## Understanding Interconnected Relationships and Interactions Between Marine, Terrestrial, and Atmospheric Systems, and Their Impacts on Health

What are the issues?

There are a number of health threats that are shared across marine, terrestrial and air/atmospheric boundaries, including pathogens, biotoxins, contaminants, agricultural runoff, and plastic pollution. These threats are often complex and interconnected. For example, certain diseases in marine animals, like leptospirosis and avian influenza, can be passed to humans or terrestrial animals and vice versa. Marine animals are increasingly being forced to adapt to anthropogenic disturbances, including climate change, with alterations in their movements and habitat use to find food. These shifts can bring marine life into closer contact with domestic animals and people creating opportunities for transmission of pathogens and exposure to other human-caused threats. In addition, pathogens and pollutants originating from agricultural and urban runoff can contaminate water sources, impacting terrestrial and marine biodiversity and posing serious health risks to human populations reliant on these resources. Pollutants such as microplastics and toxic chemicals, can also travel through the air, deposit on land, and eventually wash into marine environments, causing ecological damage and health risks to both humans and wildlife. The interactions between pathogens and microplastics or contaminants can further exacerbate these issues by concentrating pathogens in plastic-contaminated areas of the ocean and serving as a vehicle transporting pathogens far from their sources on land (microplastics), or interacting within the host to lead to disease (contaminants; e.g. infection with Otarine herpesvirus-1 (OtHV-1) and exposure to organochlorines are associated with an increased risk of developing urogenital carcinoma in California sea lions). Understanding and identifying solutions to these complex and interconnected issues requires consideration of these air-land-sea linkages and holistic approaches that span geographic and disciplinary boundaries.

*To Learn More:*

- Leptospirosis in California sea lions and other wildlife species — Katie Prager and Lloyd-Smith, UCLA
- The PNW Harmful Algal Bloom Bulletin — Northwest Association of Networked Ocean Observing Systems
- "Avian influenza" — Washington Department of Fish & Wildlife
- Shellfish and Biotoxins – Oregon Department of Fish and Wildlife
- Evaluation of contaminants in Steller and California sea lions and associations with urogenital carcinoma — Sarah Rothenburg (OSU), Julia Burco (ODFW)
- Wildlife's Toxics Biological Observation System (TBiOS) – Washington Department of Fish and Wildlife
- Health of the Salish Sea — SeaDoc Society

- Protozoans and One Health & Plastics Pollution — Karen Shapiro, UC Davis
- Persistent Contaminants and Herpesvirus OtHV1 Are Positively Associated With Cancer in Wild California Sea Lions (Zalophus californianus) — Frances Gulland, Katie Colegrove, Tenaya Norris, Pádraig Duignan, Alissa Deming, Teri Rowles

- (March, 2024) "Reduce toxic contaminants to help preserve Puget Sound wildlife" — Washington Department of Fish & Wildlife
- (August, 2023) "High temperatures send Oregonians to cool water, but state warns of toxic algae blooms" — OPB
- (November, 2022) "Disease outbreak leaves sea lions stranded on Oregon Coast" — Jim Rice, OPB
- (November, 2021) "Climate Change Likely to Worsen Impact of Urban Runoff on Southern California Ocean" — NOAA National Centers for Coastal Ocean Science
- (March 2023) "Deadly parasite threatens California sea otters" – University of California, Davis; University of Nebraska Lincoln; and California Department of Fish and Wildlife
- (April 2022) "Pathogens Can Hitch a Ride on Plastic to Reach the Sea" – University of California, Davis
- (Mar 2020) Oregon Sea Grant awards $1.15 million to OSU researchers for five marine-related projects