



Maritime Patrol Aviation: 90 Years of Continuing Innovation

John F. Keane and CAPT C. Alan Easterling, USN

Since its beginnings in 1912, maritime patrol aviation has recognized the importance of long-range, persistent, and armed intelligence, surveillance, and reconnaissance in support of operations afloat and ashore. Throughout its history, it has demonstrated the flexibility to respond to changing threats, environments, and missions. The need for increased range and payload to counter submarine and surface threats would dictate aircraft operational requirements as early as 1917. As maritime patrol transitioned from flying boats to land-based aircraft, both its mission set and areas of operation expanded, requiring further developments to accommodate advanced sensor and weapons systems. Tomorrow's squadrons will possess capabilities far beyond the imaginations of the early pioneers, but the mission will remain essentially the same—to quench the battle force commander's increasing demand for over-the-horizon situational awareness.

INTRODUCTION

In 1942, Rear Admiral J. S. McCain, as Commander, Aircraft Scouting Forces, U.S. Fleet, stated the following:

Information is without doubt the most important service required by a fleet commander. Accurate, complete and up to the minute knowledge of the position, strength and movement of enemy forces is very difficult to obtain under war conditions. If these facts are made available while the enemy is at a great distance from our shores and similar information about our own forces is denied the enemy, the commander is given time to plan his movements and select the time and position of contact in such a manner that he may operate under a tactical advantage. In other words, in the vernacular of the sports world, he can make his own breaks.

For the source of this most important information, the fleet commanders have come to rely more and more on the patrol

plane. With their normal and advance bases strategically located, surprise contacts between major forces can hardly occur. In addition to receiving contact reports on enemy forces in these vital areas the patrol planes, due to their great endurance, can shadow and track these forces, keeping the fleet commander informed of their every movement.¹

Although prescient, Rear Admiral McCain was hardly ahead of his time in highlighting the role of information in warfare. Military thinkers throughout history have recognized the importance of dispersing the Clausewitzian fog of war. While contemporary development of network-centric warfare promises to fuel the revolution in military affairs, information superiority provides a capability that Sun Tzu would have recognized 2,500 years ago. Perhaps McCain's enduring contribution lay

in his appreciation of the role to be played by maritime patrol in collecting and disseminating that information, a role which has remained essentially unchanged from the days of Bellinger and his Curtiss flying boat through today's ongoing development of the Multi-mission Maritime Aircraft (MMA).

The story of maritime patrol aviation is like a Bach fugue, filled with surprising variation woven around a few simple, recurring themes: a constant striving for increased range, endurance, and payload and the exploitation of those characteristics to provide an operational flexibility unrivaled in naval aviation. Long before persistent intelligence, surveillance, and reconnaissance (ISR) became the *sine qua non* for littoral operations, patrol aviation was developing flying boats with 15-hour endurance. When Germany twice employed unrestricted submarine warfare, only maritime patrol could deliver the necessary combination of range, endurance, speed, and weapons payload to contribute to the destruction of 12 U-boats in World War I and 59 U-boats in World War II. These same attributes were additionally harnessed in a surface warfare (SUW) role, most famously against the "Tokyo Express," and during the Aleutian Island campaign. Maritime patrol today continues to perform the variations of ISR, SUW, and anti-submarine warfare (ASW) around the themes of range, endurance, and payload.

Whether providing persistent ISR over Afghanistan, launching stand-off land attack missiles (SLAMs) in Bosnia, or sanitizing water for Persian Gulf carrier battle groups, the story remains familiar. And in acknowledgment of Rear Admiral McCain's insight, tomorrow's Fleet commanders will still rely on maritime patrol to clear the fog of war through the range, endurance, and payload of the MMA.

THE EARLY YEARS OF MARITIME PATROL

Pioneering Efforts

The Navy's maritime patrol/reconnaissance aviation community is deeply rooted in the beginnings of naval aviation. In fact, long before the aircraft carrier was introduced to the Fleet, the pioneers of naval aviation recognized the potential of the airplane as a surveillance platform capable of performing ASW and escort duties, as well as attacking surface ships, ahead of the main battle force. Within two years of Eugene Ely's first aircraft takeoff from a wooden platform onboard USS *Birmingham* (CL 2), a series of tests was begun over the Chesapeake Bay on 26 October 1912 to examine the possibility of locating submarines from the air. These tests, completed the following March at Guantanamo Bay, Cuba, determined that, under optimal environmental conditions, submarines could be detected visually at a depth of 30–40 feet from an altitude of 800 feet.²

Meanwhile, naval officers at the Naval Proving Ground, Indian Head, Maryland, began development of the Davis recoilless gun. This gun, capable of firing a projectile that would damage a submarine's pressure hull, together with the Lewis gun (the first practical air-cooled machine gun), depth bomb, and anti-shiping demolition bomb, would comprise patrol aviation's WWI arsenal. Although the Navy Bureau of Ordnance would commence experiments on aerial deployment of torpedoes as an SUW weapon in August 1917, none would be employed in WWI because aircraft of the day could not deliver a torpedo capable of damaging a modern warship.³

Troubles in Mexico

In 1911, the Mexican government of Porfirio Díaz was overthrown by popular revolt. The new President, Francisco Madero, was assassinated two years later in a counterrevolutionary movement led by General Victoriano Huerta.⁴ President Wilson refused to recognize the new regime and, when Mexican police in Tampico, Mexico, arrested a U.S. naval party, he ordered a punitive expedition. In mid-April 1914, the two combatants USS *Birmingham* and USS *Mississippi* (BB 23), with a detachment of U.S. Marines, and practically the entire complement of naval aviation, departed Pensacola, Florida, and joined Atlantic Fleet forces operating off the coast of Mexico.⁵ The first reconnaissance mission flown by the Navy under wartime conditions occurred on 25 April 1914 when Lieutenant (jg) Patrick N. L. Bellinger, piloting a Curtiss C-3 flying boat from the air detachment onboard the *Mississippi*, overflew Veracruz harbor photographing enemy positions and searching for mines (Fig. 1). Several days later, Bellinger, flying a Curtiss A-3, provided air support to U.S. Marines at Tejar, Mexico, who had come under attack from revolutionary forces. On 6 May, Bellinger became the first naval aviator to receive hostile fire while flying a reconnaissance mission over enemy positions near Veracruz.^{5,6}

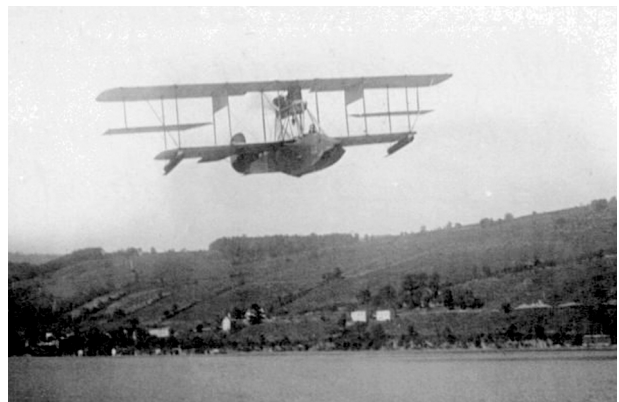


Figure 1. A U.S. Navy flying boat piloted by Bellinger at Veracruz, Mexico (photograph courtesy of June Sturgis, daughter-in-law of early pilot Parker Brooks Sturgis).

As a result of the Navy's efforts during the Mexican crisis, Secretary of the Navy Josephus Daniels declared that "the science of aerial navigation has reached that point where aircraft must form a large part of our naval force for offensive and defensive operations" and that "aircraft will take their place with the fleet." However, from 1914 until America's entry into WWI, naval aviation would continue to be shuffled aside by members of the battleship "gun club."⁶

THE FIRST WORLD WAR

Seven weeks following the action off Veracruz, war erupted in Europe after the assassination of Austrian Archduke Francis Ferdinand and his wife in Sarajevo on 28 June 1914. By the autumn of 1916, German U-boats were destroying shipping from the eastern Mediterranean to the mid-Atlantic.⁷ On 1 February 1917, certain that they could force England to capitulate within six months, Germany warned all ships sailing within the European coastal areas, regardless of flag, that they faced the possibility of a U-boat attack. This policy of unrestricted undersea warfare forced President Wilson to break off diplomatic relations with Germany.⁸ Within the first month, losses to the German U-boat campaign increased by 47%.⁹

Only when this unrestricted submarine warfare caused the loss of numerous American lives, including those on the liner RMS *Lusitania*, and the interception and decoding of the Zimmerman Telegram by the British Admiralty was revealed in February 1917, did the United States enter the war on 6 April 1917. (The Zimmerman Telegram offered California and the Southwestern states to Mexico if they would join the war on the side of the Triple Alliance.)

