DDT+ COMMUNITY MEETING

Assessing the extent and scope of contaminant impacts and mitigation strategies for deep ocean dumping sites in Southern California

On March 23rd, 2023 the first virtual DDT+ Community Meeting brought together over 95 researchers and practitioners from state and federal agencies, researchers, non-profit directors, tribal members, and community members. The meeting was hosted by UC San Diego's Scripps Institution of Oceanography and California Sea Grant and moderated by Erin Satterthwaite, Lian Guo, and Tanya Torres from California Sea Grant.

The goal of the meeting was to bring the DDT+ community together to share knowledge and to strengthen partnerships between members. Recent findings and media focus have reignited concerns about deep ocean DDT contamination in Southern California.

Research has been conducted by researchers at Scripps Institution of Oceanography, UC Santa Barbara, San Diego State University, and collaborative organizations at these deep ocean sites based on funding that was secured by Senators Feinstein and Padilla through congressionally directed spending. The research broadly consists of assessing the extent and scope of contaminant impacts and mitigation strategies. The meeting consisted of sharing preliminary research findings, providing a space for questions and discussion, and an open forum to share community updates.

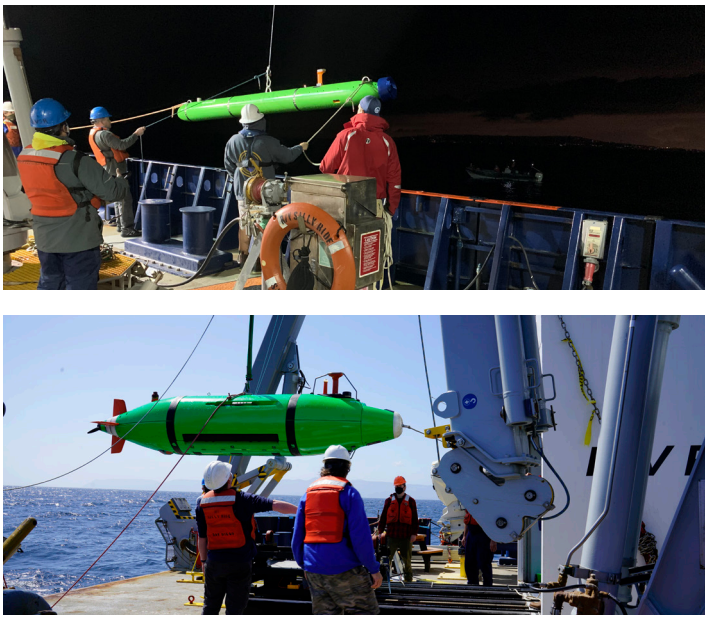
Site Characterization Plan: "Seabed Surveys"

Eric Terrill and Sophia Merrifield
Scripps Institution of Oceanography at UC San Diego

Research Goal: To characterize the extent of DDT+ disposal by identifying relevant debris and other seafloor anomalies throughout identified DDT+ disposal sites.

How: Surveyed 150 km2 within a 3 nautical mile radius of Dumpsites 1 and 2 using underwater robots (Remus 6000 and BLUEFIN 12D) to collect sidescan imagery (i.e., near-raw sonar data). Acoustically identified DDT+ debris targets from other seafloor or biota characteristics.

Update: Based on these surveys, target DDT+ debris appears to exceed the designated DDT+ disposed by a wide radius. The study pointed to the need to expand survey efforts and find the ends of the "debris lines," as well as to characterize the debris in greater detail, with greater resolution. The extended survey is slated for April 2023, where researchers will obtain much higher resolution imagery and have analysts examine data in real time and react accordingly.



Scripps Researchers deploy a Bluefin (top) and REMUS 6000 (bottom) autonomous underwater vehicles from deck of the R/V Sally Ride, March 2021. Photo: Scripps Oceanography

"Fingerprint" DDT Chemistry: Identifying the Chemical Fingerprint of DDT Sludge From Dumpsite 2

Lihini Aluwihare and Anela Choy,
Scripps Institution of Oceanography at UC San Diego
Eunha Hoh, SDSU

Research Goal: To assess whether DDT+ from contaminated sediments are entering the pelagic food web.

How: Measuring stable isotope compositions and DDT+ concentrations in sediment cores near barrels, deep biota samples from different depths, and suspended sediment samples in order to provide insight into the routes of DDT+ exposure and trophic levels of pelagic organisms.

Update: Preliminary data indicated that in some sites, high-DDT sediments may be resuspended in the water column, and pelagic fishes currently contain DDT+, especially those collected deeper in the water column or are higher in trophic level. Surprisingly, some of the highest DDT measurements came from organisms collected at a "control site" outside the DDT deep disposal site, potentially demonstrating some connectivity between food webs across deep ocean basins. These early findings were from a very small handful of samples and are interpreted with caution.

"Fingerprint" Evidence for Short Dumping, Long-distance Transport and Recalcitrance of DDT Waste

David Valentine, UC Santa Barbara

Research Goal: To characterize the extent, transport and fate of DDT+ disposal throughout the San Pedro Basin.

How: Acquired 13 sediment cores across 2 linear transects in the San Pedro Basin, with ~195 new samples for DDX analysis plus one Palos Verdes Shelf (EPA Superfund site) sediment core.

Update: This survey identified approximately 40 square miles of contaminated DDT+ sediments, which will likely increase with additional survey efforts. The expansive extent of contamination indicates that bulk dumping of DDT waste was the normal method of disposal both enroute and at designated disposal sites. For much of the San Pedro Basin, DDT has undergone little degradation. In shallower sediments near dumpsites or on the mainland slope, more DDE (an aerobic breakdown product of DDT) was found.

