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**Defense Against Kamikaze
Attacks in World War II
and its Relevance to
Anti-Ship Missile Defense**

Volume I

**An Analytical History of Kamikaze
Attacks Against Ships of the
United States Navy During World War II**

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2. This volume describes the Navy's attempts to counter the kamikaze threat during World War II, and develops estimates of the effectiveness of both the kamikaze and the Navy's effort to counter it.
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CENTER FOR NAVAL ANALYSES

Operations Evaluation Group
Study 741

DEFENSE AGAINST KAMIKAZE ATTACKS IN
WORLD WAR II AND ITS RELEVANCE TO ANTI-SHIP MISSILE DEFENSE

VOLUME I

AN ANALYTICAL HISTORY OF
KAMIKAZE ATTACKS AGAINST SHIPS OF
THE UNITED STATES NAVY DURING WORLD WAR II

November 1970

Nicolai Timenes, Jr.
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The work reported here was conducted under the direction of the Center for Naval Analyses, and represents the opinion of the Center for Naval Analyses at the time of issue. It does not necessarily represent the opinion of the Department of the Navy except to the extent indicated in the forwarding letter.

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ABSTRACT

This study examines the experience of the United States Navy in countering attacks by Japanese suicide aircraft (kamikazes) in World War II, and provides an analytical history of the kamikaze program and develops estimates of the effectiveness of the kamikaze and of efforts to counter it.

This study begins with a history of the early encounters between Japanese and American carrier aircraft and shows how the patterns of aircraft losses by both sides changed during the war. The effect on Japan of losing aircraft, pilots, aircraft carriers, and other resources is discussed as a background to the decision to employ the kamikaze tactic. A brief chapter addresses the philosophical environment which made the kamikaze tactic acceptable. Then the history of the employment of the kamikaze is discussed in terms of 2 major campaigns--the Philippines and Okinawa. In the discussion of the Okinawa campaign, where the majority of kamikazes were expended, the tactics used by the American Navy in defense are described.

Finally, statistics on results in the Philippine and Okinawan campaigns are used to establish estimates of the effectiveness of defense at various stages--attack at the source, defense by interceptors, defense by anti-aircraft guns, and the like. These estimates are used to provide a crude model of overall effectiveness.

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The quick falling cherry blossom,
 That lives but a day and dies with destiny unfulfilled,
 Is the brave spirit of Samurai youth,
 Always ready, his fresh young strength
 To offer to his lord.

--Ancient Japanese Poem.

PREFACE

This volume is different from the usual OEG study, which deserves some explanation. It lies in the genesis of the study.

The U. S. Navy today is very much concerned with the problem of countering anti-ship missiles, such as the ones that sank an Israeli destroyer off the Egyptian coast in October, 1967. It had occurred to some that a missile with an electronic brain intent on crashing into a ship might behave not unlike an aircraft piloted by a human being with the same purpose; that the experience of the U. S. Navy in countering the Japanese kamikaze attacks toward the end of World War II might provide some insight into the current problem. In response to this suggestion, the Operations Evaluation Group of the Center for Naval Analyses undertook an analysis of the question.

A preliminary examination of the available analyses of the kamikaze experience made it clear that additional work would be required to cast that experience in terms compatible with modern systems analysis. As the investigation progressed, 2 further points became apparent: (1) that a proper comparison with the current situation would have to make use of classified data on capabilities of modern systems, and (2) that examination of the effectiveness of the kamikaze would yield an analytical history which, if unclassified, could have a wider readership.

Thus the present study has 2 volumes. This volume, an unclassified analytical history, is more historical than most analyses, and more analytical than most histories. It is organized in rough chronological order to show how the Japanese moved from early successes through restrictions on a variety of resources and adoption of the kamikaze tactic to final defeat. How the kamikaze tactic was employed, and how it was defeated, are discussed. Throughout there is an attempt to derive numerical values for effectiveness. The final chapter is devoted to an attempt to combine these numbers to estimate overall effectiveness.

Inasmuch as the Japanese Navy justifiably regarded itself as the pioneer of kamikaze attacks, and since the role of the Japanese Naval Air Arm is, in general, better documented than that of the Army, the focus in this study is on Japanese Naval Air activities. It should be recognized, however, that approximately half of all kamikaze attacks were conducted by Japanese Army Air Forces.

In large measure, the narratives and data in the present volume are based on Samuel Eliot Morison's History of United States Naval Operations in World War II. Other substantial sources of data were the publications of the United States Strategic Bombing Survey. Notes providing specific citations of these and other documents are gathered at the end of the text so that they need not interrupt the casual reader. The sources used in the study are discussed further in appendix C.

An attempt has been made to define terms as they are introduced, and a brief glossary appears as appendix B.

CHAPTER I

EARLY JAPANESE SUCCESSES, PEARL HARBOR TO CEYLON

"It is agreed that if we do not fight now, our nation will perish. But it may well perish even if we do fight... In this hopeless situation, survival can be accomplished only by fighting to the last man. Then, even if we lose, posterity will have the heritage of our loyal spirit to inspire them in turn to the defense of our country... In war, soldiers ask only the chance to fight in support of the Emperor. We will fight to the last drop of blood."

---Admiral Nagano
Chief of the General Staff
September, 1941¹

INTRODUCTION

The first kamikaze attacks did not begin until 25 October 1944, so one might well ask why our story must begin with the attack on Pearl Harbor almost 3 years before. Some of the considerations which were to characterize Japanese naval thinking and experience, and ultimately lead to the decision to employ kamikazes, were manifest in the planning and execution of the attack on Pearl Harbor. It is in order to show how these characteristics developed and influenced the decision to employ kamikazes that we begin with a historical review. As the analysis proceeds, and the corresponding period under review becomes later in World War II, the emphasis is increasingly on the kamikaze experience.

The air war in the Pacific--and particularly as fought by Japanese and American carrier aircraft--may be considered in 6 phases, the major events of which are shown in table I.² The war began with the attack on Pearl Harbor by planes from a 6 carrier Japanese force. The "Nagumo force", named after its commander, contained most of the striking power of the Japanese fleet, and ranged and struck with impunity at Allied forces from Wake to Ceylon until April, 1942. The Japanese advance was blunted in the first major carrier-versus-carrier battle of the war at the Coral Sea. Then came the Battle of Midway, in which the striking power of the Nagumo force was totally destroyed, and 4 of the 6 Japanese fleet carriers sunk.

Japanese carrier forces did not again take substantial initiatives after Midway. From then until late 1943, each side built up its strength, awaiting an opportunity. The arrival of the first Essex-class carriers in 1943 gave the United States more

¹ Notes begin on p. 89 of the text.

carriers than Japan for the first time in the war. Meanwhile, the Japanese had been losing aircraft and pilots in combat, oil and other vital resources to submarines, and technical superiority in aircraft and pilots to American production and training facilities. (The question of resources is discussed further in chapter V.)

From 1 September 1943, the United States Pacific Fleet, with increasing resources at hand, began to conduct the fast carrier strikes deep into enemy territory that were to become the pattern of operations until the end of the war. The American landings at Saipan in the Marianas provided the opportunity for the fleet confrontation which the Japanese had long awaited, and great carrier fleets joined in the Battle of the Philippine Sea on 19 and 20 June 1944. The result came to be known as the "Marianas Turkey Shoot" because of the rate at which American aircraft destroyed Japanese. Although Japan continued to have substantial numbers of carriers, never after the Philippine Sea did she have the trained aviators or other resources necessary to outfit and aggressively deploy carriers other than as sacrificial decoys.

This, then, was the setting for the first kamikaze attacks at Leyte on 25 October 1944. Initially employed in an attempt to neutralize carriers so that they could be engaged and destroyed by other forces, the kamikazes soon became the primary Japanese weapon, and their use continued and intensified during the campaigns for the Philippines and Okinawa. In the Philippines, kamikazes attacked in small groups. At Okinawa, greater reliance was placed on mass attacks to saturate defenses, but, owing in part to reduce pilot experience levels, inferior aircraft, and new American defensive tactics, Kamikazes were less effective per plane at Okinawa--although many more planes were used and more damage was done.

At the conclusion of the Okinawa campaign, the Allies began preparations for the final assault on Japan, and the Japanese prepared their defense. The resources available for kamikaze attacks -- given the limited training and technological requirements -- were impressive, and invading forces would surely have suffered great casualties had not the events at Hiroshima and Nagasaki been decisive.

After the Nagumo force's strikes in the area of Ceylon in the spring of 1942, Britain was forced to withdraw from the Pacific, and to devote her remaining resources to the European war. By the end of 1944, however, she was able to send a fast carrier force to the Pacific to join the American carriers in striking the final blows at Japan--and in absorbing kamikaze attacks. The British experience, with carriers of different construction, is instructive, and is presented in detail in Chapter X.

The trends in the course of the war were accompanied by a number of trends in such important parameters as aircraft carrier complements, attrition rates, exchange ratios, and causes of loss. These trends are illustrated in the course of the discussion in the first 6 chapters.

TABLE I

SELECTED INCIDENTS IN THE PACIFIC WAR

Phase I: Early Japanese Successes, Pearl Harbor to Ceylon

- 7 Dec 1941 - Japanese carrier force strikes Pearl Harbor.
- 8 Dec 1941 - 8 April 1942 - "Nagumo Force," including most Japanese fleet carriers, strikes with impunity against targets in Solomons, Marshalls, Australia, and Java, and attacks British Eastern Fleet, sinking Hermes and damaging shore installations in Ceylon.
- 18 Apr 1942 - B-25's from Hornet, escorted by Enterprise, attack Tokyo--the "Doolittle raid".

Phase II: Stemming the Tide: Coral Sea and Midway

- 8 May 1942 - Battle of the Coral Sea. U. S. carrier forces sink light carrier Shoho and discourage Japanese advances but lose Lexington.
- 4 Jun 1942 - Japanese seek decisive carrier battle with forces supporting invasion of Midway, but U. S. has better intelligence. All 4 Japanese carriers are sunk in massive air battle, ending Japanese moves eastward. Yorktown is sunk, but Enterprise and Hornet are unscathed.

Phase III: Licking Wounds: 1943

- 24 Aug 1942 - Battle of the Eastern Solomons; light carrier Ryujo is sunk.
- 15 Sep 1942 - Wasp is sunk by submarine while reinforcing Guadalcanal.
- 26 Sep -
- 7 Oct 1942 - Battle of Santa Cruz Islands, Hornet is sunk.
- 7 Apr 1943 - Japanese employ planes from 4 carriers in "I" operation to reinforce Guadalcanal, but carriers themselves are not used.

Phase IV: The Fast Carrier Strikes and the Marianas Turkey Shoot

- 1 Sep 1943 - Essex, the new Yorktown, and the light carrier Independence, among the first of the new-construction U. S. carriers to arrive in the Pacific, conduct a raid on Marcus Island. Thereafter, strikes by ever-larger fast carrier task forces become almost continuous, and increase in vigor and aggressiveness.
- 29 Jan -
- 11 Feb 1944 - Pre-invasion strikes on the Marshalls, now by 6 fleet and 7 light carriers; opposition is only from land bases.
- 19 Jun 1944 - "The Marianas Turkey Shoot": the Battle of the Philippine Sea, in which the Japanese commit 5 fleet and 4 light carriers with 430 aircraft, of which over 300 are destroyed as American Naval Air demonstrates its superiority; 3 Japanese carriers are sunk; U. S. losses light.

Phase V: Leyte and Okinawa: Enter the Kamikazes

- 20 Oct 1944 - Landings on Leyte commence.
- 25 Oct 1944 - First kamikaze attacks on naval forces off Leyte: Battle of Leyte Gulf.
- 10 Feb 1945 - First carrier-based strikes on Japan.
- 1 Apr 1945 - Landings on Okinawa commence.
- 6 Apr -
- 22 Jun 1945 - Kikusui mass kamikaze attacks off Okinawa.

Phase VI: Endgame and Prospectus

- 6 Aug 1945 - Atomic bomb dropped on Hiroshima.
- 15 Aug 1945 - Japan surrenders.

PEARL HARBOR

The attack on Pearl Harbor is surely one of the best known in military history. The warning available to U. S. forces, the extent to which the Japanese were driven to this desperate move by the American oil embargo and other diplomatic pressures, have been argued at length and are beyond the scope of this paper. What is of interest is the outcome of this first, great carrier aircraft strike of World War II.

The Japanese Carrier Fleet, including all 6 attack carriers under the command of Vice Admiral Nagumo, and escorted by 6 destroyers, launched 353 of its 423 aircraft to attack ships and installations in Pearl Harbor, from a point about 275 miles to the north, on the morning of 7 December 1941. Only 28, or 8 percent, of the attacking aircraft failed to return to the carriers. Table II shows these and some other statistics of this and certain succeeding battles.

The finest Japanese aircrews participated in this attack, and the results were devastating to the meager American resources in the Pacific. In addition to the damage to surface ships, approximately 125 aircraft of all types were destroyed, most on the ground. The destruction at Pearl Harbor was matched elsewhere, especially in the Philippines. Overall, for example, more than 1/4 of all U. S. combat fighters in the Asiatic-Pacific theater were destroyed on 7 December 1941. Almost 3 times as many Japanese fighters remained. But the prime targets, the American carriers, were not in Pearl Harbor on that day. Lexington and Enterprise were at sea, and Saratoga about to enter San Diego. Three of the 4 carriers then in the Atlantic would eventually see action, and be sunk in the Pacific.

CEYLON AND THE BRITISH WITHDRAWAL

But it did not then appear that America could mount much of a challenge to Japanese command of the seas. The Nagumo force, after a return to home waters, sortied for attacks against shipping, and in support of amphibious operations, ranging over all of east Asia. Generally at least 4 large carriers operated together. On 5 April 1942, the Nagumo force struck at Ceylon, sank the British carrier Hermes, and forced the British to relinquish the eastern Indian Ocean until late 1944. The extent of these adventures is apparent from figure 1, which shows the track of the Nagumo force from Pearl Harbor to Midway.

TABLE II

ATTRITION RATES IN SELECTED CAMPAIGNS

	Pearl Harbor	Coral Sea ⁷	Midway	Philippine Sea	Formosa strikes	Japan strikes
Date:	7 Dec 41	8 May 42	4 Jun 42	19 Jun 44	3-9 Jan 45	16 Feb 45
Reference: Morison, vol:	III, 85ff	IV, 18ff	IV, 100ff	VIII, 257ff	XIII, 89ff	XIV, p. 22
Japanese experience						
Carriers engaged ¹	6	3	4 ¹⁰	9	—	—
Carriers sunk	—	1	4	3 ¹³	—	—
Aircraft engaged ²	423	146	261 ¹⁰	430	—	—
Aircraft lost	29	43	261	330 ¹⁴	> 200	531 ¹⁷
Loss rate ³	7%	39%	100%	62%	—	—
Attack sorties	353	69 ⁸	40	373	*	*
Attack lost	29	29	24	243	*	*
Loss rate ⁴	8%	42%	60%	65%	*	*
American experience						
Carriers engaged ⁴	—	2	3	15	14	14
Carriers sunk	—	1	1	—	—	—
Aircraft engaged ²	316 ⁶	143	231	889	*	*
Aircraft lost	125	69 ⁹	113 ¹¹	30 ¹⁵	*	*
Loss rate ³	40%	48%	49%	3%	*	*
Attack sorties	*	88	175	216	3030	738
Attack lost	*	14	63 ¹²	20	86 ¹⁶	88
Loss rate ⁴	*	16%	35% ¹²	9%	3%	12%
Exchange rate ⁵ (Jap/Amer.)	0.23	0.62	2.31	11	—	60

⁴No data or not applicable.

¹Fleet (CV) and light (CVL) carriers only.

²Generally, complements of engaged carriers.

³Aircraft lost in the engagement to all causes (combat, operational, and loss of base), expressed as percent of aircraft engaged.

⁴Losses on attack sorties, expressed as percent of attack sorties.

⁵Overall Japanese losses divided by overall American losses.

⁶Army and Navy aircraft in Hawaii on 7 December.

⁷Statistics are presented for the major carrier-vs.-carrier strikes of 8 May only, although *Shoho* was sunk in preliminary encounters the previous day.

⁸Numerous discrepancies appear; these numbers are taken from Morison, IV, pp. 56-57.

⁹Including 36 which went down with *Lexington*.

¹⁰Carrier Striking Force only. The complements of 4 attack carriers were completely destroyed when they were sunk. Actual total Japanese losses at Midway were 332, including aircraft of the occupation force, according to Fuchida.

¹¹Including 11 which went down with *Yorktown*.

¹²These values appear to include approximately 20 operational losses; excluding these, 43 losses would be 25 percent of the attack sorties.

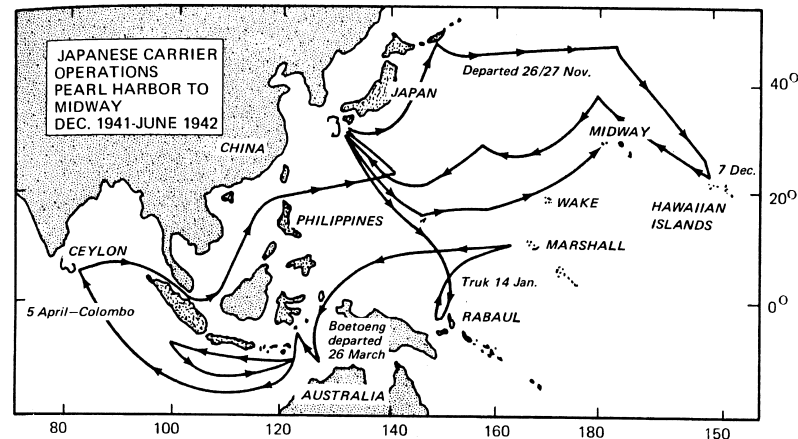
¹³Only one, *Hijo*, was sunk by air attack; *Shokaku* and *Taiho* were sunk by submarines.

¹⁴Morison, VIII, p. 320. By the end of the following day, the total lost had risen to 395 (95 percent).

¹⁵One hundred more aircraft were lost on 20 June, 80 of them operationally, in pursuit of the enemy.

¹⁶Includes 40 operational losses. Combat loss rate was 46/3030 = 1.52 percent.

¹⁷Claimed, including 341 in the air and 190 on the ground. By this time, however, a tendency to overestimate aircraft kills had developed.



Source: Morison, III, 385

FIG. 1: TRACK OF THE NAGUMO FORCE, THE JAPANESE CARRIER STRIKING FORCE, FROM PEARL HARBOR TO MIDWAY

The strike of the Nagumo Force in the area of Ceylon, and the sinking of the carrier *Hermes*, forced the British Eastern Fleet to retire to the western half of the Indian Ocean early in 1942, and the demands of the war in Europe dictated that the British would not be able to return to the battle in the Pacific in force until later in the war. But these sacrifices were not in vain, for the attrition inflicted on the crack pilots of the Nagumo force at Ceylon and elsewhere forced most of the ships to return to Japan to replenish their air groups with less seasoned aviators for the Battle of Midway.⁴

CHAPTER II

STEMMING THE TIDE: CORAL SEA AND MIDWAY

This chapter carries the historical narrative through the battle of Midway in June, 1942.

CORAL SEA

The Nagumo force returned to Japanese waters to replenish air groups depleted by attrition (fifty-five seasoned aviators had been lost at Pearl Harbor alone) and to refurbish its ships in preparation for a decisive battle at Midway in June.² At the same time two new carriers, Shokaku and Zuikaku, were being made ready for operation "Mo" -- a drive toward Port Moresby and Tulagi to gain supremacy in the Coral Sea.

The American intention to interfere with these plans was not the first attempt at counterattack-- Lexington had planned a strike on Rabaul on 21 February but was detected when 350 miles from its objective and aborted the mission³ -- but it was the first attempt to engage in a carrier-versus-carrier action. Japanese forces, built around Shokaku and Zuikaku, had about the same number of aircraft as Yorktown and Lexington but had higher proportions of fighter and torpedo types, in which they enjoyed superiority. The Zeke fighter (more popularly called the Zero) was designed for the Mitsubishi aircraft company in the 1930's by an Englishman named Smith, who had worked for Sopwith.⁴ It was considered superior to the American Navy's Wildcat (F-4F) in speed, maneuverability, and rate of climb. The TBD torpedo-bomber was slow and, because it lacked self-sealing fuel tanks, extremely vulnerable.

On the morning of 8 May 1942, in almost simultaneous strikes, all carriers were hit, including Lexington. The beginning of a change in loss rates is apparent as the Japanese lost more of their attacking aircraft (29 of 69, or 42 percent) than did the Americans (14 of 88 or 16 percent). (See table II.) But the damage to Lexington was mortal: she suffered internal explosions after disengagement and had to be abandoned with the loss of 36 planes and 216 men.

The Battle of the Coral Sea is interesting more for its pattern than for its decisiveness. The loss of Lexington made the battle a tactical victory for Japan; yet the Japanese advance was stemmed, and the costs of the small victory were substantial in foregone Japanese opportunities: Yorktown, repaired in 2 days, was able to participate in the battle of Midway less than a month later; Shokaku's damage required 2 months to repair and Zuikaku's depleted air groups

could not be reconstituted in time.⁵ Also, although the superiority of the Zeke was apparent, the Americans used radar (which in this case gave warning at 76 miles) and homing devices that greatly aided in recovering aircraft and keeping the American operational loss rate within bounds. The lack of such devices would hamper Japanese carrier aircraft operations throughout the war.

MIDWAY

The attempted Japanese amphibious assault on Midway, and the carrier air battle which ensued, were the result of the conviction of Admiral Yamamoto, Commander-in-Chief of the Japanese fleet, that he must annihilate the United States Pacific Fleet in 1942 or lose the war to American industrial productive capacity.⁶ He concluded that, despite the risks involved, the outcome could be successful if surprise were achieved.⁷ But the Japanese did not emphasize search, and the American forces were informed, through communications intelligence,⁸ of Japanese plans, preparations, and operations for almost a month in advance. (Admiral Spruance, writing in 1955, asserted that the American victory was based primarily on superior intelligence.)⁹ The Americans used land-based aircraft for searches and reserved carrier planes for attack.

Japanese forces, built around the 4 available fleet carriers, relied on battleship and cruiser float planes for search, and before finding the American carriers launched a 108-plane strike on the island early in the morning. A second strike of 108 aircraft was held in readiness to attack the American carriers. Attacks on the Japanese carriers by land-based bombers accomplished little, but 125 bombers and torpedo planes from all 3 U.S. carriers, escorted by 26 fighters, struck as the Japanese were respotting decks to recover their first strike, and delivered fatal attacks on Akagi, Kaga, and Soryu. Only Hiryu survived long enough to launch 2 attacks, one of 18 bombers and one of 10 torpedo planes, each escorted by 6 fighters. Both groups found Yorktown, and scored hits with 3 bombs and 2 torpedoes. A final strike by 24 bombers from Enterprise finished Hiryu.