Naval aviation found itself woefully unprepared, mustering only 45 seaplanes, 6 flying boats, 3 land planes, and 1 airship, none of which were deemed suitable to meet the requirements of a sustained overseas war effort. Including students, only 48 pilots and 239 enlisted men were available, all operating out of one air station—Pensacola, Florida.^{2,3,10,11} (For the purposes of this article, a seaplane is defined as an airplane equipped with pontoons for landing on or taking off from a body of water. A flying boat is defined as a large seaplane that floats on its hull rather than on pontoons.)

Since the announcement of Germany's unrestricted submarine warfare policy, nearly three million tons of shipping had been lost to U-boats when the British Royal Naval Air Service started flying anti-submarine patrols over the North Sea in May 1917.¹¹ This mission, along with convoy escort duty, became the primary missions of the U.S. Navy's First Aeronautical Detachment, the earliest American unit to arrive in France three weeks later on 5 June. Ultimately, the Navy established 27 air stations in France, England, Ireland, the Azores,

and Italy from which it flew operational missions and trained its pilots and observers to fly Allied aircraft until satisfactory U.S.-manufactured aircraft became available.² On the American side of the Atlantic, 12 flying boat bases on the Eastern seaboard, 2 in Canada, and 1 in the Panama Canal Zone supported the war effort. Between 22 November 1917 and 11 November 1918, the Navy and Marine Corps flew more than three million nautical miles on ASW patrols on both sides of the Atlantic, attacking 25 U-boats and claiming a dozen sunk or heavily damaged.³

Two months after the United States entered the war, the Secretary of the Navy dispatched a team of aviation experts to England, France, and Italy who concluded that the best results for combating the U-boat threat could be achieved through employment of kite balloons and flying boats. The small flying boats in use by the Allies at the time were too limited in payload and range to provide persistent coverage to convoys in the mid-Atlantic. In the United States, production of patrol seaplanes was increased but, because of their limited range, it was necessary to ship them via convoy through waters patrolled by the very U-boats they were intended to defeat. This would remain a constant source of frustration for American planners throughout the war. Not until the introduction of the Curtiss H-16 flying boat in early 1918 (450-mile range/920-pound payload)³ would the Navy obtain an aircraft capable of long-range surveillance missions and increased payload (Fig. 2).¹¹ Still, the H-16 was incapable of non-stop flight across the Atlantic. (Ranges provided are unarmed maximum ranges.)

Rear Admiral David W. Taylor, chief of the Navy's Construction Corps, recognized that high-endurance aircraft capable of carrying large payloads and defensive armament could defeat the U-boat threat. With the development of more powerful engines and stronger airframes, Taylor believed that such large flying boats would be able to fly across the Atlantic, thereby

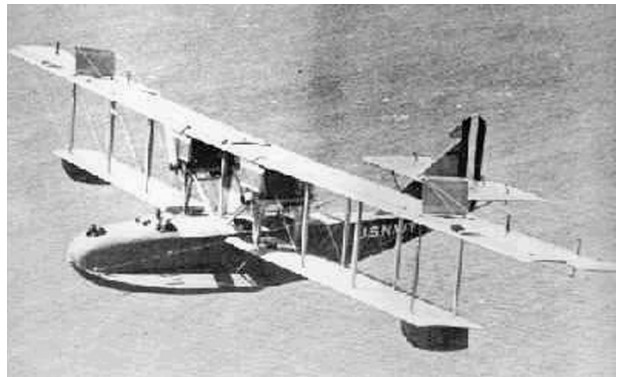


Figure 2. Conducting ASW patrols from air stations in the United States and Europe, the Curtiss H-16 flying boat was outfitted with four 230-pound bombs and five Lewis machine guns³ (photograph courtesy of Nevins Frankel).

overcoming the hazards associated with delivery by convoy and the difficulties of overseas assembly. Even so, during WWI, the suggested route across the Atlantic from Newfoundland to Ireland was over 1,900 miles, and up to this time the longest non-stop flight accomplished was 1,350 miles under ideal flying conditions.¹²

THE INTER-WAR YEARS

Before U.S. entry into WWI, the role of aircraft as ASW weapons platforms was relatively small. In fact, most German U-boat commanders considered the depth bombs employed by flying boats to be ineffective. In addition, the aircraft engines were too unreliable for sustained overwater flight and too underpowered to lift the heavy payloads required to conduct multiple attacks against a submerged submarine.¹² For maritime patrol aviation, however, the Great War served to further the development of aircraft, engines, and flying techniques that would pave the way for trans-oceanic flight. The inter-war period is therefore best described as a time of continuing effort to improve the range and endurance of flying boats, and to perfect the sensors and weapons used to find and destroy enemy submarines and surface combatants.

Initially conceived by Glenn Curtiss of the Curtiss Aircraft Company in 1914, the most talked-about event in post-war aviation was a trans-Atlantic flight. In the summer of 1918, the Navy, teamed with the Curtiss Aircraft Company, fielded the first of 10 Navy-Curtiss (NC) flying boats (1,470-mile range).³ Approximately the size of a Boeing 707, these aircraft were capable of 15 hours of endurance. On 25 November 1918, NC-1 set a record by flying with 51 passengers. Three of these aircraft would pioneer long-range over-water flight in 1919 in an attempt to fly from Long Island, New York, to Plymouth, United Kingdom, via the Canadian Maritime Provinces, the Azores, and Lisbon, Portugal (Fig. 3). Only one flying boat (NC-4) completed the mission, but the adventure clearly demonstrated a requirement

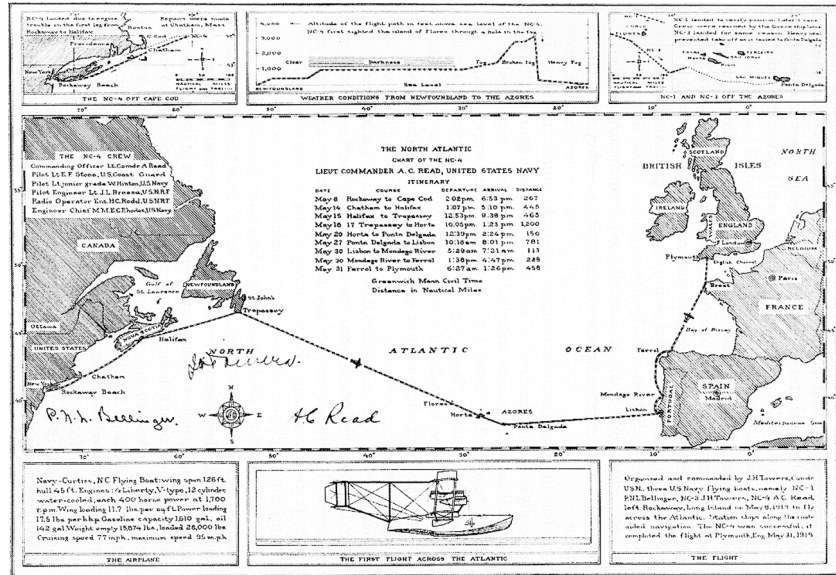


Figure 3. Trans-Atlantic route of Navy-Curtiss flying boats in 1919.^{13,14}

to develop accurate overwater, all-weather navigation techniques and would set the stage for trans-oceanic commercial flights.^{6,11,15}

Several of the NC Detachment crew members (Fig. 4) went on to Flag rank in the Navy and had considerable influence on the patrol aviation community. Marc Mitscher, pilot of the NC-1, commanded Patrol Wing One during the massed flights from the West Coast to Hawaii in the 1930s. He went on to command USS *Hornet* (CV 8) during the Doolittle Raids on Tokyo and



Figure 4. Trans-Atlantic fliers.¹⁶

the Battle of Midway. Following this battle, he relieved Patrick Bellinger as Commander, Patrol Wing Two. He would later command Task Force 58 in the Pacific and turn down the opportunity to become the Navy's first aviator Chief of Naval Operations (CNO) in favor of commanding the Eighth Fleet.¹³ Bellinger, Commander of NC-1, would command Patrol Wing Two from 1940 to June 1942 and, as Commander, Air Force Atlantic Fleet, would be responsible for all air ASW efforts during the Battle of the Atlantic, overseeing the introduction of sensor and weapons technologies still employed by the Fleet.⁶ And finally, John Towers, Commander of the NC Detachment, would become Chief of the Navy's Bureau of Aeronautics (BUAERO) at the start of WWII, and ultimately the first aviator to command the Pacific Fleet. During his tour, he would initiate and oversee efforts to introduce long-range land-based aviation to the patrol community.¹⁴

Congress approved the 1920 Naval Appropriations Act in July 1919, limiting the number of heavier-than-air stations available to the Navy to six. This precluded the Navy from acquiring land-based patrol aircraft and forced them to continue procurement of the flying boat rather than develop a long-range land-based maritime patrol aircraft.^{2,6,14} Aircraft of the day consisted mainly of the F5L (765-mile range/920-pound payload), a modified version of the venerable H-16, a veteran of WWI. The F5L would continue to serve the Fleet until 1931 with the introduction of monoplane flying boats equipped with a hull constructed primarily of an aluminum alloy known as duralumin. This metal construction would provide for a hull of considerable less weight than wooden hulls, thereby increasing the range, endurance, and payload of patrol aircraft.

