Brewster F2A2 Buffalo 44” WingSpan (1.10m)

The **Brewster F2A Buffalo** was an American fighter aircraft which saw limited service early in World War II. It was one of the first U.S. World War II monoplanes with an arrestor hook and other modifications for aircraft carriers. The Buffalo won a competition against the Grumman F4F Wildcat in 1939 to become the U.S. Navy's first monoplane fighter aircraft. Although superior to the Grumman F3F biplane it replaced,[1] the Buffalo turned out to be a big disappointment.

Several nations, including Finland, Belgium, Britain and the Netherlands, ordered the Buffalo to bolster their struggling air arms, but of all the users, only the Finns seemed to find their Buffalos effective, flying them in combat with excellent results.[2] During the Continuation War of 1941–1944, the B-239's (a de-navalized F2A-1) operated by the Finnish Air Force proved capable of engaging and destroying most types of Soviet fighter aircraft operating against Finland at that time, achieving, in the first phase of that conflict, a kill-ratio of 32:1, 32 Soviet aircraft shot down for every B-239 lost[3] and producing 36 Buffalo "aces".[4]

When World War II began in the Pacific[5] in December 1941, Buffalos operated by both British Commonwealth (B-339E) and Dutch (B-339D) air forces in South East Asia suffered severe losses in combat against the Japanese Navy's Mitsubishi A6M Zero and the Japanese Army's Nakajima Ki-43 "Oscar". The British attempted to lighten their Buffalos by removing ammunition and fuel and installing lighter guns in order to increase performance, but it made little difference.[5]

The Buffalo was built in three variants for the U.S. Navy, the F2A-1, F2A-2 and F2A-3. (In foreign service, with lower horsepower engines, these types were designated B-239, B-339, and B-339-23 respectively.) The F2A-3 variant saw action with United States Marine Corps (USMC) squadrons at the Battle of Midway. Shown by the experience of Midway to be no match for the Zero,[1] the F2A-3 was derided by USMC pilots as a "flying coffin."[6] The F2A-3, however, was significantly inferior to the F2A-2 variant used by the Navy before the outbreak of the war.

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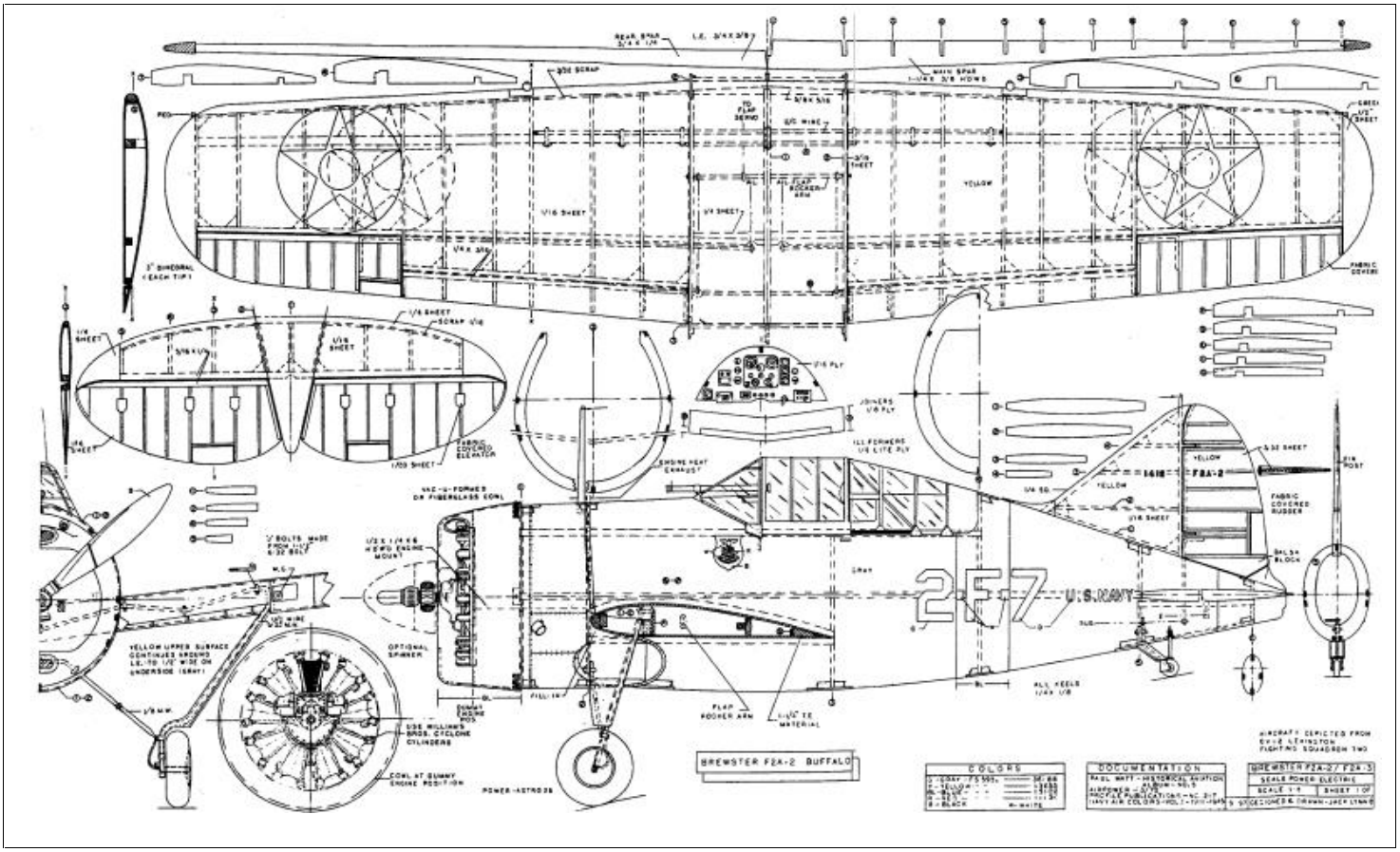
44” Wing Span Plan (1m)



