

REPORT DOCUMENTATION PAGE**Form Approved**
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 15-04-2011		2. REPORT TYPE Master of Military Studies Research Paper		3. DATES COVERED (From - To) September 2010 - April 2011	
4. TITLE AND SUBTITLE Maritime Patrol Innovation: USN PBY Catalina Squadrons in the Pacific Area of Operations, 1941-1945				5a. CONTRACT NUMBER N/A	
				5b. GRANT NUMBER N/A	
				5c. PROGRAM ELEMENT NUMBER N/A	
6. AUTHOR(S) Hollenbach, Jeffrey, D, LCDR, USN				5d. PROJECT NUMBER N/A	
				5e. TASK NUMBER N/A	
				5f. WORK UNIT NUMBER N/A	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USMC Command and Staff College Marine Corps University 2076 South Street Quantico, VA 22134-5068				8. PERFORMING ORGANIZATION REPORT NUMBER N/A	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A				10. SPONSOR/MONITOR'S ACRONYM(S) N/A	
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER N/A	
12. DISTRIBUTION AVAILABILITY STATEMENT Unlimited					
13. SUPPLEMENTARY NOTES N/A					
14. ABSTRACT Although considered obsolete in 1939, the Navy's PBY Catalina patrol aircraft made a significant contribution to the Allied war effort in the Pacific Theater. This paper explores how the planners, aircrew, and maintainers made that possible as the war for the US shifted from a desperate defense following Pearl Harbor to an offense following Midway. The availability, versatility, and survivability of the aircraft made it an indispensable asset. The innovation of the crews and maintainers allowed the aircraft to accomplish far more than what it was intended to do. By the end of the war and in the most austere and deadly conditions, PBYs conducted reconnaissance, surveillance, electronic intelligence, image intelligence, forward air control, close air support, convoy escort, harassment missions, transport, secret insertion and extraction, antisurface, and antisubmarine missions. The P-3 Orion and the new P-8 Poseidon carry on those missions and the maritime patrol tradition. The innovation shown by PBY crews may one day be required again.					
15. SUBJECT TERMS Consolidated PBY Catalina Innovation P-3 Orion P-8 Poseidon					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 34	19a. NAME OF RESPONSIBLE PERSON Marine Corps University / Command and Staff College
a. REPORT Unclass	b. ABSTRACT Unclass	c. THIS PAGE Unclass			19b. TELEPHONE NUMBER (Include area code) (703) 784-3330 (Admin Office)

United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

MASTER OF MILITARY STUDIES

**Maritime Patrol Innovation: USN PBY Catalina Squadrons in the Pacific Area of
Operations, 1941-1945**

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

LCDR JEFFREY D. HOLLENBACH, USN

AY 10-11

Mentor and Oral Defense Committee Member: Paul D. Goff

Approved: [Signature]

Date: 15 April 2011

Oral Defense Committee Member: Dr. Douglas E. Streusand

Approved: [Signature]

Date: 15 April 2011

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOLLOWING STATEMENT.

QUOTATION FROM, ABSTRACTION FROM, OR REPRODUCTION OF ALL OR ANY PART OF THIS DOCUMENT IS PERMITTED PROVIDED PROPER ACKNOWLEDGMENT IS MADE

Table of Contents

	Page
DISCLAIMER.....	i
ILLUSTRATIONS.....	ii
PREFACE.....	iv
INTRODUCTION.....	1
THE AIRCRAFT.....	2
THE PERSONNEL.....	5
PREWAR OPS: THE ROOTS OF INNOVATION.....	6
PEARL HARBOR TO MIDWAY: INNOVATION ON DEFENSE.....	8
MIDWAY TO MISSOURI: INNOVATION ON OFFENSE.....	17
RELEVANCE.....	21
CONCLUSION.....	23
BIBLIOGRAPHY.....	28

Figures

	Page
Figure 1 <i>Crew Positions</i>	5
Figure 2 <i>Crew Position in Aircraft</i>	6
Figure 3 <i>PBY Pacific Coverage</i>	10

Preface

Like most new students at the P-3 Fleet Replacement Squadron in Jacksonville, Florida, I had little knowledge of the community I chose to join. The P-3 history and its origins were a complete mystery to me. With hardly a pause I glanced at the ancient photographs of the PBYS in the upstairs passageway. Those crews and aircraft existed in a world foreign to me.

After several years spent learning, living and breathing the Maritime Patrol and Reconnaissance (MPR) community, the PBYS in those pictures take on new meaning. My hope is to enrich my current experience by learning PBY history. This Master of Military Studies program provided the opportunity. The process rewarded me immensely and the history is more entertaining than I imagined. The current MPR community has much in common with and much to learn from its World War II counterpart.

Many thanks go to Dr. Paul Gelpi for his mentoring. For the original idea I thank Dr. Douglas Streusand. Engaging these Professors in discussions about aviation was always enlightening. My deepest gratitude goes to my wife, Samantha, and our son, Mason (born 5 days before the first draft was due). Thank you for the encouragement along the way.

Introduction

No aircraft in all of history has been utilized in so many places and in so many configurations or has flown so many unusual missions.

- Admiral Thomas H. Moorer

The Japanese attacks on Pearl Harbor plunged the United States and its allies into an attritional war in the Pacific that lasted almost four years. Battlefields had enormous size and scope as ships fought for the first time without seeing each other and submarines patrolled beneath the waves. One aircraft, the PBY Catalina, owing to its availability, versatility, and survivability saw action in nearly every battle and campaign in the Pacific. From coastal patrols off Oregon and Washington states to the reconnaissance of Cam Ranh Bay in Indochina and from Nome, Alaska to Perth, Australia, PBYs operated out of every body of water and in every kind of weather.¹

The Consolidated PBY (P-Patrol, B-Bomber, Y-Consolidated Aircraft Company) Catalina was a large, slow flying boat considered obsolete by many, including the Navy, as early as 1939.² Designed as a long-range patrol bomber, PBY crews conducted thousands of patrols and dropped thousands of tons of ordnance. The creativity of the crews and staff allowed the PBY to accomplish much more than what Consolidated designed it to do. Planners and staffs assigned new missions as fast as they conceived them, while the PBY continued to prove itself as a versatile and survivable asset. By the end of the war, the short list of missions included mining, aerial reconnaissance, photographic intelligence, electronic intelligence (ELINT), search and rescue, harassment, antisubmarine patrol, special troop insertion, and VIP transport.³ The PBY was not the only aircraft performing these missions and neither was it the best. The PBYs were one of many assets under extreme pressure muddling through to victory in the Pacific.