As noted above, the limited number of air stations and the reliance on older aircraft forced the Navy to develop or convert older ships to act as seaplane tenders. The first ship, USS *Wright* (AV 1), was completed in 1921.^{6,17} Completely self-contained, tenders required only reasonably calm seas to recover aircraft (Fig. 5). Together with civilian seaplane bases, these tenders would provide the Navy with advanced bases for aircraft servicing and crew quarters while supporting Fleet operations through 1967, with the final deployment of USS *Currituck* (AV 7).³

Also in 1919, Army Air Corps General Billy Mitchell initiated a campaign for an independent national air force modeled after the British Air Ministry that would incorporate naval aviation and be responsible for all military and civilian aviation matters in the United States. Mitchell's campaign, which ended with his court-martial in December 1925, began in earnest in June 1921 when the Navy invited the Army to participate in a demonstration of airpower against surface ships off the Virginia Capes. Upon completion of the exercise, four capital ships and one U-boat had been sunk.^{2,6} By mid-1924, by

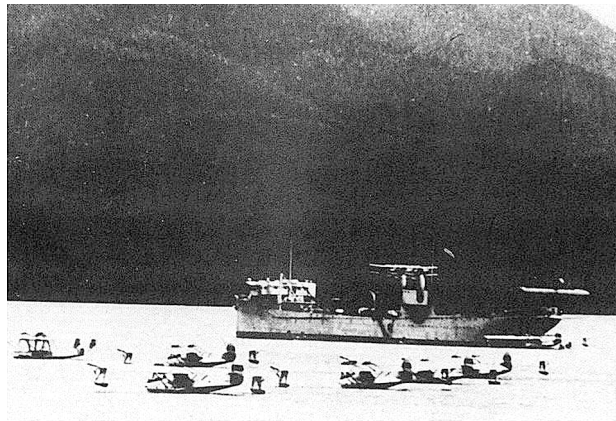


Figure 5. USS *Langley* (AV 3) shown tending six PBVs and one P2Y in Sitka Harbor, Alaska, 1937.¹⁸

means of an aggressive campaign through Congress, the services, and the press, it appeared that Mitchell would be successful in his efforts to consolidate the aviation services. That same year, Rear Admiral William E. Moffett, head of BUAERO, decided that the Navy needed a sensational event to convince the public that naval aviation had unique requirements that could only be met if the Fleet maintained an integral air arm. In April 1924, it was decided that a suitable demonstration of the Navy's requirements would be a non-stop flight from San Francisco to Honolulu.

The Navy's attempt to reach Hawaii from the West Coast is considered by many historians to have been premature. On the day of take-off in August 1925, the two PN-9 flying boats (1,840-mile range)³ still lacked the required range to make the 2,100-mile non-stop flight. Gambling on the trade winds to give them the needed ground speed, both crews pressed on. The first aircraft dropped out several hours into the mission owing to a broken oil line. The second flying boat ran out of fuel 450 miles short of its goal. Given up as lost at sea, the crew fabricated sails from their lower wings and sailed the remaining distance until finally rescued by the submarine USS *R-4* (SS 81) in the Kauai Channel 10 days later (Fig. 6).

Although the demonstration fell short of its objective, it served to draw the public's attention to the depressing state of naval aviation and, in June 1926, resulted in effective legislation to increase the Navy's air arm to 1,000 planes over the next five years. Further experimentation over the next decade would result in a flying boat capable of reaching Hawaii from the West Coast, as well as demonstrations of massed flights of patrol aircraft throughout the Pacific Rim, extending patrol aviation capabilities closer to Japan.^{2,6,13,19}

The Navy commissioned its first heavier-than-air patrol squadron, VP-1, as a utility squadron consisting of six F5L aircraft operating from Naval Air Station (NAS) San Diego, California, on 4 March 1922. (Patrol squad-

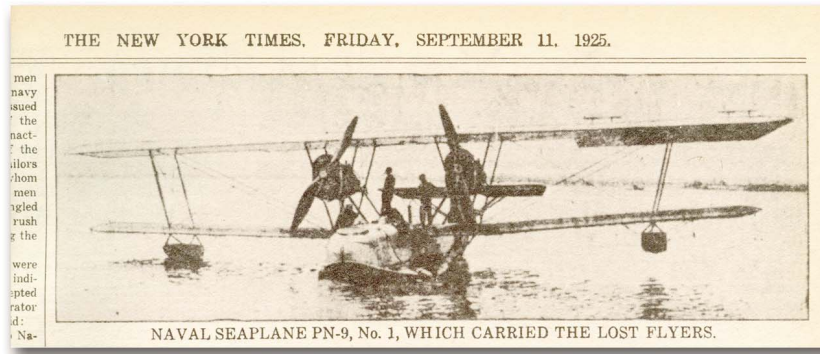


Figure 6. The PN-9 seaplane after rescue in Hawaii, 1925.¹⁶

rons listed in this article may not necessarily correspond to current squadrons of the same number. For a lineage listing of current patrol squadrons, see OPNAV Instruction 5030.4E, *Navy Aviation Squadron Lineage and Naval Aviation Command Insignia*, dated 19 March 1998.) Two years later, on 29 May 1924, the Navy further reorganized to add Naval Coastal Defense Forces that included provisions for three more patrol squadrons operating from NAS Hampton Roads, Virginia, NAS Coco Solo, Panama, and NAS Pearl Harbor, Hawaii—all operating either F5L or H-16 aircraft. On 26 May 1931, the Navy, following up on the growing belief that a confrontation with Japan would undoubtedly occur, awarded Consolidated Aircraft a contract for a twin-engine sesquiplane (a biplane with one wing half as large as the other) long-range flying boat, the P2Y-1 Ranger (1,780-mile range/2,000-pound payload)^{3,20} that would provide advanced warning of an impending attack on the Philippines, Hawaii, and Alaska. In all, the Navy procured approximately 45 Rangers, the first being delivered in early 1933. The Rangers continued service until 1941 when they were relegated to training duties at NAS Pensacola. In January 1934, six P2Y-1s were transferred from San Francisco to NAS Pearl Harbor in what was at the time the longest formation flight in aviation history (Fig. 7).^{13,20}

Throughout the remainder of the 1930s, as clear demonstrations of the Navy's reconnaissance capabilities during Japan's build-up in the Pacific, patrol squadrons continued their massed formation flights, including deployments to the Aleutians, the Galapagos Islands, and Midway Island.^{3,13,20} In June 1936, efforts by the Navy to develop a more advanced patrol bomber were initiated when Consolidated Aircraft received the largest aircraft contract since WWI to build the PBY Catalina (2,289-mile range/4,000-pound payload).³ Four months later, the PBY became operational with VP-11. This aircraft was outfitted with an automatic pilot coupled to a Norden bombsight, allowing the bombardier to fly the aircraft during bombing runs. It would become one of the workhorses of the patrol squadrons during WWII. The PBY was capable of carrying combinations

of torpedoes, depth bombs, 30- and 50-caliber machine guns, and rearward firing retro-rockets, permitting dual-purpose ASW/SUW missions.²⁰

Patrol squadrons were formally organized into patrol wings in 1938 when, according to the Naval Aeronautical Organization, five patrol wings were established under the authority of Commander, Aircraft Scouting Force, U.S. Fleet. Patrol wing staffs administered Fleet air bases and assumed operational control

of seaplane tenders. To permit patrol aviation to operate as an integral part of task forces, patrol wings were designated as Fleet Air Wings (FAWs) on 1 November 1942. This designation reverted to patrol wings in 1973 as organizational changes were made to the Navy's Fleet structure.³

As range, endurance, and payload were increased with each successive aircraft that reached the Fleet, the weapons and sensors that the patrol squadrons would use throughout the coming conflict were further developed and improved upon. Significant improvements to machine gun muzzle velocities and firing rates were made which accommodated heavier rounds than had been in use during WWI. Efforts begun in 1917 to develop an aerial torpedo capable of destroying a modern warship came to fruition. When introduced, the aerial torpedo was deemed by many to be the best SUW weapon available. The 1921 airpower demonstrations off the Virginia Capes noted above showed that, no matter how well a ship was designed, the pressure wave produced by a near miss was sufficient to sink it. Therefore, the Navy refrained from developing armor-piercing bombs and continued to rely on the 1,000- to 2,000-pound general-purpose bombs. The depth bomb reliability and effectiveness issues that plagued air ASW efforts in WWI were resolved only after the United States entered WWII.³



Figure 7. P2Ys off Diamond Head, Hawaii (photograph courtesy of Nevins Frankel).

