

Swarm of Small Robots to Map Seabed

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Why in News?

The National Institute of Ocean Technology (NIOT), under the Ministry of Earth Sciences (MoES), established the Centre for Marine Autonomous and Robotic Systems (CMARS).

Underwater Swarm Robotics

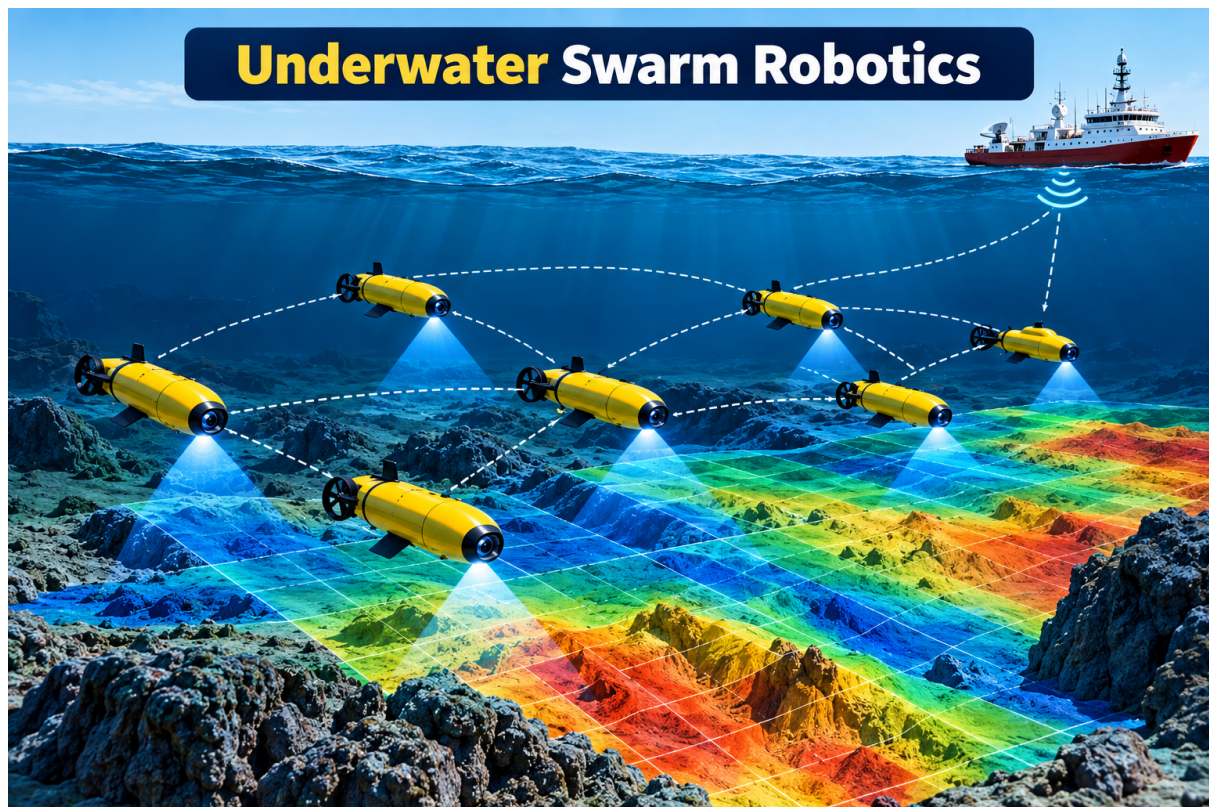
- Scientists are developing an indigenous platform of swarms of small Autonomous Underwater Vehicles (AUVs) and micro-submersibles designed to map the ocean floor collaboratively.
- Traditional seabed mapping relies on single, expensive, heavy submersibles (such as deep-sea ROVs or large AUVs).
- Swarm robotics replaces these with a coordinated network of multiple low-cost, lightweight autonomous units working concurrently.
- The swarm navigates grid pathways across the sea floor, sharing spatial data in real time via acoustic and optical communication links.
- This reduces survey time across vast oceanic areas while increasing spatial mapping resolution.

Key Technological Components

- **Bio-Inspired Swarm Intelligence**- Uses distributed swarm algorithms (such as bio-inspired fish swarm and marine predator algorithms).
- It is to enable self-organization, obstacle avoidance, and dynamic task allocation without constant operator intervention from surface vessels.
- **Hybrid Communication Framework**
 - **Acoustic Modems** - Enable long-range, low-bandwidth communication among swarm nodes across deep waters.
 - **Optical (Blue-Green) / Visual Markers** - Facilitate precise, high-speed short-range localization and coordination when units operate close to the seabed or near each other.
- **Integrated Sensor Payload** - Micro-AUVs are equipped with side-scan sonars, altimeters, and micro-bathymetric sensors to construct high-resolution 3D topography of benthic environments.

Significance

- Supports the technological objectives of India's **Deep Ocean Mission (DOM)**.
- Provides dual-use capabilities for the Indian Navy and Coast Guard.
- It aids in underwater surveillance, detection of unexploded ordnance (UXO), protection of critical subsea infrastructure (cables/pipelines), and mine countermeasures (MCM).
- Facilitates marine spatial planning, habitat classification, offshore energy site surveys, and environmental impact assessments prior to deep-sea resource extraction.



Reference

[WION | Marine Autonomous Robots](#)