Storm Hunters:
THE NAVY'S HURRICANE RECONNAISSANCE UNITS

By David Reade

The WV-3 Warning Star (here, with VW-4 in 1955), the Navy's version of the Lockheed L-1049 Super Constellation, served not only as an airborne early warning platform on radar barrier patrols but also as an effective hurricane hunter.

As U.S. Naval Aviation concludes its 100-year anniversary, there is one element of its history that has received little attention: the Navy's hurricane hunting mission to provide weather reconnaissance of Atlantic hurricanes and Pacific typhoons. In a way hurricane reconnaissance is the longest-running humanitarian effort in U.S. history. Between 1943 and 1975, U.S. Navy patrol and specialized weather reconnaissance squadrons flew hurricane and typhoon reconnaissance flights to locate, track, and provide storm information crucial for U.S. Weather Bureau-issued warnings and forecasts. In addition, Navy aircraft and personnel have also participated in scientific research vital to gaining a better understanding of one of nature's most awesome forces.

At the beginning of World War II, the Weather Bureau's hurricane warning system was severely impacted by the lack of accurate weather reports due to wartime restrictions placed on the rapid transmission of weather data from ships, which were allowed to communicate only with cipher-coding because of the U-boat threat. The bureau in effect lost two-thirds of its prewar hurricane warning capabilities,

which presented a considerable problem in forecasting storms. Aircraft could also provide weather data, but prior to 1943 aircraft flights into violent tropical storms, hurricanes, and typhoons were considered inconceivable. A number of early accidental or unofficial flights into hurricanes, however, demonstrated that flying into these storms was less hazardous than previously thought. These flights revealed the potential for dedicated weather reconnaissance.

The Joint Hurricane Warning Center (JHWC) was established on 14 July 1943, when the Weather Bureau's Hurricane Warning Service office was transferred from Jacksonville, Fla., to Miami and located with the Army Air Force's Hurricane Office and the Navy's Miami-based Weather Central. Navy hurricane reconnaissance flights began during that same season. Several initial flights were flown into tropical storms in July and into August out of San Juan, Puerto Rico, by PBY Catalina and PBM Mariner flying boats from Fleet Air Wing (FAW) 11 under the direction of the JHWC. The first "authorized" flight into an Atlantic hurricane occurred in September when a Navy PBM-3 from San Juan penetrated an unnamed hurricane 250 miles from Puerto Rico. The aircraft skirted the inner-edge of the storm's eye wall for more than five hours at 550 feet.

After the 1943 season, the Weather Bureau, Navy, and Army met to discuss the hurricane flights that had occurred with hopes of sharing information. At the conference, the bureau, interested in improving the hurricane reconnaissance process and gathering better quality storm data, pressed the military to establish dedicated hurricane reconnaissance units with specially trained crews. Although the Army heeded the bureau's advice and established a dedicated hurricane reconnaissance unit (comprised of four B-25 aircraft and four crews), the Navy did not.

In addition to FAW-11, the Navy tasked several Atlantic commands to support the hurricane reconnaissance mission in 1944, utilizing PBYs, PBMs, and PB4Y-2 Privateers. FAW-3 (Panama) and FAW-12 (Miami/Key West) as well as individual operational and training base commands (including NAS Banana River, NAS Jacksonville, and NAS Pensacola in Florida and NAS Corpus Christi in Texas) all flew hurricane reconnaissance flights during the 1944 season. In the Gulf of Mexico, reconnaissance flights were used to detect and track storms to determine their course, speed, and intensity in support of gulf area evacuations.