The final score resulted in annihilation of the Japanese carrier force and frustration of the attack on Midway in exchange for the loss of Yorktown. Total Japanese aircraft losses, including float planes and planes being ferried in the carriers, exceeded 300; American losses of all kinds, including land-based planes, were about 150. Very few of the experienced Japanese aircrews, the cream of Japanese Naval aviation, survived: Hiryu, for example, lost 130 out of 150 flying personnel. Admiral Kondo, writing in 1951, stated:

"Our forces... suffered defeat—a defeat so decisive and so grave that the details, like the plans, were kept the guarded secret of a limited circle, even within the Japanese Navy..."¹⁰

An interesting sidelight on the Battle of Midway was the nature of Japanese planning. In late February, 1942, an elaborate and fairly accurate war game of the campaign at Midway was played on board the battleship Yamato in harbor. The initial results of the game were much the same as those of the actual battle, but the unsatisfactory outcome led senior officers to revise the umpiring rules, and a more optimistic outcome was reported to higher authority.¹¹

CHAPTER III

LICKING WOUNDS, 1943

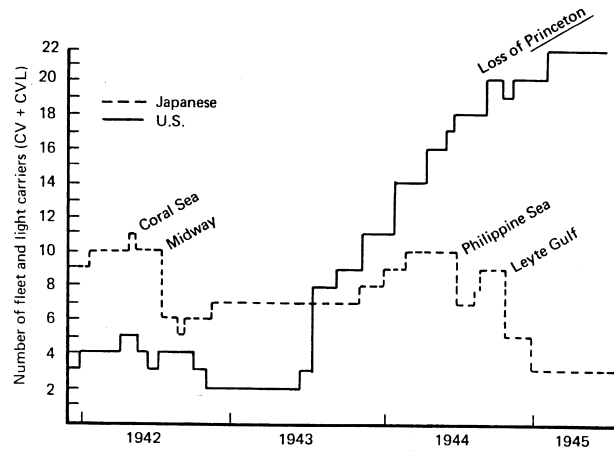
The Japanese disaster at Midway, and the very limited resources then available to the Allies, discouraged either side from seeking further major fleet encounters. The long, bitter struggle for Guadalcanal, August 1942 - February 1943, belongs to this period. There were some indecisive carrier engagements, such as the Battle of the Eastern Solomons, on 24 August 1942, in which Shokaku and Zuikaku challenged Saratoga and Enterprise; the major result was the sinking of light carrier Ryujo. Wasp was sunk on 15 September by a submarine while reinforcing Guadalcanal. On 26 and 27 October, Shokaku and Zuikaku, joined by the newly converted Junyo, succeeded in sinking Hornet at the Battle of Santa Cruz Islands. One of the hits on Hornet was a suicide crash by a crippled bomber. The U. S. Pacific Fleet was thus reduced to 2 carriers.

The year 1943 saw little carrier action, but the trends in aircraft experience were changing radically.

American aircraft were establishing superiority over Guadalcanal; during the week of 16 through 25 October, 1942, for example, 103 Japanese aircraft were shot down by American planes and 10 by anti-aircraft, at a cost of 14 U. S. planes.¹ The superior F-6F Hellcat and F-4U Corsair began to appear in numbers during March and April, 1943, and the slow and vulnerable TBD torpedo planes were replaced by TBF Avengers. The Zero remained superior to the P-40 in flying characteristics (but not pilot quality), but the Army Air Force began receiving P-38's, which had at least an advantage in altitude. However, Okumiya asserts that the greatest enemy of the Zero was the B-17, with the tremendous firepower available in large formations of heavily armed aircraft.²

In the absence of major carrier battles, the Japanese expended their carrier aircraft and pilots in land campaigns, largely in the Solomons. For example, in early October, 1943, Admiral Kogo (who became Commander-in-Chief on the death of Admiral Yamamoto) decided to support the 11th Air Fleet (of 200 land planes) with the 173 aircraft in the complements of Shokaku, Zuikaku, and Zuiho. The outcome of this effort was merely the destruction of those aircraft, for Morison notes that in the 2 weeks ending 11 November the Japanese carriers had lost 50 percent of their Zeke fighters, 85 percent of their Val dive-bombers, and 90 percent of their Kate torpedo planes at Rabaul (VI, p. 336). As a result of this sort of loss experience, all the Japanese carriers had empty decks by 5 November 1943, and all but one were in home waters.³ Comparable American losses are not available, but U. S. plane losses for the entire month of November, 1943, were 47 combat and 73 operational, or 14 percent (120) of the 831 aircraft available.

Thus the extensive Japanese carrier-building program, intensified after Midway, resulted in the delivery in late 1943 and 1944 of numbers of large carriers for which there were no qualified air groups. Several carriers were destroyed in 1944 with little effect. Figure 2, based on the examination in appendix A, shows the strengths of Japan and America in light and fleet carriers in the Pacific.



Source: Appendix A

FIG. 2: AIRCRAFT CARRIER STRENGTHS IN THE PACIFIC, 1941-1945

The loss of 4 carriers in 1942 meant that the United States was reduced to 2 carriers for over 7 months and did not gain numerical superiority until the arrival of the new Essex class fleet carriers and the light carriers in mid-1943. By the summer of 1943, over half the ships of the 5th Fleet were new.

HMS Victorious served briefly with the United States Pacific Fleet in 1943, when that force had only 2 American carriers, but did not see major action. Saratoga returned the favor early in 1944 by joining Illustrious for raids on Sumatra and Surabaya.

CHAPTER IV

HOW MANY CAN YOU LOSE?

One of the major factors leading to the introduction of the kamikaze attacks was the high rate of attrition suffered by Japanese aircraft in attacks on American ships and installations. This chapter offers some comments on the level of attrition which might be considered acceptable for sustained operations, shows some examples of attrition suffered by the Japanese in individual campaigns, and describes trends in the attrition statistics. Finally, the impact of attrition on Japanese aircraft force levels is indicated.

A number of offensive air operations in World War II have been analyzed in an attempt to determine what constitutes an acceptable level of attrition. Clearly, acceptability depends on the frequency of operations, their prospect of success, aircraft and aircrew replacement rates, and a host of intangibles. The analysis concludes:

- a. The frequently quoted World War II overall aircraft attrition rate of about one percent hides a number of occasions on which much higher loss rates, on the order of 5 to 10 percent, were accepted by operational commanders as the cost of sustained offensive operations.
- b. The acceptability of a 5 percent attrition rate seems to depend upon the availability of adequate replacements for losses.
- c. Attrition of 25 percent or higher has caused abandonment or major modification of sustained air offensive air operations, even though the operations had apparently been effective."¹

The analysis cautions further that "the inferences...are, of course, completely inapplicable to air operations which may be decisive after one or a few strikes, or in which desperation is a major factor."

The Japanese hope that each succeeding operation might be decisive is repeated often in the literature. Thus they tended to be willing to accept heavy attrition. And as operations became more costly, in terms of both attrition and strategic position, the Japanese became more desperate. Finally, attrition became so high that even conventional missions could be considered one-way trips, so that resort to kamikaze tactics appeared not unreasonable. The philosophy implicit in this decision is discussed further in chapter VIII.

Table III shows attrition rates in selected carrier operations from Pearl Harbor through early 1945. (The principal criterion for selection was the availability of statistics.) From the battle in the Coral Sea to the battle in the Philippine Sea, the forces were not unreasonably balanced; Japanese surprise at Pearl Harbor, and American numerical superiority after 1944, dominate other battle conditions. (Numbers of aircraft are given in greater detail in table II.)

TABLE III
ATTRITION RATES IN SELECTED OPERATIONS¹

Date	Campaign	Loss rates-percent				Exchange rate (Japan/U.S.)
		Japan		U.S.		
		Attack	Overall	Attack	Overall	
7 Dec 41	Pearl Harbor	8	7	—	—	0.23
8 May 42	Coral Sea	42	39	16	48	0.62
4 Jun 42	Midway	60	100	36	49	2.31
1 Apr 43	Solomons fighter sweep ²	31	—	15	—	3.0
5 Nov 43	Strikes on Rabaul	—	—	10	—	—
19 Jun 44	Philippine Sea	65	62	9	3	11.0
3-9 Jan 45	Formosa strikes	—	—	3	—	—
16 Feb 45	Japan strikes	—	—	12	—	60.0

¹Source: Table II of chapter I, except as noted.

²Morison, VI, p. 118; 58 Zeke fighters on a sweep engaged by 41 F-6F, F-4U, and P-38.

The statistics on aircraft lost per sortie on major strike missions are the most easily compared. The Japanese loss rate shows a steady rise during the war, to over 60 percent by mid-1944. The American loss rate fluctuates more widely but exhibits a fairly steady decrease to a few percent. The trends are more clearly visible in figure 3, in which the attack loss rate has been plotted as a function of time. The curves are freehand interpolations, drawn to illustrate the trends in these statistics.

The loss rates shown here are for major operations, and so are somewhat higher than overall rates for all combat operations. For example, a WSEG study examining all U.S. carrier-based experience in World War II notes that

"Losses naturally varied considerably with the intensity of operation and the character of the opposition. For fighters they ranged from 0.77 to 1.95 per 100 sorties and for attack planes from 0.87 to 2.90."²

Consistent with the trend in loss rates is the exchange rate, the ratio of total Japanese aircraft losses to total American aircraft losses in an operation. This ratio is plotted in figure 4.

These trends may be attributed to: (1) early Japanese superiority in numbers and quality of aircraft; (2) the declining quality of Japanese aviators, as the better-trained aviators were expended in combat and the amount and quality of pilot training deteriorated rapidly (see chapter V); (3) the stagnation of Japanese technology; (4) the growth to dominance of American technology in quality of aircraft

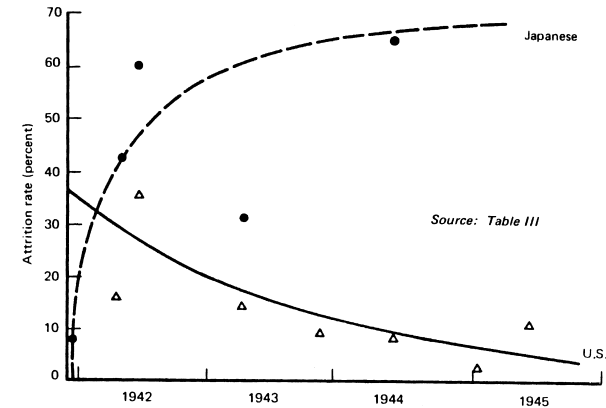


FIG. 3: ATTRITION RATES IN SELECTED OPERATIONS
(Attack sorties and losses)

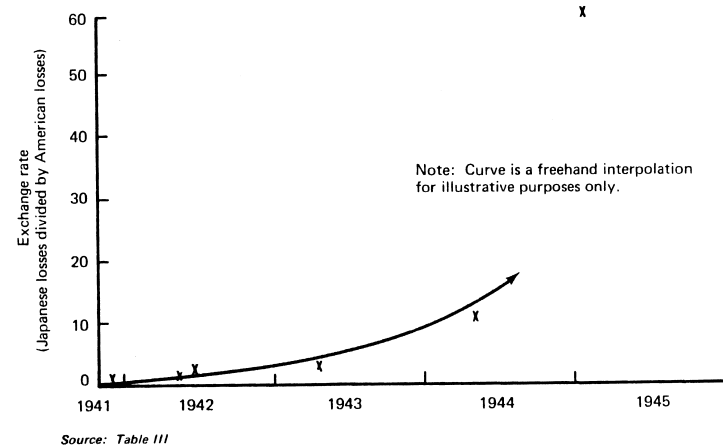


FIG. 4: TRENDS IN EXCHANGE RATE

and in such defensive measures as radar, homing devices, and tactics; and
 (5) American industrial capacity.

American productivity alone would not have caused these great gains, however, for the Japanese produced and expended tremendous numbers of aircraft during the course of the war. Overall, the Strategic Bombing Survey estimates Japanese aircraft losses as follows:

Inventory, 7 December 1941	7,500
Plus production through August 1945	<u>65,000</u>
Total	72,500
Less inventory 15 August 1945	<u>18,500</u>
Total "wastage"	54,000

The "wastage" is estimated to have been caused as follows:

Combat losses	20,000
Ferrying losses	4,000
Training losses	10,000
Other noncombat losses	<u>20,000</u>
Total losses	54,000

USSBS cautions that its estimates may be inaccurate by at least 10 percent.³

The agents (interceptors, anti-aircraft guns, etc.) that caused the Japanese losses are more difficult to establish than overall losses and loss rates, because claims are often conflicting. Clearly, however, most combat losses of airborne aircraft were to interceptors, and there were substantial numbers of noncombat losses. An attempt is made in chapter XIII to determine the exact contributions of defensive weapons to destruction of kamikazes. For the present, it is instructive to examine overall loss statistics.

Table IV shows total losses of the Japanese Army Air Force (as reported to the USSBS) in some detail. (Similarly detailed data are not available for the Japanese Naval Air Arm, nor for total losses.) These losses (23,835) can be divided into 3 roughly equal categories: combat losses (8,420), aircraft destroyed on the ground by Allied action (7,835), and noncombat losses (7,580), implying that 68 percent of losses were due to Allied action.

But USSBS finds Japanese estimates of the fraction of overall losses incurred in combat to be excessive, and instead estimates that only about 20,000 (37 percent) of the 54,000 Japanese aircraft were lost in combat⁴ (see table V). Even assuming that the Naval air arm had a higher operational loss rate due to operating over water with poor navigation equipment does not produce consistency between the results.

TABLE IV
 AIRCRAFT LOSSES OF THE JAPANESE ARMY AIR FORCE

	Lost to Allied action						Nonoperational by tactical units			Ferrying losses				Train- ing units	Grand total		
	Lost in combat			Destroyed on ground			F	B	O	Total	F	B	O			Total	
	F	B	O	F	B	O											F
Dec. 41-July 42	100	400	200	700	110	300	280	690	20	50	30	50	20	100	610	2,200	
Aug. 42-July 43	740	500	200	1,440	400	530	590	1,520	100	60	70	150	60	50	260	4,440	
Aug. 43-Mar. 44	500	500	200	1,200	200	570	370	1,140	80	50	60	120	80	40	240	3,240	
Apr. 44	70	10	20	100	200	100	400	30	10	20	60	50	20	20	90	800	
May 44-July 44	1,300	290	150	1,740	400	300	250	950	100	20	50	170	200	30	260	3,450	
Aug. 44	100	40	40	180	150	120	70	340	25	15	10	50	55	15	80	800	
Sept. 44	150	30	60	240	140	100	60	300	25	15	10	50	55	15	80	830	
Oct. 44	400	140	60	600	140	90	60	290	60	20	20	100	100	30	150	1,300	
Nov. 44	350	70	80	500	130	80	70	270	80	20	20	140	30	20	150	1,240	
Dec. 44	150	50	60	260	150	80	70	300	50	30	15	60	70	10	100	900	
Jan. 45	120	10	20	150	90	60	50	200	30	15	15	40	40	10	60	500	
Feb. 45	100	30	20	150	70	50	80	150	20	10	10	30	10	10	50	800	
Mar. 45	100	30	20	150	100	150	80	330	20	10	10	50	60	20	15	80	855
Apr. 45	250	80	100	430	60	90	50	200	30	10	10	50	40	10	60	700	
May 45	120	30	50	200	100	100	90	290	30	10	10	40	20	10	40	550	
June 45	90	20	40	150	70	70	60	200	20	10	10	40	15	5	10	300	
July 45	80	30	20	130	30	30	100	150	20	10	10	40	15	5	10	450	
Aug. 45	40	20	40	100	30	40	45	115	5	5	15	5	5	20	50	300	
Total	4,760	2,280	1,360	8,420	2,570	2,850	2,415	7,835	745	370	390	1,505	1,245	430	2,015	23,835	

Total combat losses 16,255
 Total noncombat losses 7,580

Note: F = Fighter; B = Bomber; O = Other.

Source: Furnished by JAAF.

Source: USSBS, Japanese Air Power, p. 33.

TABLE V

USSBS ESTIMATES OF JAPANESE AIRCRAFT LOSSES

	Combat	Other	Total
Solomons, Bismarcks, New Guinea, 7 Aug. 1942-15 Aug. 1945	5,500	4,500	10,000
Second Philippines campaign, 1 Sept. 1944- 31 Jan. 1945	4,000	5,000	9,000
Okinawa campaign, 18 Mar 1945-1 July 1945 ¹	3,000	4,000	7,000
Central Pacific, 7 Dec. 1941-15 Aug. 1945 ²	2,000	1,000	3,000
Defense of Japan, 7 Dec. 1941-15 Aug. 1945	1,450	2,750	4,200
Southeast Asia, 1 May 1942-15 Aug. 1945	1,200	1,000	2,200
China and Manchuria, 7 Dec. 1941- 15 Aug. 1945	1,200	800	2,000
Japanese advance, 7 Dec. 1941-30 Apr. 1942	800	300	1,100
Netherlands East Indies, 1 May 1942- 15 Aug. 1945	600	600	1,200
Midway and Aleutians, 1 June 1942- 15 Aug. 1943	250	50	300
Ferrying, 7 Dec. 1941-15 Aug. 1945	4,000	4,000
Training, 7 Dec. 1941-15 Aug. 1945	10,000	10,000
Total	20,000	34,000	54,000

¹Includes supporting operations against Kyushu and Formosa.

²Exclusive of Pearl Harbor and Midway.

Source: USSBS, Japanese Air Power, p. 34.

U.S. forces had generally superior navigation equipment and aircraft maintenance during most of the war, and still 58 percent of the 6779 U.S. carrier-based aircraft lost during the war were lost in operational accidents.⁵ (However, the U.S. combat loss rate was much lower than the Japanese for most of the war, so comparison of proportions is inappropriate.)

Overall, the effect of high attrition, both in combat and operationally, was disastrous to aircraft inventories. Data in chapter V show that the Japanese monthly production of combat aircraft was approximately 1/3 of tactical strength through most of the later years of the war, indicating the extent of wastage.

CHAPTER V

THE BATTLE OF RESOURCES

This chapter describes the military resources available to Japan during the course of the war. The discussion is divided into 5 parts, corresponding to 5 resources of interest: aircraft, pilots, aircraft carriers, other ships, and petroleum products. Japanese strength eroded in all these areas in the later years, but the shortages in pilot training and in petroleum products were especially important. Aircraft and ships, including aircraft carriers, continued to be available in numbers until the last moments of the war.

AIRCRAFT¹

The treatment of Japanese aircraft resources is divided into 3 sections: aircraft production, aircraft inventory, and a discussion of the distribution of aircraft by type.

Aircraft Production

Table VI shows Japanese aircraft production from 1930 to 1940, and table VII shows production by month from 1941 to 1945.

TABLE VI

PRE-WAR JAPANESE AIRCRAFT PRODUCTION

Year	Total aircraft
1930*	445
1931	368
1932	691
1933	766
1934	688
1935	952
1936	1,181
1937	1,511
1938	3,201
1939	4,467
1940	4,768

*Figures from 1930 to 1939 include estimates for certain manufacturers.

Source: USSBS, Japanese Air Power, p. 155.

TABLE VII
AIRCRAFT PRODUCTION, 1941-1945³

Country	Month	1941		1942		1943		1944		1945	
		Combat	Total	Combat	Total	Combat	Total	Combat	Total	Combat	Total
Japan	January	168	306	396	564	793	1,010	1,622	2,122	1,383	1,836
	February	193	339	393	580	819	1,049	1,628	2,199	999	1,391
	March	196	357	466	687	904	1,147	1,757	2,435	1,294	1,713
	April	210	367	465	646	950	1,141	1,806	2,473	1,256	1,567
	May	244	420	483	706	987	1,207	1,647	2,318	1,230	1,592
	June	245	426	458	639	978	1,217	1,809	2,541	966	1,340
	July	245	380	491	705	1,032	1,259	1,786	2,473	762	1,131
	August	292	435	485	678	1,154	1,418	1,748	2,346	372 ¹	496 ¹
	September	306	462	569	804	1,295	1,573	1,941	2,573	-	-
	October	317	510	632	886	1,337	1,662	1,809	2,371	-	-
	November	338	514	704	943	1,463	1,862	1,820	2,220	-	-
	December	426	574	793	1,023	1,694	2,148	1,685	2,110	-	-
Total		3,180	5,088	6,335	8,861	13,406	16,693	21,058	28,180	8,263	11,066
Germany	Total		11,766		15,556		25,827		39,807		*
United States	Total		19,433		49,445		92,196		100,752		*

*Not reported.

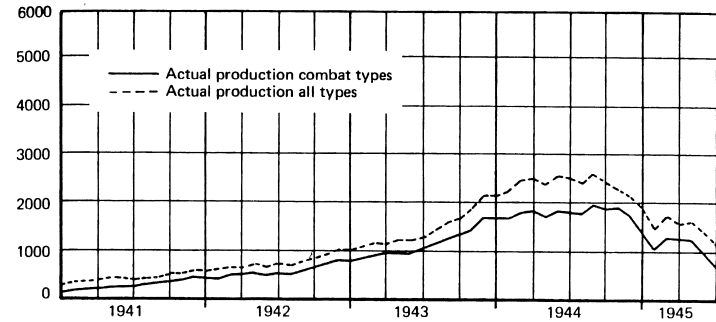
¹ Less than half month.

² Types included: fighter, bomber, reconnaissance, trainer, transport, flying boat, glider, and suicide, except the piloted bomb Baka, of which 755 were produced between September 1944 and March 1945 and 50 in June 1945.

³ Including gliders.

Source: USSBS, Japanese Air Power, pp. 155, 1.

The production rate was stable at about 700 aircraft per year from 1932 to 1935, but increased steadily from then until 1942, doubling in 1938, 1943, and again in 1944. By May 1942, the middle of the first year of the war, the monthly production had reached 700 units--the annual rate only 8 years earlier. The monthly rates of combat aircraft production, together with total production, are plotted in figure 5. By the middle of 1943, the Japanese aircraft industry was producing over 1000 combat aircraft per month, and by the middle of 1944, almost 2000 combat planes per month.



Source: USSBS, Japanese Air Power, p. 32

FIG. 5: ACTUAL AND PLANNED JAPANESE AIRCRAFT PRODUCTION, MONTHLY JAN 1941 - AUG 1945

Production began to fall off in the fall of 1944 for 3 reasons: (1) deteriorating economic conditions, in the face of drastically falling imports and the demands of war; (2) dislocations induced by the shift to underground aircraft construction space² and dispersal of surface production facilities; and (3) after December, 1944, United States strategic bombing and naval bombardment. However, USSBS estimates losses due to strategic bombing to have been only 18 percent of air-frame capacity and 43 percent of engine capacity,³ yet production continued above 1000 combat aircraft per month until June, 1945.

Almost half the production appears to have been for the Navy,⁴ which was concerned primarily with forestalling U.S. Navy advances in the Pacific. Table VII shows production of Japan, Germany, and the United States for the years

1941-1944; the United States produced more than its adversaries, but had to fight both simultaneously.

Aircraft Inventory

Early in the war, the Japanese Army Air Force concentrated in Malaya and China, avoiding flight over water, and the Navy was given responsibility for operations at Pearl Harbor and in the Philippines. From the first, the Navy deployed a large fraction of its combat-ready aircraft. Table VIII shows the deployment of Japanese Army and Navy aircraft on 7 December 1941. Note that only 163 of the Navy's 1300 aircraft (less than 13 percent) were in Japan. The best-trained pilots and aircrews deployed with the combat units.

TABLE VIII

PLANNED DEPLOYMENT OF JAPANESE AIRCRAFT, 7 December 1941

Unit	Aircraft strength	Employment
Army:		
3d Flying Division	550	Malaya
5th Flying Division	175	Philippines
1st Flying Brigade	150	China
1st Flying Division	50	Japan
2d Flying Division	450	Manchuria
Total Army	1,475	
Navy:		
Land-based:		
21st and 23d Air Flotillas	300	Philippines
22nd Air Flotilla	150	Malaya
24th Air Flotilla	150	Central Pacific
Ship-based:		
Main Carrier Force	414	Pearl Harbor
Carrier Division 4	50	South Philippines
Combined Fleet	73	Seaplanes attached to surface vessels
Miscellaneous	163	Japan
Total Navy	1,300	
Grand Total	2,675	

Source: USSBS, Japanese Air Power, p. 5

Japanese tactical strength on 7 December 1941 was 2675 aircraft, and monthly production was 426 aircraft, or 16 percent of inventory. By the beginning of 1944, monthly production had nearly quadrupled but the inventory had not quite doubled (see table IX).