Design and development

United States Navy

In 1935, the U.S. Navy issued a requirement for a carrier-based fighter intended to replace the Grumman F3F biplane. The Brewster XF2A-1 monoplane, designed by a team led by Dayton T. Brown, was one of two aircraft designs that were initially considered.[7] The XF4F-1 with a double-row radial engine was a "classic" biplane. The U.S. Navy competition was re-opened to allow another competitor, the XFNF-1, a navalized Seversky P-35 eliminated early on when the prototype could not reach more than 267 mph (430 km/h).[8] The XF2A-1 first flew on 2 December 1937 and early test results showed it was far in advance of the Grumman biplane entry. While the XF4F-1 would not enter production, it would later re-emerge as a monoplane, the Wildcat.

The new Brewster fighter had a modern look with a stubby fuselage, mid-set monoplane wings and a host of advanced features. It was all-metal, with flush-riveted, stressed aluminum construction, although control surfaces were still fabric-covered. The XF2A-1 also featured split flaps, a hydraulically operated retractable main undercarriage (and partially retractable tail wheel), and a streamlined framed canopy. However, the aircraft lacked self-sealing fuel tanks and pilot armor. Fuel was only 160 U.S. gal (606 l), stored in the fuselage. Powered by an 950 hp (708 kW) single-row Wright R-1820-22 Cyclone radial engine, it had an impressive initial climb rate of 2,750 ft/min and a top speed of 277.5 mph (447 km/h), later boosted to 304 mph (489 km/h) at 16,000 ft (4,879 m) after improvements were made to the cowling streamlining and carburetor/oil cooler intakes.[9][10] With only a single-stage supercharger, high-altitude performance fell off rapidly.[11] Fuselage armament was one fixed .50 in (12.7 mm) M2 Browning machine gun with 200 rounds and one fixed .30 in

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(7.62 mm) AN Browning machine gun with 600 rounds, both in the nose.[N 1] The Navy awarded Brewster Aeronautical Corporation a production contract for 54 aircraft as the **F2A-1**.

While service testing of the XF2A-1 prototype began in January 1938 and in June, production started on the **F2A-1**. They were powered by the 940 hp (701 kW) Wright R-1820-34 engine and had a larger fin. The added weight of two additional .50 in (12.7 mm) Browning wing guns and other equipment specified by the Navy for combat operations reduced the initial rate of climb to 2,600 ft/min. Plagued by production difficulties, Brewster only delivered 11 F2A-1 aircraft to the Navy; the remainder of the order was later diverted to the Finnish Air Force in modified form under the export designation Model 239.