During the 1944 post–hurricane season conference, Commander, Caribbean Sea Frontier, recommended that a joint Navy Weather Central/Hurricane Warning Center be established at San Juan to manage and coordinate hurricane reconnaissance. The recommendation also suggested creating a specially trained Navy weather reconnaissance unit to fly missions under the control of the Caribbean Sea

Halsey's Typhoons

In early December 1944, Adm. William F. Halsey's 3rd Fleet was supporting the invasion of the Philippine Islands. An unnamed typhoon, having tracked across the Pacific practically unnoticed, caught up to the fleet 300 miles east of the island of Luzon. The storm (later dubbed Cobra by Halsey's fleet aerologist, Cmdr. George F. Kosco), with winds in excess of 130 miles per hour slammed into the task force with devastating results. On 14 December, a Navy PBM from VPB-117 stumbled across a tropical depression 225 miles southeast of the classified location of Halsey's task force. The aircraft penetrated the outer edges of the storm. The first "directed" reconnaissance of a typhoon by a Navy aircraft occurred when a VPB-21 PBM-3 located the typhoon 550 miles west-northwest of Ulithi on the night of 16/17 December. The third flight occurred on 17 December,

The power of Hurricane Viper, which struck the U.S. 3rd Fleet off Okinawa in June 1945, is evident in this photo of USS Windham Bay (CVE 92).

when an Army Air Forces flight penetrated the eye of the storm. This flight is considered the first official aircraft typhoon reconnaissance in the Pacific. Because of delays in transmitting reports about the storm, Cobra caught Halsey's fleet while still at sea. Three destroyers sank and nearly 30 ships were seriously damaged. More than 790 men were lost and another 80 injured.

In June 1945, a second typhoon (Connie/Viper) struck Halsey's task force during the invasion of Okinawa. A number of Navy patrol aircraft units flew this storm, including VPB-53 flying PBY-5A and PBY-6A Catalinas from Samar. With sustained maximum winds between 80 and 140 mph, this typhoon caused further considerable damage to the Halsey's fleet. Both USS Hornet (CV 12) and USS Bennington (CV 20) lost 25 feet of their forward flight decks. A number of other ships sustained damage, but only six lives were lost. The two storms highlighted the limited ability of contemporary technology to deal with strong storms, but they also spurred the Navy to improve its typhoon/hurricane detection capabilities and invest in cyclone research.

Frontier and FAW-11 commanders. The proposal, however, was not adopted.

The Navy eventually assigned an existing patrol squadron, Patrol Bombing Squadron (VPB) 114 based in Port Lyautey, Morocco, to perform the hurricane reconnaissance duties throughout the Atlantic basin for the 1945 hurricane season. The squadron flew PB4Y-1 Liberators, conducting anti-submarine patrols, search and rescue, logistical transport, and area weather reconnaissance. It was this latter experience that qualified the squadron for the Navy's first dedicated hurricane reconnaissance unit for 1945. VPB-114's first operational hurricane reconnaissance flight occurred on 21 June 1945 into an unnamed hurricane that developed in the western Caribbean and moved through the Gulf of Mexico, making landfall near Dunnellon, Fla. The unit flew five flights into the storm over several days, including a number of eye penetrations. Over the course of the season VPB-114 flew 51 hurricane flights for a total of 598 flight hours.

In the Pacific, wartime limitations and priorities similar to those in the Atlantic also affected typhoon forecasts. Individual Navy weather centrals and their corresponding component weather stations sought airborne weather reconnaissance observation from adjacent operational commands and flying units. Navy combat patrol flights routinely fanned out across the vast Pacific looking for enemy vessels, and some of these flights were accompanied by trained aerologists or aerologist mates. Because of the reliance on verbal or written weather reports, there were significant delays in getting weather information to the units that needed it. These delays were a contributing factor in the destructive typhoons that struck the 3rd Fleet in December 1944 and June 1945.

The Naval Research Laboratory's NP-3D with VXS-1 is equipped with the ELDORA radar system, which has two antennas in a tail boom that provide vertical coverage of the air column above and below the aircraft.

During the final push toward mainland Japan, weather reconnaissance flights helped Navy and Marine combat units and commands to avoid or prepare for typhoon events. In early August 1945, a number of Navy units (VPB-71, VPB-106, VPB-116, VPB-109, VPB-117, VPB-119, VPB-121, VPB-123 and VPB-124) flying PBYs, PBMs, PB4Y-1s, PB4Y-2s, and PV-1 Venturas began daily weather flights that included typhoon reconnaissance.

