U.S. Navy Research Pilots Help Scientists Gather Data from the Air

U.S. Naval Research Laboratory Scientific Development Squadron (VXS) 1 research pilots and Ocean Sciences Division researchers onboard the UV-18 Twin Otter fly over the Chugach Islands, Jan. 31, using the NRL lidar and multiwavelength camera to evaluate ocean bubble fields and their characteristics helping better predict the ocean environment for U.S. Navy operations. *U.S. OFFICE OF NAVAL RESEARCH / Lt. Alex Christie*

U.S. Navy pilots and naval flight officers flying specialized aircraft are helping scientists collect data for airborne research.

The U.S. Naval Research Laboratory's (NRL) Scientific Development Squadron One (VXS-1), based in Maryland at Naval Air Station Patuxent River, operates worldwide on extended detachments and annually logs more than 400 flight hours.

The squadron currently flies two NP-3C Orion maritime patrol aircraft, one RC-12M King Air and one UV-18 Twin Otter, as well as numerous TigerShark unmanned aircraft that operate worldwide on extended detachments supporting numerous projects such as bathymetry, electronic countermeasures, gravity mapping and radar development research. All are uniquely configured to make the integration of systems, sensors and research projects easier.

"While airborne flight test typically refers to developmental and operational testing, a lesser-known aspect of the community includes science and technology research," said Cmdr. Ian Lilyquist, who commands VXS-1. "We're not graduates of the U.S. Naval Test Pilot School, but we are part of the test community doing airborne research."

While programs of record that are part of the acquisition process go through the developmental and operational test squadrons, VXS-1 works outside the acquisition cycle.

"Researchers come to us to refine their technologies before they get into acquisition, or to accelerate testing to mature their technology and streamline the acquisition process," Lilyquist said. "We're the Navy's only airborne scientific research squadron. We work directly for NRL and the Naval Research Enterprise, using airborne platforms that provide pathways for early prototyping, experimentation and demonstrations of emerging technology so we can accelerate the Navy's ability to get leading-edge capabilities to the fleet."

The P-3 is a heavy-lift, four-engine, long-endurance aircraft conducive to doing projects that need to be in the air for a long time or flown overseas into an operational environment. The RC-12 and Twin Otter are smaller, twin-engine turboprops, with a lower cost to operate, and well suited for some of the smaller projects.

"We can do projects in the ranges off of Pax River, and the warning areas offshore, as well as on detachments. The most recent example was the deployment of our Twin Otter to Homer, Alaska, where they flew missions for six weeks off the southern coast of Alaska," said Lilyquist.

"Our unit has the same structure as an operational squadron, but the difference in VXS-1 is that we have a projects department," said Lt. Michael Benner, an NP-3C and RC-12M pilot. "They plan the work, get the projects installed and ready to fly on our aircraft, and execute the research. It's the entire reason for our existence."

Benner said the squadron's aircraft adapt to meet project requirements. "On the NP-3, we have flown sensors that require very specific pitch, roll and yaw angles to be held for extended periods. On the RC-12, we've flown communications components requiring exact geographical distances and strict angle of bank limitations. On the UV-18, we have flown preplanned routes to match the exact time and place of satellite overflight."

"We use the NP-3 to conduct most of our missions," said Lt. Cmdr. Brandon Adams. "Unlike the P-3s used for the MPA mission, the interiors of our NP-3s are pretty much empty." That space can be filled with specialized sensors and data collection equipment to help the scientists conduct their research.

The squadron's RC-12M is a little faster than the Twin Otter and can operate up to 27,000 feet for five hours. It's still considered a lightweight aircraft and offers a lower cost alternative to researchers who do not require the large four-engine NP-3 for their work.

Adams said each project is unique, but they all require thorough preflight planning. Safety of flight is always of paramount concern, and before VXS-1 even operates the aircraft with the project installed it must go through a comprehensive Naval Air Systems Command review.