A later variant, the **F2A-2**, of which 43 were ordered by the U.S. Navy, included a more powerful R-1820-40 engine of 1,200 hp (895 kW), a better propeller, and integral flotation gear, but still lacked pilot armor and self-sealing tanks. The increase in engine power was welcomed, but to some extent offset by the increased loaded weight (5,942 lb/2,701 kg) of the aircraft; while top speed was increased to a respectable 323 mph (520 km/h) at 16,500 ft (5,029 m), initial climb rate dropped to 2,500 ft/min. Both the F2A-1 and the F2A-2 variants of the Brewster were liked by early Navy and Marine pilots, including Pappy Boyington, who praised the good turning and maneuvering abilities of the aircraft. "Pappy" Boyington observed: "But the early models, before they weighed it all down with armor plate, radios, and other [equipment], they were pretty sweet little ships. Not real fast, but the little [aircraft] could turn and roll in a phone booth." This might be expected from the low wing loading, only 24.1 pounds per square foot, only 10% higher than that of the Zero.

The **F2A-3** was the last version of the Buffalo to enter service with the U.S. Navy and Marine Corps. A total of 108 examples were ordered in January 1941. By this time, the Navy had become disenchanted with the Buffalo, and had become especially annoyed at Brewster Aeronautical Corporation's frequent production delays and its seemingly never-ending management difficulties. This order was seen more as a way of keeping Brewster's production lines running (they would eventually build Corsair fighters for the Navy) as well as Buccaneer/Bermuda dive bombers.

The F2A-3s were conceived as a long range reconnaissance fighter with a new wet wing with self-sealing features and a larger fuselage tank which provided increased fuel capacity and protection, but this also increased the aircraft's weight by more than 500 lb (227 kg).[11] The wing and enlarged fuselage tank carried an additional 80 U.S. gal (300 L) of fuel; at 6 lb/U.S. gal (0.72 kg/L), the fuel alone weighed nearly 500 lb (227 kg). The addition of armor plating for the pilot and increased ammunition capacity further increased the aircraft's weight, resulting in a reduced top speed and rate of climb, while substantially degrading the Brewster's turning and maneuvering capability.[11] The Navy found that the added weight of the F2A-3 also aggravated the problem of landing gear failure during carrier landings. However, the Curtiss engine in the F2A-3 was an excellent "cruising" engine and as such the F2A-3 had some value and saw initial service on the carriers *Saratoga* and *Lexington*.

Even in late 1940 it was apparent that the Buffalo was rapidly becoming obsolete.[N 2] It badly needed a more powerful engine, but the limits of the airframe had been reached, making installation of a larger engine

impossible. Soon after deliveries of the F2A-3 began, the Navy decided to eliminate the type altogether. By then, considered a second line aircraft, some were transferred to the U.S. Marine Corps, which deployed two F2A-3 squadrons to the Pacific, one at Palmyra Atoll, and another at Midway Island. Those which still remained on board aircraft carriers narrowly missed a combat opportunity when a relief mission was dispatched to Wake Island, but the relief force was withdrawn before completing the mission. Shortly thereafter, F2A-3s still in naval service were transferred to training squadrons for use as advanced trainers.

Operational history

The first unit to be equipped with the F2A-1 was Lt. Cdr. Warren Harvey's VF-3, assigned to USS *Saratoga* air group. On 8 December 1939, VF-3 received 10 of the 11 Buffalos delivered to the U.S. Navy.[13] The remaining 43 F2A-1s were declared surplus and sold to Finland.[14] Although it was becoming clear the F2A was inferior to the latest German fighters, in the early years of World War II, all modern monoplane fighter types were in high demand, even the F2A. Consequently, the United Kingdom, Belgium, and the Netherlands East Indies purchased several hundred export models of the Buffalo.[15]

Belgium

Just before the start of the war, Belgium sought more modern aircraft to expand and modernize its air force. Belgium ordered 40 Brewster B-339 aircraft, a de-navalized F2A-2, fitted with the Wright R-1820-G-105 engine approved for export use. The G-105 engine had a power output of 1,000 hp/746 kW (peak) at takeoff, some 200 hp (149 kW) less than the engine fitted to the U.S. Navy F2A-2. The arrestor hook and life raft container were removed, and the aircraft was modified with a slightly longer tail.

Only one aircraft[16][17][N 3] reached France by the time Germany launched its *Blitzkrieg* in the West on 10 May 1940. The Buffalo was later captured intact by the Germans.