Post-War Storm Reconnaissance

After much reorganization after the war, the Navy and Air Force weather services formally established weather reconnaissance squadrons and clear-cut hurricane hunting requirements for the Atlantic and Pacific.

On 17 May 1946, Atlantic hurricane reconnaissance was furthered by the establishment of Weather Reconnaissance Squadron (VPW) 3 at NAS Miami flying PB4Y-2M Privateers. After several re-designations (VPM-3, VP-HL-3), the squadron became VP-23 in September 1948.

Although the squadron's primary mission became anti-submarine warfare, VP-23 continued with seasonal hurricane hunting from Miami and Puerto Rico. In 1949, the squadron began deployments to NAS Roosevelt Roads to be closer to the hurricane breeding grounds. From this point onward, "Rosie Roads" became an important support base for Navy hurricane hunters for the next 26 years.

Before the start of the 1952 hurricane season, the Navy ordered VP-23 split into two units, with one half reassigned to NAS Brunswick, Maine, and the other half retained in Miami to form the core of a new dedicated hurricane reconnaissance unit, Weather Squadron (VJ) 2. This was the Navy's first genuine dedicated hurricane reconnaissance squadron, equipped with six weather-reconnaissance-equipped P4Y-2 Privateers (and later with meteorological P2V-3W Neptunes). On 15 September 1953, VJ-2 flew the first penetration of a hurricane by a P2V-3W during Hurricane *Dolly*, some 240 miles northwest of San Juan.

In December 1953, VJ-2 was redesignated Airborne Early Warning Squadron (AEW) 4 and again Weather Reconnaissance Squadron (VW) 4 in January 1954. The squadron received newer P2V-5JF Neptunes (with wing-mounted J-34 jet engine pylons, to augment the main reciprocating engines) beginning in January 1954 and took delivery of its first Warning Star, a WV-1, in January 1955. The squadron received WV-3 Warning Stars (the Navy's version of the L-1049 Super Constellation) in 1956, equipped with an advanced APS-20 radar providing improved night-time hurricane radar tracking, a 20,000 foot ceiling to permit penetrations of hurricanes at higher altitudes, and longer range. VW-4's first storm penetration with a "Connie"

An RF-8A Crusader with VFP-62 flies over Hurricane Gracie *during a research mission in September 1959. (Photo from NOAA)*

occurred during Hurricane *Diane* in August 1955. While flying its "Connies," the squadron continued the hurricane reconnaissance mission for the next 20 years until 1975, when it was the last hurricane hunter unit in the Navy.

The last and final Navy weather reconnaissance aircraft used for hurricane hunting was the WP-3A Orion. The WP-3A was a specialized variant of the Navy's highly successful multimission P-3 patrol aircraft, which provided improved range, speed, and weather research and reconnaissance capabilities over the WV-3/WC-121N it replaced. The WP-3A's first storm penetration was a low-level night mission into Hurricane *Edith* in early September 1971. As a result of continued U.S. defense budget cuts, the Navy discontinued the hurricane reconnaissance mission in April 1975, when VW-4 was disestablished, leaving the hurricane reconnaissance mission solely shouldered by the Air Force.

Over a 32-year period from 1943 to 1975, the Navy flew into more than 281 named storms in the Atlantic (of which 178 were hurricanes), encompassing 2,119 mission flights (22,437 flight hours), and approximately 1,390 eye penetrations.

In the Pacific, typhoon reconnaissance developed along similar lines. In November 1945, the Navy established a patrol weather reconnaissance training school at the Naval Auxiliary Air Station Camp Kearney, Calif. (today's

MCAS Miramar). This school was established to teach the procedures of weather reconnaissance, including the most up-to-date information on typhoon and hurricane research. The facility also provided an extensive ground training school supporting squadron-level maintenance for the weather reconnaissance version of the PB4Y-2 Privateer, as well as its mission systems and aircrew training.