"Because of the uniqueness of each project, we must conduct a thorough examination of what is different about the project and if there are potential impacts to our normal operating and emergency procedures, as well as have an understanding of the desired flight profile and possible impacts. From there, an understanding of the desired flight profile can be achieved," Adams said.

There's a lot of crew coordination between the air crew and researchers.

"When we fly, we communicate with the scientists in the back to make sure we're getting the right data they need," Adams said.

Adams and Lt. Evan Pappas recently took the squadron's UV-18 to Alaska to conduct an airborne lidar and camera survey to look at the ocean surface and immediate subsurface in a high wind environment to collect data on the water column in support of NRL's ocean sciences division.

"We correlated that data with information from [a] buoy station off the coast and satellites," said Pappas. "The lidar can provide high-resolution measurements of the ocean physical properties. It allows us to measure things like oil thickness in the event of a hazardous material spill and characterize bubbly surfaces to improve our ocean modeling."

The deployment was the result of a year and a half of planning to determine the best area to conduct the research.

U.S. Naval Research Laboratory researchers Damien Josset, Ph.D., NRL oceanographer, Stephen Sova, NRL technician, and Stephanie Cayula, NRL physical scientist from the laboratory's Ocean Sciences Division gather for a group photo Jan. 11 prior to conducting airborne lidar research in Homer, Alaska. *U.S. NAVAL RESEARCH LABORATORY*

Low and Slow

The UV-18 is the military designation of the DeHavilland DHC-6 Twin Otter. Because the aircraft isn't pressurized, it's easier to modify for experiments. The Twin Otter can fly low and slow and linger in an area at speeds around 100 knots.

For the recent airborne lidar research, Adams and Pappas required a thorough review of the necessary precautions and limitations for conducting testing in Alaska in the winter. Requirements included obtaining required survival equipment and completing a major maintenance inspection while deployed.

"We also coordinated hangar space and preflight procedures that ensured the project's lidar equipment maintained optimal storage temperature and was rapidly warmed for flight use, despite the below-freezing temperatures,” Adams said.

According to Adams, it’s essential for the VXS-1 pilots to clarify with the project specialist what the significance of each flight parameter holds.

“The recent airborne lidar research required us to maintain 5,300 feet and fly slow, which is ideal for the UV-18. That is what it is designed to do. Ultimately, the more we know about the desired testing parameters, the more efficiently we can complete the testing. By actively engaging with our customers and thoroughly reviewing their desired objectives, together we can develop the best plan for a successful project.”

Because the ultimate goal of NRL research is a capability that can be transitioned to the fleet, the interaction with VXS-1 research pilots and the research team in early stages of a research project is invaluable.

“This helps NRL research, prototyping and testing to remain focused on the mission as the flight clearances and logistics are already following the active-duty processes,” said Dr. Damien Josset, an NRL oceanographer.

Josset, who participated in the recent deployment to Alaska, said the support from the squadron’s research pilots allowed the researchers to collect critical ocean sciences data that can be used to improve numerical simulations and as inputs of ocean models, and better predict the ocean environment for Navy operations.

“No two projects are the same,” Pappas said. “The biggest determining factors in selecting an aircraft for our customers are typically the size of their payload and the flight envelope that they’re looking for. As long as the payload fits on board the plane and the desired flight profile matches the aircraft’s performance capability, we can meet most customers’ demands for instrument and sensor configuration. This capability is what makes our aircraft unique and differentiates them either from their fleet variants or commercial civilian variants. We could have an aircraft outfitted for a project one day, de-install the equipment and any sensors, and install an entirely new project just a few days later with a different purpose and scope.”

Pappas said it’s gratifying to help the scientists take their research ideas and turn them into executable projects that yield results.

“A lot of what we do to help develop and test does not have an immediate application to the fleet at this time, but the research opens up opportunities for the scientists, and they can apply the testing to future applications.”