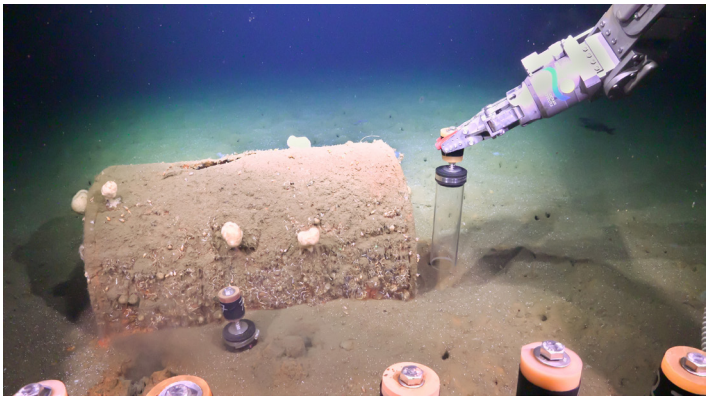
Seafloor Biota and Relation to DDT Uptake, Accumulation, and Redistribution: Part 1

Lisa Levin, Scripps Institution of Oceanography at UC San Diego

Research Goal: Determine whether seafloor macrofaunal communities are impacted by DDT+ from dumped barrels.

How: Measured DDT+ concentrations in sediments collected via paired push cores ~0 m, 1m (within the bacterial halo), 3m, and 5m away from disposed barrels. Analyzed meiofauna (< 42µm) and macrofauna (> 300µm) taxa and densities at 0, 1, 3 and 5 m from barrels.

Update: Preliminary findings indicate that DDX is highest 2-6 cm below the surface but there is no consistent DDT+ pattern in sediments with distance from barrels. The average densities of fauna was similar to other oxygen minimum zones globally. Some fauna collected on barrels, such as sponges, polychaetes, and snails, had high DDT+ concentrations in tissues. There are several fauna that require additional study, as they may act as bioturbators or have benthic-pelagic life cycles that could contribute to transport of DDT+ from sediments to the water column.



Schmidt Ocean Institute's ROV SuBastian collects sediment push cores around a DDT barrel. Photo: Schmidt Ocean Institute

DDT Uptake, Accumulation, and Redistribution by Seafloor Animals: Part 2

Gregory Rouse
Scripps Institution of Oceanography at UC San Diego

Research goal: Identify organisms found in seafloor samples, with an emphasis on those growing on the barrels.

How: Collected 3D photogrammetry models of the barrel and peripheral area using Metashape. Suction sampling of the barrel surface yielded a range of small to relatively large organisms. External experts assisted in identifying observed organisms, which is being linked with DNA analysis.

Update: A variety of sponges, molluscs, anemones, and polychaetes have been identified to order or genus. The infaunal invertebrates are still being identified through DNA sequencing, and each specimen will be linked to sediment DDT measurements.

Maintaining Confidence in California's Healthy Seafood Products

Brice Semmens, Lillian McGill and Toni Sleugh,
Scripps Institution of Oceanography at UC San Diego

Research Goal: Understand how toxins and chemicals from deep ocean dumpsites are entering the coastal ecosystem through important fish species, as a potential path of human exposure to deep ocean DDT+.

How: Collected 1165 fish representing 16 species opportunistically through ride-along sampling trips on charter fishing vessels. Of these, there are 5 priority species in the study because they are high-value recreational species, are commonly kept and eaten, and have different roles in the ecosystem, representing distinct potential routes of transfer for DDX contaminants. Historical samples of myctophids, which are highly abundant midwater fish that act as a conduit between the upper and mid-ocean food webs, will also be measured for DDT+ concentrations.

Update: Based on previous data, the suite or fingerprint of toxin burdens in fishes can be separated by similarity in ecological roles, as well as geographic location in the Southern California Bight. Toxin measurements and aging of recreational fish is ongoing to understand whether specific fish are being impacted by toxins in the barrel field and how those toxins may be accumulating. The team is also digitizing thousands of pages of CalCOFI records to understand when and where myctophid samples were collected and potentially available to measure pollutant concentrations.

Microbiological Effects and Remediation Strategies

Johanna Gutleben, Paul Jensen, and Jack Gilbert,
Scripps Institution of Oceanography at UC San Diego

Research Goal: Understand impacts to microbiological communities and potential bioremediation strategies related to deep ocean dumpsites.

How: Conducted a survey to collect 100 sediment push core samples in a gradient moving away from the barrels, including control sites, to characterize sediment microbiomes, DDT+ concentrations, and identify potentially bioremediating microbes.

Update: The microbial communities were found to be very diverse in sediment samples collected 3m away from barrels compared to those within the microbial halo, which tended to be dominated by a few microbial taxa. DDX pollution remained high, especially close to barrels, with DDE being the most concentrated pollutant. Potentially dehalogenating taxa were identified, especially high in abundance in the microbial halos. The contents of the barrels may have influenced the seafloor properties, with highly alkaline crusts around barrels appearing to coincide with alkaliphilic microbial communities within the microbial halo. We are also working on bioremediation efforts to create metabolic models and simulate microbial communities that can reduce bioaccumulation of toxic products in tissues.

Community Updates

Heal the Bay is sponsoring bill AB343 this year with Congressmen Lowenthal and Muratsuchi, with the goal to require California Environmental Protection Agency (CalEPA) to host public meetings on the DDT issue as a means to offer opportunities to give comments and recommendations.

There was some discussion about permits to conduct research on the seafloor and whether there is a blanket waiver for this research. Most federal and state funding requires environmental compliance, but likely needs to be filed on a research project basis. If you are seeking to conduct research similar to the PIs who have obtained permits, please reach out to get some guidance on how they completed the process.