THE SECOND WORLD WAR

America's involvement in WWII began on 5 September 1939, four days after Germany's invasion of Poland, when President Roosevelt ordered the U.S. Navy to organize a Neutrality Patrol, fundamentally to emphasize the readiness of the Navy to defend the Western Hemisphere.²¹ Almost immediately, patrol squadrons began to patrol the North Atlantic, escorting convoys along the East Coast and, from bases in the Philippines, surveying the Japanese buildup of forces in the South China Sea.²² While flying a variety of aircraft, patrol squadrons conducted reconnaissance and combat missions in support of Fleet operations in every theater. It is well beyond the scope of this article to tell the story of patrol aviation during WWII. Therefore, to demonstrate this community's multi-mission nature, only critical warfare areas and contributing technologies/innovations are briefly discussed.

Project Baker, an experiment in "blind landings," began in early 1940 by Patrol Wing One specifically to help patrol plane pilots land under the hazardous weather conditions of the high latitudes in locations such as Iceland and the Aleutian Islands. It would be fielded by mid-1942 as the Ground-Controlled Approach (GCA) radar system.³ In March 1946, GCA equipment would be adopted as the standard blind landing equipment for the Navy.² By October 1940, vulnerability reductions in the form of aircrew armor and self-sealing fuel tanks were beginning to enter service, and within a year, all PBV aircraft in service, except those in Patrol Wing Two at Pearl Harbor, would be so equipped.^{2,6,20} In May 1941, jet-assisted takeoff (JATO) was developed at the Naval Engineering Experiment Station at Annapolis, Maryland, primarily to enhance the takeoff abilities of heavily loaded flying boats, and was first used operationally by VPB-19 at Iwo Jima. That same summer, the first British ASV (air-to-surface vessel detection) radar sets and aircraft identification friend or foe (IFF) equipment were installed on aircraft of Patrol Wing Seven which were operating with their aircraft tenders out of Argentia, Newfoundland, and Reykjavik, Iceland. In October, magnetic anomaly detection (MAD) equipment capable of detecting submerged submarines made its debut in tests against the submarine USS S-48 (SS 159) off Quonset Point, Rhode Island.^{2,3,20} On 29 October 1941, VP-82 became the first patrol squadron to transition from the flying boat to the land-based Lockheed

PBO-1 Hudson bomber (1,750-mile range/1,400-pound payload).³ (On 1 March 1943, patrol squadrons flying land-based aircraft were redesignated VB with a three-digit number to differentiate them from carrier-based bombing squadrons, which were also designated VB. On 1 October 1944, both patrol and land-based bombing squadrons were redesignated patrol bombing squadrons [VPB]. After WWII, these squadrons reverted to VP, regardless of the aircraft in their inventories.³) A year later, VP-82 would again transition to its second land-based patrol aircraft, the Lockheed PV-1 Ventura (1,360-mile range/5,000-pound payload).^{2,3,15}

At the end of 1941, 26 patrol squadrons under the command of eight patrol wings were flying neutrality patrols in the North Atlantic, Caribbean, and Pacific, operating from bases in Iceland, Canada, Puerto Rico, the Caribbean, Bermuda, Brazil, Hawaii, and the Philippine Islands.^{3,20,21} These squadrons were equipped with PB2Y-2 Coronado flying boats (1,380-mile range/12,000-pound payload),³ variants of the PBV Catalina, PBM-1 Mariner (2,420-mile range/16,800-pound payload),³ and PBO-1 Hudson bombers (Fig. 8). (Of the 26 squadrons, 4 were in training, awaiting delivery of aircraft or ferrying aircraft from San Diego, California, to Norfolk, Virginia.³) However, the number of available patrol aircraft was woefully insufficient to detect the Japanese striking force at Pearl Harbor and to patrol the Atlantic coastline during the German U-boat offensive of 1942.^{6,15} In addition, PBV and PBM flying boat operations under the extreme weather conditions of the high latitudes during the winter months became extremely hazardous, making takeoff and landing, even in sheltered waters,

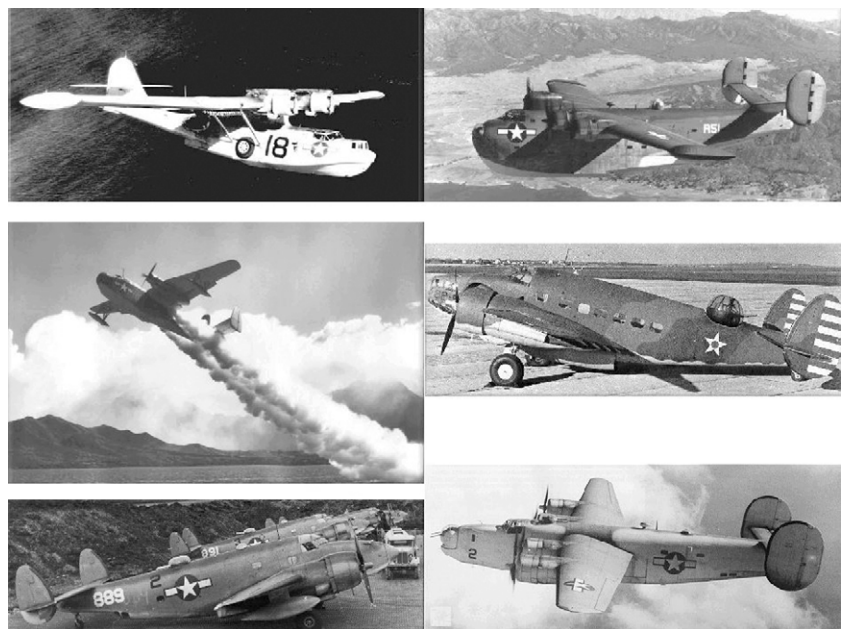


Figure 8. Clockwise from upper right: PB2Y-2 Coronado, PBO-1 Hudson, PB4Y Liberator, PV-1 Ventura, PBM-1 Mariner conducting jet-assisted takeoff, and PBV-5A armed with retrorockets (photographs courtesy of Nevins Frankel).

risky. Earlier in the conflict, the British RAF Coastal Command had learned that land-based patrol bombers were better suited to all-weather operations over the North Atlantic. Therefore, in his January 1942 aircraft request, Rear Admiral John Towers (BUAERO) identified a significant need for land-based aircraft, specifically PB4Y Liberator (2,800-mile range/12,800-pound payload)³ and PV-1 Ventura aircraft.¹⁵

ASW operations commenced on 7 December 1941 when a PBY-5 from VP-14, in concert with USS *Ward* (DD 139), attacked and sank a Japanese midget submarine attempting to enter Pearl Harbor.^{2,3,6,21-23} Before the establishment of adequate command and control (C2) in the Atlantic in the spring of 1942, only two submarines had been sunk by American forces—both by VP-82 flying the PBO-1 Hudson bomber.^{3,21,24} Hunter-killer (HUK) tactics were developed whereby patrol aircraft, airships, escort carriers, and surface ships coordinated search and attack efforts in the Atlantic, Mediterranean, and Caribbean.^{6,21,24} New sensors and weapons were introduced. More improved versions of the British ASV radar were developed and installed in patrol aircraft. In April 1944, while flying a barrier mission in the Strait of Gibraltar, VP-63 sank the U-761 using MAD gear and retro-rockets.^{3,20,21} Before then, the primary means of detection was via radar and visual sightings followed by an attack with 3.5-inch rockets, machine guns, and depth bombs equipped with hydrostatic fuzes, often putting the aircraft within the lethal range of a U-boat's guns. In 1945, VP-84 scored the first submarine kill using the Mk-24 acoustic homing torpedo (FIDO) in the North Atlantic.^{3,20,21} Omnidirectional sonobuoys made their debut and were used in both theaters to further classify MAD contacts.^{3,6,20} Once again, the vulnerabilities of patrol bombers to air defenses became apparent when Admiral Karl Doenitz, head of the German U-boat force, determined that his U-boats would be equipped with stronger air defense measures in 1944.^{3,6,14,20} In all, patrol squadrons were involved in the sinking of 59 Axis submarines throughout the period of hostilities.³

In every major naval campaign in both theaters of operations, patrol squadrons provided over-the-horizon (OTH) surveillance to the carrier battle force commander. Following the attack on Pearl Harbor, patrol squadrons were essentially all that remained of the defensive air arm for Hawaii and the Philippine Islands.^{6,20,21} Immediately, surveillance missions were stepped up to provide intelligence to carrier battle groups as they conducted strikes against Japanese territory and to provide early warning to the Asiatic Fleet before their withdrawal from the Philippines to the Dutch East Indies.²² Patrols were increased in the North Atlantic to protect shipping, supply, and troop transport against the German U-boat force as well as prowling Luftwaffe bombers and the occasional surface

raider. Photoreconnaissance missions over hostile bases and port facilities provided vital intelligence prior to VP, VPB, and carrier strikes.^{3,20,21,25} Squadrons of Patrol Wing Two were the first to locate the Japanese attacking force before the Battle of Midway, and those of Patrol Wing Four proved to be the most valuable ISR asset available to the Alaskan Command during the Aleutian campaign.^{20-22,25} Throughout the war, patrol squadrons conducted ISR missions, culminating with the detection by VPB-21 of the Japanese battleship *Yamato* on 7 April 1945 and its ultimate sinking by carrier aircraft.³

