



## NOAA Office of Coast Survey AUTONOMOUS SYSTEMS STRATEGY

**Autonomous systems**—from self-driving cars, to camera-equipped drones, the capabilities of unmanned systems are rapidly advancing. NOAA’s Office of Coast Survey has been investigating the use of autonomous survey systems to support hydrographic survey operations since 2004. The goal is to explore how autonomy provides more efficient and effective acquisition of environmental data to support NOAA’s navigation products and services.

### Coast Survey’s autonomous systems strategy

- Develop technologies and procedures, including automated data acquisition and processing tools, new data acquisition procedures, and data telemetry to support unmanned operations and benefit conventional manned survey platforms.
- Establish a dedicated Coast Survey team specializing in the operational use of unmanned systems.
- Convert existing hydrographic survey launches to operate in either manned or unmanned modes to take advantage of existing shipboard infrastructure and expertise, while incrementally adopting new technology and procedures.
- Continue to support the development and transfer-to-operations of unmanned systems that benefit Coast Survey’s mission.
- Continue to collaborate with government, academic, and industry partners to share expertise and resources and direct and expedite development.

### Why develop autonomous systems?



**Innovation** - pioneer and be the nation’s experts



**Efficiency** - reduce operational cost, manpower requirements, or time to produce products



**Enhanced Capabilities** - improve responsiveness; ability to collect data previously inaccessible; Improve data quality



**Personnel Management** - with automation, workforce can focus on tasks that require their expertise, rather than on repetitive, laborious tasks



*Operational evaluation of a USV during a bathymetric and marine habitat survey offshore of the Carolinas.*



**Autonomous underwater vehicles (AUVs)** are unmanned, untethered systems capable of underwater operation.

**Unmanned surface vehicles (USVs)** are untethered, self-propelled surface craft ranging in size from portable to small boat-size vessels that are capable of autonomous, semi-autonomous, or remote-controlled operations.

### Experience and collaboration

Coast Survey has the broadest operational portfolio and expertise with unmanned maritime systems in NOAA. This expertise is gained through operational experience and collaborative work with other NOAA offices, government agencies, academia, and private industry.

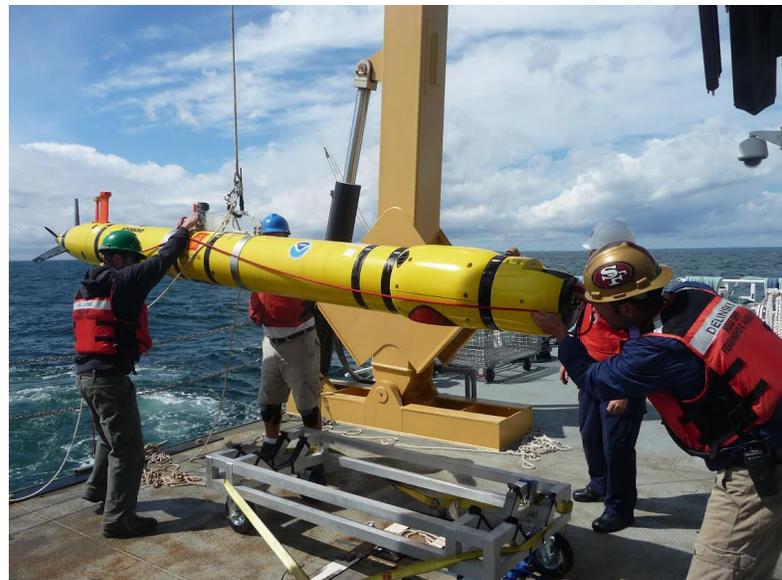
Coast Survey has operated small, portable AUVs in support of its navigation safety mission and projects supporting NOAA offices including Office of National Marine Sanctuaries, National Marine Fisheries Service, and the Office of Response and Restoration. Additionally, Coast Survey has operated a large, bathymetric mapping AUV for evaluation in support of nautical charting and high-resolution seafloor mapping requirements for other NOAA offices.

Coast Survey supports several activities in the evaluation of USVs with the University of New Hampshire in coordination with the Integrated Ocean Observing System (IOOS), NOAA National Centers for Coastal and Ocean Science (NCCOS), and the Alliance for Coastal Technologies (ACT) to hold workshops and demonstrations on USVs for shallow water observations.

Coast Survey also supports an Office of Marine and Aviation Operations (OMAO) effort to demonstrate small, remote-controlled USVs for hydrographic surveying aboard NOAA Ship *Thomas Jefferson*, and has tested a large, long endurance USV aboard a NOAA survey vessel to define shipboard support requirements and evaluate operational procedures.

### What we've learned

- Unmanned systems **require the development of new technologies**, such as automated data acquisition and processing and data telemetry to support the operational use of these platforms.
- Unmanned systems **must provide new capabilities or mission profiles**; one-for-one replacement of manned platforms in existing mission profiles is not effective.
- Unmanned systems **require skilled personnel to operate and maintain**, and do not necessarily reduce staffing requirements but rather can allow for the more effective use of personnel.
- Unmanned systems **do not diminish the need for ships**, which are necessary to deliver the systems to remote locations and provide operational control and logistical support.
- Unmanned systems **require unique shipboard infrastructure**, including launch and recovery systems (LARS), maintenance facilities, and communications, for their safe and effective operation.
- **Autonomous navigation is rudimentary and unmanned systems require supervision**, operating on a spectrum of control ranging from remote-controlled to fully autonomous depending on the environment and system capabilities.



*Deck and survey crew of the NOAA Ship Ferdinand R. Hassler deploy Coast Survey's Remus-600 bathymetric AUV in 2013 during the evaluation of AUVs for charting applications.*