precise components of urban runoff driving the observed toxicity. Absent this "smoking gun," management actions in the chemical-specific context of the Clean Water Act have been limited. In fact, many of the candidate petroleum hydrocarbons (e.g., tricyclic PAHs) do not have established water quality criteria under the CWA.

The results of the predictive modeling analysis based on urban land cover have broader management implications. Thus far, predictive mapping has been completed for the four Seattle-area counties in central Puget Sound. If the model outputs are reliable, the models can be expanded to include all of Puget Sound and the Lower Columbia River (greater Portland metropolitan area) where coho are currently listed under the ESA as threatened. The models can also be expanded to predict how and where coho spawner mortality will increase as a function of projected human population growth and land use change in the coming decades. This, in turn, can be used to identify spawning habitats at lowest risk (for conservation prioritization), restoration areas that may become ecological traps (for restoration prioritization), population-scale links between water quality and coho abundance (for salmon recovery planning and essential fish habitat consultation). An important first step will be to validate the model predictions for the four central Puget Sound counties using available and vetted coho spawner survey data collected by regional salmon biologists (Wild Fish Conservancy, Washington State Department of Fish and Wildlife, the Suquamish Tribe, etc.). If the model outputs are accurate for the watersheds that were not surveyed by the FWS-NOAA Team but were surveyed by those other entities, the Services (FWS and NOAA) will have a more robust scientific foundation for expanding the models and using the results and the aforementioned management contexts.

There are at present four distinct coho population segments listed for protection under the U.S. Endangered Species Act (ESA). These include the Central California Coast, Southern Oregon and Northern California Coasts, Oregon Coast, and Lower Columbia River population segments. In 1999, FWS determined threatened status for all Distinct Population Segments (DPSs) of bull trout within the coterminous United States, including the Coastal-Puget Sound DPS. This off-refuge investigation will inform a variety of salmonid ESA-related management activities by the Services, including Section 7 consultations on a variety of land use activities such as NPDES permitting for stormwater discharges, federally-funded transportation projects, etc. The information generated by this study will not only help inform consultations on projects related to land conversion/urbanization, stormwater/non-point source pollution, and impervious surfaces (i.e. NPDES permits, transportation projects, etc.), it will also assist biologists with recovery planning efforts, with critical habitat and EFH processes, and with restoration efforts undertaken by our agencies (i.e., not focus purely on physical habitat but also include water quality when improving fish "habitat") for not only coho but for listed salmonids in general.

Summary

By the Services conducting this off-refuge EC investigation and jointly publishing the results in the two aforementioned manuscripts, we were able to address some of the uncertainties associated with this phenomenon known as pre-spawn mortality. The information generated by this study provided the appropriate regulatory authorities with information so that trust resources could be more adequately protected and recovered.