Attacks against surface combatants started almost immediately after the commencement of hostilities with Japan as PBY-4s from Patrol Wing Ten conducted daylight attacks against the Japanese invasion fleet approaching the Philippines.²² In June 1942, VP-44, flying PBY-5As equipped with radar and carrying torpedoes, conducted the initial attacks against Japanese forces to the west of Midway Island—the first documented use of radar to aid in a nighttime attack, and the first attacks by naval aircraft at the Battle of Midway.^{3,6,20,21,26} Meanwhile, in the Aleutian Island chain, PBYs of Patrol Wing Four conducted non-stop dive-bombing attacks against Japanese combatants in Kiska Harbor. Known as the “Kiska Blitz,” this operation lasted over 48 hours and ended only when their tender, USS *Gillis* (AVD 12), was depleted of ammunition and fuel.^{20,21,25} Operating from Henderson Field on Guadalcanal, radar-equipped PBYs known as “Black Cats” conducted nighttime search and attack missions against the “Tokyo Express” and shore installations.^{18,20,27,28} Off the coast of Indonesia in April 1945, aircraft of VPB-109 successfully attacked Japanese shipping and oil storage facilities in Balikpapan Harbor using the Bat missile. This marked the first U.S. employment of a stand-off, radar-guided missile in combat (Fig. 9).³ This technology, in development since the end of WWI, was introduced to

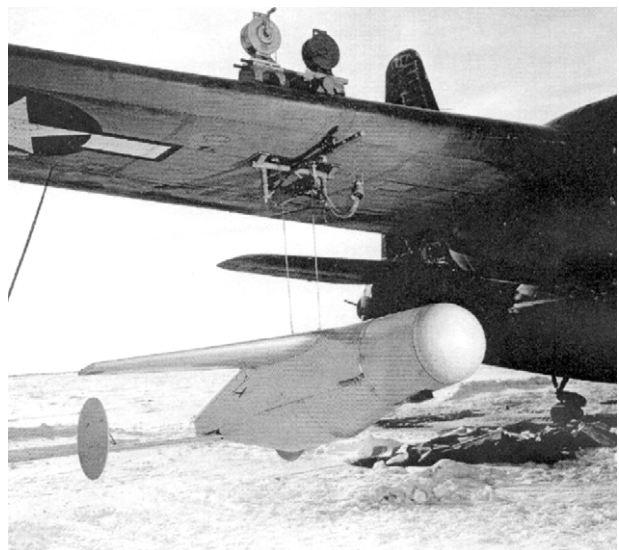


Figure 9. Bat missile being loaded in position on a PB4Y.³

the Fleet prior to detailed evaluation or environmental testing, and as such, had a high failure rate.³

Throughout the war, patrol squadrons performed numerous secondary missions as well. In the Pacific theater, they deployed all offensive minefields assigned to the Navy, closing several port facilities and forcing the closure of two key Japanese bases. The success of aerial mining against the Japanese during WWII led to the incorporation of this mission in nearly all patrol squadrons after the war.³ Several aircraft were modified to perform electronic eavesdropping missions along the European French Coast and Japanese bases in the Far East in what would become the Fleet air reconnaissance squadrons (VQs) of the Cold War.^{3,6,28} Missions of mercy were conducted during the withdrawal of forces from the Philippines and for resupplying coast-watchers in the Solomons.^{3,20,21,29} On several occasions, aircrew were called upon to insert and extract commando forces on intelligence gathering missions prior to amphibious landings.^{3,20,21,29} As part of the “Empire Express,” PB4Ys and PV-1s operating from bases in the Aleutians and equipped with long-range navigation (LORAN) flew low-level overland strike and photoreconnaissance missions against Japanese bases in the Kurile Islands.^{2,3,21,26} In the South Pacific, several land-attack missions were conducted with homemade daisy cutters fabricated by strapping iron construction rods to 500-pound general-purpose bombs.²⁰ Finally, squadrons spent many hours conducting combat search and rescue (CSAR) missions in support of convoy escort and carrier battle force operations.^{3,20,21}

Initial development of unmanned aircraft had been conducted during WWI.² As the technology progressed through the following decades, the thought of deploying such a weapon against heavily armed strategic targets such as U-boat pens and V-1 sites became tempting. However, problems with guidance systems continued to plague development and, in 1944, a hybrid drone bomb was specifically developed using the body of a PB4Y Liberator bomber. This aircraft would be flown to a pre-planned point at which the pilot would bail out. Radio control of the aircraft would be assumed by another PB4Y flying at line-of-sight distances, and directed to its intended target. Two such missions were flown by the Special Air Unit of Fleet Air Wing Seven, neither of which hit its intended target.³

At war’s end, 73 patrol squadrons under the operational control of 11 FAWs had conducted operations around the globe.³

THE COLD WAR

After the cessation of hostilities in August 1945, proponents of strategic bombing argued, as had Billy Mitchell in the 1920s, that the armies and navies of WWII were obsolete and that a fleet of long-range strategic

bombers armed with nuclear weapons was all the United States needed to deter any aggressor. Accordingly, the military undertook a considerable reduction in its conventional forces, including its patrol squadrons. When the United States became involved in the Korean War, only 25 squadrons were operational (9 reserve squadrons would be activated in the first year of the war).³

As East and West began to partition the former Axis possessions, it became apparent that the Soviet Union was developing its own nuclear arsenal. In 1946, the Peacetime Airborne Reconnaissance Program (PARPRO) was inaugurated to support photo- and electronic-reconnaissance missions along the peripheries of the Soviet Union, China, and other countries deemed unfriendly to the United States in order to update the Strategic Air Command (SAC) target lists in the event of an all-out nuclear confrontation. Patrol squadrons took an active part in this program; between April 1950 and April 1969, approximately half of the reconnaissance aircraft shot down on such missions were Navy patrol aircraft.³⁰

The Navy came to realize that its requirements for a patrol aircraft could not be satisfied with “off-the-shelf” solutions as they had been with the PBO-1, PB4Y, and other WWII aircraft. It was felt that the requirements of range, endurance, and payload could only be achieved through the procurement of an aircraft specifically designed for the mission. Therefore, in April 1944, the Navy reached an agreement with Lockheed for 15 P2V-1 Neptune aircraft (Fig. 10; 4,350-mile range/10,000-pound payload), whose primary missions would be long-range ASW and SUW.^{2,3,15,31} The Navy accepted its first Neptunes in July 1946 and in September of that same year, the “Truculent Turtle,” a stripped-down P2V-1 assigned to VP-2, broke the world’s record for unrefueled flight—11,235.6 miles from Perth, Australia, to Columbus, Ohio, in 55 hours and 18 minutes—demonstrating the long-distance capability of the new patrol aircraft. The record held until 1962, when a B-52H flew non-stop from Kadena, Okinawa, to Madrid, Spain—12,532 miles in 21 hours and 52 minutes.^{2,3,31} The P2V would con-



Figure 10. VP-1 P2V Neptune on patrol during Operation Market Time.³

tinue service with patrol squadrons until VP-23 retired the last Fleet Neptune in 1970.^{3,31}

In late 1945, weapons that were still being tested during WWII began to be issued to the operational patrol squadrons. The 50-caliber guns were replaced with 20mm cannon, providing the P2V-2 aircraft with six guns in the nose and two more in the tail turret. In September 1948, several P2V-3C aircraft were modified to operate from the Navy's *Midway*-class aircraft carriers as a strategic bomber carrying the 14-kiloton Mk-1 atomic bomb. Future versions of the aircraft would lack any defensive armament and would be equipped with bomb bays and external wing mounts for general-purpose bombs, rockets, etc.³ As improvements in sensor and weapons systems were introduced to the P2V fleet, aircraft gross weight increased by some 40%, limiting on-station performance. To offset this differential, Lockheed proposed the addition of a pair of turbojet engines to assist in takeoffs, increase dash speed, and use for emergencies should the reciprocating engines fail.³¹

The Korean War

On 25 June 1950, seven infantry and one armored division of the North Korean army crossed the 38th Parallel and invaded the Republic of South Korea. At the time, the patrol aviation force in the Pacific consisted of VP-28 with nine PB4Y-2s at Agana, Guam, and VP-47 with nine PBM-5 Mariners at Naval Station Sangley Point, Republic of the Philippines. On 29 September 1950, VP-731 was called to active duty, and by the end of 1950, 7 reserve squadrons would augment the 25 active squadrons to provide Fleet surveillance worldwide. By war's end, 17 squadrons flying PB4Ys (designated as P4Ys after WWII), PBMs, and P2Vs would serve in the combat zone, flying a variety of combat missions.