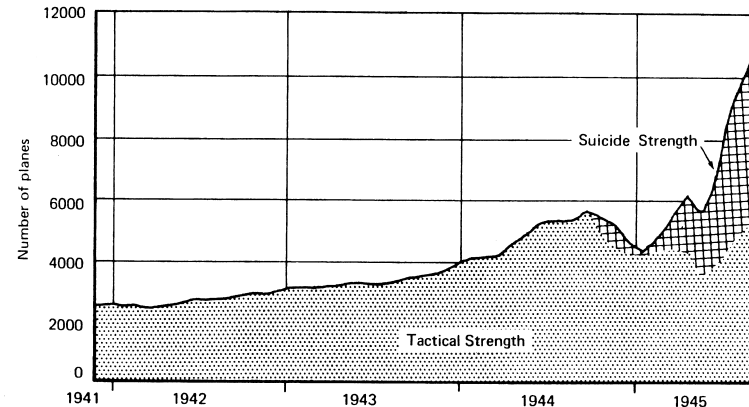
TABLE IX

MONTHLY PRODUCTION AS A FRACTION OF TACTICAL UNIT STRENGTH

Date	Strength	Monthly production	Percent
7 December 1941	2,675	426	16
1 July 1942	2,800	491	18
1 January 1943	3,200	793	25
1 July 1943	3,550	1,032	29
1 January 1944	4,050	1,622	40
1 July 1944	5,500	1,786	32
1 January 1945	4,100	1,383	34
1 July 1945	4,600	762	17

Source: USSBS, Japanese Air Power, p. 29

Through early 1945, the inventory, shown in figure 6, rose and dipped in response to similar changes of direction of the production. But the high loss rates, both combat and operational, took a heavy toll of the inventory, reducing it at one point to 2-1/2 months production.



Source: USSBS, Japanese Air Power, p. 33

FIG. 6: EFFECTIVE AIR FORCE; JAPANESE ARMY & NAVY AIR FORCES COMBINED (INCLUDING TRAINERS TRANSFERRED TO TACTICAL & SUICIDE USE)

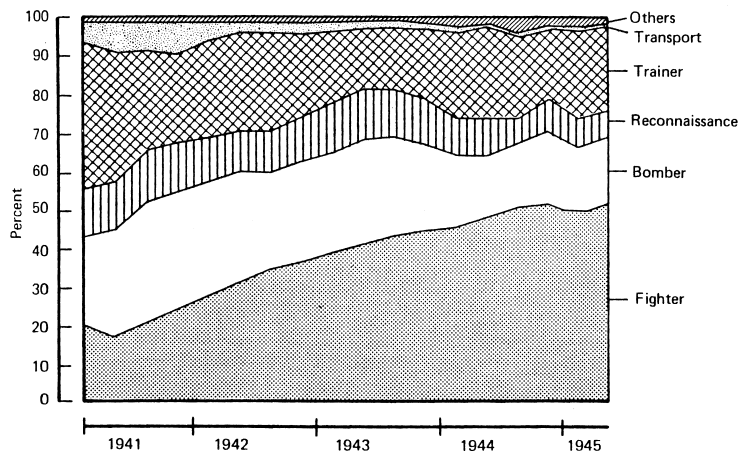
Shortages of aircraft and trained aircrews were particularly acute in the Naval air arm, which required specially trained pilots to fly the limited number of aircraft which could be accommodated on an aircraft carrier. The problem had already become severe by the middle of 1942, as the air groups of the Nagumo Force had been depleted by continuous action for several months (see chapter I). Fuchida notes:

"The problem of aircraft supply [prior to Midway] ...was... becoming increasingly serious. Every air unit was supposed to be equipped with reserve aircraft amounting to one-third of its regular operational complement. Actually, the vast majority of units not only had no reserve planes whatever but were below normal operating strength...even carrier RYUJO had not yet been equipped with Zero fighters to replace her outmoded Type -96 planes."⁵

Other operations, such as the "I" operation in April and May, 1943, appear to have been delayed or modified because of a shortage of aircraft,⁶ and by the end of the war Japanese planners thought of their assets in terms of aircraft coming off the assembly lines.⁷ But as figure 6 shows, the adoption of kamikaze tactics, and the diversion of noncombat types to the kamikaze role, artificially inflated the aircraft inventory in 1945.

Distribution of Aircraft by Type

The Japanese Army and Navy built 90 basic models of combat aircraft and 164 variations.⁸ Distribution by type is shown in figure 7.



Source: USSBS, *Japanese Aircraft Industry*, p. 69

FIG. 7: PERCENTAGE DISTRIBUTION OF JAPANESE AIRCRAFT BY TYPES BY QUARTERS

Two points are worth noting: (1) the proportion of fighter aircraft, which could be used as interceptors, escorts, or kamikazes increased; and (2) the fraction of trainers, which, at the end, provided cheap, easy-to-build, and easy-to-fly kamikaze aircraft, continued large.

PILOT TRAINING

A consequence of the pre-war decision to deploy the best pilots with the operational units was the steady erosion of quality as these pilots were lost and their replacements indifferently trained. Fuchida says of the Battle of Midway:

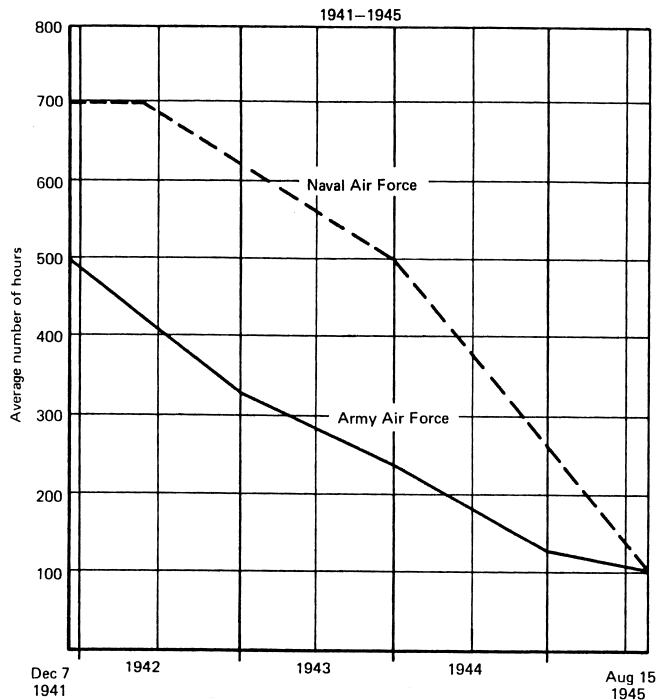
"Another important cause of Japan's defeat was what may be called the 'crack-man policy' of the Navy Air Force. Under this policy all our best pilots were assigned to and kept on combat duty with the carrier air groups. Opponents of the policy concluded that this was shortsighted and that some of the best and most experienced flyers should be sent to naval air stations as instructors to impart their wisdom and battle experience to fledgling students. But the crack-man policy had worked so successfully at Pearl Harbor and in the Indian Ocean that few, if any, pilots from the carriers were transferred to duty as instructors. As a result, there was no reserve of able pilots available to fill the ranks left vacant by losses in the Battle of the Coral Sea--none, that is, who were combat ready. The best replacement pilots available after Coral Sea required weeks of practical training in carrier take-offs and landings alone, plus additional weeks of training in combat techniques, before they would be ready for combat operations. This shortage of combat-ready pilots was the sole reason for Zuikaku's inability to take part in the Battle of Midway."⁹

The "crack men" were well trained for the time: figure 8, which shows average number of flying hours during the war, indicates that the pilots in the Japanese navy at first averaged 700 hours each. But early operations took their toll, and carrier air groups were essentially wiped out at Midway and again in the defense of Rabaul.¹⁰ By the Battle of the Philippine Sea, every U.S. Naval aviator had 2 years' training and over 300 hours flying time before flying from a carrier in combat; the 3 Japanese air groups, on the other hand, averaged 6, 3, and 2 months' training at that time.¹¹ By the end of the war, average Japanese experience had sunk to 100 hours. Pilots who were trained only for kamikaze missions had flown only 30 to 50 flight hours.¹²

AIRCRAFT CARRIERS

Japan began the war with 10 aircraft carriers (9 fleet carriers) to the United States' 7 (of which only 3 were in the Pacific).

The number, characteristics, and fate of Japan's aircraft carriers is difficult to establish, since otherwise reliable sources are often contradictory.



Source: USSBS, Japanese Air Power, p. 40

FIG. 8: DECREASE IN PILOT FLYING EXPERIENCE

Appendix A, based on a synthesis of the apparently more reliable sources, shows that Japan had 10 carriers on 7 December 1941 and completed 13 more of all types by the end of the war.

Despite Japan's aggressive use of carriers from Pearl Harbor to Midway, and the existence of others under construction, her shipbuilding program and even her tactical doctrine emphasized the surface fleet. The large fast carriers Shokaku and Zuikaku, employed at Pearl Harbor, had been laid down as part of the 1936 program, which included the 2 super-battleships Yamato and Musahi. The next major program, that of 1938, provided for only one fast carrier but 2 more battleships of the Yamato class. The 1939 and 1941 programs each included only one fast carrier (which would not be ready until 1944), although the 1939 program did provide for the conversion of 6 fast merchant ships.

The battle at Midway caused a drastic re-ordering of priorities. The third super-battleship Shinano was to be completed as a carrier and the fourth cancelled. Five large fleet carriers and 15 fast light carriers were planned, of which only 4 of the light carriers could be completed by war's end.¹³

The result of these machinations was that, while the United States completed a number of carriers in 1943, Japan's carrier construction program did not make itself felt until 1944--by which time aircraft and suitably trained pilots were unavailable. Thus Japan sacrificed her initial superiority and emphasized carrier construction too late; at the battle for Leyte Gulf, new carriers served merely as sacrificial decoys (see chapter VI). The strengths of the Japanese and American carrier forces in the Pacific are discussed further in appendix A, and summarized in figure 2.

OTHER SHIPBUILDING

While aircraft carrier construction is of greatest interest to this discussion, it is revealing to examine the construction of other types of ships. Table X shows the tonnage and number of ships delivered to the Japanese Navy for each fiscal year from 1930. (Aircraft carrier deliveries do not correlate exactly with those in appendix A, which should be more reliable.) Of interest are the large numbers of "special attack vessels" (suicide craft) delivered in 1944 and 1945. The resulting monthly production curve, figure 9 (which has been normalized to April, 1941 = 100) looks remarkably like the aircraft production curve (figure 5), including the bulge in 1944 for suicide boats, a substantial fraction of the "secondary fleet". But little was left of the major units at the close of the war. Allied forces sank 686 naval vessels totalling 1,965,646 tons (more than were produced) during the course of the war; of these, U.S. forces sank 611 (1,822,210 tons).¹⁴

OIL

During the pre-war years, Japan imported about 88 percent of all oil products consumed in the country, and 80 percent of the total came from the United States.¹⁵ Thus, when President Roosevelt issued an executive order on 26 July 1941 freezing Japan's assets in the United States and thus restricting

TABLE X
 TONNAGE AND NUMBER OF SHIPS, JAPANESE NAVY,
 PRIOR TO 1931, AND DELIVERED, BY FISCAL YEAR, 1931-45*

Class	Total prior 1931 ¹		1931 ¹		1932 ¹		1933 ¹		1934 ¹		1935 ¹	
	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number
Battleships	298,000	9	---	---	19,500	1	---	---	---	---	---	---
Carriers	92,500	5	---	---	---	---	7,400	1	---	---	---	---
Cruisers	149,000	25	9,850	1	29,550	3	---	---	---	---	17,000	2
Destroyers	86,050	73	5,100	3	8,500	5	2,738	2	5,472	4	---	---
Submarines	48,450	35	---	---	6,880	4	---	---	1,400	1	6,855	5
Coast defense	43,090	5	---	---	---	---	---	---	---	---	---	---
Transports	---	---	---	---	---	---	---	---	---	---	---	---
Minesweepers	1,840	3	---	---	1,135	1	443	1	886	2	---	---
Subchasers	3,690	6	---	---	---	---	984	2	984	2	452	1
Gunboats	---	---	---	---	---	---	600	2	---	---	---	---
Torpedo boats	---	---	---	---	---	---	1,581	3	527	1	---	---
Landing craft	---	---	---	---	---	---	---	---	---	---	---	---
Special attack vessels ²	---	---	---	---	---	---	---	---	---	---	---	---
Auxiliaries ³	203,920	---	7,600	---	7,750	---	17,675	---	7,500	---	7,800	---
Grand total all classes	929,940	170	22,550	4	73,304	14	31,419	11	16,769	10	32,147	8

Class	1936 ¹		1937 ¹		1938 ¹		1939 ¹		1940 ¹		1941 ¹	
	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number
Battleships	---	---	---	---	---	---	---	---	---	---	64,000	1
Carriers	---	---	10,050	1	27,000	3	10,060	1	9,500	1	74,000	5
Cruisers	---	---	17,000	2	8,500	1	8,500	1	11,600	2	800	1
Destroyers	6,840	5	17,340	12	1,500	1	13,000	7	16,000	8	18,160	9
Submarines	4,755	3	700	1	4,755	3	2,180	1	12,640	6	21,930	11
Coast defense	---	---	---	---	---	---	---	---	3,440	4	---	---
Transports	---	---	---	---	---	---	---	---	---	---	890	1
Minesweepers	4,400	1	---	---	720	1	3,040	4	3,760	4	7,760	5
Subchasers	492	1	---	---	1,260	2	1,260	2	---	---	1,260	2
Gunboats	270	1	---	---	1,450	5	1,160	4	1,320	3	5,720	13
Torpedo boats	---	---	---	---	---	---	320	1	1,310	2	990	1
Landing craft	2,380	4	2,380	4	---	---	---	---	---	---	---	---
Special attack vessels ²	---	---	---	---	---	---	---	---	---	---	---	---
Auxiliaries ³	---	---	7,890	---	18,404	---	18,738	---	35,135	---	24,649	---
Grand total all classes	28,049	15	55,360	20	63,589	16	58,248	21	94,705	30	225,159	49

Class	1942 ¹		1943 ¹		1944 ¹		1945 (April-July)		Total by class, 1931-45		Grand total by class	
	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number	Tons	Number
Battleships	64,000	1	---	---	---	---	---	---	147,500	3	445,500	12
Carriers	86,050	6	60,360	3	114,500	4	---	---	398,610	25	491,410	30
Cruisers	14,500	2	16,000	2	8,000	1	---	---	146,300	18	295,300	43
Destroyers	21,660	9	30,360	16	45,600	31	9,000	6	201,268	117	287,318	190
Submarines	26,676	22	49,016	40	53,580	37	14,930	22	206,266	156	254,716	191
Coast defense	3,760	4	26,730	32	87,730	111	14,400	18	136,060	169	179,150	174
Transports	---	---	6,840	7	61,100	57	6,280	5	75,110	70	75,110	70
Minesweepers	2,880	4	720	1	---	---	---	---	25,744	24	27,594	27
Subchasers	3,150	5	3,780	6	2,520	4	---	---	16,182	27	19,872	33
Gunboats	6,600	15	7,040	16	1,320	3	---	---	25,480	62	25,480	62
Torpedo boats	---	---	---	---	---	---	---	---	2,620	4	6,020	13
Landing craft	---	---	6,280	24	38,655	1,464	10,420	617	6,888	12	6,868	12
Special attack vessels ²	---	---	---	---	---	---	10,509	5,121	55,355	2,105	55,355	2,105
Auxiliaries ³	24,716	---	22,940	---	44,909	---	2,500	---	19,670	6,854	19,670	6,854
Grand total all classes	253,992	68	230,066	146	468,402	6,833	66,692	2,401	1,720,451	9,646	2,650,391	9,816

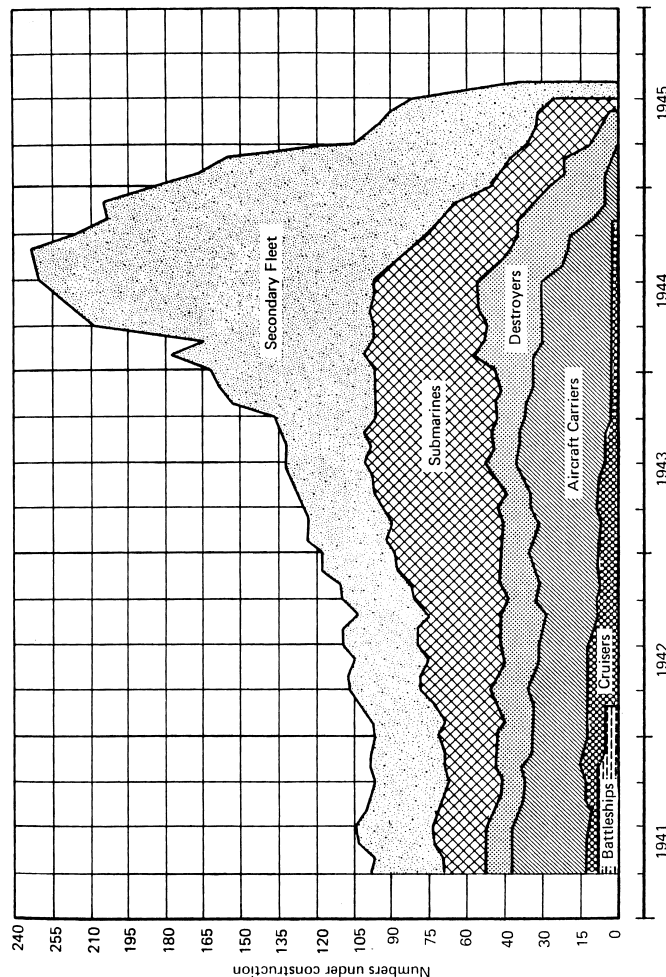
¹Fiscal year.

²Include Suicide Boat, S- and 2-man Submarines and the "Human" Torpedo. All Special Attack vessels were classified under Naval Ammunition—not ships—by the Japanese Navy.

³Estimated.

NOTE.—Over all table prepared from information received from Japanese Navy Ministry and Japanese Navy Technical Bureau.

*Source: United States Strategic Bombing Survey, Japanese Naval Shipbuilding, 1946 (page 15).



Source: USSBS, Japanese Naval Shipbuilding, p. 5

FIG. 9: NAVAL SHIP CONSTRUCTION BY PRIMARY FLEET TYPES, 1941 TO 1945 (1941=100), BY QUARTERS

her ability to import oil, he began a process which was to facilitate both Japan's declaration of war and her defeat in that war. For although she conquered oil-rich lands and developed oil substitutes, total inventories declined throughout the war (and in fact from 1938; see table XI). U.S. submarines sank numbers of tankers and severely reduced the flow of imports to the zone; production of substitutes never achieved adequate levels and caused problems in maintaining and operating aircraft. The overall fuel situation is exemplified by the availability and use of high-priority aviation fuel. Figure 10 shows the steady decline in aviation fuel stocks after the beginning of the war.

TABLE XI
PRODUCTION, CONSUMPTION, AND IMPORTS OF LIQUID FUELS
AND LUBRICATING OIL - INNER ZONE

Fiscal year quarter	Production (thousands of barrels)							Total products added to inventory	Consumption	Total inventories beginning of period
	Refined products imported	Refined products from crude oil	Refined oils from synthetic plants	Substitute fuels (alcohol, benzol, etc.)	Refined oils from synthetic plants	Substitute fuels (alcohol, benzol, etc.)	Total products added to inventory			
1931	13,303	4,675	0	52	0	52	18,050	14,930	7,527	
1932	14,868	6,245	0	53	0	53	21,166	18,276	20,586	
1933	15,077	7,275	0	75	0	75	22,427	19,422	23,603	
1934	17,181	8,955	0	97	0	97	26,233	22,665	26,609	
1935	20,633	10,006	0	127	0	127	30,766	28,592	28,919	
1936	18,739	10,337	0	115	0	115	29,191	27,699	31,095	
1937	16,651	12,323	31	219	31	219	29,224	28,927	32,595	
1938	14,044	12,809	69	264	69	264	27,186	27,951	31,891	
1939	11,818	11,247	133	601	133	601	23,799	25,261	31,156	
1940	15,110	9,352	146	1,308	146	1,308	25,916	28,558	29,680	
1941	5,242	14,114	1,164	719	1,164	719	21,239	22,648	28,036	
1942	2,378	13,993	1,403	1,278	1,403	1,278	19,052	25,794	25,883	
1943	4,652	14,141	881	1,145	881	1,145	20,819	27,780	18,488	
1944	3,334	7,537	1,116	962	1,116	962	12,949	19,401	11,462	
1945 (Apr.-Sept.)	0	1,041	169	723	169	723	1,933	4,582	4,751	

Source: USSBS, Oil in Japan's War, p. 27.

THE FAST CARRIER STRIKES AND THE MARIANAS TURKEY SHOOT

In this chapter we resume the historical narrative.

Three new carriers, Essex, Yorktown (second of that name), and the light carrier Independence conducted a strike on Marcus Island on 1 September 1943, ushering in the era of the fast carrier strikes. By 23 February 1944, the striking force had grown to 6 carriers for raids on the Marianas, which destroyed 168 Japanese aircraft at a cost of 6 American planes.

The pattern of the American thrust in the Pacific made it clear to Japanese planners that the Philippines could be the next target in the summer of 1944, and all available forces were to be committed in a desperate attempt to stem the American advance and the course of the war.¹ For this purpose the Japanese gathered 8 of their 10 light and fleet carriers, embarking 430 aircraft, and substantial additional forces. (There were about 43 float planes on surface ships, plus about 50 land-based aircraft on Guam.) The Fifth Fleet at this time contained 7 fleet carriers (including the venerable Enterprise and 6 of the Essex class), and 8 light carriers, carrying almost 900 aircraft, including nearly 500 fighters. The major units of the opposing forces are shown in table XII.

The battle began inauspiciously enough for the Japanese as the large carrier Taiho was sunk by a U.S. submarine on 18 June. Shokaku was sunk by a submarine on the 19th. That was the day of the great air battle which became known as the "Marianas Turkey Shoot." Although it is not possible to sort out from the various accounts the exact numbers of aircraft available for each function, especially with respect to American interceptors, some of the flavor of the outcome can be had from an examination of the first Japanese raid to reach the vicinity of the American force. At 0830, the van Japanese carriers (Chitose, Chiyoda, and Zuiho) launched 16 Zeke fighters, 45 Zekes configured as bombers, and 8 Jill torpedo-bombers, or almost their entire complement. The raid was detected on radar at 1000 while still 150 miles from the task force. At 1023 the force started launching interceptors (deck-launched interceptors (DLI) to reinforce the combat air patrol (CAP) already airborne. The Japanese orbited for 10 to 15 minutes while only 60 miles from the task force, providing additional time for reaction. Well over 100 interceptors must have been launched against this raid in the ample time available; Task Group 58.2 alone (1/4 of the American force) launched 50 interceptors. With these numbers and times, it is not surprising that 42 of the 69 Japanese attackers were destroyed, and that none succeeded in reaching the American carriers.

A second raid (129 aircraft including 48 fighters), launched at 0856 from Shokaku and Zuikaku, was detected at 1107 while 115 miles from the force. The interceptors first engaged at 1139 and may have destroyed about 70 of the intruders. More were shot down by anti-aircraft fire, and only 6 survived to reach the force, causing minor damage to Wasp and Bunker Hill. In all, 97 of the 129 aircraft failed to return.