The Netherlands, Russia, Great Britain, Australia, Canada, and New Zealand also operated the PBY and found success with it in their own campaigns.⁴

The PBY's size, endurance, and ability to land virtually anywhere in the theater made it extremely valuable. Most significant to its success were the squadron personnel. Mission after mission they turned an unwieldy aircraft into a formidable opponent and often while operating in the most austere conditions. With great courage and determination they succeeded in establishing a reputation for innovation in the maritime patrol community that carried on after the war and in some measure exists in the community today.

The Aircraft

It wasn't love at first sight, my meeting with the PBY Catalina patrol bomber. Hardly! In that moment I felt fate had dealt me a cruel blow and that my first flight would be my last.

- Mel Crocker, PBY Radioman

The PBY was just one of many flying boats built in the competitive aircraft market of the early twentieth century. In the early days of aviation runways were few in number so the combination of a boat and a plane made sense. The Navy's interest in flying boats heightened in consideration of their vast ocean patrolling commitments. One aircraft covered a huge amount of ocean when compared to a ship on a similar mission. The aircraft also performed the task cheaper, faster and with a significant reduction in manpower. Among many other things, the investment in flying boats made sound financial sense.

Consolidated Aircraft Corporation designed and built the prototype PBY at their plant in Buffalo, New York. Consolidated picked up and moved to San Diego, California after the Navy purchased sixty PBYs for a total of \$6,000,000. The convenience of San Diego Bay and the weather were important factors. The PBY was their third generation flying boat and the one

produced in the greatest numbers. The Navy signed the initial contract on 29 June 1935 and with a short time, PBYs patrolled around the world.⁵ The PBY also made a name for itself in the media by setting flying records. On one flight in October 1935, for example, a PBY made the record 3,281 mile trip from Cristobal Harbor in the Panama Canal Zone to Alameda, California in 33 hours and 45 minutes.⁶ One year later in October 1936, VP-11 became the first Navy squadron to take delivery of PBYs. Soon after, VP-11 relocated to Pearl Harbor, Hawaii.⁷

For offense, PBYs carried bombs and torpedoes attached to drop points beneath both wings. To aid in the accuracy of high altitude bombing, ground crews installed top-secret Norden bomb sites in every PBY. Coupled to the aircraft's autopilot, the Norden site allowed an off-duty crewmember acting as bombardier to fly the aircraft to the target. For defense against enemy aircraft, PBYs carried up to four machine guns. Designers positioned two .50 caliber guns on either side of the fuselage at the waist position, one .30 caliber in the nose forward of the flight station and a second .30 caliber in the tunnel along the bottom of the hull. Any crewmember not engaged in flying or bombing manned a gun as necessary.⁸

Consolidated's design was progressive but also the result of compromise. Two examples of progress were the cantilevered wing and retractable wing floats. The cantilevered wing placed aerodynamic loads on an internal structure, which reduced the number of external braces required to support the wing. Retractable wing floats created a smoother wing surface in flight. The flight mechanic lowered the floats for water taxi and parking and retracted them after take-off. These advances were new to float planes at the time and they both produced dramatic increases in aerodynamic efficiency and corresponding increases in speed and range.⁹

Two Pratt and Whitney radial engines powered the PBY. Designers maximized these engines for range and endurance but compromised on heavy-weight take-off performance. This compromise resulted in the need for long stretches, sometimes several miles, of calm water for take-off. Bad weather, tides, debris, and open ocean swells made it difficult to find calm water where the PBYs operated.¹⁰ Underpowered engines, lack of armor, and self-sealing fuel tanks combined to make the PBY vulnerable to Japanese fighters and antiaircraft fire. PBYs also lacked environmental controls and insulation, which made crews susceptible to hypothermia and dehydration. When the Navy realized the offensive potential of the PBY, they ordered armor and added self-sealing fuel tanks. PBYs equipped with environmental controls did not arrive in theater until very late in the war, much to the dismay of crews operating out of the Aleutian Islands in Alaska.¹¹

Consolidated added retractable landing gear to several hundred later model PBYs and designated them PBY-5A and PBY-6A. The "A" in the designation denoted amphibious capability.¹² The weight of the gear decreased the amount of fuel carried, increased drag, and reduced range. The ability to taxi directly onto a beach without a tow and to land on a prepared runway made up for the losses. Crews found the landing gear useful in the North Pacific where water often froze overnight and in the South Pacific where crews concealed beached aircraft with foliage for cover overnight. Ground crews affixed temporary, removable beaching gear to aircraft not so equipped.¹³ In the absence of land altogether, decades old Navy ships, designated seaplane tenders, serviced the PBYs and acted as mobile bases.

Consolidated produced the flying boat and amphibious versions of the PBY in greater numbers than any other aircraft. Test pilots flew the prototype of its successor, the Model 31,

prior to the start of the war. Consolidated only produced one Model 31 because, "More PBYS could be built much sooner than any Model 31s, which must await tooling up and availability of untried power plants." In other words, the Navy needed flying boats and at the time Consolidated could only produce PBYS in great numbers.¹⁴ The Model 31 also shared the same motor as the B-29 Superfortress. When push came to shove for engines, the B-29 took priority. The Navy prepared for war with what it had on hand and ordered more PBYS.¹⁵

The Personnel

Before it became clear that the United States would enter the war, the Navy was a stagnant place for career progression. Promotions were rare and sailors maintained the same job for great lengths of time. This was particularly true of PBY crews. The result, which ultimately worked in favor of the United States, was that crews flew many hours together. When not conducting regular patrols (to include Neutrality Patrols in the North Atlantic), PBY crews trained in the use of bombs, torpedoes, gunnery, communications, navigation, and weather mapping. The maintenance and ground crews also gained a great deal of experience loading and unloading weapons, beaching and launching aircraft, and maintaining the aircrafts engines and systems. Skills in these areas required constant exercising.¹⁶

Officer and enlisted aircrew staffed the positions listed in the following Figure:¹⁷

<u>Officers</u>	<u>Enlisted</u>
Plane Commander *	Plane Captain (First Mechanic)
Copilot *	Second Mechanic
Third Pilot *	Third Mechanic
Navigator	First Radioman
* Bombardier when not piloting	Second Radioman