Six more Belgian Brewsters were offloaded at the French Caribbean island of Martinique and languished on a coastal hillside, never to be flown.[*citation needed*] The rest of the order went to the RAF.

British Commonwealth (Malaya)

Brewster Buffalo Mk Is being inspected by RAF personnel at RAF Sembawang, Singapore on 12 October 1941.

Facing a shortage in combat aircraft in January 1940, the British government established the British Purchasing Commission to acquire U.S. aircraft that would help supplement domestic production. Among the U.S. fighter aircraft that caught the Commission's attention was the Brewster. The remaining 32 B-339 aircraft ordered by the French, suspended at the fall of France, were passed on to the United Kingdom.[18] Appraisal by Royal Air Force acceptance personnel criticized it on numerous points including lack of armament and pilot armor, poor high-altitude performance, engine overheating, maintenance issues, and cockpit controls, while it was praised

for its handling, roomy cockpit, and visibility.[7] With a top speed of about 323 mph (520 km/h) at 21,000 ft (6,400 m), but with fuel starvation issues over 15,000 ft (4,600 m), it was considered unfit for duty in western Europe.[7] Still desperately in need of fighter aircraft in the Pacific and Asia for British and Commonwealth air forces, the UK ordered an additional 170 aircraft under the type specification **B-339E**.[19] The aircraft were sent to Royal Australian Air Force, RAF and Royal New Zealand Air Force fighter squadrons in Singapore, Malaya and Burma, shortly before the outbreak of war with Japan.

Brewster B-339E (AN196/WP-W) of No. 243 Squadron RAF. This aircraft was flown by Flying Officer Maurice Holder, who flew the first Buffalo sortie in the Malayan Campaign on 8 December 1941, strafing landing barges on the Kelantan River.[20] Damaged by ground fire, it was abandoned at Kota Bharu, where it was captured by the Japanese.[20]

The B-339E, or Brewster Buffalo Mk I as it was designated in British service, was initially intended to be fitted with an export-approved Wright R-1820-G-105 Cyclone engine with a 1,000 hp/746 kW (peak takeoff) engine.[21][N 4] The Brewster aircraft delivered to British and Commonwealth air forces were significantly altered from the B-339 type sold to the Belgium and French forces in accordance with their purchase order. The Brewster factory removed the Navy life raft container and arrestor hook, while adding many new items of equipment, including a British Mk III reflector gun sight, a gun camera, a larger fixed pneumatic tire tail wheel, fire extinguisher, engine shutters, a larger battery, and reinforced armor plating and armored glass behind the canopy windshield.

The Brewster Model B-339E, as modified and supplied to Great Britain was distinctly inferior in performance to the F2A-2 (Model B-339) from the original order. It had a less powerful (1,000 hp/746 kW) engine compared to the F2A-2's 1,200 hp (895 kW) Cyclone, yet was substantially heavier due to all of the additional modifications (some 900 lb/400 kg). The semi-retractable tail wheel had been exchanged for a larger fixed model, which was also less aerodynamic. Top speed was reduced from 323 mph (520 km/h) to 313 mph (504 km/h) at combat altitudes.

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Brewster B339E wrecks cannibalized for parts, probably in Singapore circa late January 1942. Two of the Buffalos, serials W8156 and W8207, were operated by 453 Squadron RAAF.[23]

In its original form, the B-339 had a theoretical maximum speed of 323 mph (520 km/h) at a rather unrealistic 21,000 ft (6,400 m), but fuel starvation problems and poor supercharger performance at higher altitudes meant that this figure was never achieved in combat; the B-339E was no different in this regard. Its maneuverability was severely impaired (the aircraft was unable to perform loops), and initial rate of climb was reduced to 2,300 ft/min. The Wright Cyclone 1890-G-105 engine designated for use in the Brewster Mk I was in short supply; many aircraft were fitted with secondhand Wright engines sourced from Douglas DC-3 airliners and rebuilt to G105 or G102A specifications by Wright.[19] In service, some effort was made by at least one Brewster squadron to improve the type's sluggish performance; a few aircraft were lightened by some 1,000 lb (450 kg) by removing armor plate, armored windshields, radios, gun camera, and all other unnecessary equipment, and by replacing all .50 in (12.7 mm) machine guns with two .303 in (7.7 mm) nose-mounted guns. The fuselage tanks were filled with a minimum of fuel, and run on high-octane aviation petrol where available. At Alor Star airfield in Malaya, the Japanese captured over 1,000 barrels (160 m^3) of high-octane aviation petrol from British forces, which they promptly used in their own fighter aircraft.[24]