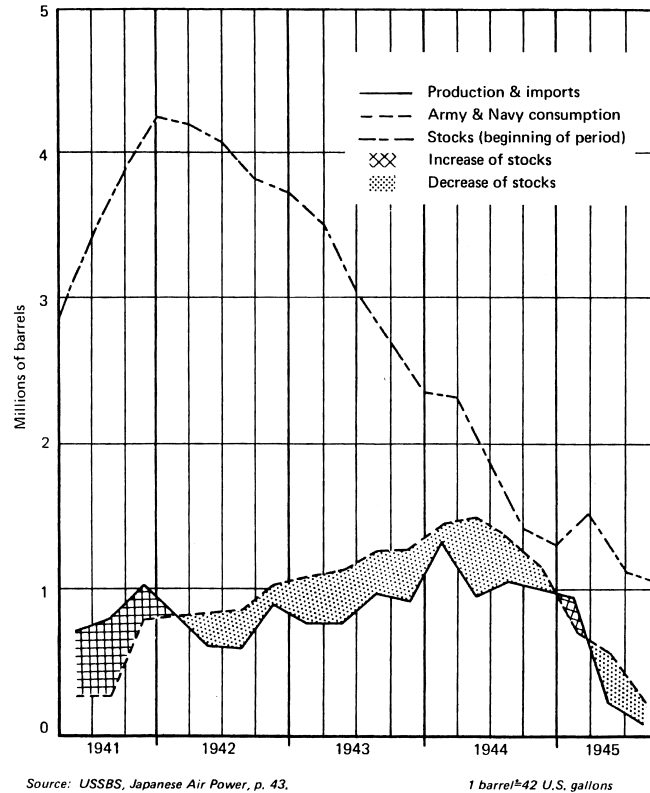


FIG. 10: JAPANESE AVIATION FUEL PRODUCTION, CONSUMPTION, AND STOCKS (JAPAN, KOREA, FORMOSA, AND MANCHURIA) BY QUARTERS

TABLE XII
OPPOSING FORCES AT THE BATTLE OF THE PHILIPPINE SEA

Country	Carrier	Fighters	Bombers	Torpedo planes	All types
Japan	Chitose ⁽¹⁾	62	--	26	
	Chiyoda				
	Zuiho				
	Taiho ⁽²⁾	79	77	51	
	Shokaku ⁽²⁾				
	Zuikaku				
	Junyo				
Hiyo ⁽²⁾	81	36	18		
Ryuho ⁽¹⁾					
Totals		222	113	95	430 ⁽³⁾
U.S.	Hornet	37	33	9	
	Yorktown	46	44	17	
	Belleau Wood ⁽¹⁾	26	--	9	
	Bataan ⁽¹⁾	24	--	9	
	Bunker Hill	42	33	18	
	Wasp	39	32	18	
	Monterey ⁽¹⁾	21	--	8	
	Cabot ⁽¹⁾	24	--	9	
	Enterprise	34	21	14	
	Lexington	42	34	18	
	San Jacinto ⁽¹⁾	24	--	8	
	Princeton ⁽¹⁾	24	--	9	
	Essex	43	36	20	
	Langley ⁽¹⁾	23	--	9	
	Cowpens ⁽¹⁾	23	--	9	
Totals		472	233	184	889 ⁽⁴⁾

Sources: Morison, VIII, pp. 416, 423 (Japan), 412 (U.S.)

(1) Light carriers

(2) Sunk in this operation

(3) Plus 43 float planes and perhaps 50 land-based

(4) Plus 65 float planes

So it continued through the day. Of some 373 Japanese sorties on the 19th, there were 243 losses (plus 22 planes which went down with Shokaku). U.S. losses on intercept and search missions on that day were 15 in combat and 2 to other causes. Thirteen more were lost in strikes on Guam.

When United States forces had finally located the Japanese carriers and come in range, 216 strike sorties were launched, and these aircraft succeeded in sinking Hiyo at a cost of 20 combat losses. But the extreme range and the darkness on return caused 80 aircraft to be lost operationally, so the total aircraft lost in 2 days — but not aviators — was 130. The Japanese had only 35 operational aircraft, out of 430, at the end.

A number of factors contributed to the American success. Air-search radar provided detection ranges to 150 miles. We employed large numbers of fighters --over 300 interceptor sorties on 19 June alone. Atmospheric conditions were of the sort that created vapor trails, simplifying the vectoring of interceptors. The gunfire of the massed battleships was effective against the few aircraft that got through the interceptors. And, finally, the Japanese airborne controller was heard and his instructions translated for American use throughout the battle.²

The Battle of the Philippine Sea was decisive in that it demonstrated the superiority of American air and showed the Japanese that they could not hope to win a conventional air battle. In fact, their carriers never again played a role except as decoys --and they began to be delivered in numbers as the earlier construction programs bore fruit. The hopeless state of Japanese naval air at this point set the stage for the introduction of the kamikaze.

CHAPTER VII

ADMIRAL OHNISHI AND THE FIRST KAMIKAZES

In blossom today, then scattered;
Life is so like a delicate flower.
How can one expect the fragrance
To last forever.

--Ohnishi, Kamikaze Special Attack Corps¹

INTRODUCTION

As was shown in chapters IV and VI, the attrition suffered by Japanese aircraft attacking U. S. Naval task forces by mid-1944 was so severe as to amount to annihilation. The pilot of a fighter or bomber could not expect to survive even a single raid. In the unlikely event that he could reach the task force to deliver ordnance, he would be unlikely to return home and even less likely to be able to penetrate to the task force again. Kamikaze tactics would assure that a pilot reaching the task force would inflict substantial damage; the idea seems to have been that since he was going to die anyway, he might as well make the sacrifice worthwhile.

In interrogations after the war, General Masahi, who supervised the design of the army suicide bomb, stated:

"When the degree of mastery of the air is equally divided between opposing forces, planes should be used for the purpose for which they were originally intended. However, when the strength of the enemy forces becomes overwhelming, it is scientifically more efficient to adopt kamikaze tactics."²

EARLY STAGES OF THE KAMIKAZE AND BAKA PROGRAMS

The first recommendations for the construction of a special-purpose piloted glide bomb may have come as early as late 1943.³ The Japanese Naval Air Research Development Center had instituted development of the baka bombs in August, 1944, and pilots had been selected for them before the first kamikaze attacks in October.⁴ (The baka bombs are discussed further in chapter X.) Thus the idea that the kamikaze program was initiated in response to requirements of the moment or in emulation of the example of Admiral Arima, who was reputed to have crashed a carrier on 14 October 1944,⁵ is apparently a fabrication.

The first kamikaze attacks, and indeed the entire kamikaze program, appear to have been guided by Vice Admiral Takijiro Ohnishi. To illuminate the origins of the kamikaze program, it is useful to follow his career briefly. Early in the war, Admiral Ohnishi was regarded by some in the Japanese Navy as second only to Admiral Yamamoto in aviation expertise.⁶ Yamamoto, who had conceived the idea of a surprise attack on Pearl Harbor, asked his chief of staff, Admiral Fukudome, to select "... a senior flying officer whose past career had not influenced him in favour of conventional operations. I want him to study this... problem in all its aspects." Fukudome chose Ohnishi, then a Rear Admiral, who undertook the planning almost a year before the actual attack.

In the summer of 1944, Admiral Ohnishi was Chief of the General Affairs Bureau of the Aviation Department in the Ministry of Munitions.⁸ As such, he must have been aware of the increasing superiority of American aircraft and pilots, of the many Japanese suggestions for suicide attacks, and of the development work on the Baka bombs.

It is unlikely, therefore, that Admiral Ohnishi intended to limit kamikaze attacks to those of the first unit, some 13 planes,⁹ as has been alleged.

On 17 October 1944, Ohnishi became primarily responsible for air defense of the Philippines against American invasion when he relieved Admiral Teraoka as Commander of the First Air Fleet at Manila. (At that time there were perhaps 30 serviceable Zero fighters in the Philippines.)¹⁰ On the 18th, Ohnishi and Teraoka met to discuss possible strategies for defense of the Philippines. There is some suggestion that Admiral Teraoka felt that they had then decided, despite his reluctance, that the kamikaze approach was required, solely on its merits in that situation, and that the idea was Ohnishi's.¹¹ Also, with difficulty, Ohnishi convinced Vice Admiral Fukudome, Commander of the Second Air Fleet, by the 26th.¹²

On 19 October, Ohnishi arrived at Mabalacat (Clark) Airfield and set about to form the first of the Kamikaze Special Attack Squads (Kamikaze Tokubetsu Kogekitai), to consist of Zeros carrying 250-kg bombs.

In 1281, 13 Kublai Khan led an armada against Japan. Just as it seemed clear that Japan would fall, a great typhoon arose and dispersed the mongol fleet. The Japanese saw in this typhoon the intervention of the gods, and credited the kamikaze, or "Divine Wind," with salvation of the empire. Thus it seemed appropriate to give the same name to suicide pilots when they were the last hope for the salvation of the empire in 1944 and 1945.

The first attempt to attack began on 21 October, when 6 Zeros had been readied. All were promptly destroyed on the ground by a flight of American Navy planes. Two more Zeros were hastily prepared, and launched, escorted by a third. One of the suicide planes became separated and did not return; the others could not find targets and returned to base.¹⁴ The beginning was generally

viewed as inauspicious, although the aircraft which did not return may have been the one that crashed the Australian cruiser Australia on that date, killing the captain and forcing the ship to withdraw for repairs.¹⁵

It is generally accepted, however, that the first successful kamikaze unit attack was one which occurred on 25 October. Six kamikazes,¹⁶ led by a Lt. Yukio Seki, struck an escort carrier group. Santee was damaged first, at 0740, and then Suwannee. Santee was also hit, in the confusion, by a submarine-launched torpedo, but both carriers were soon able to resume air operations.¹⁷

Later that morning at about 1050, a further attack by 5 aircraft was more successful. The carrier St. Lo was hit by a single kamikaze, a Zeke which crashed through the flight deck and caused detonation of bombs and torpedoes on the hangar deck. Explosions and fires followed, and the carrier sank less than an hour later. Kitkun Bay was also hit and damaged.¹⁸

Ohnishi was greatly encouraged by the early reports of successes,¹⁹ which included 3 hits on fleet carriers, and many attacks followed rapidly in the next week as aircraft assets became available. That Ohnishi's views may not have been universally acceptable, but that they were imposed nevertheless, is suggested by his narration of the Emperor's reaction and of his interpretation of it:

"When told of the special attack, His Majesty said, 'Was it necessary to go to this extreme? They certainly did a magnificent job!' His Majesty's words suggest that His Majesty is greatly concerned. We must redouble our efforts to relieve his Majesty of this concern.

I have pledged our every effort toward that end." ²⁰

Apparently the initial kamikaze attacks were not expected to be decisive but only to inflict temporary incapacitation, so that U. S. carrier forces could be destroyed by other means. The cynicism and contempt for the value of life and hope which underlie the calculation of per-sortie effectiveness and the command decision which followed it are no less unacceptable for the reasonableness of the calculation. These tactics were adopted by the Japanese at a time when it must have been clear to the high command that the war was moving irreversibly against them; yet by the end of the campaign over 2400 Japanese naval aviators had been expended in suicide attacks.

CHAPTER VIII

THE SUICIDE SPIRIT

It is beyond the scope of this study to seek a full understanding of the emotional and philosophical climate in Japan which permitted, and even perhaps encouraged, adoption of the kamikaze tactic. The notion of self-sacrifice is very much a part of any nation's view of heroism in war. Many posthumous decorations are given to those who chose, either premeditatedly or in the heat of combat, to sacrifice themselves to destroy an enemy or save a friend.

But the Japanese kamikaze program was something different. To wage an entire campaign as an exercise in mass, deliberate suicide had no precedent. Suicide and a peculiar sense of honor have held particularly interesting places in Japanese mythology and history. The hara-kiri, or ritual suicide in expiation of dishonor or defeat, is accorded a special place of honor in Japan, and finds no recent Western analog. The warrior, or samurai, is an object of respect in Japanese history and mythology, and his chivalric code, the bushido, finds a modern counterpart in the behavior of the kamikaze. Kuwahara, for example, argues:

"No real man ever wavered. . . In the tradition of the bushido (the samurai code of chivalry) he spoke of the glory of death, saying, 'I go to die for my country. It fills me with humility to have been selected by the emperor'." ¹

It is fashionable for modern Japanese writers, including some who were participants in World War II and spectators of kamikaze, to deprecate and ridicule the notions in retrospect and to suggest that they had reservations at the time. There does not appear to be evidence, however, that such opposition was ever expressed.

Kuwahara spoke of the attitudes at the beginning of kamikaze. The evidence on the enthusiasm of later "volunteers" is conflicting. Lieutenant General Kawabe, deputy chief, Imperial General Headquarters, said in 1945:

"The pilot did not start out on his mission with the intention of committing suicide. He looked upon himself as a human bomb which would destroy a certain part of enemy fleet for his country. He considered it a glorious thing. . . we had no shortage of volunteers." ²

Imperial General Headquarters issued an order, early in 1945, that all armed forces should emphasize suicide tactics. Yokoi argues, however, that this represented a change from the original kamikaze missions:

"Critics... should distinguish the completely volunteer flights of October 1944 from those made after this... outrageous and unprecedented order."

The United States Strategic Bombing Survey concludes that, by the end of the war, the "volunteers" were reluctant.⁴ The extent of the opposition of those selected, however, seems to have been limited to statements such as that made by one saved by the surrender that he was "saddened to tears at receiving the death sentence [although]... it is unmanly to say so."⁵ These sentiments do not seem to have been accompanied by large-scale refusals to fly.

CHAPTER IX

THE PHILIPPINES. ENTER THE KAMIKAZE

INTRODUCTION

The first kamikazes attacked on 25 October, and enjoyed substantial success, as discussed in Chapter VIII. Kamikaze tactics were further developed during the Philippines campaign, and many more kamikazes expended. This chapter discusses the prelude to the Philippines campaign, describes kamikaze airframes, pilots, and tactics, and mentions some of the statistics arising from the campaign. A fuller analysis that includes the Okinawa campaign is contained in chapter XIII. The kamikaze experience in the Philippines has been overshadowed by the more massive effort at Okinawa. But this exposure (by no means trivial, since 650 kamikazes were expended) allowed the United States Navy to develop tactics for countering the kamikaze which were to prove extremely useful at Okinawa.

LEYTE

The Allied landings at Leyte on 20 October 1944 apparently came somewhat earlier than the Japanese expected, for on 18 October the Japanese air strength in the entire Philippines area consisted of only about 70 Army and 35 Navy planes. Promised reinforcements were seriously deficient in training.¹ The Allies took no chances, however, and from 21 through 24 October escort carriers launched 855 sorties against airfields and aircraft in the area. The Japanese were able to mount a major raid on the 24th, but few of these planes reached their targets.

Perhaps the most interesting aspect of the early battle at Leyte was the great battleship action on the night of 24-25 October. This action was made possible because Task Force 38, with its 10 carriers, 6 battleships, and 607 aircraft, including 324 fighters, was decoyed to chase the Japanese carrier force. This decoy force included Zuikaku, 3 light carriers carrying only 116 aircraft, and the carrier-battleships Ise and Hyuga. The ruse worked, but all save Ise and Hyuga were sunk on 25 October,² and the surface action was an American victory. Save for a few units, this marked the end of the Japanese navy as an effective force.

As these major battles subsided, the kamikaze attacks began. The narrative of the first attacks was given in chapter VII. Individual attacks of modest size continued throughout the Philippines campaign; the most significant ships sunk were the escort carriers St. Lo and Ommaney Bay, but the toll of ships sunk and damaged was high. As many as 650 kamikazes may have been expended before the evacuation of aircraft from the Philippines in January 1945.³ The aircraft expended, and the damage they caused, are discussed at length in chapter XIII.

KAMIKAZE: AIRFRAME, PILOTS, AND TACTICS

The first kamikaze attacks were carried out using combatant Zero fighter planes, modified to carry 250-kg bombs. By this time, the Zero, only slightly modified since Pearl Harbor, was no longer the best fighter aircraft in the Pacific. U. S. Navy Hellcats (F-6F) and Corsairs (F-4U and FG) were superior, and American pilots better trained.

As time passed, other combat aircraft, and some obsolete combat types, were pressed into service, but Zeros continued to be the mainstay for both kamikaze and escort functions. The characteristics of some of these aircraft are shown in table XIII.

TABLE XIII
SOME JAPANESE NAVAL COMBATANT AIRCRAFT USED
ON KAMIKAZE MISSIONS

Name	Zeke (Zero)	Val	Kate
Type	Type Zero Mk-1 Fighter	Type 99 Mk-1, 2 Dive bomber	Type 97 Mk-3 Torpedo bomber
Cruise speed (mph)	240	190	166
Range (miles)	790	1095	1060
Ordnance	2 - 20mm guns 2 - 7.7 mm guns	1078 lbs bombs 3 - 7.7mm guns	1-1760 lb torpedo 3 - 7.7mm guns

Source: Morison, III, p. 94n.

Pilots for the first attacks were apparently the regular pilots of one of the better combat squadrons who had been selected to initiate the program. One of the young pilots undergoing better-than-average training at the time said of the fighter training curriculum:

"The course was stringent, involving gunnery, air maneuvers, and suicide practice. The latter entailed diving at the control tower from specified heights, and was the most difficult part of flying because of the psychological effect--the idea that we were practicing to die. It was taken for granted that any pilot with a disabled plane would die in true samurai tradition provided he couldn't make it back to home territory. He would dive into an enemy ship or plane, taking as many of his adversaries with him as possible."⁴

Later, conventionally trained fighter pilots would be saved for escort missions, and units of novices "specially trained" for kamikaze would be used for the suicide missions. Pilots in these special units averaged only 30 to 50 hours of flight training--barely enough to perform the suicide mission.⁵ Due to the level of training, few kamikaze missions could be flown at night.

Suicide tactics were generally simple, and became more so as training levels declined. Initially, a kamikaze attack consisted of 5 or 6 aircraft: 3 kamikazes and 2 or 3 escorts.⁶ Later, at Okinawa, massed attacks were used in an attempt to saturate defenses.⁷ The escorts, whose primary mission was to decoy interceptors, were ordered not to engage if engagement would result in their falling behind the kamikaze aircraft. When kamikazes and escorts were of similar performance, as when both were Zeros, this instruction meant that escorts could not be aggressive.⁸ The tactic also explains in part the behavior which American pilots found curious. For example, even earlier, in the battle of the Philippine Sea, one officer reported:

"... the enemy planes seemed to have no formulated defense tactics. The bombers mostly scattered, rendering themselves vulnerable, and the fighters did not appear to cover them, but went into individual... maneuvers... to escape the Hellcats."⁹

Carriers were to be primary targets, and the aim point was to be an elevator.¹⁰ At Okinawa the Japanese Navy was ordered to concentrate on warships, and the Army on transports.¹¹ However, especially in the Okinawa campaign, poorly trained pilots, possibly already engaged by CAP, often aimed at the first sizeable ship they came to, which generally turned out to be a radar picket destroyer.

CHAPTER X

OKINAWA, I: PRELUDE AND BATTLE

Capt. Inoguchi describes tactics as follows:

High: Cruise at 6000-7000 meters, then, on sighting the target, go into a shallow (20°) dive, so as not lose control, to 1000-2000 meters, and finally a steep, terminal 45° - 55° dive to the target.

Low: Fly all the way at 10 - 15 meters, and then pop up to 400-500 meters for a final dive.¹²

USSBS found most terminal dive angles between 20 degrees and 45 degrees. There was little evidence of evasive maneuvering in the final dive. One analysis of tactics showed that, to maximize their effectiveness, kamikazes

"should crash the ship in a low dive (20° or less), fast (over 300 mph), and on the ship's beam.

When these optimum tactics were employed, 47 percent of the planes hit their targets. When tactics other than the optimum were employed, only 35 percent of the planes hit their targets.¹³ Note, however, that the hitting process is there defined to include not being shot down by AA; thus the effects of maneuver and defensive fire are compounded.

Another interesting aspect of Japanese bomber tactics in the Philippine Sea, and of kamikaze attacks later, was the tendency to orbit for as much as 10 to 15 minutes, in sight of the target carrier, to reform and select targets. Valuable additional time was thus provided for defense interceptors to be launched and vectored to engagement.

INTRODUCTION

After the failure of the defense of the Philippines, even using kamikazes, much of the original justification for the kamikaze effort was gone — especially the idea that the kamikazes would reduce the effectiveness of American carriers by crashing on their decks so that they could be destroyed by the Japanese surface fleet. Nonetheless kamikaze attacks continued, and were in fact the mainstay of plans for the defense of Okinawa¹.

This chapter describes events leading up to the battle for Okinawa, and discusses the nature of the kamikaze attacks there. The history of involvement of British carriers is also detailed, to suggest how different approaches to ship construction resulted in different experience with ship vulnerability. In subsequent chapters, other aspects of the Okinawa campaign are discussed: the introduction of the piloted glide bomb *baka* (chapter XI), defensive tactics adopted by the Americans (chapter XII), and effectiveness of attack and defense (chapter XIII).

FROM LEYTE TO OKINAWA

During this period the Third and Fifth Fleet carriers, with their complements including more and more fighters, established new patterns of operation, emphasizing fighter sweeps over enemy airfields. For example, during the period 14-16 December 1944, carrier aircraft flew 1427 fighter and 244 bomber sorties, a total of 1671, over airfields in the Philippines, and claimed destruction of 270 aircraft, including 208 on the ground. By this time such claims began to acquire the optimistic quality which they have enjoyed since, but Morison quotes one estimate that the actual number destroyed was over 170 (XII, p.57). In the course of this operation, 27 American planes were lost in combat and 38 to other causes.

On 5 January 1945, a group consisting of *Enterprise*, *Independence*, and 6 destroyers was formed to take advantage of radar and conduct flying operations at night. On 9 January, General LeMay's B-29's began bombing Japan. On 16 February the Fifth Fleet conducted the first carrier-based strikes on Japan. Eleven fleet and 5 light carriers, carrying over 1300 aircraft, were escorted by 7 battleships and battle cruisers, 14 cruisers, and 77 destroyers. Half of the air groups were on their first combat sortie. But even so, they flew 2761 sorties, 738 engaged with the enemy, and lost only 60 aircraft in combat and 28 to other causes, while claiming the destruction of 500 Japanese aircraft.

PRELUDE TO OKINAWA

By the beginning of 1945, the Japanese Navy still looked powerful on paper. There were still a few carriers, (but only 48 aircraft for them), and 6 battleships, one of them the mighty Yamato. There were 44 submarines, capable of doing substantial mischief, but Japanese submarine deployment had never been aggressive, and they contributed little. During the preliminary strikes on Kyushu in March, a single dive bomber scored a hit on Franklin that caused the greatest damage to a carrier that remained afloat. (She never returned to service). This was the last instance of crippling damage to a major fleet unit by orthodox Japanese air attack.

But the kamikaze had become the greatest concern. Churchill notes that, going to Yalta in January 1945:

"Mr. Roosevelt... was concerned at Japanese suicide attacks in the Pacific, which meant constantly losing forty or fifty Americans for one Japanese, and he was not very hopeful about an early end of either war."²

And for the defense of Okinawa, the Japanese planned to commit all of their remaining sea and air power, with emphasis on suicide attacks. Aircraft were massed on Kyushu and Formosa. Although they knew that Okinawa would be the next objective, Japanese planners were not aware that the landings would begin as early as 1 April.

One of the factors contributing to this ignorance, and to the continuation of the kamikaze attacks, was the inflated claim of damage inflicted. Damage assessment was performed by fighters escorting kamikaze aircraft, but the primary concern of these fighter pilots appears to have been to preserve themselves from destruction by CAP. These exaggerated claims of destruction caused the Japanese to underestimate subsequent U.S. capability. Thus the massive kamikaze attacks at Okinawa did not begin until 6 April 1945, after the landings of 25 March had been completed. By that time a beachhead had been established and the most vulnerable phase of the amphibious operation was over.