Established that same month at Camp Kearney, Weather Reconnaissance Squadron (VPW) 1 became one of the first Navy patrol squadrons purpose-built for weather reconnaissance. It was subsequently deployed to NAS Agana, Guam, in early May 1946, just in time for the Pacific typhoon season. The unit became the first dedicated Navy squadron to fly operational typhoon reconnaissance in the Pacific and earned the nickname "Typhoon Chasers." The squadron was split into three detachments: one at Kwajalein, one at Peleliu, and the headquarters detachment at Guam. The squadron's first typhoon reconnaissance flight occurred shortly after the units' arrival at Guam, on 12 May 1946, into Typhoon *Charlotte* near Taiwan.

Between December 1947 and early 1952, the Navy did not have a dedicated typhoon reconnaissance squadron in the western Pacific. A number of Navy units were tasked with part-time support for the typhoon reconnaissance mission. During the 1950s, typhoon frequency in the northwestern

Pacific averaged 22 storms per year, while the Atlantic on average produced only seven hurricanes per year. To address this issue, the Navy established a new weather reconnaissance unit, (VJ) 1, in early 1952. Between 1952 and 1953, VJ-1 became the primary Navy typhoon reconnaissance squadron in the western Pacific. The squadron flew specially equipped Privateers out of NAS Agana. VJ-1, equipped with WV-3s, later would be redesignated VW-3. Between 24 December 1959 and 2 January 1960, VW-3 flew its last typhoon missions, comprising three radar fixes on Typhoon *Harriet*, in an area between Guam and Philippines. In July 1960, VW-3 was disestablished and transferred its typhoon tracking mission over to VW-1.

With both the Navy and Air Force maintaining various typhoon warning centers in the Pacific, each issuing uncoordinated typhoon warnings that were often contradictory (not only between the services, but within the services), there was a need for coordinated typhoon reconnaissance operations and forecasts. The solution was the establishment of the Joint Typhoon Warning Center (JWTC) at the Fleet Weather Central (Guam) in June 1959. The JTWC brought together the efforts of the Navy's Weather Centrals at Guam, the Philippines, and Hawaii as well as the Air Force's Weather Wing (in Japan) and their component typhoon warning centers near Manila and in Japan under one coordinating organization. Between 1959 and 1999, the center issued more than 1,299 tropical cyclone warnings for 728 typhoons, 407 tropical storms, and 167 tropical depressions. Fleet Air Reconnaissance Squadron (VQ) 1 would be the last dedicated Navy squadron to fly typhoon missions before turning the job over to the Air Force in 1971.

Storm Research

Since World War II, Navy operational squadrons have supported tropical cyclone scientific research, much of it conducted as part of large projects such as the long-running
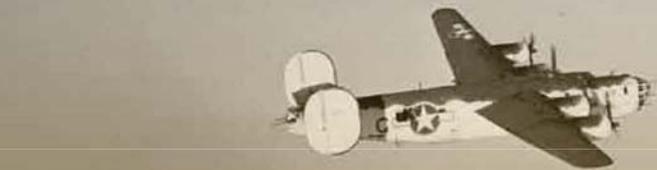
joint Navy/Weather Bureau National Hurricane Research Project (NHRP) that began in 1956, or the subsequent Project Stormfury, a joint Navy/Weather Bureau hurricane modification experiment project initiated in 1962.

One of the first incidents where Navy aircraft flew in support of hurricane research was in August 1955, when VC-62 flew F2H-2P Banshees into the eye of Hurricane *Connie* to photograph cloud formations and structures. Redesignated Light Photographic Squadron (VFP) 62 a year later, the squadron over time flew a variety of aircraft modified for tactical photo reconnaissance, including F9F-6P/F9F-8P Cougars and F8U-1P (RF-8A and RF-8G) Crusaders in addition to Banshees.

From 1956 to 1965, VFP-62 supported NHRP and flew high-altitude hurricane photo surveillance missions. Based at NAS Cecil Field, Jacksonville, the squadron was tasked to fly the hurricane surveillance mission on any Atlantic storm that came within range of the aircraft. In October 1962, the squadron became famous for taking many of the key photographs of Soviet ships and missiles that precipitated the Cuban Missile Crisis.