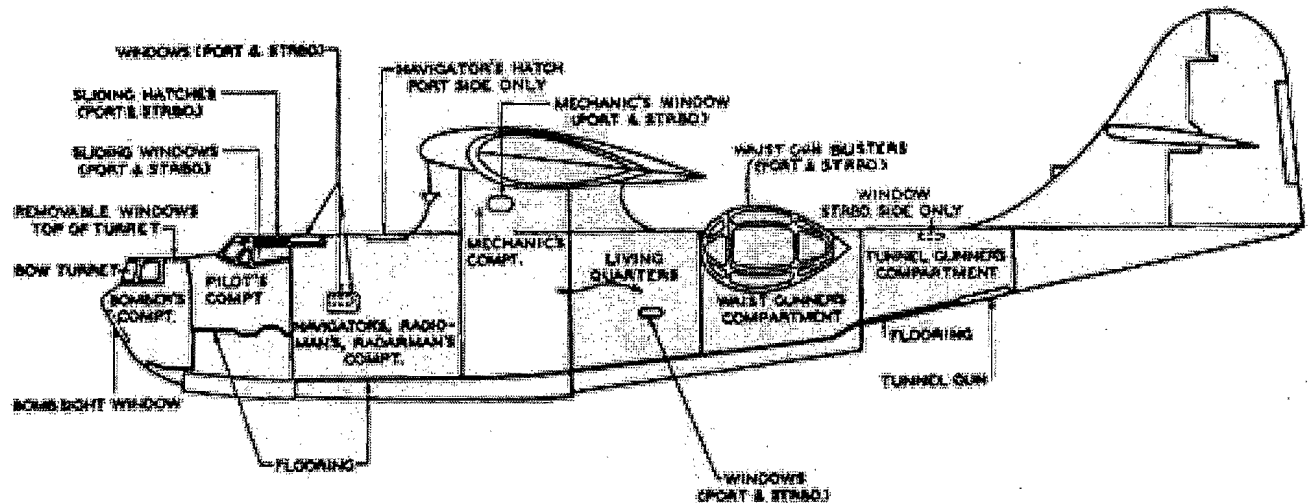


Figure 2 – Crew Position in Aircraft¹⁸

Enlisted members filled the Navigator, Copilot, and Third Pilot positions as situations and manpower changed. Enlisted pilots who attended regular flight school earned the designation Naval Aviation Pilot (NAP). Protocol restricted NAPs from serving in the role of Plane Commander despite NAPs possessing greater flight time and experience. Some Plane Commanders leveraged NAP experience by taking two NAPs instead of two junior officers.¹⁹ The remainder of the crew conducted a standard duty rotation that included manning guns, monitoring engine instruments and fuel usage, making coffee, dishing out flight rations, and sleeping. Missions lasted from four to eighteen hours and were usually monotonous.²⁰

Pre-War Ops: The Roots of Innovation

In the late 1930s and early 1940s, PBVs conducted patrols in every corner of the Pacific. Patrol Wing Ten flew for the Asiatic Fleet in the Philippines and ranged as far west as Formosa Island, China, and Indochina.²¹ Squadrons based out of Naval Air Station Seattle undertook routine summer deployments to the Aleutian Islands stretching off Alaska.²² The Hawaiian squadrons made regular patrols west to Midway and south to Australia. Squadrons based at

Coco Solo Naval Air Facility in Panama covered the Caribbean and portions of the southeastern Pacific.

Individual PBY crews spent very little time at their home bases leading up to the war. Aggressive commanders like Captain Frank Wagner, the Skipper of Patrol Wing Ten, opted instead for remote site operations all around the South Pacific. Captain Wagner and others predicted that if the Japanese attacked, the home bases would be the first ones destroyed. Remote site operations not only kept the crews safe from the initial attacks but also forced them to learn how to operate without the benefit of seaplane tenders and to gain an independent and expeditionary mindset. Captain Wagner's foresight and preparation served the crews well in future operations.²³

In the Philippines and the Aleutians, crews learned to scout out and utilize remote harbors and inlets. They stashed barrels of aviation fuel at secret locations for use in emergencies.²⁴ The crews befriended local islanders and treated them to tours of the PBY and extra food on hand. The islanders developed a fondness for the crews, which proved valuable later in the war. Downed crews relied on the islanders for assistance and transport.²⁵

The PBY was also a valuable test platform for new equipment due to the ample space inside the fuselage. One example of this prewar mission included the test of the first multimode version in May 1941. Single mode radars existed for several years but this British version incorporated both surface search and interrogation modes. MAD (Magnetic Anomaly Detection) gear for anti-submarine warfare appeared on the PBY at this time as well. Finally, in a rather extreme attempt to compensate for the underpowered engines, mechanics bolted

JATO (Jet Assisted Take-Off) rockets to a PBY to test the feasibility of their use in an urgent or emergent take-off scenario.²⁶

The PBY crews that conducted remote site training missions benefited the most in terms of maintenance. They learned how to be self-sufficient and creative and to keep the PBYs flying using minimal tools and spare parts. Open ocean landings were particularly hazardous due to unpredictable swells and wind. Even the most experienced pilots popped rivets in the hull when landing at sea. Large enough holes sometimes developed and threatened to sink the aircraft. Flying mechanics regularly used pencils as impromptu rivets; thus, the navigator's pencil became a required item for use after open ocean landings. One crewmember mated the seams of the hull while another inserted the pencil and broke off the remainder. The pencil fix was only adequate for perhaps one more take-off and landing but saved many aircraft from premature sinking.²⁷

Crews used palm tree trunks, wool blankets, and marine glue to patch larger holes in the hull. Spent ammo cans covered holes in the wings.²⁸ Plane Commanders approved such impromptu fixes because the only other alternative involved a lengthy wait. Seaplane tenders and other aircraft brought tools and spare parts but the process took days in some cases. While not always the safest route, maintenance performed by the crews allowed them to return to base that day. Otherwise they waited, slept under the stars, and perhaps went hungry. And as a major benefit, the crews that learned to make impromptu decisions before the war had a much easier time under the pressure of the Japanese.

Pearl Harbor to Midway: Innovation on Defense

*Certainly their designers never dreamed that they would be used as torpedo-bombers or as dive-bombers.*²⁹

- Gilbert Cant, Historian

Partly in response to Japanese politico-military aggression in Indo-China and the South China Sea, the Allies instituted a series of embargoes against Japan. The first, in December 1940, restricted aviation fuel and high grade scrap iron. The second, enacted one month later, restricted copper and brass. If not countered, these measures signaled Japan's eventual undoing.³⁰ A daunting decision faced the Japanese; but with dwindling supplies of materials and an increasingly militant government, they saw no alternative to war against the Allies. By capturing allied territory and inflicting damage on allied forces, the Japanese hoped to secure access to the raw materials that their military building programs and extended supply lines demanded.³¹

For initial targets, the Japanese chose the following: British forces in the Indian Ocean and on the Malay Peninsula, Dutch forces in the Netherlands East Indies and United States forces on the Hawaiian and Philippine Islands. By seizing the Malay Peninsula, Japan hoped to gain access to the Straits of Malacca, a valuable commercial waterway and strategic choke point.³² By seizing the East Indies, Japan hoped to gain access to Dutch oil reserves and rubber.³³ Finally, by attacking United States forces, Japan hoped to eliminate a potential roadblock. The Japanese goal was to establish the Greater East Asia Co-Prosperity Sphere and hegemony over the Western Pacific.³⁴

By the end of 1941 Dutch, British and US PBVs patrolled as much of the Pacific as possible. Standard patrols consisted of flying between 600 to 1000 miles on a single heading away from home base, making a ninety degree turn to the right or left, flying for an hour more then making a turn to return home. The number of PBVs available determined the range of the

search boxes and how frequently the PBVs revisited them. Figure 3 depicts the enormous amount of ocean the PBVs covered at the time. The nominal 1000 mile search rings centered on major PBV bases in late 1941 to early 1942.³⁵ PBVs had the ability to search more area, however, when supported by tenders. Crew fatigue alone limited missions supported by seaplane tenders.