FLOATING CHRYSANTHEMUM

The essence of the plan for the defense of Okinawa, called Operation TEN-GO, was to launch a series of mass kamikaze attacks, called kikusui (floating chrysanthemum), to saturate Allied defenses and destroy shipping in the amphibious area. The first and largest attack, over 6 and 7 April, encompassed 355 suicide sorties, plus almost as many reconnaissance sorties and escorts. Figure 11 shows the distribution of suicide sorties during the campaign; the peaks correspond to the kikusui attacks. Although the threat was constant, these 10 concentrated attacks included more than 3/4 of all suicide sorties.

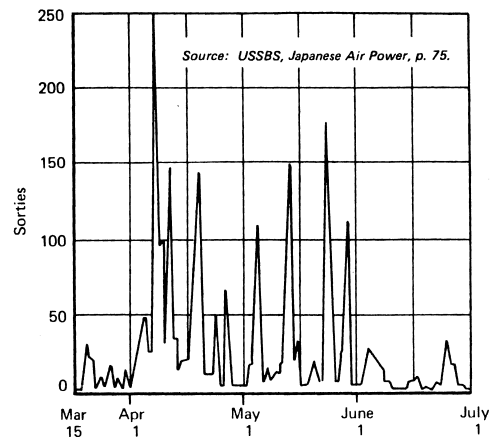


FIG. 11: SUICIDE SORTIES DURING RYUKYUS CAMPAIGN ARMY AND NAVY COMBINED MAR 1945-JUNE 1945 (24-Hour Periods)

The attacks were massed in time in the sense that they occurred within hours and in place in the sense that they all attacked the forces off Okinawa. But they were far from simultaneous: the first was spread over a 36-hour period.

The fate of individual missions is difficult to establish. Table XIV shows the total suicide sorties in each of the kikusui attacks and indicates the number of ships sunk and damaged. But the totals of ships sunk in these attacks (as given by USSBS) - 11 - do not seem to be consistent with the total of ships sunk by suicide planes in the campaign - 25 - since kikusui dominate the total kamikaze sorties.

Morison's narrative is useful in regard to terminal defense and hits received, but rarely is he able to determine the results of all aircraft in a raid. An exception is an attack on 14 May (not part of the kikusui), in which of 26 kamikaze sorties, 19 were splashed by CAP, 6 by anti-aircraft, and one penetrated to crash the deck of Enterprise, which was put out of action. But this result cannot be typical, as a much higher fraction of all sorties obtained hits or near misses.

TABLE XIV
KIKUSUI MASS SUICIDE ATTACKS AT OKINAWA

Kikusui		Suicide sorties			Allied ships	
Number	Date	Navy	Army	Total	Sunk	Damaged
1	6-7 Apr	230	125	355	4	24
2	12-13	125	60	185	1	14
3	15-16	120	45	165	1	9
4	27-28	65	50	115	0	9
5	3-4 May	75	50	125	3	14
6	10-11	70	80	150	0	5
7	24-25	65	100	165	1	9
8	27-28	60	50	110	1	6
9	3-7 Jun	20	30	50	0	7
10	21-22	30	15	45	0	5
Total:		860	605	1465	11	102
Additional suicide sorties between mass attacks		140	45	185	*	*
Suicide sorties from Formosa		50	200	250	*	*
Grand total		1050	850	1900	25	*

* Not available.

Sources: Inoguchi, *Divine Wind*, p. 151, and USSBS, *Air Power*, p. 23, give sorties per kikusui attack, and agree; USSBS gives additional sorties, and Inoguchi states damage. USSBS gives a total of 279 hits and near misses for the 1900 sorties. On p. 67, USSBS divides this total into 182 hits and 97 damaging near misses. The distinction between number of hits and number of ships hit obscures certain comparisons.

The determination of the human kamikaze pilot to press his attack home caused great damage. The experience of Oberrender, a destroyer escort on anti-submarine patrol off Okinawa, illustrates that a ship could sustain mortal damage despite early warning, timely radar and visual detection, and even destruction of the attacking kamikaze! The following narrative, condensed from the ship's Action Report by a destroyer officer who had studied the engagement, is quoted in Roscoe's United States Destroyer Operations in World War II, p. 480.

"On 9 May OBERRENDER was patrolling on A/S Screening Station No. A-34-A off Okinawa. At 1840 her crew was called to GQ when enemy planes were reported over the inter-fighter director circuit to be in the vicinity. At 1844 an enemy plane was reported 34 miles away. Several more reports were received on this plane. OBERRENDER picked it up on her SA radar at 16 miles and plotted it in to 1.5 miles. At 1850 flank speed of 24 knots was rung up. At 1852 the plane was picked up visually, bearing about 260°, range about 9,000 yards, altitude 18,000 feet, position angle 35°. The sun was near the western horizon at this time, and the atmosphere was very clear, although visibility of the plane was impeded somewhat by the fact that it was approaching out of the west. At about the time OBERRENDER sighted the plane, it started a power dive for her at an angle of descent of about 35°. The ship was put in a hard left turn and fire was opened with both 5-inch guns. The 40mm guns opened fire at about 4,000 yards range. Almost immediately after these guns opened fire, a 40mm shell hit the engine of the plane at a range of about 3,000 yards and 40mm shells appeared to be registering hits from there in. At about 2,000 yards a 5-inch burst seemed to loosen the port wing. It was flapping from there in to about 250 yards, when it came off the plane altogether. Guns 21, 23, 25, 26, and 27 opened fire at about 1,500 yards. Guns 29 and 30 were not able to fire as the after 5-inch gun was firing right over them. As the plane closed in, the ship had swung around sufficiently far in the turn to bring it well back on the starboard quarter, almost dead aft. When the wing came off, the plane swerved somewhat to the right, but not quite enough to miss the ship altogether. It hit the gun platform of Gun 25 a glancing blow. The port wing, which was floating clear of the plane, hit the after fireroom uptake just below the stack, doing slight damage. The plane was on fire and smoking badly for the last 2,000 or 2,500 yards. Guns 25 and 27 continued firing until the plane actually hit Gun 25, and they were getting hits. The plane itself did little damage other than demolish the gun bucket of Gun 25. What is believed to have been a 500-pound delayed-action bomb apparently went through the main deck a few inches inside the starboard gunwale, and the bomb went off in the forward fireroom, causing very heavy damage in the amidships area of the ship. At 1940 a patrol craft -- PCE(R)855 -- came alongside and remained there until all serious personnel casualties had been transferred to her. At 2045 the tug TEKESTA passed a line and towed OBERRENDER into Kerama Retto."

Eight officers and men of Oberrender were killed and 53 wounded in this action. At Kerama Retto, technicians found her beyond repair, and she was stricken from the register on 25 July.

The gravest damage to a carrier in the Okinawa campaign was received by Bunker Hill, hit by 2 kamikazes on 11 May. A Zeke crashed into the carrier and fell over the side after doing little damage. But just before impact, it had released its bomb, which fell through the flight deck to explode on the hangar deck. Then a Jill crashed the flight deck near the island, and portions of the plane penetrated to the hangar deck. It, too, released its bomb, which exploded in the gallery deck. There were large fires, and high casualties: 396 killed or missing. The ship was saved but never returned to combat.

WILLOW AND WHITE CHRYSANTHEMUM

It soon became apparent that using the best combat aircraft and combat-ready pilots for kamikaze missions resulted in further depletion of those already scarce resources. Thus, in 1945, increasing use was made of Shiragiku (white chrysanthemum) monoplane and Willow biplane training aircraft. Navy trainers apparently had performed kamikaze missions as early as 24 May 1945, and both Army and Navy made plans for their extensive use in the final defense of the Japanese homeland.³

Data in chapter V show that converting training planes to kamikaze missions greatly increased the assets available to the Japanese, and the numbers alone would have posed a serious threat to invasion forces. Individual aircraft effectiveness would doubtless have been even further reduced, as the slower, more lightly constructed trainers were even more vulnerable than combatants to defensive CAP and AA. The nature of some of these efforts, and a reason for their reduced terminal effectiveness in later battles, is suggested by their ordnance load. Both in the Ryukyus and in the defense of the homeland, trainers carried from 250 to as little as 50 kilograms of bombs. Extra fuel was carried, and hand grenades were sometimes piled around the pilot in the cockpit. The serviceability of trainers and other older aircraft was never very good, and, according to one of the Army officers in charge, was never more than 50 percent and often 20 percent in Japan.⁴

SUMMARY OF RESULTS AT OKINAWA

In all, Japanese Army and Navy pilots flew 1900 kamikaze sorties in the Okinawa campaign, plus many more conventional sorties. USSBS gives total Japanese combat losses as 3,000 aircraft, and total losses to all causes as 7,000 aircraft. In this campaign, lower Japanese training levels, inferior aircraft, and improvements in American tactics and equipment caused reduced kamikaze effectiveness

per sortie, when compared with the experience at Leyte. However, many more kamikaze sorties were flown, and as a result more Allied ships were sunk and damaged at Okinawa.

AN AMERICAN ATTACK

An interesting sidelight to the campaign is the fate of the Japanese battleship Yamato, largest in the world. She sortied from Japan on 6 April, the day of the first kikusui attacks, with only enough fuel for a one-way trip to the Okinawa area. She was discovered by search planes from Task Force 58 on the 7th, and attacked that day by 386 aircraft, loaded as follows:

180 fighters, each carrying three 500-lb bombs,
75 dive-bombers, each carrying one 1000-lb
semi-armor-piercing bomb, plus two 250-lb
general-purpose bombs, and
131 torpedo planes, each carrying one torpedo.

Fifty-three of the planes failed to find the target, but the remainder managed to place 10 torpedoes and 5 bombs in Yamato, sinking her, a light cruiser, and 4 of the 8 destroyers accompanying her, all at a cost of 7 aircraft. The disparity between this performance (essentially in the absence of air opposition) and that of the kamikazes is striking.

THE BRITISH CONTRIBUTION

Towards the end of 1944 the British could consider sending a major force to the Pacific. There appears to have been some reluctance at American staff levels, and consequent annoyance among the British, over the subject of British participation.⁵ The difficulties may be traced to problems of logistics. The conduct of fast carrier task force operations over broad expanses of ocean far from home bases requires extensive logistic support, and United States fleet logistics in the Pacific, though superb, did not have excess capacity. Thus, when joint staffs agreed that the British Fleet should participate, and reported so to the President and the Prime Minister on 16 September 1944, it was also agreed that the British should provide all their own support. This proved to be a considerable task, because the British were unaccustomed to operations far from base, but they organized and deployed a substantial fleet train in time for major operations early in 1945.

The British conducted some modest bombardments in October 1944, with 2 carriers and the battleship Howe. The larger British Pacific Fleet did not sortie from Australia until 18 March 1945, but its experience with kamikaze aircraft began earlier. On January 6, a kamikaze crashed the bridge of New Mexico, killing Lieutenant-General Lumsden, Churchill's personal liaison with General MacArthur, and several others. Admiral Fraser, Commander of British forces in the Pacific, escaped by moving to the other side of the bridge only moments earlier.⁶

CHAPTER XI

OKINAWA II: THE BAKA

The British carrier task force, initially designated Task Force 113, consisted of over 250 aircraft aboard the fleet carriers Indomitable, Victorious, Illustrious, and Indefatigable, the modern battleships King George V and Howe, 5 cruisers, and 15 destroyers. It was supported by an extensive service squadron designated Task Force 112. Later in the campaign, the carrier force was joined by Formidable and more escorts and was redesignated Task Force 57 to reflect its close relationship to the American Fifth Fleet. Still later, after 16 July 1945, Task Force 57 operated as the fourth carrier task group under Admiral Halsey, when damage from kamikaze attacks had reduced American carrier strength.

Task Force 57 conducted its first strikes on March 26 off Formosa. Kamikaze attacks began on 1 April. A fighter sweep, launched at 0640, was diverted when radar picked up Japanese aircraft at 0650, some 75 miles from the task force. The fighters shot down 4 kamikazes, but a number penetrated to the force. More were shot down, but one crashed the flight deck of Indefatigable at the base of the island. The damage was quickly repaired, and flight operations continued on a reduced scale. Another Japanese plane in the same raid got a near-miss with a 500-lb bomb on destroyer Ulster, which lost power and had to be towed home. Formidable and Indomitable were hit on 4 May, and Victorious (twice) and Formidable (again) on 9 May.

Morison notes of the 4 May attack on Formidable that the flight deck was "holed" at 1131, and large fires started on the flight deck, but that the hole had been repaired and aircraft could be recovered by 1700. He observed further that

"The armored flight decks of British aircraft carriers, which American ship planners disliked because the weight affected stability and reduced the number of planes that could be carried, proved their value in these actions. A kamikaze hitting a steel flight deck crumpled up like a scrambled egg and did comparatively little damage, whilst one crashing the wood flight deck of an American carrier usually penetrated to the hangar deck and raised hell below."⁷

Only after the hit on 9 May was Formidable forced to withdraw, and then only because she had lost so many planes in combat and in fires on the flight deck that only 15 remained. She was back in action 3 days later. (American carrier air groups were replenished from escort carriers moving with the replenishment groups).

During its first period in action, 26 March through 25 May, the British Pacific Fleet flew 5,335 sorties, of which 2,073 were offensive. They delivered 958 tons of bombs and 200 tons of battleship shells in bombardment. They destroyed 90 Japanese aircraft and 200 small vessels, and in the course of this operation established a record for time at sea for a British fleet. The force lost 98 aircraft in combat and 62 to other causes.

This chapter discusses the baka, the piloted glide bomb first used by the Japanese in the Okinawa campaign.

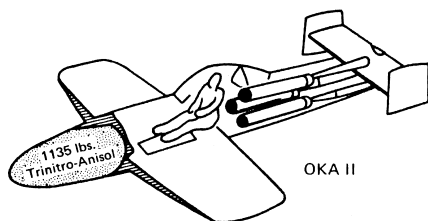
Early in 1944, a transport pilot, one Ensign Ohta,¹ submitted designs for a piloted, rocket-assisted glide bomb to be carried by the twin-engined Betty bomber. By August 1944, before the first kamikaze attacks, the Naval Air Research and Development Center instituted development of such a weapon, to be called Oka (Cherry Blossom).² Much to the consternation of the Japanese, the Americans referred to this development as the baka (foolish) bomb. Pilots for several Jinrai Butai (divine thunderbolt) units had been selected before the first kamikaze attacks.

The first baka version, and the only one to be produced in quantity before the end of the war, was the Oka 11, shown in figure 12, which was carried to within 20 to 30 kilometers of its target (from a 6000-meter altitude it had a maximum range of 30,000 meters) and launched.³ Although its high speed made the baka a difficult AA target, it was also hard to maneuver and frequently was unable to hit its target even if undeflected by gunfire.⁴ In addition, since power was provided by three small rocket motors that gave little additional thrust, the vulnerable mother aircraft, Betty, had to carry the baka much closer to the target than a more successful design would have envisaged.

There is considerable confusion in the literature concerning the first employment of these weapons, but the consensus of the more reliable sources⁵ is that the first raid occurred on 21 March 1945, off Okinawa. A flight of 18 Bettys, 16 of them carrying bakas, and an escort of 30 Zeros, was engaged at 50 to 60 miles from the task force by 50 Hellcats. Half of the Zeros and all the bombers were destroyed in a few minutes, and no bakas reached the force, although some may have been released out of range.

The first successful baka raid did not occur until almost a month later, on 12 April 1945, again off Okinawa. A new 2200-ton destroyer, Mannert L. Abele, was hit by a kamikaze, which penetrated the after engine room. Its bomb exploded, the ship lost power and went dead in the water. Moments later, the ship was hit by a baka, which penetrated the forward fireroom and exploded. The ship sank within 5 minutes.⁶

How many Oka 11 were launched against American ships is not known. In all, 755 Oka 11 were produced.⁷ Fifty were lost when the supercarrier Shinano was sunk by an American submarine.⁸ USSBS states that no more than 50 were launched;⁹ SPECORG analysis notes that, "of the rather large number of bakas



which were carried into the air, only 13 were seen in flight by ships. Of these, 9 missed ships (one causing some damage), and 4 hit ships, sinking one." ¹⁰ The ineffectiveness of the baka and the vulnerability of its mother aircraft, the Betty, quickly became apparent, and production was terminated in March 1945. ¹¹ (Further discussion of production may be found in chapter V.)

A variety of designs for other piloted bombs were developed, and experimental models of several were produced early in 1945. Characteristics of several are shown in table XV. Although a number of jet and rocket engines were considered, the most promising type appeared to be the Ki-115, essentially a propeller-driven aircraft making extensive use of wood and other metal substitutes in its construction. (The Army version was to be known as the Toka, or Wisteria Blossom). ¹²

There is little evidence that the Germans provided much of their technological advances to the Japanese until too late. In January 1945, Hitler ordered some top secret radar, missile, and jet propulsion information released to the Japanese, and enough arrived so that the Japanese began to copy German jet engines and the Me-262 jet interceptor, but most of what was released was destroyed enroute to Japan. ¹³

	OKA II	OKA 22	OKA 43
Manufacturer	Ist. Nata	Ist. Nata	Ai chi
Type	3 solid-fuel Rockets.	TSU-II engine jet	(Turbo-jet NE 22)
Crew	1	1	1
Span (m)	5.0	4.12	9.0
Length (m)	6.066	6.88	8.16
Height (m)	1.16	1.15	1.15
Wing area	6.00 m ²	4.00 m ²	13.00 m ²
Wt., empty	440 kg	545 kg	1150 kg
Normal wt.	2140 kg	1450 kg	2270 kg
Static thrust	800 kg X 9 X 3	200 kg	475 kg
Fuel cap. (liters)	—	290	400
Max. spd. (sea level)	—	230kt	250kt
Bomb (kg)	1200	600	800
Wing load	351	363	175

Source: Copied from USSBS, *Japanese Air Weapons and Tactics*, p. 21.

FIG. 12: BAKA BOMB

OKINAWA III: DEFENSIVE TACTICS

This chapter discusses the measures taken to counter the kamikaze and offers some indication of the effectiveness of each measure. Reconciliation of conflicting evidence concerning overall results of kamikaze attacks is presented in the chapter on effectiveness, which follows. The discussion begins with a brief examination of attacks on kamikaze aircraft bases and other sources of support, and proceeds to a discussion of active defense measures: warning, detection, and identification; air intercept; and gunfire.

ATTACKS AT THE SOURCE

The United States Navy expended considerable effort in forestalling kamikaze attacks at their source. A basic limitation on kamikaze attacks was the state of the Japanese economy and war machine, both subject to extensive air and submarine attack in rear areas and to attrition at the front. (The degradation of resources during the course of the war has been discussed in detail in chapter V.) Particularly severe were restrictions on strategic materials, which limited aircraft design and performance; petroleum products, which limited tactical employment and (to a lesser extent) aircraft performance; and training, which limited pilot proficiency in combat. At Okinawa, the influence of declining Japanese proficiency was particularly apparent as kamikaze effectiveness per sortie fell.

A major factor, both in the Philippines and off Okinawa, was the fighter sweeps over base areas, which succeeded in destroying many kamikazes before they left the ground. The delays in the first kamikaze attacks caused by such sweeps have been described; at Okinawa they allowed a number of vital American functions to be transferred to less vulnerable shore facilities. Data in table III show that almost half the Japanese Army aircraft lost to Allied action in World War II were destroyed on the ground and that this ratio was consistent throughout the war. Also very important were the operational (non-combat) losses, which must have been aggravated by the pressures applied at various points in the support chain.

DEFENSE

Passive defense, such as dispersing units of the task force, so as to obscure the location of the carrier, or other deceptive measures were little practiced. In most situations the range capabilities of Japanese and American aircraft were similar, if not favorable to the Japanese. The massive American air and surface forces would have been difficult to conceal in any event, and they were often required to support amphibious operations and thus forced to operate in a very restricted area. Also, massing forces enhanced defense effectiveness, and reliance was placed on active defense. In rare instances, strike forces maintained radio silence before launching strikes on new targets in heavily defended areas, but once strikes had begun the force's position was compromised.

TABLE XV

SPECIAL-PURPOSE SUICIDE AIRCRAFT DESIGNS

Designation	Length	Propulsion	Warhead weight (lbs)	Range (miles)	Launch	Production Scheduled	Actual	Flight tested
Oka-11	19'10"	Rocket assist	2645	Glide	Air (Betty)	No data	755	No data
Oka-22	22'8"	Glide 1 jet	1320	70	Air (Francis)	No data	50	*
Oka-43	26'9"	1 jet	1760	125-175	Land	293	0	No data
Kikka	30.3'	2 jet	1100*	340	Cata-pult takeoff	No data	2	1
Ki-115	31.8'	1 prop	1100*	685	Conventional takeoff	No data	104	No data
I-go-A**	19.7'	Rocket	1760	7	Air (Peggy)	No data	0	0
I-go-B**	13.1'	Rocket	660	7	Air (Peggy)	No data	192	No data

Notes:

*Releasable bomb

**Pilotless aircraft, using preset altimeter at 100 feet

Source: USSBS, The Japanese Aircraft Industry, pp. 73-87

Despite this massing of forces, even to the point of providing a "bulls-eye" for attackers (see figure 13), inexperienced kamikaze pilots often struck less valuable units. Especially at Okinawa, kamikazes tended to attack the first substantial unit they encountered and thus concentrated their attacks on the radar picket destroyers.

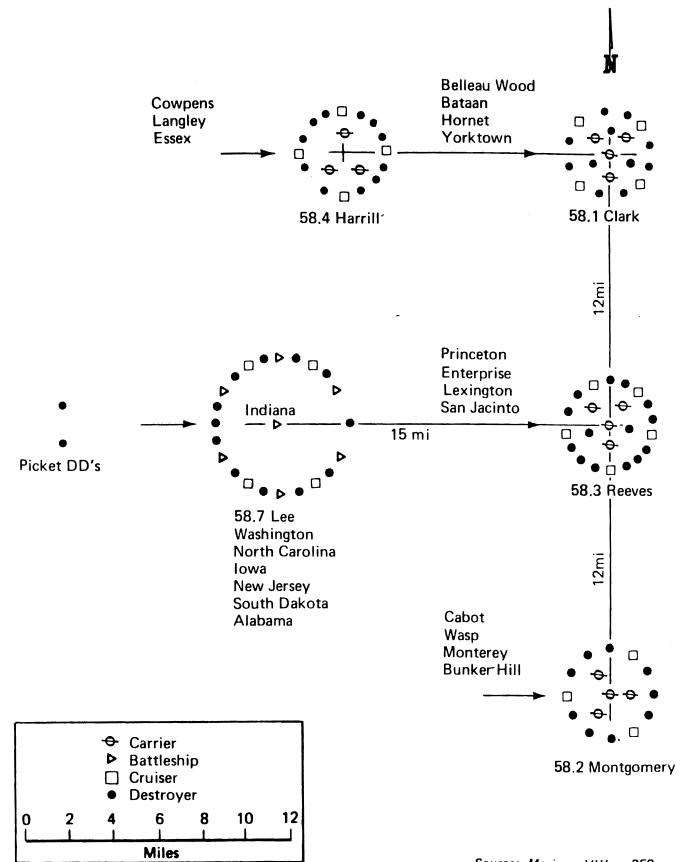
Discussion of tactics to counter the kamikaze is presented here largely in terms of the practices at Okinawa. As the Okinawa campaign progressed, tactics which had been evolving during the course of the war were refined with little further change.

Warning, Detection, and Identification

The United States had little warning of the introduction of the kamikaze program. Investigation shows that the Far East Air Force had monitored a Radio Tokyo release reporting the decoration of a sergeant-major who had dived his plane into a torpedo aimed at a convoy in April 1944.¹ Other instances of suicidal sacrifice were praised, but no one seems to have anticipated the large-scale introduction of suicide tactics. Once the attacks began and especially at Okinawa the Japanese knowledge of the American operating area and the essentially continuous kamikaze threat, all ships were forced to maintain a high state of readiness.

