

REEFENSE

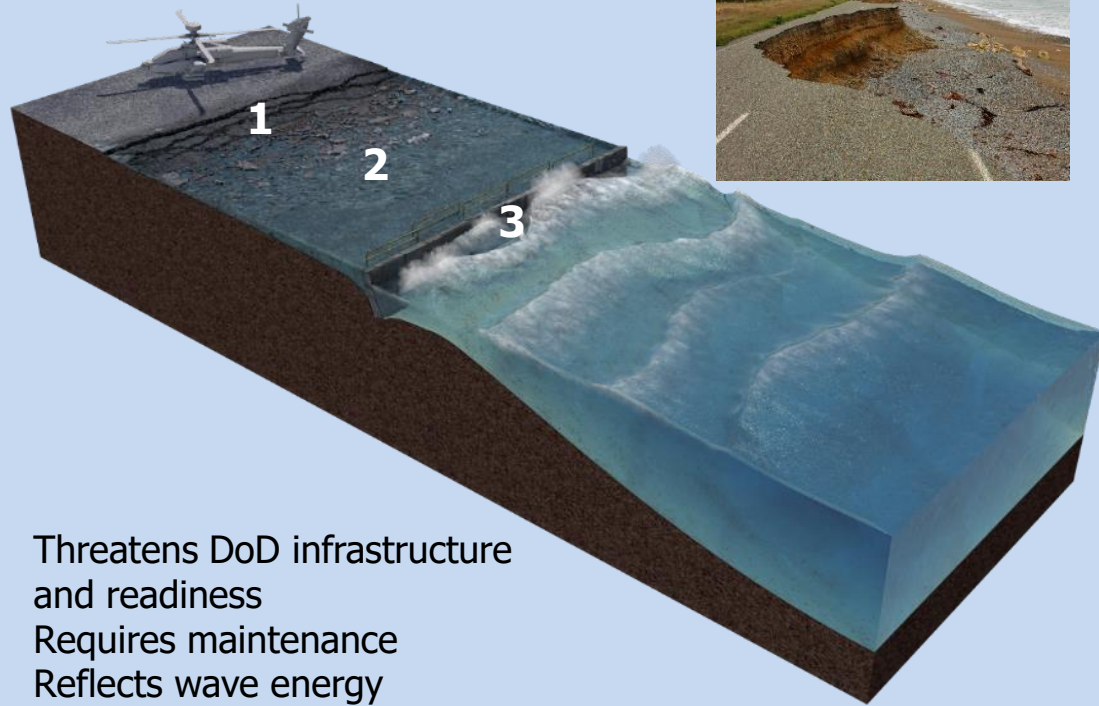
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Reefense: Developing Self-healing, Hybrid Biological and Engineered Reef-Mimicking Systems