Many of the pilots assigned the Buffalo lacked adequate training and experience in the type. A total of 20 of the original 169 Buffalos were lost in training accidents during 1941. By December 1941, approximately 150 Buffalo B-339E aircraft made up the bulk of the British fighter defenses of Burma, Malaya and Singapore. The two RAAF, two RAF, and one RNZAF squadrons, during December 1941-January 1942, were beset with numerous problems,[25] including poorly built and ill-equipped aircraft.[7] Aviation historian Dan Ford characterized it as, "The performance... was pathetic." Inadequate spare parts and support staff, airfields that were difficult to defend against air attack, lack of a clear and coherent command structure, a Japanese spy in the Army air liaison staff, antagonism between RAF and RAAF squadrons and personnel, and inexperienced pilots lacking appropriate training would lead to disaster. Although the Mk I had .50-inch guns, many aircraft were equipped with .30 Browning mounts and electric firing solenoids, which tended to fail in service.[19]

Buffalo Mk I formation over Malaya, late 1941.

Buffalos of No. 453 Squadron RAAF lined up at RAF Sembawang, circa November 1941. Buffalo AN185/TD-V was flown by Flight Lieutenant Richard Vanderfield, who shot down three Japanese bombers (two Ki-48s and one Ki-51) over Butterworth, Penang on 13 December 1941, while his undercarriage was still down.[26]

When the Japanese invaded northern Malaya on 8 December 1941, the B-339E initially performed adequately. Against the Nakajima Ki-27 "Nate", the overloaded Brewsters could at least hold their own if given time to get to altitude, and at first achieved a respectable number of kills. However, the appearance of ever greater numbers of Japanese fighters, including markedly superior types such as the Nakajima Ki-43 "Oscar" soon overwhelmed the Buffalo pilots, both in the air and on the ground. Another significant factor was the Brewster engine's tendency to overheat in the tropical climate, which caused oil to spray over the windscreen, usually forcing an

aborted mission and greatly complicating attempts to intercept and destroy enemy aircraft. In the end, more than 60 Brewster Mk I (B-339E) aircraft were shot down in combat, 40 destroyed on the ground, and approximately 20 more destroyed in accidents. Only about 20 Buffalos survived to reach India or the Dutch East Indies.[27]

It is not entirely clear how many Japanese aircraft the Buffalo squadrons shot down, although RAAF pilots alone managed to shoot down at least 20.[28] Eighty were claimed in total, a ratio of kills to losses of just 1.3 to 1. Additionally, most of the Japanese aircraft shot down by the Buffalos were bombers.[19] The Hawker Hurricane, which fought in Singapore alongside the Buffalo from 20 January, also suffered severe losses from ground attack; most were destroyed.[29] The Fleet Air Arm also used the Buffalo in the Mediterranean in the Battle of Crete in early 1941.

The Brewster Mark I produced four Commonwealth aces: Geoff Fisken, Maurice Henry Holder, Alfred Wattle Benjamin Clare and Richard Douglas Vanderfield.[30] New Zealander Fisken, the top-scoring pilot, later flew RNZAF P-40s and became the highest-scoring Commonwealth pilot within the Pacific theatre.

U.S. Marine Corps

At Midway Island, United States Marine Corps fighter group VMF-221 operated a mixed group of 20 Brewster F2A-3 Buffalos and six Grumman F4F-3 Wildcats.[34] They were originally assigned to the USS *Saratoga* as part of a relief force bound for Wake Island, but were diverted to Midway instead after the force was controversially recalled on 22 December 1941. Wake Island fell on the following day.[35] The squadron first saw action on 10 March 1942 when a Kawanishi H8K "Emily" flying boat was shot down by Captain James L. Neefus near Midway, the Buffalo's first kill in U.S. service.[36][37][38][39]

