

Environmental Studies Program: Ongoing Study

Field	Study Information
Title	Tuna Contaminants, Habitat, Movements, and Prey (Tuna CHaMP) (PC-26-x06)
Administered by	Pacific Regional Office
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Procurement Type(s)	Interagency Agreement
Conducting Organization(s)	National Oceanic and Atmospheric Administration
Total MMA Cost	\$800,000
Performance Period	FY 2026–2028
Final Report Due	May 2028
Date Revised	October 22, 2026
Problem	Seabed mining-associated plumes may alter pelagic food webs and introduce metals that could affect tuna populations, prey communities, and seafood safety; baseline data and potential exposure pathways are insufficiently characterized.
Intervention	Integrate micronekton ecology, tuna diet, telemetry/behavior, and tissue contaminant monitoring with plume modeling to quantify exposure, responses, and risk from seabed mining-associated plumes.
Comparison	Spatial/temporal reference areas for pre-mining baselines; gradient designs across predicted plume footprints; before–during–after and/or control–impact contrasts.
Outcome	Information on potential contaminant exposure pathways in marine food webs that enables development of mitigation measures (e.g., dewatering plume discharge depth) and adaptive management of mining plumes.
Context	U.S.-flagged Pacific Islands and neighboring Exclusive Economic Zones (EEZs) or high-seas areas where seabed mining pilots or operations

could occur; multi-jurisdictional fisheries and migratory species distributions.

MMA Information Need(s): Seabed mining activities may include releasing de-watering plumes into the marine environment, potentially introducing heavy metals and other contaminants into pelagic habitats (Drazen et al., 2020). These inputs could disrupt offshore food webs, affect tuna populations (and other apex predators) and their prey, and pose risks to seafood safety (Van Der Grient and Drazen, 2021). Current baseline data and exposure pathways are insufficiently characterized to support MMA's review of preliminary activities, delineation, commercial operations, and decommissioning. A key decision point, for example, is determining the depth at which de-watering plumes may be discharged. This research will provide the biological information and exposure-pathway analysis needed to inform National Environmental Policy Act environmental reviews, Endangered Species Act and Essential Fish Habitat consultations, and permit conditions such as environmental monitoring and management plans.

Background: The pelagic waters surrounding tropical islands support vital ecosystem services, including productive tuna fisheries that contribute to food security, local livelihoods, and export economies (Barclay and Cartwright, 2007; Gillett and Tauati, 2018; WPRFMC 2009). These offshore habitats are essential not only for all life stages of tuna, billfish, and other pelagic predators (e.g., mahimahi, wahoo, and elasmobranchs), but also for the larvae and pelagic juvenile stages of coral reef and deep-water fishes (Bandara et al., 2021; Leis, 2006. Moore et al., 2020). Because these ecosystems depend on tightly linked trophic pathways, disturbances that alter water quality or prey availability can have far-reaching biological and socioeconomic consequences. Seabed mining may introduce midwater de-watering plumes that contain suspended sediments, dissolved metals, and other contaminants. These plumes have the potential to disrupt trophic transfer (Dowd et al., 2025), alter community composition, and promote the bioaccumulation of harmful substances in species consumed by humans (Drazen et al., 2020; Pethybridge et al., 2025). Tuna and other pelagic predators are especially relevant to assessing these risks because they are targeted by many fisheries and depend on micronekton (small fishes, squids, and crustaceans) that undergo diel vertical migrations through the same depth ranges where midwater plumes may occur (Deary et al., 2015; Domokos, 2007; Hetherington et al., 2017; Perelman et al., 2021). As a result, tuna, their prey, and the food webs they depend on may have substantial spatial, temporal, and depth overlap with plume pathways. Significant knowledge gaps limit MMA's ability to evaluate these risks,

including (1) plume–biota spatial and temporal overlap; (2) behavioral responses to plume characteristics; (3) contaminant transfer through food webs; and (4) baseline contaminant levels in tissues.