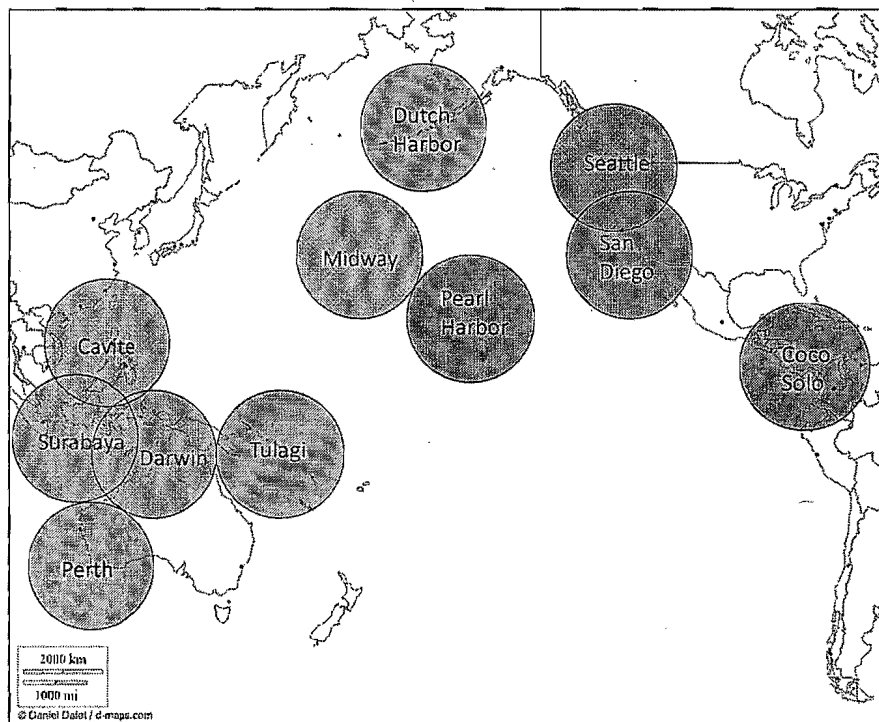


Figure 3 – PBV Pacific Coverage³⁶

PBV squadrons in the Pacific suffered heavily when the Japanese attacked on 7/8 December 1941. At Pearl Harbor, on Oahu, unsuspecting crews moored nearly half of the PBVs next to ships in Pearl Harbor while the rest were sitting across the island, undefended in Kaneohe Bay. Japanese pilots approaching from the north targeted Naval Air Station Kaneohe Bay first on the morning of 7 December. Just minutes later, the remainder of the Japanese aircraft attacked Pearl Harbor Naval Base. Crews of Patrol Wing Ten in the Philippines

positioned their aircraft in unfortunate locations as well. PBY squadrons at US Naval Base Subic Bay and Sangley Point, an unfinished seaplane base on Cavite Navy Yard, lay in the path of Japanese destruction.³⁷

Of the eighty-one PBYs located on or around Oahu, only eight remained flyable after the morning attacks on 7 December. Seven of the eight were on patrol and avoided contact with enemy fighters. Japanese fighters strafed but missed the eighth, moored in Kaneohe Bay, but it was still in danger as flames engulfed the aircraft floating next to it. Crews pulled it to safety, fueled it and got it airborne where it joined the seven other survivors in a sector search for the Japanese fleet. Uncertainty remained about Japanese intentions so the search continued for days after the attacks.³⁸

PBY squadrons in the Philippines fared worse than Hawaii. Japanese aircraft attacked targets in the Philippines just hours after Pearl Harbor, inflicting massive damage. Within hours, Japanese aircraft destroyed most of General MacArthur's fighters and bombers before they could get airborne.³⁹ The PBYs, vulnerable to begin with, lost their friendly air cover in an instant. Japanese forces maintained air superiority over the Philippines from the first day of hostilities and the PBYs, along with the rest of the fleet, assumed a defensive posture.

Crews did manage initially to save more PBYs in the Philippines. Without fighter support though, Japanese fighters outmatched the PBYs in the air. In the six months following the initial attacks, Patrol Wing Ten lost twenty five aircraft and withdrew under pressure thousands of miles south to Perth, Australia. Patrolling Japanese aircraft routinely downed Allied aircraft and scattered surviving aircrew across the southeast Pacific. A few survived the forced landings and

aided by friendly natives, found their way back to Allied territory. Others survived only to be captured and killed or shipped off to prison camps on Singapore and mainland Japan.⁴⁰

Ground crews suffered during this time as well. With no means of evacuation, over one hundred Patrol Wing Ten maintainers and a mixed group of Allied forces took up a position on the southern tip of the Bataan Peninsula and awaited the Japanese ground advance. They formed impromptu combat units, conducted small arms training, dug entrenchments, and did their best to avoid Japanese bombs. In a desperate fight for survival and running low on food, water, and ammo, the Bataan defenders managed to inflict a small amount of damage on a Japanese amphibious landing force before surrendering. The Japanese force-marched the survivors, at gun and sword point, back up the Bataan Peninsula to the north. Many died along the way and this episode is now known as the Bataan Death March.⁴¹

PBY crews won small victories during this defensive period, but not many. One example occurred less than an hour before the attacks on 7 December when a PBY spotted an unknown vessel ten miles south of Pearl Harbor. The crew was on a training mission to prove whether a PBY could covertly link up with a friendly submarine, refuel, rearm and take off again. Before finding the US submarine, however, the crew sighted an unknown surface vessel and radioed its position around 0700. A nearby destroyer answered the call and together with the PBY, confirmed that the vessel was hostile. The PBY crew initiated an attack by dropping depth bombs and the destroyer fired its deck guns on the spot. The vessel, later confirmed to be a Japanese mini-submarine conducting last minute reconnaissance, sank and did not resurface.⁴²