In the early days of the conflict, squadrons under the control of FAW-1 patrolled the Korean coastline as part of the U.N. blockade and conducted reconnaissance flights in the Formosa Strait to observe Chinese activity. Those squadrons under the control of FAW-6 and -14 were often tasked with ASW, mine reconnaissance, convoy escort, land and sea interdiction, naval fire support prior to the Inchon landings, and reconnaissance over the Korean mainland. As the war progressed, patrol squadrons conducted attacks against communist supply routes, including attacks against railroad lines. From June 1951 to June 1952, patrol squadrons participated in Operation Firefly. Operating in conjunction with Marine Corps night-fighter F7F aircraft, PB4Y crews dropped parachute flares to light North Korean roads, bridges, supply depots, and convoys to aid the attacking F7Fs. Often, these missions prevented North Korean and Chinese troops from overrunning Marine positions on the ground.^{2,3,31}

The Korean War saw several improvements and addi-

tions to the patrol community's arsenal. The Mk-34 parachute-stabilized acoustic torpedo, developed from the original Mk-24 FIDO of WWII service, was developed and introduced to the Fleet in 1951. In 1956, as development in acoustic torpedoes continued, the Mk-44 Mod 1 was introduced and would remain in service through the 1970s. Finally, in April 1956, VP-24 put the Petrel air-to-surface guided missile into its first operational use. Built around a Mk-13 torpedo with an active radar, the Petrel could be launched well outside of the ship self-defense systems of the day. Once within the effective range of the Mk-13, the Petrel would jettison its wings and fins and act as a torpedo.³

The Cuban Missile Crisis

When the United States placed an embargo on Cuba in response to the discovery of Soviet missiles on the island in 1962, two new aircraft were in the patrol squadron inventory. Acquired too late to see action in the Korean War, the Navy's last flying boat, the P5M Marlin (Fig. 11; 2,880-mile range/8,000-pound payload)³ was fielded in 1953 when technological improvements in submarines enabled them to spend more time under water. Equipped with an improved radar and underwater acoustic system, most notably the "Julie and Jezebel" sonobuoy system, the P5M had a larger bomb bay to accommodate torpedoes and nuclear depth bombs.³ VP-50 was the last active-duty PBM squadron to transition to the new P5M. Both the seaplane tender and the P5M would continue service until 1967 when VP-40 conducted the last flying boat deployment to Vietnam in the *Currituck*. The aircraft was officially retired on 15 November 1967, ending 56 years of flying boat service in patrol aviation.^{2,3,32,33}

In 1956, owing to technological improvements in ASW sensors and weapons, the Navy began considering replacement of both the P2V and P5M. Therefore, in



Figure 11. VP-44 P5M being loaded aboard USS *Currituck*.³

1957, the CNO established requirements for a new land-based maritime patrol aircraft with the range and endurance required to meet the Soviet submarine threat in the far reaches of the Pacific Ocean. Cost and schedule constraints dictated the need to modify an off-the-shelf airframe. The Navy announced the winner of the competition in May 1958 and, in July 1962, the Lockheed P-3 Orion (Fig. 12; 3,420-mile range/19,225-pound payload),³ a militarized version of Lockheed's L-188 Electra airframe, made its debut when it became operational with VP-8 at NAS Patuxent River, Maryland.^{2,3,32,34} Since 1970, this aircraft, after several modifications to accommodate a host of new missions and a wide array of weapons and sensor system upgrades, has been the sole maritime patrol aircraft in service with the Navy.

Squadrons flying P2Vs, P5Ms, and P-3As operated from Guantanamo Bay, Cuba; Bermuda; Roosevelt Roads, Puerto Rico; and Jacksonville, Florida, maintaining surveillance over the sea-lanes approaching Cuban territorial waters for more than two years in support of the quarantine. VP-5 was the first Navy squadron to spot and photograph a Soviet ship, *Bucharest*, carrying missiles to Cuba, and later the first to locate and track the first Soviet ship departing Cuba with dismantled missiles onboard.³

Vietnam

During the Vietnam War, 22 of the 30 active patrol squadrons outfitted with P2V, P5M, and P-3 aircraft would deploy to Southeast Asia, participating in Operation Market Time, Operation Yankee Team and, to a lesser degree, Operation Double Eagle.^{2,3,31,33,35} After South Vietnamese President Diem was assassinated in

November 1963, North Vietnamese General Vo Nguyen Giap stepped up communist operations in the south and initiated an elaborate logistics campaign, moving troops and ammunition down the Ho Chi Minh Trail through Laos and via seaborne infiltration along the South Vietnamese coast. In March 1965, a North Vietnamese trawler was discovered unloading supplies on the banks of Vung Ro Bay. The Vung Ro Incident was the first hard evidence of General Giap's resupply efforts and was cause for serious doubt about South Vietnam's ability to counter this infiltration. Within days, General William C. Westmoreland requested Pacific Fleet assistance in countering these resupply efforts. By mid-March, patrol squadrons operating from Cam Ranh Bay, Republic of Vietnam, and Sangley Point, Republic of the Philippines, operating in conjunction with USS *Black* (DD 666) and USS *Higbee* (DD 806), commenced Operation Market Time, a multi-year effort of inglorious operations along the 1,200 miles of South Vietnamese coastline, in attempts to stem the flow of communist supplies.^{2,3,31,33}

Meanwhile, Operation Yankee Team, a joint U.S. Navy and Air Force effort, consisted of low-level reconnaissance missions flown along the Ho Chi Minh Trail in eastern and southern Laos, targeted at communist resupply efforts. Initiated in May 1963, this operation relied heavily on the intelligence collection capabilities of the P2V and P-3.^{3,35}

In January 1966, Operation Double Eagle, the largest amphibious operation of the Vietnam War, took place when 5,000 U.S. Marines assaulted the North Vietnamese and Viet Cong forces in the Quang Ngai Province of South Vietnam. Patrol squadrons provided surveillance in support of the 12 assault ships in the landing force. In addition to these operations, patrol squadrons conducted ASW, SUW, and ISR missions for units attached to Task Force 77 operating off the coast of Vietnam.³

The Soviet Threat

In 1928, the Soviet Union embarked on a major submarine construction program to supplement its coastal defense forces. By the time the Germans invaded the Soviet Union on 21 June 1941, the Soviets possessed 276 submarines—the largest submarine fleet in the world.^{7,36} In July 1945, Joseph Stalin ordered a 20-year program to construct what he hoped to be a powerful navy consisting of 1,200 submarines, 200 destroyers, 36 cruisers, 4 battleships, and 4 aircraft carriers.³⁶

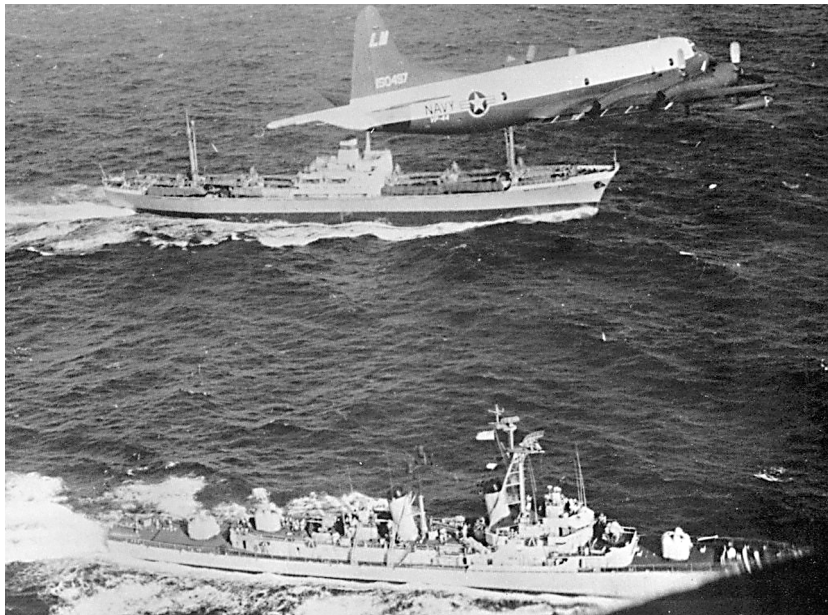


Figure 12. VP-44 P-3A on patrol during the Cuban Missile Crisis³² (photograph courtesy of the U.S. Naval Institute).

The Soviet submarine force continued to grow with the introduction of the *Whiskey* and *Zulu* classes in 1951.³⁴ When Stalin died in 1953, Soviet shipyards were turning out 40 surface ships and 70 submarines a year. However, Nikita Khrushchev and others within the Politburo had decided against Stalin's dream of a large blue water fleet, cutting back production by 60%.³⁶

Only when Sergei G. Gorshkov assumed the title of Admiral of the Fleet of the Soviet Union in 1956 did it appear that the Soviet navy had any hope of shedding its defensive role in favor of a blue water navy. Gorshkov convinced Khrushchev of the vital need to keep American aircraft carriers and ballistic missile submarines from attacking targets within the Soviet Union or attempting to resupply NATO Allies in the event of another European war.^{7,34} By 1962, the nuclear-powered *November* attack and *Echo I* guided missile submarines and the *Kynda*-class guided missile cruisers were deployed.^{34,36} In the early 1970s, Gorshkov was well on his way to building a navy primarily designed for sea control rather than defense. Soviet guided missile, attack, and ballistic missile submarines would eventually patrol both coasts of the United States and stalk American carrier battle groups in the Mediterranean and Western Pacific. Surface combatants of the *Moskva* class, designed to search for American and British submarines, were introduced and, by the end of the 1970s, the *Kirov*-class nuclear powered battle cruisers and *Kiev*-class aircraft carriers were deployed worldwide.³⁶

From their home bases of Brunswick, Maine, Patuxent River, Maryland, Jacksonville, Florida, Moffet Field, California, and Barbers Point, Hawaii, maritime patrol squadrons operated up and down the U.S. coast as Soviet ballistic missile submarines took station to bring the American heartland within ballistic missile range. In response to Soviet initiatives, and in particular the burgeoning submarine threat, forward-deployed bases were established that enabled coverage of worldwide strategic choke points and sea-lanes of communication such as the Strait of Malacca and the Strait of Gibraltar. From these bases, P-3 squadrons were poised to track all Soviet submarine movement in addition to providing locating data on Soviet surface vessels.