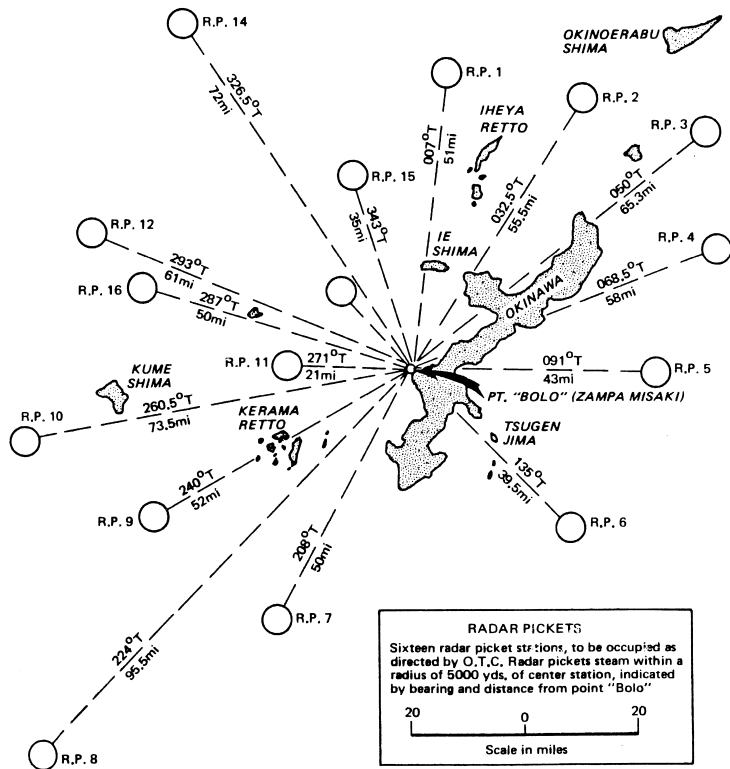
Radar was relied on to provide initial detection, and a system of radar picket stations was established. Those at Okinawa are shown in figure 14. By 16 April 1945, each picket station was maintained by a destroyer or destroyer-minesweeper with a fighter-director team embarked, a second destroyer for additional firepower ("shotgun"), 2 aircraft as Combat Air Patrol (CAP), proximity-fuzed (VT) ammunition, and one or more landing craft for additional support. (The landing craft came to be known as "pall bearers" for their role in rescuing survivors.)²

Although radar was extremely important, radars of the period had severe limitations. For example, although initial detection at substantial ranges could be achieved under certain circumstances, radars had difficulty tracking because of extensive nulls and limited coverage at low and high altitudes (over 20,000 feet)³. Also, "A detailed analysis of the action reports indicated that...height determination gave signs of being the weakest link in the defensive pattern. Enemy planes were nearly always detected at ranges greater than 75 miles. CAP units were nearly always vectored to intercept, but in entirely too large a fraction of the cases no intercept resulted...Experts were sent out to several ships having height-finding radars installed, and they found a considerable amount of inaccuracy in their readings. In a number of these cases it was found that the alignment of the antenna was out of adjustment, and in a number of other cases the operators were not adequately trained. In a number of cases the readings were more than 1000 feet in error in elevation /altitude/ which could easily explain the lack of interception of the enemy."⁴



Source: Morison, VIII, p. 259.

FIG. 13: DISPOSITION OF UNITED STATES CARRIER FORCES IN THE BATTLE OF THE PHILIPPINE SEA, 19 JUNE 1944



Source: Morison, XIV, p. 189.

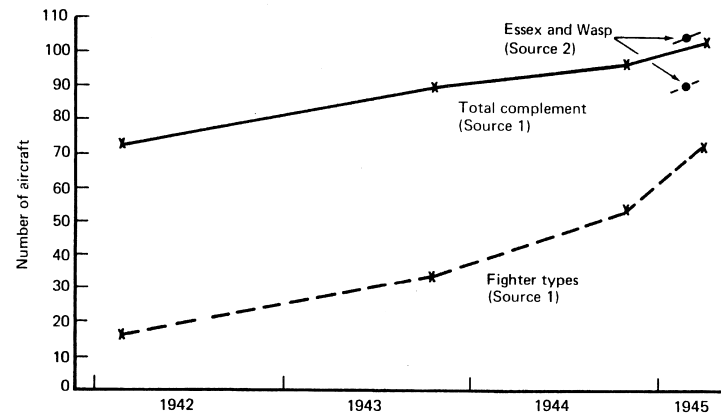
FIG. 14: RADAR PICKET STATIONS AT OKINAWA

Further, much of the surprise commonly reported as attending the first detections of kamikazes may have resulted from the very low altitudes of approach. In the Okinawa campaign, for example, 38 percent of the kamikazes were at less than 500 feet when first detected by ships.⁵ Low altitude sharply curtails the radar horizon, and radars of the period were particularly susceptible to other problems with low-altitude targets, such as surface clutter.

To aid in identification, returning strikes were supposed to circle one of the picket destroyers, called a "TOMCAT", and be visually identified by the associated CAP. Although most kamikazes appear to have been correctly identified, some did escape detection and succeeded in reaching the task force unopposed in the company of returning strike aircraft.⁶

Air Intercept

Most kamikazes were lost to interceptors. As defense became more important, and bombing strikes were replaced by fighter sweeps, aircraft carrier complements changed to include more and more fighters, some of which (such as the Hellcat (F-6F) and Corsair (F-4U)) could also serve to attack. Figure 15 shows aircraft complements during the course of the war. The rise in fighters was constant, and by the end of the war fleet carriers embarked 70 to 90 fighter types. Escort carrier complements also changed, from 16 fighters and 12 torpedo planes to 24 fighters and 9 torpedo planes.⁷



Sources: (1) WSEG Study No. 4, (2) Morison, XIII, p. 37.

FIG. 15: AIRCRAFT CARRIER COMPLEMENTS

As a result, hundreds of fighters were available for intercept roles. (Note in table 12, for example, that 472 fighters were available on 15 carriers at the Battle of the Philippine Sea.) As the Okinawa campaign progressed, fewer carriers were usually available, but those present carried a higher proportion of fighters and employed them as CAP. In preparation for the kikusui attacks on 11 April 1945, for example, the bombers and torpedo planes of Task Force 58 were emptied of gas and ordnance and parked on the hangar deck. The force was able to maintain 12 CAP over the pickets and 24 over each of 2 task groups-- a total of 60 CAP airborne and ready. Additional aircraft were launched as required.⁸ Three escort carriers with the replenishment groups (oilers, ammunition ships, etc.) carried replacement planes and pilots to replace losses. During the period 19 February to 1 March 1945, the escorts delivered 254 aircraft and 66 pilots and aircrew to fleet, light, and escort carriers.⁹

The superiority of American aircraft and pilots has been discussed. Control of the CAP by the fighter-director teams on the pickets and ships of the main force was good throughout. The CAP defenses were weakest at dusk, since kamikaze pilots were too poorly trained to fly even from land bases at night, and night takeoffs and landings were still hazardous and little practiced by carrier aviators.

Radar and Guns at Force Center

Kamikazes which escaped detection or destruction by pickets and CAP encountered further defenses in the main body of the force. In the Philippines and at Okinawa, main forces were diffuse, with amphibious, support, and combatant ships spread over large areas in pursuit of their missions. In other cases the main body was highly concentrated. While most of the present discussion is set in the context of a compact main body, all comments save those concerning massed firepower apply also to dispersed formations.

Although the pickets and their CAP were not able to engage and destroy all intruders, they were frequently able to alert the main body to expect kamikazes from a specified direction at a specified time. Nonetheless, in many cases ships were still taken so completely by surprise that they did not even have a chance to open fire.¹⁰ Visual detection of kamikazes seems to have been at least as important as radar: in 41 cases in which ships attacked by kamikazes reported the method by which the kamikaze was first detected, it was first detected by visual means in over half (21) and by radar in the remaining 20.¹¹

Thus, even with warning and radar, individual target ships were often unable to detect kamikazes at long ranges. This inability to make timely detections resulted in late reaction; for example, an analysis of early suicide attacks in the Philippines showed that the average open-fire range for all ships engaging suicide attacks was 5700 yards, and the average for the ships under attack was 4000 yards. (Ships not directly under attack might be expected to engage at longer ranges because of geometric considerations.) The average open-fire range for all ships in the Marianas campaign was 5500 yards.¹² Later, the average open-fire ranges had shrunk to 4400 yards for all ships, and 3700 yards for target ships.¹³ The 4400-yard average may then be

decomposed into an average of 6400 yards for carriers, battleships, cruisers, and destroyers, and 2800 yards for all other types. Since the other types must include numbers of landing ships and amphibious and support ships that may have had smaller-caliber guns and more modest combat directions, they should not be considered representative of the capabilities of the major combatants.

Still, the open-fire range of 6400 yards for major combatants is very much smaller than the range capability of the 5-inch gun would suggest. Analysts suggested that this very short range was due to the limited warning. A further result of the limited open-fire range was that the numerous smaller weapons accounted for a large proportion of the targets killed. One estimate is that 40mm and 20mm accounted for almost 80 percent of the kamikazes shot down by anti-aircraft, and 5 inch for only about 15 percent.

The effectiveness of these tactics and weapon systems is discussed in the next chapter.

CHAPTER XIII

A REVIEW OF EFFECTIVENESS

This chapter is an attempt to determine kamikaze effectiveness per sortie, as a prelude to the discussion of the relevance of kamikaze experience to the anti-ship missile problem in volume II of this study. We begin with a discussion of the effectiveness of defensive measures, in terms of detection, air intercept, anti-aircraft guns, and evasive maneuvering. Damage caused by kamikazes which succeeded in hitting ships is discussed briefly. Finally, an attempt is made to synthesize these results. The presentation is in the context of carrier defense, although most kamikazes actually attacked other targets.

DEFENSE EFFECTIVENESS

It was shown in chapter XII that attack on kamikazes at the source, through fighter sweeps and strikes on airfields, was as effective as active defense, in the sense that as many Japanese aircraft were destroyed on the ground as in the air. Also, operational (non-combat) accidents resulted in the loss of at least as many Japanese aircraft as were destroyed in the air by Allied action. (The statistics in table III tend to indicate that over half of these non-combat losses were incurred in training commands; however, USSBS finds Japanese estimates of operational losses far too low, and that operational losses may have been as high as 68 percent of all Japanese losses; see discussion in chapter IV.) The point of interest to the present discussion is that attack on bases was as effective as destruction of aircraft in the air; in what follows only those kamikazes which left base are considered.

Detection

The detection performance of the force as a whole, and of the pickets in particular, must have been fairly good in order to achieve the high attrition rates imposed on kamikazes. There were several instances in which high-flying non-suicide raids were detected up to 150 miles from the task force; many kamikazes at Okinawa were detected by pickets stationed 60 miles from the force.

Very low flight profiles (see discussion of kamikaze tactics in chapter X) must have limited detection ranges in many cases, however. It was noted in chapter XII that 38 percent of kamikazes were at or below 500 feet when detected, and that half of the initial detections of kamikazes in a small sample were made visually. Difficulties with extensive nulls and limited coverage at high and low altitudes have been noted, as have errors in determining target altitudes.

It is not possible to ascertain, from the sources of this study, the ranges at which kamikazes were detected. (Many must have been detected only a few thousand yards from the target ship.) On the other hand, successful CAP engagement implies detection at substantial ranges from the force, so CAP engagements must represent a lower bound on detection effectiveness. Due to the absence of data, detection effectiveness is not considered further in the treatment which follows.

Air Intercept

The attempt to establish the contribution of various defensive measures to kamikaze destruction is rendered difficult by the conflicting evidence of the numbers and results of kamikaze raids. The overall magnitude of the kamikaze effort may be estimated from table XVI. Several sources agree that the Navy expended approximately 2300 aircraft and 2500 pilots and crewmen, suggesting that at least 2100 kamikaze aircraft were single-place planes. The Japanese army apparently expended slightly more aircraft, so that approximately 5000 kamikaze sorties must have been flown in all.

The outcome of these sorties is more difficult to establish. Table XVII shows sorties and results for the Philippines and Okinawa campaigns, as given by various sources. Where sources agree, they tend to agree with the USSBS, which may be taken as definitive. Thus, the total sorties (650 in the Philippines and 1900 off Okinawa) may be taken as given, and have been entered in table XVIII. Both Okumiya and Inoguchi claim large fractions of the kamikaze raids returned to their bases; this hypothesis is not inconsistent with the navigational ability and operational reliability of the Japanese at this point. However, accepting Okumiya's larger figure leaves far too few sorties countered by Allied action to be consistent with other results; Inoguchi's figure of approximately 10 percent would seem more reasonable, and more consistent with non-suicide experience in 1944.

TABLE XVI
TOTAL KAMIKAZE EFFORT

Source :	Okumiya, p. 344	Inoguchi
Navy sorties	2363	2314*
Returned to base	-	1086*
Expended	-	1228**
Men expended	2530	2519**
Army sorties		
Returned to base	-	-
Expended	-	-
Men expended	≥2530	-
Total sorties	-	-
Returned to base	-	-
Expended	-	-
Men expended	≥5060	-

*Divine, p. 234.

**Kamikaze, p. 945.

TABLE XVII

OUTCOMES OF KAMIKAZE ATTACKS

Source:	USSBS p. 23	Okumiya	Inoguchi	AAORG Study 4	SPECORG Study 13
Philippines					
Kamikaze sorties	650	447 ⁴	421 ⁵	*	*
Arrived over force	*	*	*	320	364 ⁷
Returned to base	*	179 ⁴	43 ⁵	*	*
Hits	*	*	*	115	*
Near misses	*	*	*	*	*
Hits plus near misses	174	201 ⁴	*	*	*
Escort sorties	*	249 ⁴	239	*	*
Returned to base	*	*	137	*	*
Okinawa					
Kamikaze sorties	1900	1819 ³	>1800 ⁶	*	*
Arrived over force	*	924 ³	*	*	793 ⁷
Returned to base	*	*	*	*	*
Hits	182 ²	*	*	*	181
Near misses	97 ²	*	*	*	95
Hits plus near misses	279	*	*	*	276
Escort sorties	*	*	*	*	*
Returned to base	*	*	*	*	*
Grand totals⁸					
Kamikaze sorties	2550	2266	>2221	*	*
Arrived over force	*	*	*	*	1157
Returned to base	*	*	*	*	*
Hits	*	*	*	*	*
Near misses	*	*	*	*	*
Hits plus near misses	453	*	*	*	*
Escort sorties	*	*	*	*	*
Returned to base	*	*	*	*	*

*Not given.

¹Hits plus near misses divided by total sorties.²p. 67.³p. 344.⁴The number entered here under "hits plus near misses" is that given by Okumiya for "completed kamikaze attack"; the remainder (67) were unable to complete attacks due to weather, anti-aircraft, or CAP (p. 338).⁵Divine, p. 222.⁶Kamikaze, p. 945. In Divine, p. 222, Inoguchi notes 1809 Navy sorties at Okinawa for Kamikaze and escort functions combined, of which 879 returned and 980 were expended. USSBS gives 1050 Navy suicide sorties at Okinawa. (See table XIV.)⁷Suicide planes fired on.⁸Obtained by adding numbers for Philippines and Okinawa, except as noted.

TABLE XVIII

RECONCILIATION

	Philippines	Okinawa
Kamikaze sorties	650*	1900*
Returned to base	65 (10%)	190 (10%)
Net attacks	585	1710
Splashed by CAP	263 (45%)	855 (50%)
Appeared over force	322	855
Splashed by AA	148 (46%)	576 (68%)
Hits plus damaging near misses	174*	279*

Note: Figures marked with an asterisk are from USSBS, Japanese Air Power; other figures are estimates developed in the text.

Applying a 10 percent reduction leaves 585 kamikazes to be countered in the Philippines and 1710 at Okinawa. It has been noted that most of the kamikazes and conventional aircraft which attacked the task force were shot down by air-borne interceptors (combat air patrol (CAP) and deck-launched interceptors (DLI)).¹ Attrition of conventional attacks by CAP had risen to over 60 percent by mid-1944,² and given the similarity of kamikaze airframes and tactics to the conventional strikes (at least outside the immediate vicinity of the task force), CAP effectiveness against kamikazes must have been similar, i. e., in the range of 50 to 70 percent, leaving 30 percent to 50 percent (176 to 292 in the Philippines, 513 to 855 at Okinawa).

These numbers seem low when compared with the numbers of aircraft which arrived over the force, as shown in table XVII. Assuming 45 percent CAP attrition would appear to produce good agreement with estimates of kamikazes over the force (322 versus 320 or 364) in the Philippines. Improvements in CAP procedures off Okinawa may have increased the CAP attrition rate to about 50 percent, which produces fairly good agreement with estimates of the number of aircraft reaching the force there.

Another comment on the nature of CAP defense suggests that data from the Philippines campaign are not representative of the ability to defend a force at sea:

"Apparently fighter defense of task forces out at sea is much more effective than are patrols near shore. At least 60 percent of the attacking enemy force has been consistently shot down by the CAP of fast carrier task forces before the enemy reached our ships. However, the Army Air Forces report that... 771 enemy aircraft were encountered and 230 destroyed in their defensive missions from the Philippines. Thus it appears that in the case of task forces in harbor or near shore, only about 30 percent of the enemy attackers are downed by fighter defense before they get to the ships." 3

At Okinawa, although some units were attacked in the harbor, the enemy had to approach over water and past defensive picket forces; as a result, the defensive posture was much like what would be expected of a fast carrier force. Thus the estimate of 50 percent attrition by CAP is not inconsistent with these observations.

Further indication of the effectiveness of CAP may be gained by examining the results of kamikaze escort missions--which would not have been subjected to anti-aircraft guns and which would not have deliberately expended themselves. In the Philippines, Inoguchi notes that, of 239 escort sorties, 102 (43 percent) were expended (table XVII). Since the escorts were none too aggressive in their defense of the kamikazes, and since some of them, at least, were also responsible for returning to report results of the kamikaze attacks, they may have allowed similar attrition of the kamikazes. Attrition of kamikazes is not likely to have been much larger than that of the escorts, however, so the estimates of 45 percent in the Philippines and 50 percent at Okinawa seem reasonable. These results have been entered in table XVIII.

Anti-Aircraft Gunnery

The effects of anti-aircraft gunnery are somewhat easier to establish. Sources are internally consistent. For example, an analysis of 99 Japanese aircraft that arrived over the force in the Philippines showed that 47 (47.5 percent) missed ships completely and did no damage; the remainder either hit (37, 37.4 percent) or landed close enough to cause damage (15, 15.2 percent). 4 An analysis of another and larger sample (477 attacks in the Philippines and Okinawa), showed that 172 (36 percent) hit ships. 5 It is not clear whether "hits" in the larger sample includes damaging near misses, which were 35 percent (97 of 279) of the damage-causing kamikazes at Okinawa (table XVII).

Kamikazes known to have hit ships or to have struck near enough to cause damage (USSBS data, table XVII) comprise 54 percent of those estimated to have appeared over the force in the Philippines and 32 percent of those estimated to have appeared over the force at Okinawa. These differences are substantial, but the overall results in the 2 campaigns (the ratio of hits plus damaging near misses to total sorties: $174/650 = 27$ percent in the Philippines; $279/1900 = 15$ percent at Okumiya) are different in approximately the same ratio: 54 percent/ 32 percent = 1.7 ;

27 percent/ 15 percent = 1.8 . Assuming that most of the kamikazes which did not hit were splashed by anti-aircraft 6 suggests AA effectiveness of approximately 46 percent in the Philippines and 68 percent of Okinawa. These values are not inconsistent with the results of the smaller, detailed studies and have been entered in table XVIII.

Whether all the kamikazes which appeared over the force but failed to hit ships were actually destroyed by anti-aircraft is perhaps unimportant; those which were not actually destroyed may have been discouraged in some other fashion. An analysis of tactics which should be used to counter the kamikaze, 7 for example, suggests that small ships ought not to maneuver when under direct attack, since a higher fraction of maneuvering ships was hit (36 percent versus 26 percent). The degradation of already limited gunfire capability may have more than compensated for increased kamikaze difficulty in hitting the target. Large units probably should maneuver, however, since maneuvering ships suffered proportionately fewer hits (22 percent of attacking aircraft) than non-maneuvering ships (49 percent). This may reflect the fact that the greater firepower of the larger units is dispersed more uniformly throughout the ship.

Another interesting aspect of the effectiveness of anti-aircraft guns is the distribution of kamikaze kills by type of gun, shown in table XIX for the Philippines campaign, along with number of rounds expended per gun. Although almost half of the kamikazes shot down in this sample were shot down by the 40 mm anti-aircraft gun, over a quarter million rounds of 40 mm ammunition were expended, for a rate of almost 2500 rounds per kill. Far fewer kamikazes were killed by the larger, longer-range 5 -inch gun. But the average open-fire ranges (6400 yards for major combatants; see chapter XII) were such that the longer-range weapons were unable to take advantage of range superiority to fire early; and the number and rate of fire of the smaller weapons were more important.

Also of interest in table XIX is the fact that the proximity-fuzed 5 -inch ammunition was twice as effective perround in bringing down kamikazes as conventional (common) ammunition.

Note, however, that the distribution of kills by gun type is extremely difficult to determine. In particular, there is probably a tendency to overestimate the success of the smaller weapons, since a plane may have been severely damaged by long-range weapons before it reached the short range of the small caliber weapons. Thus, the statistics in table XIX are subject to considerable error.

TABLE XIX
GUNFIRE EFFECTIVENESS IN THE PHILIPPINES
October 1944 - January 1945

Gun and ammunition	Planes destroyed		Rounds expended	
	No.	Percent	Total	Per kill
5" common	22.0	8.9	26,302	1,196
5" proximity-fuze (VT)	17.0	6.9	7,083	417
3" common	5.5*	2.2	4,667	849
3" proximity-fuze	0.5	0.2	544	1,088
40mm	115.5	46.8	287,556	2,490
1.1"	0.5	0.2	2,695	5,390
20mm	78.5	31.8	645,315	8,221
.50 cal	5.5	2.2	119,232	21,678
.30 cal	2.0	0.8	14,381	7,191
Totals	247.0	100.0	1,107,775	4,480 per kill

*Means that 2 or more different caliber guns appeared to be responsible for the same kill.

Source: AAORG Study 4, p. 10.

TACTICS: OFFENSIVE AND DEFENSIVE

The effects of offensive tactics, defensive tactics, and the characteristics of ships attacked are all confounded. One summary analysis of the kamikaze experience shows that

"... suicide planes should crash the ship in a low dive [20° or less], fast [over 300 mph], and on the ship's beam. When these optimum tactics were employed, 47 percent of the planes hit their targets. When tactics other than the optimum were employed, only 35 percent of the planes hit their targets."⁸

Here success is defined to include the effects of anti-aircraft. The effects of ship maneuver have been noted in the previous section. Analysis showed that a ship should present its beam to a high diver (presumably to maximize effectiveness of active defense) and turn its beam away from a low diver (presumably to minimize the profile presented).

The number of ships hit, by ship type, is shown in table XX. Comparison with table XVII shows that these figures do not include ships which suffered damaging near misses. The fraction of hits per aircraft, considering the sample sizes, seems to be independent of type for most ships but somewhat lower for smaller landing ships and landing craft, and possibly destroyers. Similar statistics for a different categorization of ship types showed much lower values of hits per aircraft attacking landing ships and small craft (0.22 in both cases);⁹ other results generally agree with those in table XX.

It is interesting to note the distribution of attacks by ship type. In the Philippines, 15 percent (48/320) of the kamikazes appearing over the force attacked carriers of all types; at Okinawa the fraction had sunk to 3 percent (21/624). Destroyer types at Okinawa, most of them on picket stations, absorbed 37 percent of the attacks, with auxiliaries and landing craft receiving most of the remainder (table XX).