Another victory occurred off the Philippines on 10 December when a PBY became the first Allied aircraft to shoot down a Japanese fighter. At the time, Japanese pilots enjoyed showing off for the Allies. After attacking they conducted aerobatics as a show of superiority. On this day, however, Japanese pilot's maneuver ended too close to the PBY and the nose gunner calmly pumped several rounds into the enemy aircraft's belly. The crew watched the aircraft burst into flames and crash into the ocean. Although it was only a small victory, the PBY crews in theater gained a great deal of confidence from the episode because it proved that the PBY could defend itself.⁴³

The overall situation for the US forces in the Pacific was desperate defense. PBYs in Alaska and Hawaii continued patrols as usual. Replacement PBYs filtered into theater from San Diego, Seattle, and even the Atlantic to replace those destroyed in the initial attacks. In the South and West Pacific, Patrol Wing Ten withdrew first to Borneo, then Mindanao, then islands in the Celebes and Sulu Seas and ultimately to Java and Australia beyond. Prewar lessons served the surviving crews well.

In the initial months, the aggressive Japanese patrols prevented the PBYs from taking off and landing at the same location. Out of necessity then, remote site operations became the norm and home bases ceased to exist in practice. Crews and mechanics worked round the clock to fix broken aircraft, often from concealed positions under the cover of jungle foliage or whatever else they could find.⁴⁴ Japanese pilots targeted uncovered aircraft and ships wherever they found them, including the seaplane tenders. Like the PBY, a seaplane tenders best defense was concealment and the crews went to great lengths to hide their vulnerable ships. On at least one noted occasion, a tender skipper saddled his ship up to a small island,

lashed his ship to palm trees, and heaved on the lines in order to list his ship toward the island. After covering the vessel with foliage, his crews rode out the day manning anti-aircraft guns on what then appeared to be a small extension of the island.⁴⁵

PBY crews learned new lessons like how to avoid contact with Japanese aircraft by staying in or around clouds and flying low near the coasts of islands.⁴⁶ Crews flying at night extinguished all navigation and interior lights. Even the smallest bit of escaped light could reveal their position in a dark sky. Engine exhaust was another culprit for visual detection but initially nothing could be done about it.⁴⁷ Crews learned these lessons the hard way and due to an almost non-existent command structure at the time, the lessons filtered slowly up the chain of command and even slower out to the other crews. This ignorance often led to dangerous and unnecessarily risky tasking. For PBYs, the fatal example of this was the raid on Jolo Island.

For the Japanese, Jolo Island represented a stronghold in their quest to gain control of the Dutch oil fields on Borneo and a springboard to their conquest of Java. As a sign of Jolo's strategic importance, the Japanese identified the island as a site for a fighter aircraft production line.⁴⁸ At the time, allied intelligence placed several Japanese ships in the harbors on the north and south sides of the island. Not known to the allies, was that a newly built dirt airstrip on Jolo allowed a small contingent of Japanese aircraft to both defend the island and patrol the critical Celebes and Sulu Seas. On the day of the attack, PBY crews found the ships exactly as predicted. The fighters, on the other hand, were an unwelcomed surprise.

US planners, who subsequently formed a part of ABDACOM (American British Dutch Australia Command), agreed to use six PBYs for a daylight bombing of Jolo's harbors.⁴⁹ Not one other available US or allied aircraft possessed the range to accompany the PBYs so they were

forced to attack without cover. The PBVs took off at midnight and arrived over Jolo at dawn. Without any other known or approved tactic, the crews assumed the standard high altitude bombing formation and closed the island between 10,000 and 12,000 feet. The fighting did not last long. Within a matter of minutes, Japanese anti-aircraft fire and Zeros forced down and destroyed four of the six PBVs and not a single bomb made contact with a ship. The bombs dropped from altitude missed because the Japanese ships maneuvered in the time it took the bombs to fall.⁵⁰ A few of the crews scored near misses, but not by dropping from altitude. Out of sheer desperation, three of the PBVs made impromptu dive bombing attacks at lower altitude. Two unexpected and significant results came from these dramatic and unheard of attacks. First, the tactic almost worked. Second, two of the planes survived to tell the tale. The common understanding among PBV crews up until this point was that a low altitude attack on a Japanese ship was suicide. Although costly in terms of man and materials, the raid on Jolo Island proved otherwise.⁵¹ The remaining PBV crews made rapid changes. Almost overnight they threw out the Norden site and avoided high altitude bombing.

Early on, PBVs conducted transport missions in the South Pacific because there were no other assets available. With their water landing capability, PBVs landed on inland lakes and rivers to evacuate personnel and deliver secret passengers and cargo.⁵² One of the most dramatic transport missions involved two PBVs and the last ditch effort to evacuate stranded personnel in Manila Bay. The highly classified mission originated in Perth, Australia and covered multiple flights over a five day period. Complicating matters further, Japanese aircraft owned and patrolled all of the airspace north of the Australian coast. Japanese artillery also shelled the destination, the Island of Corregidor. The crews only flew at night to avoid

detection and hid, refueled and slept during the day. Friendly natives helped the crews cut foliage for cover and provided food and shelter as well. The crews rescued several dozen Allied personnel, including nurses and high-ranking officers, from imprisonment after Corregidor fell.⁵³

In the central Pacific, PBY crews conducted round the clock patrols in search of the Japanese fleet. US intelligence suspected from partially broken Japanese messages that Midway was the next target and they needed confirmation. On the morning of 3 June 1942, two PBYs settled the issue when they found and radioed the position of the Japanese Minesweeper Group and Invasion Force.⁵⁴

Later that same night, four radar equipped PBYs conducted a search and torpedo attack on the incoming Japanese fleet. The goal was to disrupt the Japanese advance and buy preparation time for the island defenders. One problem was that none of the PBY crewmembers on any of the planes had experience conducting a live torpedo attack. To make matters even more difficult, commanders ordered the attack to take place under the cover of darkness. PBYs had never attempted a night torpedo attack because leadership deemed them too dangerous. The four crews went as ordered and made up the tactics as they went. The attack itself proved futile with only one Japanese ship taking minimal damage. For the mid-Pacific PBY crews, however, the mission was an overall success. The crews experienced their first real combat, took a small measure of revenge against the Japanese, and earned a new reputation for fearlessness and aggression. They came through the Japanese anti-aircraft fire unscathed while adding the night torpedo attack to their expanding mission repertoire.⁵⁵

Midway to *Missouri*: Innovation on Offense

*Before that ill-fated campaign in the East Indies had ended, the patrol plane pilots and crews had learned their business the hard way. The lessons learned were applied elsewhere as fast as aircraft, equipment, and trained crews could be obtained.*⁵⁶