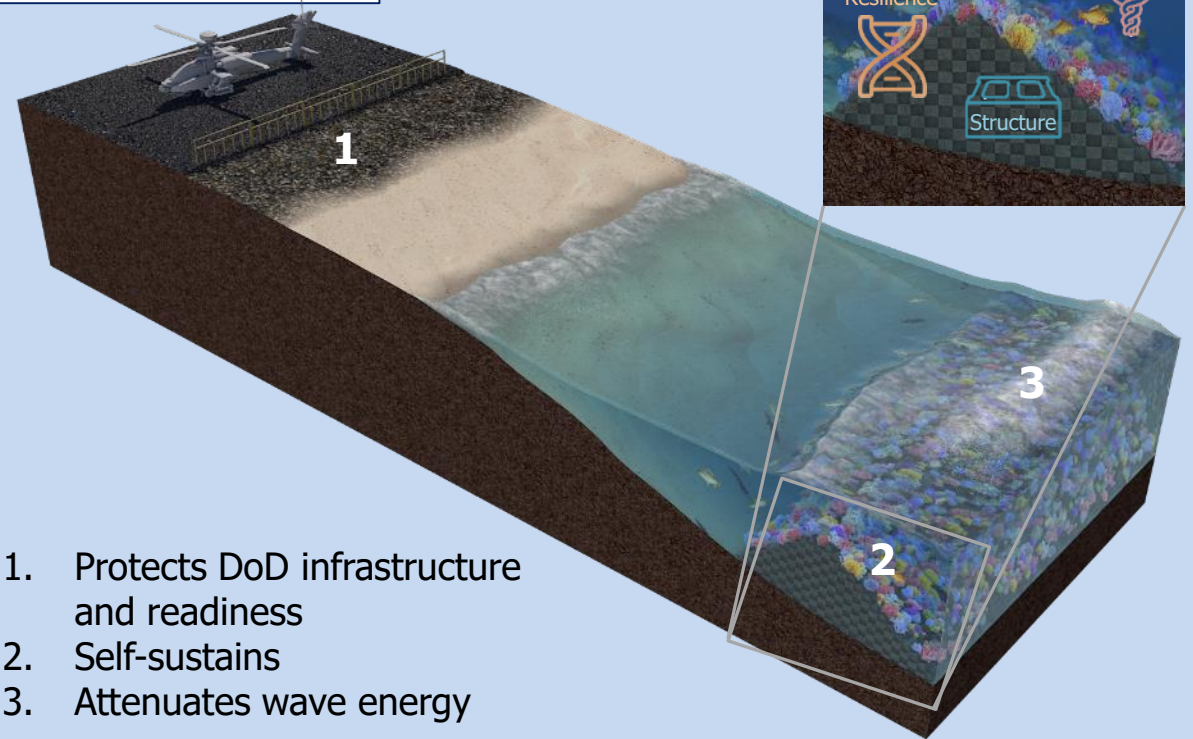


Standard approach



1. Threatens DoD infrastructure and readiness
2. Requires maintenance
3. Reflects wave energy

Reefense approach



1. Protects DoD infrastructure and readiness
2. Self-sustains
3. Attenuates wave energy

Vision: Develop hybrid biological and engineered reef-mimicking structures to mitigate wave and storm damage that increasingly threaten DoD personnel and infrastructure



Inundation



Maintenance



Erosion

Current Storm Damage and Wave Impacts on DoD

- Wave-driven storm damage impairs the DoD's ability to maintain its infrastructure and military readiness
- Weather-related natural disasters abroad increase need for DoD to respond to political discord and social tensions that accelerate conflict and instability detrimental to U.S. interests
- Flooding and erosion impact capacity-building projects, readiness, and construction of military and civilian infrastructure

Constituent parts of a self-sustaining, man-made, biologically-dynamic reef-like structure:

TA 1

Substrate Design and Structure



TA 2

Ecosystem Engineering



TA 3

Adaptive Biology



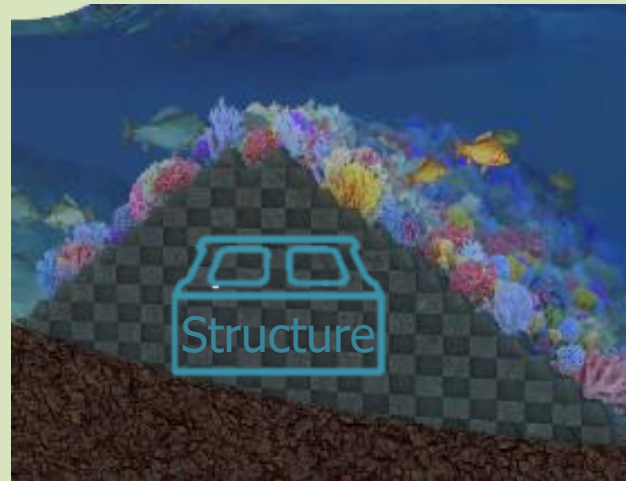
Teams must propose to all three technical areas to develop comprehensive, enduring solutions.