TERMINAL EFFECTIVENESS

The effectiveness of a kamikaze, once it has hit a ship, depends on the type of ship hit, the ordnance load, angle of attack, point of impact, and many other variables. It has been noted that the first kamikaze attacks used Zero fighters configured with 250-kg (550-lb) bombs. Subsequent efforts were highly varied. USSBS notes some of the difficulties:

"When trainers were used by the Navy in the Ryukyus campaign and when they were being prepared by the Army for final defense of the homeland, they carried loads of from 250 kg. down to only 50 kg. To boost their crash effectiveness, additional gasoline was loaded

and even hand grenades were sometimes piled about the pilot in the cockpit. Practically all but the heavier Army and Navy planes were using bombs of insufficient caliber, which accounted in part for the fact that no major Allied fleet unit (battleship, regular or light carrier, or cruiser) was ever sunk by a suicide plane. Three escort carriers were the most important single ships sunk. Even small ships sometimes survived several hits, one United States destroyer remaining afloat after five crashes." 10

"Bombs adequate to penetrate armored ships were still a problem when the war ended but the only attempt to solve it was experiments by the Army's Air Technical Laboratory with a suicide bomb weighing over a ton. But the bomb was not perfected when the war ended and the great increase in the number of light planes introduced for suicide missions meant that very few planes could have carried the new bomb even if it had been manufactured and transported to forward fields." 11

Nevertheless the destructive power of the aircraft, combined with that of the ordnance, probably exceeded that of a conventional bomb hit. The ratio of sinkings to damage was much higher for suiciders than for non-suiciders. 12 Most of the sinkings, as table XX shows, were of the smaller ship types; but the larger ships were infrequently hit by more than one or two kamikazes before being withdrawn from the battle. Table XXI shows the fraction of hits which required withdrawal for repair, and the amount of time consumed in repair and out-of-action (to transit to the repair yard and back), for a limited sample of fleet and light carriers.

Seventy percent of the kamikaze hits resulted in a carrier out-of-action, and the average time out of action was a month. Another source notes that, of the 279 ships damaged at Okinawa, 90 (32 percent) were badly enough damaged to be out of action for over a month. 13 Further, most of the damage caused by kamikazes was caused not by the impact but by the ensuing fires, and most of the casualties had been horribly burned. 14 Overall, indeed, the kamikazes off Okinawa caused more casualties to the Navy than the Japanese Army did ashore. 15

American carriers of the time had wooden flight decks; the British carriers, with armored flight decks, suffered less, as discussed in chapter X. But they paid a substantial price in the number of aircraft which could be carried into battle. When she joined the Pacific Fleet, Indomitable, for example, carried only 29 Hellcat fighters and 15 Avenger torpedo planes, on a ship almost the size of the Essex Class. 16

TABLE XX
KAMIKAZE DAMAGE BY TYPE OF SHIP

Ship type	Battle-ships	Cruisers	Fleet	Carriers light	Escort	Destr.	Auxiliary/landing	Merchant	TOTALS
Philippines (1)									
Aircraft attacking	11	32	13	5	30	72	122	35	320
Hits	5	11	6	2	12	21	37	21	115
Hits/aircraft	0.44	0.34	0.46	0.40	0.40	0.29	0.30	0.60	0.36
Ships sunk	0	0	0	0	2	3	14	3	22
Sinkings/hit	-	-	-	-	0.16	0.14	0.37	0.14	0.19
Okinawa (2)									
Aircraft attacking	26	10	17	5	9	231	306	20	624
Hits	7	4	4	0	3	71	84	8	181
Hits/aircraft	0.27	0.40	0.24	0.00	0.33	0.31	0.27	0.40	0.29
Ships sunk	0	0	0	0	0	9	11	3	23
Sinkings/hit	-	-	-	-	-	0.12	0.13	0.38	0.13
TOTALS									
Aircraft attacking	37	42	30	10	39	303	428	55	944
Hits	12	15	10	2	15	92	121	29	296
Hits/aircraft	0.32	0.35	0.33	0.20	0.33	0.30	0.28	0.52	0.31
Ships sunk	0	0	0	0	2	12	25	6	45
Sinkings/hit	-	-	-	-	0.13	0.13	0.20	0.20	0.45

Notes: (1) Source: AAORG Study 4, p. 7.
(2) Source: SPECORG Study 13, p. 4.

TABLE XXI

EFFECT OF DAMAGE ON FLEET AND LIGHT CARRIERS

Source	Percent of hits requiring repair	Weeks in yard per hit	Weeks out of operation per hit
Kamikaze	70	1.8	4.3
Bomb	40	0.3	0.7
Aerial torpedo	100	10.0*	17.5
Submarine torpedo	100	10.0*	12.4

* Estimate

Source: WSEG Study 4, p. 8.

OVERALL EFFECTIVENESS

The overall effectiveness of the kamikazes in attacks on carriers can be estimated from the data in tables XVIII, XX, and XXI by multiplying together the following probabilities. Using the Okinawa data:

- 0.90 - probability of not having to return to base;
- 0.50 - probability of not being splashed by CAP;
- 0.32 - probability of not being splashed by anti-aircraft and not missing the target; and
- 0.70 - probability that a hit will cause the carrier to be out of action.

Thus the overall probability of putting a carrier out of action for a month, given that the kamikaze can correctly locate the carrier, would be about

$$(0.90) \times (0.50) \times (0.32) \times (0.70) = 0.10 .$$

(That this figure is lower than the 14.7 percent of kamikaze sorties which were effective in hitting ships, quoted by USSBS, is due to incorporation of the carrier-out-of-action probability.)

Only about 3 percent of the kamikazes at Okinawa selected a carrier target. But carriers were not always the preferred targets; see discussion of target selection policy in chapter X.

Overall, analysis showed that kamikazes were 7 to 10 times as effective per sortie as conventional attackers.¹⁷ In terms of the probabilities of the preceding paragraph, a bomb hit was only half as likely to put a ship out of action, so only one in 10 to 20 bombing sorties that released bombs could have hit the target. Thus, with high attrition of both kamikaze and conventional attacks (over 50 percent), neither was likely to make many attacks, and the kamikaze was clearly the more effective weapon.

CHAPTER XIV

ENDGAME AND PROSPECTUS

On 6 August 1945, the first atomic bomb was dropped on Hiroshima, and Japan surrendered on the 15th. Thus operation Olympic, the invasion of Japan planned for late 1945, did not have to take place.

It is clear from the postwar statements of Japanese commanders, and from the preparations they took, that they fully intended to conduct a determined defense, making fullest use of the available suicide resources. Churchill argues,

"...by the end of July [1945] the Japanese Navy had virtually ceased to exist.

"the homeland was in chaos and on the verge of collapse. The professional diplomats were convinced that only immediate surrender under the authority of the Emperor could save Japan from complete disintegration, but power still lay in the hands of a military clique determined to commit the nation to mass suicide rather than accept defeat. The appalling destruction confronting them made no impression on this fanatical hierarchy, who continued to profess belief in some miracle which would turn the scale in their favor."¹

And the resources still available to Japan were substantial; figure 16 shows the distribution of suicide aircraft in Japan at the end of the war--each of the over 20 symbols represents 200 aircraft. Table XXII shows a USSBS estimate of the number of aircraft available to the Japanese Army and Navy at the end of the war. Even with fairly conservative assumptions, USSBS estimates that 5350 of the almost 18,000 Japanese aircraft were fully ready for suicide use. Another estimate showed 3000 aircraft ready for kamikaze use among 5130 effective aircraft.² By any estimate, the potential for havoc was great.

Plans for the final defense of the Japanese homeland included other suicide weapons and tactics, in addition to the air-to-surface kamikaze and baka attacks. One of these was foreshadowed at Pearl Harbor by the midget submarines which were supposed to attack simultaneously with the aircraft.

A new type of "human torpedo", called kaiten, was developed; it was launched from the deck of a conventional submarine fairly close to its intended victim. The pilot could abandon the torpedo some 150 feet from the target;³ there appears to be no record of such successful abandonment. Over 6000 suicide boats -- wooden craft of 1-1/2 to 2 tons, powered by gasoline truck engines and carrying explosives -- were produced by the end of the war;⁴ few appear to have been expended. There were also aircraft which crashed into B-29's (not a very successful program) and airfields, and there were suicide squads which would land on Allied airfields to destroy parked aircraft and supplies. None of these programs appear to have received the determined direction nor to have enjoyed the success of the kamikaze attacks.⁵

TABLE XXII

ESTIMATE OF JAPANESE ARMY AND NAVY AIR POTENTIAL
AT END OF WAR(Planes in Japan and in area from which Japan could be reinforced:
Korea, Manchuria, North and Central China, Formosa)

Type of aircraft	Air Force	Navy	Total
Planes ready for orthodox use	2,150	3,200	5,350
Planes ready for suicide use:			
Combat types	900	--	900
Advanced trainers	1,750	--	1,750
Primary trainers	--	2,700	2,700
Total	2,650	2,700	5,350
Total effective planes	4,800	5,900	10,700
Percent ready for suicide use	(55.2%)	(48.0%)	(50.0%)
Additional planes available but not currently effective (i. e., still in training units, in storage, undergoing repair or modification, etc.)	3,000	4,200	7,200
Maximum number of planes	7,800	10,100	17,900

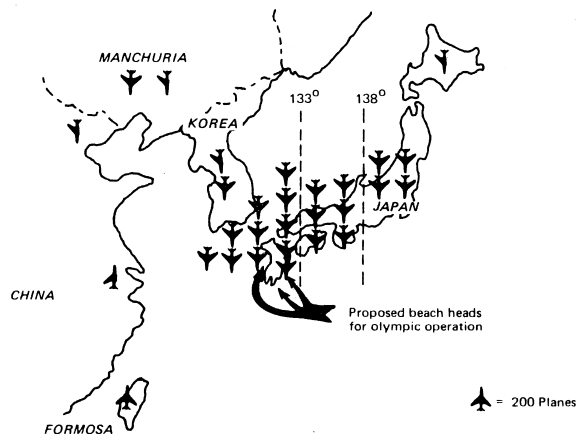
Source: USSBS, *Japanese Air Power*; p. 70.Source: USSBS, *Japanese Air Power*, p. 80.

FIG. 16: DEPLOYMENT OF JAPANESE SUICIDE PLANES AT THE END OF THE WAR

CHAPTER XV

THE PRICE

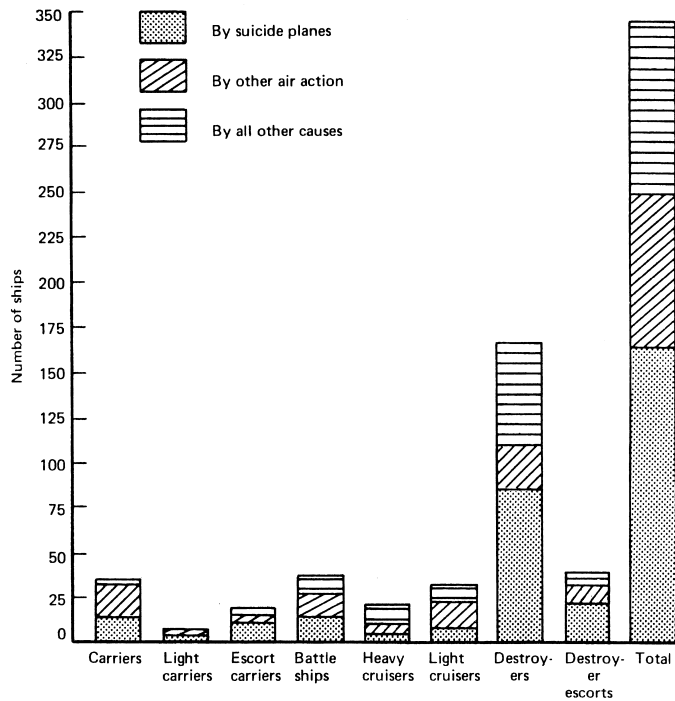
Despite the inflated claims of early successes, and the great damage done to American ships in the Leyte Gulf and off Okinawa, the kamikazes were not enough to save Japan from defeat. Admiral Ohnishi, by then Vice Chief of the Naval General Staff, was however, unwilling to give up the fight and chose *hara-kiri* within a few hours of the surrender. Vice Admiral Ugaki, Commander in Chief of the Fifth Air Fleet, the major air command in Japan at the end of the war, may have flown the last kamikaze of the war from Kyushu.¹

The kamikazes failed to achieve their objective in the sense that they did not destroy the United States fleet nor forestall the occupation of the Philippines and Okinawa. But they did extract a terrible price. The United States Strategic Bombing Survey, in its volume on Japanese Air Power, concludes:

"The suicide plane was by far the most effective weapon devised by the Japanese for use against surface vessels. Over a period of only 10 months of the 44-month war, suicide planes accounted for 48.1 percent of all United States warships damaged and for 21.3 percent of the ships sunk. But the suicide effort was expensive. During the 10-month period of the employment of the suicide tactic, the 2 air arms expended 2,550 planes to score 474 hits on all types of Allied surface vessels for an effective rate of 18.6 percent." (p. 74)

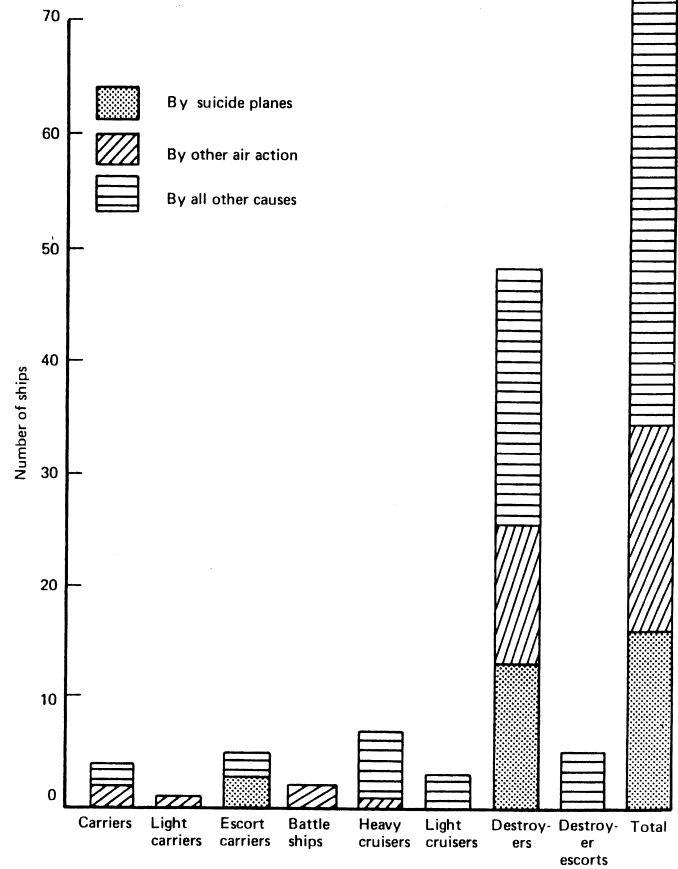
Overall, kamikaze aircraft caused incidents of damage and loss to United States Naval vessels in much larger numbers than would have been expected simply from the time period during which they were employed. Figures 17 through 19 show causes of loss, damage, and loss or damage to United States warships in the Pacific in World War II. Although kamikazes sunk only escort carriers and destroyers among the major types, the toll in ships damaged is much greater--and the extent of damage suffered by *Bunker Hill* suggests that damage could be severe, indeed.

Figure 20, which presents causes of loss of United States destroyers, by year, shows that losses to surface action, submarines, and conventional air attack, which were severe in 1942, were small by 1945, but of the 15 destroyers lost that year, 12 were lost to kamikazes. This reflects the changes in the nature of the war and of ultimate Japanese capabilities.



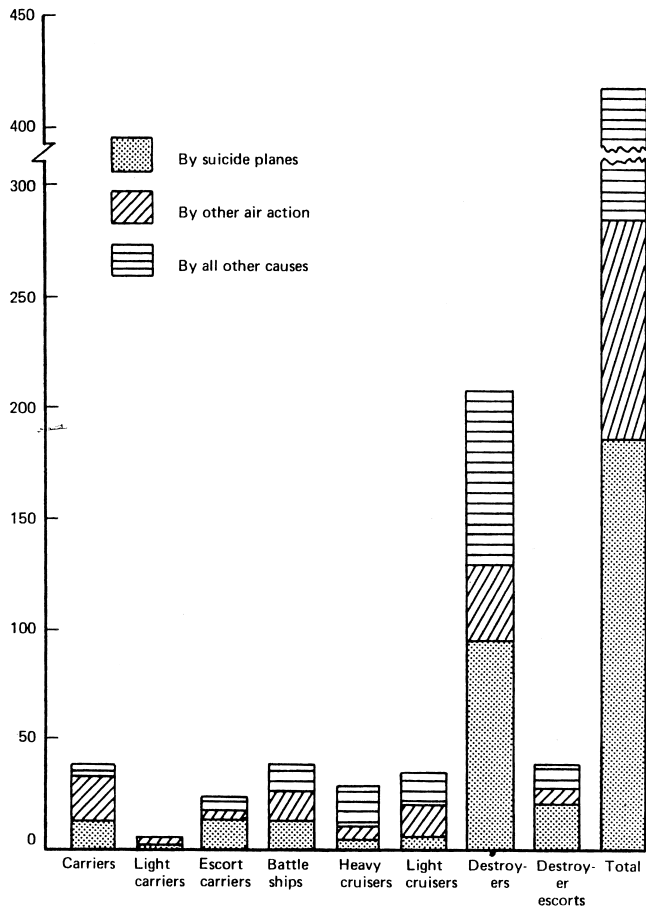
Source: USSBS, Japanese Air Power, p. 77

FIG. 17: CAUSE OF DAMAGE OF U.S. WARSHIPS IN THE PACIFIC



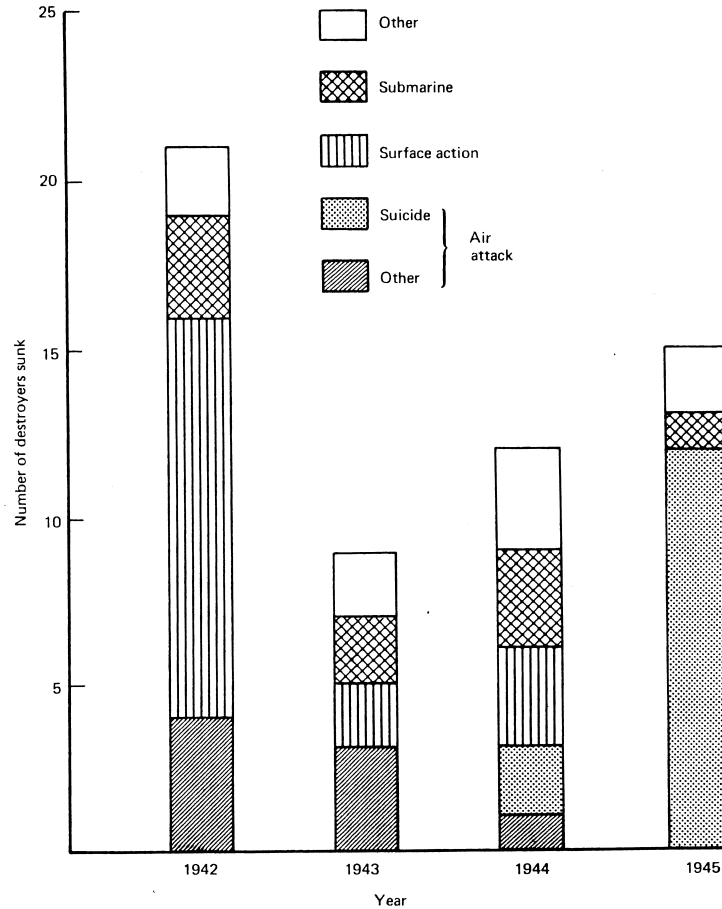
Source: USSBS, Japanese Air Power, p. 78

FIG. 18: CAUSE OF LOSS OF U.S. WARSHIPS IN THE PACIFIC



Source: USSBS, Japanese Air Power, p. 79

FIG. 19: CAUSE OF LOSS OR DAMAGE OF U.S. WARSHIPS IN THE PACIFIC



Source: USSBS, Japanese Air Power, p. 77

FIG. 20: CAUSE OF LOSS OF UNITED STATES DESTROYERS AND DESTROYER ESCORTS IN THE PACIFIC IN WORLD WAR II, BY YEAR

NOTES

General Note

Notes are numbered sequentially by chapters. Initial appearance of a source merits full citation; thereafter citations are severely abbreviated. A key to the abbreviations is contained in table C-1 of appendix C, the final page of the study. Some bibliographical notes are also contained in appendix C, Sources.

CHAPTER I: EARLY JAPANESE SUCCESSES, PEARL HARBOR TO CEYLON

1. Inoguchi, Rikihei; Nakajima, Tadashi; and Pineau, Roger: The Divine Wind: Japan's Kamikaze Force in World War II, Annapolis, United States Naval Institute, 1958 (hereafter Inoguchi, Divine), p. XIV.
2. Except as noted, the narratives and figures in this study have been taken from Morison, Samuel Eliot, History of United States Naval Operations in World War II, in 15 volumes (full citation in appendix C). Specific citations appear thus: Morison, volume number, page number. Any interpretation is mine. Morison does not appear to be accurate in some details, such as losses per attack, but overall statistics seem quite good. It is often difficult if not impossible to determine total sorties for CAP and all other functions in detail; thus the data are not always strictly comparable. Total losses for all causes give a good measure of contribution to aircraft and pilot inventory problems, while losses per attack sortie illuminate comparable attrition rates.
3. "When asked, 'What was the final thing that touched off the war between Japan and the United States', Vice Admiral Hoshima, Chief of the Naval Affairs Bureau in 1945, replied, 'The stoppage of oil imports. Without them Japan could not survive'." United States Strategic Bombing Survey, Oil in Japan's War, p. 29. Tansill, who saw Roosevelt conspiring to force the United States into war, makes little of the impact of this embargo, however. (Tansill, Charles Callan, Back Door to War: The Roosevelt Foreign Policy, 1933-1941, Chicago, H. Regnery Co., 1952.)
4. Morison, III, p. 385

CHAPTER II: STEMMING THE TIDE -- CORAL SEA AND MIDWAY

1. Fuchida, M., and Okumiya, M., Midway, the Battle that Doomed Japan, Annapolis, United States Naval Institute, 1955 (Edited by Kawakami, Clarke H., and Pineau, Roger) p. 7.
2. Morison, IV, p. 11
3. Morison, III, p. 267

4. Potter, John Deane, Yamamoto: The Man Who Menaced America, New York, Viking Press, 1965, p. 23
Zero was the popular name for the Naval Fighter Type Zero, Mk-1; the name assigned by the Americans for recognition purposes was Zeke. The 2 names are used interchangeably in this study.
5. Morison, III, p. 63; Fuchida, p. 106
6. Morison, IV, p. 70
7. Fuchida, p. 94
8. Morison, IV, p. 80
9. Fuchida, p. vi
10. Ibid., p. ix
11. Ibid., pp. 95-97

CHAPTER III: LICKING WOUNDS, 1943

1. Morison, V, p. 197
2. Okumiya, Masatake; Horikoshi, Jiro; and Caidin, Martin, Zero!, New York E.P. Dutton, 1956, p. 216
3. Morison, VII, p. 143

CHAPTER IV: HOW MANY CAN YOU LOSE?