- Critical Review of U.S. Naval Aviation in the Pacific, 1947

In the first six months of the war the Japanese won the majority of victories. The Japanese also possessed the initiative they earned in the surprise attack on Pearl Harbor. A small shift occurred, however, at the Battle of the Coral Sea. During this battle the Japanese fully sensed the incredible demand of their Pacific supply lines.⁵⁷ A much greater shift in initiative occurred after the Battle of Midway. At Midway, US aircraft and submarines sank four Japanese carriers and reestablished naval and air parity over the Pacific. PBYs helped at Midway by constantly patrolling, locating, and harassing the Japanese fleet and by conducting search and rescue of downed carrier pilots. Towards the end of the battle, PBYs reported two Japanese destroyers (the cruisers *Mikuma* and *Mogami*) after they collided while attempting to withdraw. Carrier-based dive-bombers later sunk the *Mikuma* on 6 June.⁵⁸

The first combat action designed to capture the shift in initiative involved the subsequent landing at Guadalcanal and the campaign in the Solomon Islands. PBYs were a part of this campaign from the beginning and played a crucial role throughout. On 12 August 1942 in fact, Admiral John McCain's PBY was the first Allied aircraft to land at the newly acquired airfield at Guadalcanal. Several PBY squadrons called Guadalcanal home throughout the war.⁵⁹

The primary missions of the PBYs on Guadalcanal included harassment raids on enemy ground forces and interdiction of Japanese ships. From these missions sprouted the most famous example of PBY innovation, the use of lamp black and soap. Lamp black was carbon

soot resulting from the burning of oil. When added to soap and applied to the skin of PBVs, the aircraft became difficult to see, especially on moonless or cloudy nights.⁶⁰ This technique proved so effective that by December 1942, just months after the initial landing at Guadalcanal, aircraft arrived in theater already painted black. Maintenance crews also added flame arrestors to cut down on visible exhaust gases.⁶¹

With the new black planes, crews set out to establish matching techniques and procedures. Flying low to the ocean became the norm and served two important purposes. First, it prevented the Japanese from attacking the vulnerable underbelly of the PBV. Second, the procedure had a tendency to confuse diving Japanese pilots. On more than one occasion, a disoriented Japanese pilot crashed into the water because he failed to pull out of a dive in time. Allied PBV pilots facing a similar problem developed a new technique in order to see their instruments at night. The pilots shined a flashlight, but only for a moment so as not to diminish their night vision. This technique energized the iridescent radium on the gauges and made them visible for a short time.⁶²

The squadrons with black PBVs caused the most damage to the Japanese in an area of water called the "slot." Bounded by the northern and southern Solomon Islands, the "slot" was an area of water in which the Japanese conducted nightly resupply missions to Guadalcanal. These Japanese operations were known as the "... Tokyo Express and it was the PBVs job to disrupt them as much as possible."⁶³ PBVs equipped with radar flew nightly missions up and down the slot seeking enemy ships to attack. Thanks to the tragic lessons learned at Jolo Island, the crews possessed new bombing techniques and stopped using torpedoes almost entirely. New tactics involved flying low and slow, sometimes only at masthead height, and

using the “airman’s eye” for release point timing. PBVs using this technique in the “slot” inflicted massive amounts of damage to Japanese ships.⁶⁴

The area of weapons development saw the most creative innovations. Crews developed anti-personnel munitions by strapping steel bars to bombs. At impact, bar fragments shot out at high speed, cutting through anything in the area.⁶⁵ After dropping their initial load, however, PBVs lacked an offensive capability. Crews thus sought new and creative methods of inflicting damage. Ground crews loaded 100-pound bombs internally which crewmembers armed and tossed on the pilot’s command.⁶⁶ When the supply of 100-pounders ran out, crews continued the attack with empty beer bottles. The bottles supposedly emitted a shrill whistle, which sounded like a falling bomb. Almost every night a PBV overflew the Japanese positions on Guadalcanal and dropped anything they had. Such harassment missions attacked Japanese morale, prevented them from sleeping, and increased fatigue.⁶⁷

LT William Lahodney and his crew created the most aggressive innovation. Called “Lahodney’s guns,” the crew installed a square set of four .50 caliber guns in the nose of a PBV. The addition forced the nose gunner to straddle the .50 caliber contraption when firing his usual .30 caliber nose gun. At the same time, the nose gunner carefully avoided burning his legs on the hot barrels and brass. The pilot controlled the firing of the .50 calibers with a cable attached between the triggers and the yoke. After the crew dropped their regular ordnance, they dove and strafed any Japanese ships they could find. As the Allies sank the larger enemy ships, the Japanese resorted to using smaller vessels and even barges to ferry troops and supplies between the Solomon Islands. The smaller vessels became perfect targets for Lahodney and crew.⁶⁸

As the tide of war tipped in favor of the Allies and newer aircraft arrived in theater, the PBY's workload did not lessen. The crews instead picked up new mission sets over an expanding battle space. PBYs even conducted Forward Air Controller duties. In July 1943, for example, PBYs overflew enemy ships and spotted US naval gunfire during the Battle of Kolombangara. The PBY radioman relayed range and bearing corrections to the gunners.⁶⁹

When the Japanese withdrew overnight from Guadalcanal, PBYs harassed them by dropping flares on their ships and highlighting their position for dive-bombers.⁷⁰ Australian PBY crews used a similar technique over Rabaul where they dropped incendiary bombs on the city and lit it on fire for the following bombers.⁷¹ Another example involved PBYs in a photoreconnaissance role. After maintenance crews removed the waist blisters and added wind deflectors, they fitted newer model PBY-5s with a camera. The specially equipped planes took pictures of potential amphibious landing sites and determined order of battle near Japanese held harbors and bays.⁷²

Not all of the innovation occurred in the Pacific theater. The Washington, DC based Naval Research Laboratory (NRL) developed airborne ELINT (Electronic Intelligence) equipment after analyzing a captured Japanese radar from Guadalcanal. Creative maintainers then built and attached Yagi type antennae to the wings and fuselage of ELINT equipped aircraft. NRL codenamed the mission CAST MIKE, PBYs and various other large aircraft conducted it throughout the war.