A coordinated program integrating oceanographic information, plume modeling, micronekton ecology, diet studies, telemetry, contaminant monitoring, and socioeconomic data is needed to link exposure pathways to population-level and fishery-level risks and to inform adaptive management throughout the seabed mining lifecycle. Because of the breadth of information needed to characterize plume–biota interactions and contaminant pathways across pelagic ecosystems, the research approach will be implemented in a phased manner. Early phases will focus on establishing baseline biological, oceanographic, and contaminant datasets, refining sampling strategies, and integrating data streams across MMA-supported efforts. Subsequent phases will expand coordinated field sampling, telemetry deployments, micronekton characterization, and food-web contaminant analyses as results from initial efforts inform the design of later activities. Multiple geographic locations will be assessed.

The proposed research supports Executive Order (EO) 14285 (April 24, 2025) *Unleashing America's Offshore Critical Minerals and Resources*, which directs federal agencies to accelerate the responsible development of seabed mineral resources without compromising environmental and transparency standards, and EO 14241 (March 20, 2025) *Immediate Measures to Increase American Mineral Production*, which focuses on boosting domestic mineral production, including offshore sources, through streamlined permitting and interagency coordination.

Objective(s): The overall objective is to describe the pathways through which mining-associated plumes and operational stressors may affect pelagic marine food webs across the tropical Pacific, with an emphasis on tuna species.

Methods: Study areas will focus on the OCS of U.S.-flagged Pacific Islands and may extend into neighboring EEZs or high seas areas when scientifically justified (e.g., potential effects of Cook Islands seabed mining on American Samoa tuna fisheries). Sampling locations will be selected to represent predicted plume exposure gradients and appropriate reference areas, ideally using Before–During–After and/or Control–Impact designs with seasonal replication where feasible to account for tuna migratory behavior.

Micronekton communities will be described using a combination of historical and new samples, and may include midwater trawls, bioacoustic surveys, genomic/eDNA sampling, and optical/imaging transects to estimate biodiversity, biomass, vertical distribution, migrations, and response of micronekton to oceanographic features. Once key prey groups are identified through tuna diet analysis (see below), targeted samples from micronekton communities representing those same prey taxa will be collected and analyzed for metal contaminants and speciation and both reference and exposure sites. Oceanographic parameters, microbes, phytoplankton, zooplankton, and marine snow may also be sampled and/or laboratory studies conducted if further food web information is needed to elucidate contaminant exposure pathways. Samples will be retained and analyzed for other life history or ecological information, including isotopic analyses to link prey dynamics with predator diets and food-web structure, particularly across depth.

Tuna diet, along with diet of other important pelagic species, may be assessed through stomach content analysis, stable isotopes ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$), essential amino acids, and DNA metabarcoding to characterize prey composition and trophic positions across exposure gradients. Tissue samples (e.g., muscle, liver, gonads, or parasites) from tuna and other pelagic fish species entering local seafood markets and key prey (see above) will be analyzed for metals (e.g., Hg, MeHg, Cd, Pb, Cu, Zn, Se) and metal speciation to support future food-web modeling (e.g., Ecopath/Ecotracer). If funding is available, future studies may also measure persistent organic pollutants if further evidence or proposed mining operations suggest this may be an important issue (e.g., Sackett et al., 2024).

Telemetry studies will deploy pop-up satellite archival tags on key tuna and other important species that are within regions where mining operations are foreseeable for assessment of their relationship with oceanographic features and distribution of prey identified in the diet studies. Tags will record position, depth, temperature, and, when feasible, integrate environmental sensors (e.g., turbidity, dissolved metals, sound levels) to characterize exposure conditions. If funding is available, future studies may also measure behavior response to experimental plumes or other operational stressors.

Biological observations will ultimately be integrated with hydrodynamic plume models and laboratory exposure experiments (PC-26-01) and operational stressor profiles to develop exposure maps, behavioral response curves, and contaminant transfer estimates.

Specific Research Question(s):

1. What micronekton (prey) assemblages are present in areas with foreseeable seabed mining activities, and how are they vertically structured?
2. How does predator (e.g. tuna) diet vary spatiotemporally in the water column and in relation to exposed vs. reference areas?
3. How does the distribution (including depth) and behavior of tuna and other important marine species change spatiotemporally and in relation to micronekton (prey) distributions?
4. What are the baseline contaminant levels of important species?
5. Which biological indicators and thresholds (behavioral, dietary, contaminant) may be most informative for adaptive management triggers?

Publications Completed: None

Affiliated WWW Sites: N/A

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