During the Battle of Midway in 1942, VMF-221 was destined to participate in one of the few aerial combats involving the Buffalo in U.S. military service. The initial Buffalo interception of the first Japanese air raid was led by Major Floyd B. Parks, whose 13-aircraft division did not fly in paired flights of mutually supporting aircraft. After attacking a formation of 30-40 Aichi D3A1 "Val" dive bombers escorted by 36 Zeros, the Marines, flying in two divisions of aircraft, downed several Japanese bombers before the escorting Zeros reacted; a furious dogfight developed. Thirteen out of 20 Buffalos were lost;[40] of the six Wildcats, only two remained flyable at the end of the mission. The losses included the Marine air commander, Major Parks, who bailed out of his burning Buffalo, only to be strafed by Zeros after parachuting into the sea.[34]

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F2A-3, probably fromat Marine Corps Ewa, Hawaii, 25 April 1942.

F2A-3 of VMF-211 rests in the flight deck gallery walkway after suffering landing gear failure while landing on board USS Long Island, off Palmyra Atoll, 25 July 1942. VMF-211 was the last Marine Corps unit to operate the F2A in a front-line capacity.

The Marine pilots who managed to shake off the Zeros used high speed split-s turns or very steep dives.[34] These maneuvers were later found to be the best means to evade pursuit by the highly maneuverable Japanese fighters. One F2A-3 pilot, Marine Captain William Humberd, dove away from his pursuers, then attacked a Zero in a head-on pass, shooting his opponent down.[41] In the battle, some F2A-3s suffered from inoperative guns.[7] The nose-mounted guns' occasional failure to fire was noticed by other users as well; the phenomenon may have been caused by frayed electrical wires in the mechanism that synchronized the nose guns with the propeller. Other Buffalos had not been fitted with plate armor behind the pilot, making them vulnerable to even a single bullet or shell. Losses were aggravated due to the Japanese practice of strafing pilots who had bailed out.[34] Second Lt. Charles S. Hughes, whose Buffalo was forced to retire at the start of the raid due to engine trouble, had a ringside view of the aerial combat:

The Zeros came in strafing immediately afterward. I saw two Brewsters trying to fight the Zeros. One was shot down and the other was saved by ground fires covering his tail. Both looked like they were tied to a string while the Zeros made passes at them.

Second Lt. Charles M. Kunz reported that after successfully downing two Val bombers, he was attacked by Japanese fighters:

I was at an altitude of about 9,000 ft, and shoved over in a dive trying to shake the plane on my tail until I was about 20 feet from the water. I was making radical turns hoping the pilot couldn't get steadied on me. I glanced out of the rear and saw that it was a [Mitsubishi A6M Zero] fighter. I continued flying on a rapid turning course at full throttle when I was hit in the head by a glancing bullet. After he fired a few short burst he left as I had been in a general direction of 205 degrees heading away from the island. My plane was badly shot up... In my opinion the [Zero] fighter has been far underestimated. I think it is probably one of the finest fighters in the present war. As for the F2A-3, (or Brewster trainer) it should be in Miami as a training plane, rather than used as a first line fighter.

The poor performance of the Buffalo at Midway later prompted Finnish Air Force ace Hans Wind to develop new combat tactics for the FAF Brewster, which were later used with remarkable success in 1942 and 1943 against the Soviet Air Force during the Continuation War.[43] Wind's combat tactics, which emphasized diving speed and zoom climbs, were much the same as Claire Chennault's advice for employing the Curtiss P-40 against the A6M Zero in Burma and China.[43] Chennault's report on the Zero and air combat reached Washington in 1941, where it was disseminated to aviation forces of the U.S. Army and Navy.[44] This information, along with the development of two-plane mutual defensive formations and tactics, were incorporated into U.S. and Marine Corps air combat training doctrine by some prescient U.S. commanders, including Lieutenant Commander "Jimmy" Thach. The Thach Weave was developed for use by Wildcat pilots against the Zero, and was later adopted by other Wildcat squadrons in the Pacific.[44]

With the emergence of new tactics for the F4F-3 and F4F-4 Wildcat (which was superior in all respects to the F2A-3 Buffalo, with the sole exception of maximum range), the Battle of Midway marked the end of the Buffalo in both U.S. Navy and Marine Corps fighting squadrons. Surviving F2A-3 aircraft were hastily transported to the U.S. mainland, where they were used as advanced trainers. The introduction in late 1943 of vastly superior American carrier-borne fighters such as the F6F Hellcat and Vought F4U Corsair soon relegated the Brewster F2A-3 to a distant, if painful memory.