In the ELINT mission's infancy, the equipment lacked Direction Finding (DF) capability. Signals received by the equipment did not produce a bearing to the transmitter, making it difficult to pinpoint an enemy radar's position. ELINT crews required multiple flights,

sometimes several dozen, over multiple days and weeks to collect enough data to reveal a rough location of a Japanese radar site. On 8 September 1943, Allied bombers attacked an installation on the southeast end of Poporang Island. The Japanese strategically positioned the radar to cover the northwestern approach to the “slot” in order to cover their ship’s movements. The Allied attack signaled a significant proof of concept for the NRL and a tactical victory for Allied ships and aircraft operating in the Solomon Islands.⁷³

PBY crews conducted hundreds of Search and Rescue (SAR) flights in addition to the offensive and reconnaissance missions. Crews early on performed SAR in an impromptu fashion, often rescuing downed airman after happening across a life raft or spotting some other signaling device. As the war progressed crews increasingly prepared for SAR and conducted missions entirely devoted to it. It became standard practice for commanders to dispatch PBYs where Allied aircraft were conducting bombing raids. If a bomber pilot ditched, their last radio transmission included a position report for the waiting PBY.⁷⁴ LT Nathan Gordon received the Medal of Honor for such a mission off Kavieng Harbor. Gordon and crew, despite heavy enemy fire, landed in Kavieng four separate times in one flight to retrieve downed pilots.⁷⁵

Relevance

The current Maritime Patrol community flying the P-3 Orion is in a similar state to that of the PBY only seventy years ago. First, the P-3 and PBY are similar aircraft. Both are large, versatile, reliable platforms, capable of long range and endurance. Second, P-3s conduct similar missions to that of the PBY. A partial list of P-3 missions includes patrol, intelligence (SIGINT, ELINT, IMINT, etc.), surveillance, reconnaissance, search and rescue, antisubmarine warfare, and anti-surface warfare. PBYs pioneered or at least conducted every one of those missions

during a war. Third, like the PBY in 1939, the P-3 is nearing the end of its life. Test crews are currently flying the prototype for its replacement, the P-8 Poseidon, at Naval Air Station Patuxent River, Maryland.

It is important for P-3 operators to remember the hard lessons learned by the PBY community in World War II. The significance of their early innovations in the face of the Japanese offensive cannot be overstated. Under great pressure, survival became the catalyst for dramatic and creative change. It is notable, however, that leadership scorned risk taking and risk takers as much during World War II as now.⁷⁶ Commanding officers discouraged dangerous flying and the disregarding of standard procedures, but they encouraged thinking outside of the box and passing lessons on from one mission to the next.

Now consider that if the US engaged in a state on state, conventional war in the near future, the faithful P-3, not the P-8, will play the decisive role in maritime patrol. Further, as America's enemies expand their capabilities, P-3 crews will likely face missions, platforms, and scenarios not previously encountered. Innovation and creativity, like that seen by PBY crews in World War II, will provide the new tactics, techniques, and procedures needed to survive and win. Just as PBY crews learned how to bomb without the Norden sight and fix enemy radars with jury-rigged antennae, so might P-3 crews need to learn new techniques with new equipment. For instance, consider a future battle-space in which the electromagnetic spectrum is unavailable for use. Consider also a war in which P-3s return from missions riddled with bullet holes or damage from antiaircraft fire. P-3 operators must not become complacent in current operations and training; future innovation may still be required. The P-3 is not the perfect asset but, like the PBY in 1939, it is the one available.

Consider finally that many PBYs went out for missions and never returned. Not to diminish the many casualties within the P-3 community, but PBY crews faced the prospect of death daily. Crews in Alaska flew into mountains; engines caught fire or died, causing aircraft to be lost at sea; diving Japanese Zeros strafed and killed waist gunners; maintainers succumbed to sickness in squalid, malaria ridden camps; Japanese ground forces beheaded captured aircrew; and many simply vanished. If ever a community understood the term "operational necessity," it was the PBY. Should a similar situation befall the P-3 community in the future, it will be wise to revisit the stories and mindset of the flyers who fought with courage not so long ago.

Conclusion

The PBY proved far more useful than expected. Combined with the efforts of hundreds of thousands of Allied personnel, the PBY helped to turn the tide in the Pacific from a strategic defense to offense. Better, faster, and more capable assets flooded into the Pacific as the war progressed but the PBY participated all the way until the final surrender. The PBYs proven versatility, reliability and survivability are a credit to Consolidated Aircraft Corporation's design and manufacturing. The PBY's record of tactical success, however, is a credit to the innovation of the crews that flew it and the ground crews that kept it flying.

Notes

¹ Dwight Messimer, *In the Hands of Fate: The Story of Patrol Wing Ten 8 December 1941 – 11 May 1942* (Annapolis, MD: United States Naval Institute Press, 1985), 28.

² Roscoe Creed, *PBY: The Catalina Flying Boat* (Annapolis, MD: Naval Institute Press, 1985), 1.

³ Chief of Naval Operations, *U.S. Naval Aviation in the Pacific: A Critical Review* (Office of the Chief of Naval Operations, 1947), 15 and Richard C. Knott, *Black Cat Raiders of WWII* (Annapolis, MD: Naval Institute Press, 2000), 114.

⁴ David Monday, *Concise Guide to American Aircraft of World War II*, rev. ed. (New York: Smithmark Publishers, 1996), 58-62.

⁵ Creed, 33.

⁶ Andrew Hendrie, *Flying Cats: The Catalina Aircraft of World War II* (Annapolis, MD: Naval Institute Press, 1988), 2.

⁷ Creed, 35.

⁸ Creed, 49.

⁹ Monday, 57.

¹⁰ Hendrie, 6-7.

¹¹ Louis B. Dorny, *US Navy PBY Catalina Units of the Pacific War* (Oxford, UK: Osprey Publishing, 2007), 12.

¹² Creed, 307.

¹³ Gerald Astor, *Wings of Gold: The U.S. Naval Air Campaign of World War II* (New York: Presidio Press, Ballantine Books, 2004), 37.

¹⁴ Ray Wagner, *American Combat Planes* (Garden City, NY: Hanover House, 1960), 295.

¹⁵ Creed, 45.

¹⁶ Knott, 8. Messimer, 8-10.

¹⁷ Creed, 313.

¹⁸ Dave's Warbirds, "Black Cats: US Navy PBY Catalinas Fighting in the Pacific During World War II," <http://www.daveswarbirds.com/blackcat/catalina.htm> (accessed March 2011).

¹⁹ Messimer, 8.

²⁰ Messimer, 8 and Elmer Freeman, *Those Navy Guys and Their PBY's: The Aleutian Solution* (Spokane, WA: University Press, 1992), 58.

²¹ Messimer, 19.

²² Freeman, 38.

²³ Messimer, 19-20.

²⁴ Crocker, 19.

²⁵ Creed, 89.

²⁶ Creed, 50.

²⁷ Creed, 38.

²⁸ Knott, 47 and Messimer, 105.

²⁹ Gilbert Cant, *America's Navy in World War II*, rev. ed. (New York: The John Day Company, 1944), 84.