The majority of these operations were conducted in "lone wolf" fashion or by pairs of aircraft employing "highboy-lowboy" tactics. However, to better integrate with the carrier battle group and provide effective wide area surveillance, maritime patrol developed coordinated operations tactics that allowed the P-3 to operate as a near "organic" element of the battle group. This capability became crucial as the Soviets developed OTH cruise missile firing submarines such as the *Echo II* which fully matured with the introduction of the *Oscar*. As U.S. submarines began to provide dedicated battle group support, it became necessary for maritime patrol to develop tactics and doctrine to permit coordinated

prosecution of threat submarines.

Throughout the era of the Soviet threat, numerous improvements and additions to the patrol community's suite of weapons and sensors were made. The Mk-46 air-launched torpedo began to enter service in 1966 as a replacement for the Mk-44. In 1990, the Mk-50 Barracuda air-launched torpedo was added to the inventory. In 1965, the introduction of the P-3B to the Fleet included provisions for the ASM-N-7 Bullpup air-to-surface missile, which would remain in inventory until mid-1978 when it would be replaced with the AGM-84 Harpoon anti-ship missile. Throughout the 1970s and 1980s, the Mk-20 Rockeye cluster bombs and 5-inch Zuni rockets were also added to the armament inventory. Additional improvements were made to the suite of sensor systems with the introduction of the directional low-frequency analysis and recording (DIFAR), vertical line array DIFAR (VLAD), and active acoustic sonobuoys. Electronic support measures (ESM) sensors were improved as well, and an infrared detection system (IRDS) was introduced throughout the 1970s and 1980s.³

As a result of a major reorganization of the Naval Air Reserve, 12 Reserve squadrons flying P2Vs and P-3As were established in November 1970. These squadrons, structured along the lines of regular Navy squadrons, had nearly identical organizational and manning levels.³

A NEW WORLD ORDER

Following the collapse of the Soviet Union and the Warsaw Treaty Organization over a decade ago, a new series of threats emerged, and the focus shifted away from the high seas to the littoral environment. Among these "new" dangers are regional and trans-national threats, and the increased threat of weapons proliferation and terrorism. It can be argued that these threats have always existed, albeit in the background of the Cold War and the threat of the Soviet Union. The maritime patrol community has responded to the Navy's shift in focus to the littoral environment through the development of new sensors and tactics, often resurrecting and updating old technologies and missions to continue to provide the war fighter with real-time tactical data.

The Persian Gulf War

The Persian Gulf War marked the first return of patrol squadrons to the littoral since the Vietnam War. When Iraqi forces invaded Kuwait on 2 August 1990, patrol squadrons were among the first forces to respond. Operating from Diego Garcia, British Indian Ocean Territory (BIOT), aircrews conducted surveillance missions in the Arabian Sea and Persian Gulf pursuant to the U.N.-sponsored sanctions against Iraq. Within 12 days of the invasion, VP-1 stood up detachments at Jeddah, Saudi Arabia, and Al Masirah, Oman, enabling aircrews to support carrier battle groups during the buildup of Coali-

tion forces. Throughout the course of Operation Desert Shield, patrol squadrons flew in excess of 6,300 hours of Maritime Interdiction Operations (MIO). These missions included locating and identifying Iraqi vessels and vectoring Coalition ships to intercept and board suspected vessels of interest. Other missions included convoy escort of maritime support ships through the Red Sea to ports of debarkation in the Persian Gulf.^{33,34} When hostilities began, patrol squadron aircrews provided classification and targeting information for carrier strikes against Iraqi naval vessels attempting to assault the Kuwaiti-held Maridim Island, as well as those attempting to flee to Iran.³⁴ After the Persian Gulf War, the number of patrol squadrons was reduced to its current level of 12 active and 6 reserve.

As a result of Persian Gulf War experiences, a series of improvements to the P-3C aircraft known as the SUW Improvement Program (AIP) were made to provide the aircraft with a more robust capability within the littoral battle space. This capability included improved connectivity via numerous data links and information processors as well as improvements to the organic sensors and weapons. Specifically, detection and resolution capabilities of the Inverse Synthetic Aperture Radar (ISAR) were improved to add an overland surveillance capability with a SAR mode of operation, state-of-the-art electro-optical sensors were added, the ESM capability was upgraded, the AGM-84E SLAM and AGM-65F Maverick missile capabilities were installed, and self-defense enhancements were made, including the ALE-47 Countermeasures Dispensing System (CDS) and a passive missile warning system to detect infrared air-to-air and surface-to-air threats.³⁴

Bosnia

In the spring of 1999, during Operation Allied Force, patrol squadrons introduced the AIP suite to combat as aircrews flew force protection flights over the Adriatic Sea. Outfitted with SLAM and Maverick missiles, Rockeye cluster munitions, and CDS, the P-3C performed armed surface combat air patrol (SUCAP) missions for the carrier battle group. In addition to supporting Tomahawk and carrier air strikes, AIP-equipped aircraft located Yugoslavian patrol boats at sea and in port, passing real-time and near real-time imagery data to battle group commanders and the Combined Air Operations Center (CAOC).³⁴ More significantly, the P-3C Update III (UIII) AIP Orions conducted strike missions employing the SLAM (Fig. 13) against a

range of fixed and mobile targets including airport control and maintenance facilities as well as threat and integrated air defense systems (IADS). In all, the maritime patrol community launched 14 SLAMs, achieving a 93% success rate, the highest of all air-to-surface and surface-to-surface missile platforms during the operation. In the words of Vice Admiral D. Murphy, Commander, Sixth Fleet, "Point of fact: VP was the most responsive weapons platform in the entire war" (Patrol Squadron Ten briefing, April 2000).

Afghanistan

Since the 11 September 2001 terrorist attacks on the Pentagon and World Trade Center, patrol squadrons have been active in the conflict throughout South West Asia and Afghanistan, flying leadership interdiction operations (LIO), overland surveillance, and MIO. Operating in conjunction with Coalition maritime patrol aircraft such as the Canadian CP-140 Aurora, British MRA2 Nimrod, and French ATL3 Atlantique, patrol squadrons flying MIO and LIO missions work to ensure that fleeing Taliban and Al Qaeda leaders are unable to evade anti-terrorist forces in their search for safe havens.³⁷ Overland flights, conducted under the control of the Combined Forces Air Component Commander via the Joint Combined Air Operations Center in Saudi Arabia, provide OTH situational awareness to support small Allied military units on the ground. In the early stages of the conflict, P-3s were tasked to search for surface-to-air missile sites, armored convoys, and troop concentrations.³⁸

The Future



Figure 13. AGM-84E stand-off land attack missile (SLAM) on a P-3C (photograph courtesy of CAPT K. Hohl, Chief of Staff, Commander, Patrol Reconnaissance Force Pacific).

Recognizing that the P-3C UH and AIP inventories are beginning to approach the end of their fatigue lives, the Navy has launched an acquisition program to ensure that the capabilities of today's maritime patrol community are preserved. In response to a Mission Needs Statement (MNS) approved by the Joint Requirements Oversight Council (JROC) in 2000, the Center for Naval Analyses (CNA) conducted an Analysis of Alternatives (AoA) to determine the range of possible material and non-material solutions. Once again, the need to conduct wide-area ASW dictated range, endurance, and payload requirements that made inescapable the conclusion that a large (and therefore land-based) manned aircraft was required. Of interest was the stated potential of adjunct unmanned air vehicles (UAVs) to augment the manned aircraft where the routine or dangerous nature of missions allowed. With this conclusion, the Navy began development of the Multi-mission Maritime Aircraft (MMA) and the Broad Area Maritime Surveillance (BAMS) UAV. When delivered, the MMA will enable the growth necessary to provide flexibility and adaptability, which have been the historical hallmarks of maritime patrol. And MMA and BAMS will continue the tradition of supplying the information that Sun Tzu, Clausewitz, and Rear Admiral McCain all found so important as these capabilities evolve into critical nodes of the network-centric battle space.

