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TITLE: Pacific Ocean?Wide Profile of CYP1A1 Expression, Stable Carbon and Nitrogen Isotope Ratios, and Organic Contaminant Burden in Sperm Whale Skin Biopsies

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ABSTRACT:

Ocean pollution affects marine organisms and ecosystems as well as humans. The International Oceanographic Commission recommends ocean health monitoring programs to investigate the presence of marine contaminants and the health of threatened species and the use of multiple and early-warning biomarker approaches.We explored the hypothesis that biomarker and contaminant analyses in skin biopsies of the threatened sperm whale (Physeter macrocephalus) could reveal geographical trends in exposure on an oceanwide scale.We analyzed cytochrome P450 1A1 (CYP1A1) expression (by immunohistochemistry), stable nitrogen and carbon isotope ratios (as general indicators of trophic position and latitude, respectively), and contaminant burdens in skin biopsies to explore regional trends in the Pacific Ocean.Biomarker analyses revealed significant regional differences within the Pacific Ocean. CYP1A1 expression was highest in whales from the Galapagos, a United Nations Educational, Scientific, and Cultural Organization World Heritage marine reserve, and was lowest in the sampling sites farthest away from continents. We examined the possible influence of the whales' sex, diet, or range and other parameters on regional variation in CYP1A1 expression, but data were inconclusive. In general, CYP1A1 expression was not significantly correlated with contaminant burdens in blubber. However, small sample sizes precluded detailed chemical analyses, and power to detect significant associations was limited.Our large-scale monitoring study was successful at identifying regional differences in CYP1A1 expression, providing a baseline for this known biomarker of exposure to aryl hydrocarbon receptor agonists. However, we could not identify factors that explained this variation. Future oceanwide CYP1A1 expression profiles in cetacean skin biopsies are warranted and could reveal whether globally distributed chemicals occur at biochemically relevant concentrations on a global basis, which may provide a measure of ocean integrity.

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