³⁰ H. P. Willmott, *Empires in the Balance: Japanese and Allied Pacific Strategies To April 1942* (Annapolis, MD: Naval Institute Press, 1982), 62-63.

³¹ Creed, 51.

³² Ronald H. Spector, *Eagle Against the Sun* (New York: The Free Press, 1985), 67.

³³ Spector, 132.

³⁴ Jonathan B. Parshall and Anthony P. Tully, *Shattered Sword: The Untold Story of the Battle of Midway* (Washington D.C.: Potomac Books, 2005), 74.

³⁵ Naval Historical Center Archives, *Location of US Naval Aircraft (1942-1945)*, <http://www.history.navy.mil/a-record/ww-ii/loc-ac/loc-ac.htm>.

³⁶ Naval Historical Center Archives, *Location of US Naval Aircraft (1942-1945)*.

³⁷ Messimer, 12.

³⁸ Creed, 76.

³⁹ Messimer, 45.

⁴⁰ Creed, 273.

⁴¹ Astor, 35.

⁴² Creed, 71.

⁴³ Dorny, 4.

⁴⁴ Messimer, 204.

⁴⁵ Messimer, 212-213.

⁴⁶ Messimer, 204.

⁴⁷ Messimer, 115.

⁴⁸ Walter D. Edmonds, *They Fought With What They Had: The Story of the Army Air Forces in the Southwest Pacific, 1941-1942* (Boston: Little, Brown and Company, 1951), 253.

⁴⁹ Messimer, 133.

⁵⁰ Messimer, 151.

⁵¹ Messimer, 115-122.

⁵² Crocker, 248.

⁵³ Messimer, 286-295.

⁵⁴ Parshall and Tully, 106.

⁵⁵ Knott, 52-57.

⁵⁶ Bureau of Aeronautics Navy Department, 9.

⁵⁷ Parshall and Tully, 421.

⁵⁸ Dorny, 35 and Creed, 105-115.

⁵⁹ Creed, 145.

⁶⁰ Office of the Chief of Naval Operations, *A Critical Review*, 27.

⁶¹ Crocker, 235.

⁶² Messimer, 107.

⁶³ Knott, 96.

⁶⁴ Crocker, 237.

⁶⁵ Knott, 71.

⁶⁶ Creed, 150.

⁶⁷ Knott, 71.

⁶⁸ Crocker, 245-246.

⁶⁹ Knott, 109.

⁷⁰ Knott, 100.

⁷¹ Bruce Gamble, *Fortress Rabaul: The Battle for the Southwest Pacific, January 1942 – April 1943* (Minneapolis, MN: Zenith Press, 2010), 248.

⁷² Colonel Roy M. Stanley, USAF (ret), *World War II Photo Intelligence* (New York: Charles Scribner's Sons, 1981), 106.

⁷³ Knott, 109-116.

⁷⁴ Office of the Chief of Naval Operations, *A Critical Review* 11-12.

⁷⁵ Crocker, 255-258.

⁷⁶ Bureau of Aeronautics Navy Department, *Bureau of Aeronautics Navy Department Newsletter Numer 185*, January 1, 1943, <http://www.history.navy.mil/nan/backissues/1940s/1943/backissues1943.htm> (accessed March 21, 2011).

Bibliography

- Astor, Gerald. *Wings of Gold: The U.S. Naval Air Campaign in World War II*. New York: Presidio Press, Ballantine Books, 2004.
- Bureau of Aeronautics Navy Department. *Bureau of Aeronautics Navy Department Newsletter Number 185*. January 1, 1943. <http://www.history.navy.mil/nan/backissues/1940s/1943/backissues1943.htm> (accessed March 21, 2011).
- Cant, Gilbert. *America's Navy in World War II*. Rev. ed. New York: The John Day Company, 1944.
- Chief of Naval Operations. *U.S. Naval Aviation in the Pacific: A Critical Review*, Issued by the Office of the Chief of Naval Operations. United States Navy, 1947.
- Creed, Roscoe. *PBY: The Catalina Flying Boat*. Annapolis, MD: Naval Institute Press, 1985.
- Crocker, Mel. *Black Cats and Dumbos: WWII's Fighting PBY's*. Huntington Beach: Crocker Media Expressions, 1987.
- Dave's Warbirds. *Black Cats: US Navy PBY Catalinas Fighting in the Pacific During World War II*. <http://www.daveswarbirds.com/blackcat/catalina.htm> (accessed March 21, 2011).
- Dorny, Louis B. *US Navy PBY Catalina Units of the Pacific War*. Oxford, UK: Osprey Publishing, 2007.
- Edmonds, Walter D. *They Fought With What They Had: The Story of the Army Air Forces in the Southwest Pacific, 1941-1942*. Boston: Little, Brown and Company, 1951.
- Freeman, Elmer. *Those Navy Guys and Their PBY's: The Aleutian Solution*. Spokane, WA: University Press, 1992.
- Gamble, Bruce. *Fortress Rabaul: The Battle for the Southwest Pacific, January 1942 – April 1943*. Minneapolis, MN: Zenith Press, 2010.
- Hendrie, Andrew. *Flying Cats: The Catalina Aircraft of World War II*. Annapolis, MD: Naval Institute Press, 1988.
- Jablonski, Edward. *Airwar Volume II: Outraged Skies*. Garden City, NY: Doubleday & Company, Inc., 1971.
- Knott, Richard C. *Black Cat Raiders of WWII*. Annapolis, MD: Naval Institute Press, 2000.

Messimer, Dwight. *In the Hands of Fate: The Story of Patrol Wing Ten 8 December 1941 – 11 May 1942*. Annapolis, MD: United States Naval Institute, 1985.

Monday, David. *Concise Guide to American Aircraft of World War II*. Rev. ed. New York: Smithmark Publishers, 1996.

Naval Historical Center. *Location of U.S. Naval Aircraft (1942-1945)*. <http://www.history.navy.mil/a-record/ww-ii/loc-ac/loc-ac.htm>

Parshall, Jonathan B. and Anthony P. Tully. *Shattered Sword: The Untold Story of the Battle of Midway*. Washington D.C.: Potomac Books, 2005.

Spector, Ronald H. *Eagle Against the Sun*. New York: The Free Press, 1985.

Stanley, Roy M, Colonel, USAF (ret). *World War II Photo Intelligence*. New York: Charles Scribner's Sons, 1981.

Wagner, Ray. *American Combat Planes*. Garden City, NY: Hanover House, 1960.

Willmott, H. P. *Empires in the Balance: Japanese and Allied Pacific Strategies To April 1942*. Annapolis, MD: Naval Institute Press, 1982.