Another Navy photo reconnaissance unit, Heavy Photographic Squadron (VAP) 62, based in Jacksonville, also supported NHRP research. The squadron flew A3D-2P (RA-3B) jets, the photo reconnaissance variants of the A-3 Skywarrior. Beginning in 1964, VAP-62 took over the cloud seeding mission as part of Project Stormfury, which sought to determine if hurricanes could be weakened and potentially dissipated by seeding specific areas of storms with silver iodide.

The seeding mission was pioneered by another Navy A-3 squadron, Heavy Attack Squadron (VAH) 11, based at NAS Sanford, Fla. The squadron deployed a four-plane special detachment to NAS Roosevelt Roads as seeding aircraft for the project. Although VAH-11 supported Stormfury until 1964, it was discovered early that the A-3 had problems

The PB-1W was a variant of the B-17 Flying Fortress equipped with the APS-20 radar capable of tracking storms out to 100 miles. It entered service in 1946.

with high-altitude icing on its wings and tail control surfaces. Beginning in 1967, the Navy began assigning seeding missions to attack squadrons operating A-6A Intruders. Each year a different A-6 squadron was assigned the mission and deployed a five-plane detachment to Puerto Rico for training and potential storm sorties. Between 1967 and 1972, these included VA-35, VA-75, VA-176, VA-85, and VMA-224. Only a couple of these attack units ended up seeding hurricanes: VA-176 seeded Hurricane *Debbie* in August 1969 and VA-85 seeded Hurricane *Ginger* in 1971.

With the disestablishment of VW-4 in 1975, the Navy's operational support to hurricane research ended. In more recent years, a Navy organization has resumed tropical cyclone research in both the Atlantic and Pacific after a 30-year hiatus. Beginning in 2005, the Naval Research Laboratory (NRL), a division of the Office of Naval Research, participated in a research project that would see one of its aircraft—equipped with an Electra Doppler Radar (ELDORA)—fly into Atlantic hurricanes. NRL's flight support detachment, now designated Scientific Development Squadron (VXS) 1, maintains a fleet of specially equipped and modified NP-3D Orions capable of investigating geophysical, atmospheric, oceanographic, and multispectral sciences as well as electronics research. The ELDORA system, with two antennas mounted in a tail radome, emits two conical radar helixes (fore and aft) that provide three-dimensional atmospheric data above and below the aircraft.

Operating out of MacDill AFB, Tampa, Fla., the VXS-1 ELDORA NP-3D flew into Hurricane *Katrina*, on 29 August 2005, through the outer rain bands on the more intense (east) side of the storm. Later, between 6 and 11 September, the same aircraft flew three flights into Hurricane *Ophelia*'s rain bands and outer edges. During one of the

four flights flown into Hurricane *Rita* (between 20 and 22 September), the ELDORA NP-3D penetrated the storm's eye. The aircraft maps the vortex structures of the storm, providing insights into the influences of intensification and the changes that occur within the inner core, supporting satellite-based prediction techniques for estimating tropical cyclone intensity using computer models.

In 2008, NRL participated in a multinational tropical cyclone study, the Tropical Cyclone Structure Project, to investigate typhoon formation, cyclo-genesis, and intensification in the western Pacific. The project's goal was to reduce errors in tropical cyclone structure and intensity predictions of satellite-based observation forecasts and to improve warning times and forecasts. The VXS-1 ELDORA NP-3D along with several Air Force Reserve WC-130J Hercules were the primary research aircraft for the project, staging out of Anderson AFB, Guam, and collecting data on storm structure during four typhoon events.

Renewed on a regular basis, the contract to field the ELDORA radar system on the VXS-1 NP-3D will continue for several more years, providing more opportunities for NRL to participate in future tropical cyclone research projects and continue the Naval Aviation tradition of storm hunting.

A PB4Y-1 Liberator with VPB-114 flies an early hurricane reconnaissance mission in 1944.

David Reade is a freelance journalist, aerospace consultant, and leading authority on maritime patrol and scientific research aircraft. He is completing an authoritative book on the history of hurricane reconnaissance and research aircraft. The author would like to acknowledge Rick Burgess for his insights and editorial support.