Goal: Develop biocompatible, wave-attenuating structures

Micro-Structural Design



Macro-Structural Design



Materials Science



Hydrodynamic Modeling



Technical Approach

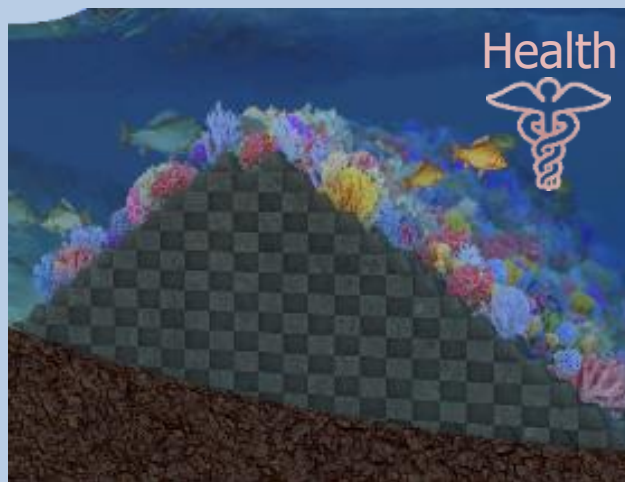
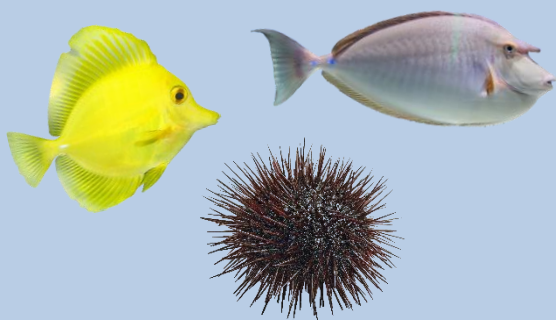
- Incorporate recent discoveries in resilient, bio-compatible materials into base structural components
- Jumpstart biological communities with fortified structures that attract and provide shelter to reef dwellers
- Promote biological recruitment and filter feeding through micro-scale design elements

Deliverables

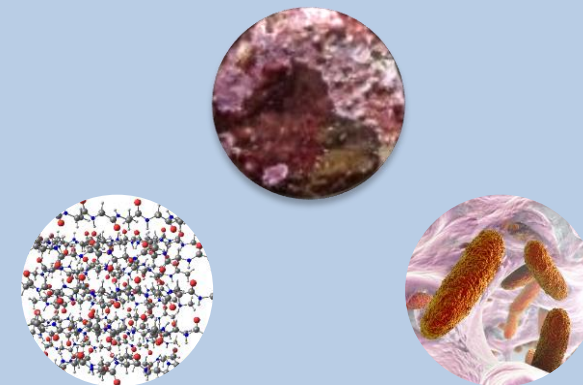
- Wave-attenuating structures that attract reef organisms
- Techno-economic analysis of structure production/installation

Goal: Promote ecosystem health to enable build up of calcium carbonate depositing organisms

Beneficial organisms



Recruitment attractors



Technical Approach

- Promote rapid population recruitment of non-reef building organisms needed to protect and promote reef health
- Recruit additional reef building promoters through a wide array of approaches
- Promote favorable conditions for biological settlement and growth on and around the base structure

Deliverables

- Strategies and solutions for ecosystem establishment and maintenance
- Proof of successful field implementation

Goal: Build sustainable, self-repairing reef structures by improving resilience



Resilient oysters and corals



Enabling technologies



Technical Approach

- Better breeding: use adaptive breeding to stimulate growth and disease resistance to Dermo caused by *Perkinsus marinus* for oysters, and Stony Coral Tissue Loss Disease in corals
- Promote natural genetic diversity to help increase the probability of survival under changing environments
- Enhance symbiotic relationships to mitigate bleaching based on temperature stress

Deliverables

- Evidence (including biomarkers) of resilient corals and oysters

- Performers are expected to engage with relevant regulatory bodies and support Ethical Legal Social Implications (ELSI) activities with DARPA, including semi-annual teleconference calls, and should consider feedback from the ELSI Panel regarding research activities