SUMMARY

Maritime patrol reconnaissance is the oldest mission in naval aviation. The maritime patrol community has been involved in every major conflict from the Banana Wars to the current crises in South West Asia and Afghanistan, acting as the eyes of the Fleet to meet the battle force commander's ever-insatiable needs for critical OTH situational awareness. Throughout the 56 years of flying boat service, and with each successive land-based aircraft in its inventory, the Fleet has recognized the need for increased range and payload in meeting mission objectives.

Visionaries such as Glenn Curtiss and David Taylor recognized the range and payload requirements needed to protect convoys during their trans-Atlantic journeys in WWI. The inter-war long-range flight demonstrations not only paved the way for trans-oceanic flight but also set the stage for innovations in overwater navigation and long-haul communications. As weapons and sensors were further developed and improved upon, each successive aircraft to reach the Fleet saw increases in range, endurance, and payload. When technologies of the day failed to meet the war fighter's requirements, seaplane tenders provided advanced bases to enable extended-range operations. When John Towers introduced land-based aviation to the patrol community's inventory in 1940, he unknowingly forced the require-

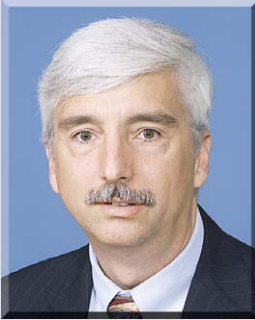
ment for an airframe capable of providing long-range reconnaissance over the vast reaches of the world's oceans—today's P-3.

Throughout the history of warfare, it can be shown that the kill chain begins and ends with good ISR. Since the commissioning of the first patrol squadron in 1922 through today's AIP-equipped P-3s, the maritime patrol community has demonstrated its dedication to meeting the challenge of providing timely mission-critical information to the war fighter. However, innovations and the necessities of warfare, as demonstrated throughout the history of maritime patrol aviation, have dictated the additional need to react to time-critical events as the kill chain unfolds. As such, the Navy has embarked on a program to preserve the capabilities of today's maritime patrol aviation. With the MMA and BAMS UAV, the patrol community is poised to continue its proud history of persistent armed surveillance well into the 21st century.

REFERENCES

- ¹McCain, J. S., *VPB—The Patrol Bomber* (1942), available at http://www.vpnavy.org/vpb_article_25apr2000.html (accessed 24 Jun 2003).
- ²Grossnick, R. A., *United States Naval Aviation 1910–1995*, Naval Historical Center, Washington, DC (1997).
- ³Roberts, M. D., *Dictionary of American Naval Aviation Squadrons, Volume 2, The History of VP, VPB, VP(HL) and VP(AM) Squadrons*, Naval Aviation History Office, Washington, DC (2000).
- ⁴Langley, L. D., *The Banana Wars, United States Intervention in the Caribbean 1898–1934*, The University Press of Kentucky, Lexington (1985).
- ⁵Johnson, B., *Fly Navy, A History of Naval Aviation*, William Morrow and Co. Inc., New York (1981).
- ⁶Coletta, P. E., *Patrick N.L. Bellinger and U.S. Naval Aviation*, University Press of America, Inc., Lanham, MD (1987).
- ⁷Middleton, D., *Submarine*, The Playboy Press, Chicago, IL (1976).
- ⁸Mead, G., *The Doughboys, America and the First World War*, The Overlook Press, Woodstock, NY (2000).
- ⁹Marder, A. J., *From the Dreadnought to Scapa Flow, The Royal Navy in the Fisher Era, 1904–1919*, Oxford University Press, London, UK (1970).
- ¹⁰Sheely, L. D. (ed.), *Sailor of the Air, The 1917–1919 Letters and Diary of USN CMM/A Irving Edward Sheely*, The University of Alabama Press, Tuscaloosa (1993).
- ¹¹Sitz, W. H., *A History of U.S. Naval Aviation*, Technical Note No. 18, U.S. Navy Department, Bureau of Aeronautics, U.S. Government Printing Office, Washington, DC (1930).
- ¹²Messimer, D. R., *Find and Destroy—Antisubmarine Warfare in World War I*, U.S. Naval Institute Press, Annapolis, MD (2001).
- ¹³Taylor, T., *The Magnificent Mitscher*, W. W. Norton and Co. Inc., New York (1954).
- ¹⁴Reynolds, C. G., *Admiral John H. Towers—The Struggle for Naval Air Supremacy*, Naval Institute Press, Annapolis, MD (1991).
- ¹⁵Wilbur, T., *The First Flight Across the Atlantic*, NC-4 50th Anniversary Committee, Smithsonian Institution, National Air and Space Museum, Washington, DC (1969), available at <http://www.history.navy.mil/download/nc4-5.pdf> (accessed 24 Jun 2003).
- ¹⁶Fleischer, S., and Keylin, A. (eds.), *Flight—As Reported by The New York Times*, Arno Press, New York (1977).
- ¹⁷Lindley, J. M., *Wings Over the Water, Part 11*, Naval Aviation News, Washington, DC (Jun 1978).
- ¹⁸Messimer, D. R., *Pauns of War—The Loss of the USS Langley and the USS Pecos*, Naval Institute Press, Annapolis, MD (1983).
- ¹⁹Messimer, D. R., *No Margin for Error—The U.S. Navy's Trans-Pacific Flight of 1925*, Naval Institute Press, Annapolis, MD (1981).
- ²⁰Creed, R., *PBY—The Catalina Flying Boat*, Naval Institute Press,

- Annapolis, MD (1985).
- ²¹Morison, S. E., *History of United States Naval Operations in World War II*, Little, Brown and Co., Boston, MA (1984).
- ²²Messimer, D. R., *In the Hands of Fate—The Story of Patrol Wing Ten—8 December 1941–11 May 1942*, Naval Institute Press, Annapolis, MD (1985).
- ²³Prange, G. W., Goldstein, D. M., and Dillon, K. V., *At Dawn We Slept—The Untold Story of Pearl Harbor*, Penguin Books, New York (1981).
- ²⁴Hoyt, E. P., *U-Boats Offshore—When Hitler Struck America*, Stein and Day Publishers, Briarcliff Manor, NY (1978).
- ²⁵Garfield, B., *The Thousand-Mile War—World War II in Alaska and the Aleutians*, Bantam Books, New York (1982).
- ²⁶Prange, G. W., Goldstein, D. M., and Dillon, K. V., *Miracle at Midway*, McGraw-Hill Book Co., New York (1982).
- ²⁷Lord, W., *Lonely Vigil—Coastwatchers of the Solomons*, The Viking Press, New York (1977).
- ²⁸McCue, B., *U-Boats in the Bay of Biscay—An Essay in Operations Analysis*, National Defense University Press, Washington, DC (1990).
- ²⁹Crocker, M., *Black Cats and Dumbos—WWII's Fighting PBYS*, Tab Books, Inc., Blue Ridge Summit, PA (1987).
- ³⁰Burrows, W. E., *By Any Means Necessary—America's Secret Air War in the Cold War*, Farrar, Straus and Giroux, New York (2001).
- ³¹Mutza, W., *Lockheed P2V Neptune: An Illustrated History*, Schiffer Publishing Ltd., Atglen, PA (1996).
- ³²Reade, D., *The Age of Orion: The Lockheed P-3 Story*, Schiffer Publishing Ltd., Atglen, PA (1998).
- ³³Cutler, T. J., *Brown Water, Black Berets*, Naval Institute Press, Annapolis, MD (1988).
- ³⁴Elward, B., "Lockheed Martin P-3 Orion: US Service," in *World Air Power J.* 43, Aerospace Publishing, Ltd., London, UK (Winter 2000).
- ³⁵Doleman, E. C. Jr., *The Vietnam Experience—Tools of War*, Boston Publishing Co., Boston, MA (1984).
- ³⁶Cockburn, A., *The Threat—Inside the Soviet Military Machine*, Vintage Books, New York (1984).
- ³⁷Fulghum, D. A., "Air Patrols Watch for Fleeing Leaders," *Aviation Week & Space Technology* (4 Mar 2002).
- ³⁸Fulghum, D. A., "Navy Exploits P-3 in Overland Recce Role," *Aviation Week & Space Technology* (4 Mar 2002).



JOHN F. KEANE is a member of APL's Principal Professional Staff and Supervisor of the Aviation Systems Group in the Power Projection Systems Department. He received a B.S. in electrical engineering from The Virginia Military Institute in 1980 and an M.S. in operations research from The Naval Postgraduate School in 1993. A retired naval officer, he served several tours in maritime patrol aviation and has led the APL Multi-mission Maritime Aircraft Team since 2001. In addition, he has conducted affordability analyses for the JSF Program Office, served as a member of DoD's Simulation Based Acquisition Joint Task Force and as lead analyst on the POET Validation Team for Wargame 2000, and participated in numerous studies involving force composition and command and control. Mr. Keane is a member of the adjunct faculty of the JHU Whiting School of Engineering and of the Military Operations Research Society Board of Directors. His e-mail address is jack.keane@jhuapl.edu.