1. An analysis by Mr. George Haering contained in an informal memorandum of the Naval Warfare Research Group that is not available for wider distribution.
2. Office of the Secretary of Defense, Weapons Systems Evaluation Group, WSEG Staff Study No. 4, "Operational Experience of Fast Carrier Task Forces in World War II," Unclassified, 15 August 1951. (Forwarded by Op-504F, ltr ser 0577P50 of 19 Oct 1951), p. 6
3. USSBS, Air Power, p. 30
4. Ibid., pp. 32-34
5. Memorandum for Director, Southeast Asia Combat Analysis Group (Op-03Z), (OEG) 469-69, "Preliminary Comparison of Carrier Air Operational Statistics for World War II, Korea and Southeast Asia (U)," Secret of 9 October 1969, (Gear, Mullenix, Free, DePoy), p.7

CHAPTER V: THE BATTLE OF RESOURCES

1. The discussion of Japanese aircraft production and inventory is based on two USSBS publications, Japanese Air Power and The Japanese Aircraft Industry, except as noted.

2. Japan planned over 12 million square feet of underground construction space and completed 58 percent of it. Dispersed surface and semiunderground plants were to have added another 26 million square feet. USSBS, Aircraft Industry, p. 39
3. Ibid., p. 3
4. Compare statistics in Morison, VI, p. 21, with those in table D-II.
5. Fuchida, p. 57
6. Morison, VI, p. 117
7. Ibid., XIV, p. 92
8. USSBS, Aircraft Industry, p. 68
9. Fuchida, p. 242
10. Morison, VIII, p. 11
11. Ibid., p. 235
12. USSBS, Air Power, p. 71
13. Okumiya, pp. 173-174
14. U. S. Joint Army-Navy Assessment Committee (RADM Jerauld Wright, Chm.), Japanese Naval and Merchant Shipping Losses During World War II by All Causes, (NAVEXOS P-468), Washington, Government Printing Office, February 1947, p. vi
15. Morison, III, p. 63

CHAPTER VI: THE FAST CARRIER STRIKES AND THE MARIANAS TURKEY SHOOT

1. Inoguchi, Rikihei, "The Kamikaze Attack Corps", (translated and condensed by Chikaya, Mosataka, and Pineau, Roger), United States Naval Institute Proceedings, Vol. 79, No. 9 (September 1953), pp.933-945. (Hereafter, Inoguchi, Kamikaze.)
2. Morison, VIII, p. 274

CHAPTER VII: ADMIRAL OHNISHI AND THE FIRST KAMIKAZES

1. Inoguchi, Divine, frontispiece.
2. United States Strategic Bombing Survey, Japanese Air Weapons and Tactics, p.20 (Full reference fo USSBS documents in appendix C.)
3. Okumiya, p. 340
4. Ibid., p. 341

5. Admiral Arima and about 19 colleagues were shot down by CAP, and the remainder of his strike returned to base. No United States ships were hit on that day. Morison, XII, p. 101
6. Inoguchi, Divine, p. 181
7. Potter, pp. 52-54
8. Inoguchi, Divine, p. 27
9. *Ibid.*, p. 55
10. Okumiya, p. 332
11. Inoguchi, Divine, p. 20, and Kamikaze, p. 935
12. Inoguchi, Divine, p. 67
13. *Ibid.*, p. 19. Different sources give different dates.
14. Inoguchi, Kamikaze, p. 940
15. Roskill, S. W., The War at Sea, 1939-1945, (4 vols.) (in J. R. M. Butler (ed.), History of the Second World War: United Kingdom Military Series), London H. M. Stationery Office, Vol. III, The Offensive, (2 parts) (Hereafter, Roskill + part number) Part II, 1st June 1944 - 14th August 1945 (1961), p. 211
16. This number is subject to some question. Inoguchi, Kamikaze, p. 941, gives 6 kamikazes. Potter, Elmer Belmont, and Nimitz, Chester W., (ed.), The Great Sea War: the Story of Naval Action in WW II, Englewood Cliffs, N.J., Prentice-Hall, 1960 (Hereafter, Nimitz), concurs. Inoguchi, Divine, p. 59 gives 5 kamikazes plus 4 escorts, of which 3 returned. But Inoguchi, Kamikaze, p. 941, at a different place, also gives the 5 plus 4 breakdown. It may be that one of the escorts decided on a suicide attack, and that the 3 remaining escorts were not associated with the attack by all observers.
17. Morison, XII, 301; Nimitz, p. 396
18. Morison, XII, 302
19. Okumiya, p. 236
20. Inoguchi, Divine, p. 64

CHAPTER VIII: THE SUICIDE SPIRIT

1. Kuwahara, Yasuo; and Allred, Gordon T., Kamikaze, New York, Ballantine, 1957, p. 22
2. USSBS, Aircraft Industry, p. 80
3. Yokoi, RAdm. Toshiyuki, "Kamikazes and the Okinawa Campaign", United States Naval Institute Proceedings, Vol. 80, No. 5 (May 1954), p. 505
4. USSBS, Japanese Air Power, p. 61
5. *Ibid.*

CHAPTER IX: THE PHILIPPINES: ENTER THE KAMIKAZE

1. Inoguchi, Kamikaze, p. 934
2. Morison, XII, pp. 37, 162, and 191. Following the Battle of Midway, the after turrets on these post-World War I battleships were replaced by truncated flight decks, so that they could carry 22 aircraft. (Inoguchi, Divine, p. 48). But owing to the aircraft shortage, they never carried any into battle, and their last employment was to carry a load of drummed gasoline from Singapore to Kure in February, 1945. (Morison, XII, p. 335). They have not been included in the list of carriers in appendix A.
3. USSBS, Air Power, p. 64
4. Kuwahara, p. 99
5. USSBS, Air Power, p. 71
6. *Ibid.*, p. 68
7. *Ibid.*, p. 23
8. Inoguchi, Divine, p. 61
9. Morison, VIII, p. 267
10. Inoguchi, Divine, pp. 91ff; USSBS, Air Power, p. 68
11. USSBS, Air Power, p. 65
12. Inoguchi, Divine, p. 19
13. Davidson, S. R., Effect of Ship Maneuvers and Certain Enemy Tactics on Success of Suicide Planes, SPECORG Study No. 5, (LO)2090-45, 14 July 1945; p. 11 (Hereafter, SPECORG Study 5)

CHAPTER X: OKINAWA, I: PRELUDE AND BATTLE

1. Morison, XIV, p. 89. The numbers and narratives in this chapter have been extracted from Morison, except as noted.
2. Churchill, Winston S., The Second World War, Vol. 6, Triumph and Tragedy, Boston, Houghton Mifflin, 1953, p. 339
3. Yokoi, p. 510; USSBS, Air Power, pp. 64, 71
4. USSBS, Air Power, pp. 68, 72
5. Roskill, Part II, p. 187
6. Churchill, p. 624
7. Morison, XIV, p. 285. See also Roscoe, Part II, pp. 346, 352

CHAPTER XI: OKINAWA, II: ENTER THE BAKA

1. Inoguchi, Divine, p. 140
2. Okumiya, p. 341. Various spellings; see Glossary, appendix B. I have adopted that of the USSBS.
3. Inoguchi, Divine, p. 141
4. Kip, A. F., Anti-Aircraft Actions in the Okinawa Campaign, 18 March - 15 August 1945, SPECORG Anti-Aircraft Study No. 13, (LO)3514-45, 12 October 1945; p. 1 (Hereafter SPECORG Study 13)
5. Inoguchi, Divine, p. 143; Kamikaze, p. 944; Okumiya, p. 342; Yokoi, p. 507
6. Morison, XIV, p. 223
7. USSBS, Aircraft Industry, p. 81
8. Okumiya, p. 342
9. USSBS, Air Power, p. 60
10. SPECORG Study 13, p. 5
11. USSBS, Aircraft Industry p. 81
12. Okumiya, p. 344
13. Ibid., p. 5

CHAPTER XII: OKINAWA, III: DEFENSIVE TACTICS

1. Craven, Wesley Frank, and Cate, James Lea, ed., U.S. Air Force, USAF Historical Division, The Army Air Forces in World War II, vol. 5, The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945, Chicago, University of Chicago, 1953, p. 352; quotes AAFSWPA Intelligence Summary #214, 7 June 1944, p. 32
2. Roscoe, Theodore, United States Destroyer Operations in World War II, Annapolis, United States Naval Institute, 1953, p. 477; also Morison, XIV, p. 178
3. Fine, R. and Little, J.L., Memorandum on Suicide Attacks, Anti-Aircraft Study No. 3, Anti-Aircraft Operations Research Group, Headquarters of the Commander in Chief, United States Fleet, (LO) 376-45, 3 February 1945. (Hereafter, AAORG Study 3).
4. Morse, Philip M., and Kimball, George E., Methods of Operations Research, Operations Evaluation Group Report No. 54, Washington, D.C., 1946, p. 54. (Hereafter, OEG Report 54)
5. Fine, R., Anti-Aircraft Action in the Philippines Campaign, 17 October 1944-13 January 1945, AAORG Study No. 4, (LO) 1632-45, 1 June 1945, p. 6. (Hereafter, AAORG Study 4).

6. Morison, XIII, p. 54
7. Ibid., p. 21
8. Ibid., XIV, p. 209
9. Ibid., pp. 8,9
10. AAORG Study 4, p. 5
11. AAORG Study 3, p. 5
12. Ibid., p. 6
13. AAORG Study 4, p. 9

CHAPTER XIII: A REVIEW OF EFFECTIVENESS

1. The term DLI is a common term to distinguish interceptors launched to engage a specific raid, from CAP, which are security forces kept airborne (although CAP must obviously have been launched from decks).
2. AAORG Study 4, p. 3
3. Ibid.
4. AAORG Study 3, p. 1
5. OEG Report 54, p. 81; SPECORG Study 5, p. 4
6. AAORG Study 3 makes this assumption. While it is clearly not perfect, there is no basis for estimating the fraction which failed to damage, but not as a result of AA. The difference in fraction of ships hit, by type, discussed below, though not statistically significant, suggests a lower limit of 50 percent on AA effectiveness.
7. OEG Report 54, p. 82; SPECORG Study 5
8. OEG Report 54, pp. 81-83
9. Ibid.
10. Japanese Air Power, p. 68
11. Ibid., p. 72
12. AAORG Study 4, p. 16
13. Morison, XIV, p. 272
14. Ibid., p. 195
15. VADM C.R. Brown, USN, in Inoguchi, Divine, p. vii
16. Roscoe, p. 344
17. AAORG Study 3, p. 2

CHAPTER XIV: ENDGAME AND PROSPECTUS

1. Churchill, p. 641
2. Okumiya, p. 387
3. Morison, XII, p. 51
4. USSBS, Shipbuilding, p. 9
5. USSBS, Air Power, pp. 68, 72

CHAPTER XV: THE PRICE

1. Churchill, p. 172; Okumiya, p. 345; USSBS, Air Power, p. 62

APPENDIX A

APPENDIX A

JAPANESE AIRCRAFT CARRIERS

Interestingly enough, there does not seem to be a single, reliable source of information on the history of Japanese aircraft carriers during the war. Sources on prewar strengths are readily available; losses during the war are reasonably well documented; but compilations of data are usually incomplete in some fashion. Thus, the list of Japanese aircraft carriers, table A-I, is compiled from a variety of sources.

From this table it is possible to chart the numbers of fleet, light, and escort carriers available to the Japanese in the Pacific by noting completion dates and dates of sinking; this is shown in figure A-1. Although the Japanese built several escort carriers, they do not seem to have been used extensively in convoys or in support of major operations. When Morison mentions Japanese escort carriers, it is to record their sinking or their use as aircraft ferries; but JANAC records the sinking of at least 11 (additional) aircraft ferries. Thus Japanese escort carriers are not considered in this study.

Fleet and light carriers available to the United States Navy in the Pacific are shown for comparison. These numbers have been obtained by examining the narratives in Morison. No attempt has been made in either figure to compensate for carriers out of action for repair; such periods were relatively short (generally about a month or two), except in the cases of damage incurred in 1945 (terminal for Franklin and several of the Japanese carriers).

The figures for fleet and light carriers for Japan and the United States have been combined and presented in figure 2 of chapter III.

TABLE A-1
FATE OF JAPANESE AIRCRAFT CARRIERS IN WORLD WAR II¹

Number ²	Type ³	Name	Date of construction/ conversion	Displacement (tons) ⁴	Aircraft ⁵	Speed (knots)	Date/agent of loss ⁶	Remarks
1	CVL ¹²	Hooho ¹⁶	27 Dec 22	9500	15	25	Intact/—	(26)
2	CV	Akagi ²¹	25 Mar 27	34000	63	31	4 Jun 42/USNCBA ⁹	(27)
3	CV	Kaga	31 Mar 28	33000	72	27.5	4 Jun 42/USNCBA	
4	CVL	Ryujo ¹⁷	9 May 33	11700	36	29	24 Aug 42/USNCBA	
5	CV ¹⁴	Soryu	29 Dec 37	18800	63	34.5	4 Jun 42/USNCBA	
6	CV ¹⁴	Hiryu	5 Jul 39	20250	63	34.3	4 Jun 42/USNCBA	(28)
7	CVL	Zuiko	27 Dec 40	13950	30	28	25 Oct 44/USNCBA	
8	CV	Shokaku	8 Aug 41	29900	75	34.2	19 Jun 44/U.S. Sub	(29)
9	CVE ¹⁹	Taiyo ²³	5 Sep 41	20000	24	21	18 Aug 44/U.S. Sub	
10	CV	Zuikaku	25 Sep 41	29800	75	34.2	25 Oct 44/USNCBA	
11	CVL	Shoho ¹⁵	26 Jan 43	13950	30	28	7 May 42/USNCBA	(30)(31)
12	CV ¹⁸	Junyo ²⁴	3 May 42	27500	54	25.5	9 Dec 44 ² /U.S. Sub	(29)
13	CVE	Hiyo ²²	31 May 42	20000	24	21	15 Sep 44/U.S. Sub	(29)(32)
14	CV	Uryu ²	31 Jul 42	27500	54	25.5	20 Jun 44/USNCBA	(28)
15	CVL ²⁰	Ryuho	28 Nov 42	15300	36	26.5	Damaged/—	(30)(33)
16	CVE	Chuyo	25 Nov 42	20000	24	21	4 Dec 43/U.S. Sub	(29)(32)
17	CVL	Chiyoda ⁷	31 Oct 43	13600	30	29	25 Oct 44/USNCBA	(34)(35)
18	CVE	Kaiyo	23 Nov 43	16700	24	23	Damaged ¹¹ /—	(29)(31)
19	CVE	Shinyo ¹³	15 Dec 43	20900	24	21	17 Nov 44/U.S. Sub	(29)
20	CVL	Chitose ⁷	1 Jan 44	13600	30	29	25 Oct 44/USNCBA	(34)(35)
21	CV	Taiho	7 Mar 44	34200	75	33.3	19 Jun 44/U.S. Sub	
22	CV	Uryu	6 Aug 44	20400	63	34	19 Dec 44/U.S. Sub	
23	CV	Amagi	10 Aug 44	20400	63	34	Serious damage ¹⁰ /—	
24	CV ²⁵	Katsunagi	15 Oct 44 ⁸	20200	63	32	Serious damage/—	(36)
25	CV	Shinano	19 Nov 44 ⁸	68060	54	27	29 Nov 44/U.S. Sub	(36)(37)
26	CVL ²⁵	Ibuki	—	14800	27	29	Not completed/—	(36)(38)
27	CV ²⁵	Karagi	—	20400	63	34	Not completed/—	(36)
28	CV ²⁵	Aso	—	20200	63	32	Launched damaged/—	(36)
29	CV ²⁵	Ikoma	—	20450	63	34	Launched damaged/—	(36)

FOOTNOTES TO TABLE A-1

- ¹All data from Okumuiya, pp. 176-177, except as noted. Agreement with JANAC is good. WSEG, p. 83, is apparently incomplete.
- ²In order of date of construction or conversion, whichever is later, as given in Okumuiya, pp. 176-177.
- ³Includes fleet (CV), light (CVL), and escort (CVE) carriers only; seaplane carriers (CVS and AV) and aircraft ferries are not included. Source is JANAC, except as noted.
- ⁴Apparently at full load. Displacements given in Morison and JANAC tend to be similar or somewhat less.
- ⁵Complement varied considerably with mission and time.
- ⁶JANAC, except as noted; battles from Morison.
- ⁷Chiyoda and Chitose both served offensively as seaplane carriers in World War II before their conversion to aircraft carriers.
- ⁸Not completed.
- ⁹USNCBA — United States Navy Carrier-Based Aircraft.
- ¹⁰Thus, Okumuiya. JANAC says Amagi, a CV of 18,500 tons, was sunk 24 July 1945 at 34-11N, 132-30E by USNCBA. Morison, XIV, p. 331 mentions "strikes" on Amagi, and that Katsuragi and Ryuho "were put out of business" on 24-28 July.
- ¹¹Thus, Okumuiya. JANAC says Kaiyo, a CVE of 17,000 tons, was sunk 24 July 1945 at 33-21N, 131-32E by a combination of USNCBA, U.S. Army air, and mines.
- ¹²Sources: Morison, Fuchida, Jane's.
- ¹³Type, date and agent of loss are those of Jinyo (21,000T.) in JANAC, p. 18, which appears to be the proper association.
- ¹⁴The assertion of JANAC that Soryu and Hiryu were CVL's does not seem to be supported by the speed or complement of the carriers, nor by Morison, Fuchida, or WSEG. Morison notes that they were much larger than Wasp and Ranger (III-p. 88).
- ¹⁵Shoho in WSEG, p. 83. The name Ryukaku, which appears in Jane's (along with its loss at the Coral Sea), is apparently an incorrect transliteration of the characters of Shoho (Morison, p. 11n). Also, Jane's gives Ryukaku as the third ship of the Shokaku (CV) class; Shoho was a CVL.
- ¹⁶Hosyo in Jane's.
- ¹⁷Ryuzyo in Jane's.
- ¹⁸Thus Fuchida. Morison (IV, p. 133) gives CVL, but comparison with Hiyo suggests CV.
- ¹⁹Morison, V.
- ²⁰Morison, VIII, p. 416.
- ²¹A third ship of the Akagi class, Koryu, was mentioned in Jane's 1942, but its existence was discounted in the 1943 edition.
- ²²JANAC gives Hitaka, but this is clearly the same ship as the Hiyo whose loss is described in Morison, VIII, p. 307. At p. 295 Morison explains that Hitaka is an incorrect transliteration.
- ²³JANAC: gives Otaka, but no other sources do. Association is by elimination.
- ²⁴Okumuiya suggests Junyo had been sunk by the end of the war; JANAC does not mention her. Morison, XIV, pp. 285-286 notes that she was torpedoed by USS Redfish and Sea Devil on 9 December 1944, and "so badly damaged as to be out of the war." The organization of the Japanese Navy as of 1 January 1945 (Morison, XIII, pp. 158-159) does not include Junyo. Morison, XIV, p. 286n, notes that the characters of Junyo had been erroneously transliterated as Hayataka earlier in the war.
- ²⁵Deduced from characteristics.
- ²⁶Begun as battle cruiser.
- ²⁷Begun as battleship.
- ²⁸Begun as submarine tender.
- ²⁹Converted merchant ship.
- ³⁰Converted submarine tender.
- ³¹Built 1939.
- ³²Built 1940.
- ³³Built 1934.
- ³⁴Converted seaplane carrier.
- ³⁵Built 1938.
- ³⁶Not completed.
- ³⁷Converted cruiser.

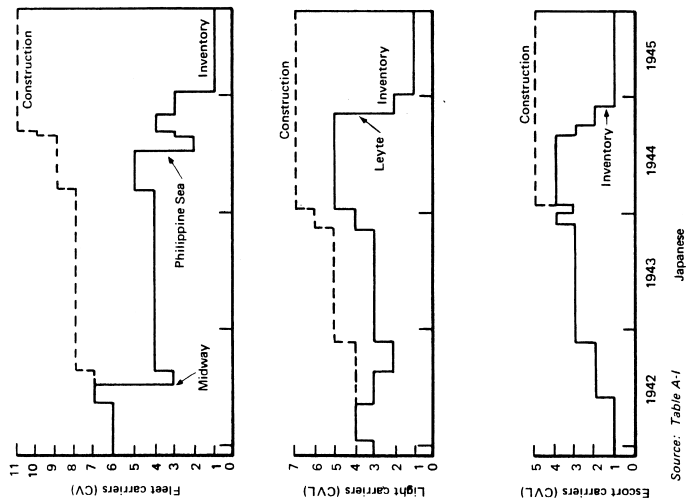
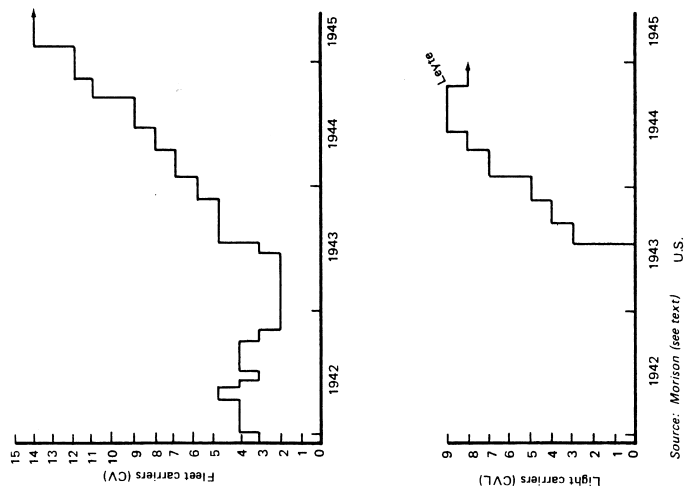


FIG. A-1: COMPARITIVE CARRIER STRENGTH

APPENDIX B

GLOSSARY

A few of the terms used in the study are partly defined in the following.

- A-Go - The name given by the Japanese to their plan for the defense of the Philippines in the fall of 1944.
- Baka - "Foolish" - The name given by the Americans to the built-for-the-purpose suicide glide bomb which the Japanese called "Oka".
- Bushido - The code of the Japanese samurai.
- CAP - Combat Air Patrol: Aircraft maintained airborne in readiness to defend the force.
- DLI - Deck-launched Interceptors: Aircraft maintained in alert status and launched when an attack begins as distinguished from CAP.
- F-4F - Wildcat: American carrier-based fighter aircraft in 1943.
- F-4U - Corsair: American carrier-based fighter aircraft in 1944 and later.
- F-6F - Hellcat: American carrier-based fighter aircraft in 1943 and later.
- Harakiri - Japanese ritual suicide.
- Jinrai Butai - Divine Thunderbolt: Name given to the units organized to deliver the first baka bombs.
- kamikaze - "Divine wind" - after the typhoon which scattered an invasion fleet of Mongols threatening Japan in the thirteenth century. Inasmuch as the term has become popular for describing Japanese suicide attacks in World War II, it is used without initial capitalization throughout. Properly, the term should apply only to the first special units organized in the Philippines by Admiral Ohnishi (c.f. Inoguchi, Divine, p. xvi), but it is here used in the larger sense to encompass both Army and Navy suicide attacks after 25 October 1944.
- kikusui - "floating chrysanthemum." Name given by the Japanese to the ten mass suicide attacks on American forces off Okinawa. The characters making up the word were used in the crest of a 15th-century Japanese hero who took the side of the emperor in a prolonged war against heavy odds (USSBS, Air Power, p. 66).
- Marianas Turkey Shoot - The major air battle of the Battle of the Philippine Sea, after the lopsided exchange of Japanese and American aircraft.
- Ohnishi - Vice Admiral Ohnishi, the guiding force of the early kamikaze attacks (see brief biography in chapter VII).

Oka - (also, Ota, Ohka): Japanese designation for the baka.

Samurai - Medieval Japanese warrior.

Special Attack Unit - Kamikaze Tokubetsu Kogekitai: Units formed to act as kamikazes in the Philippines and later.

Ten-go - The name given by the Japanese to their plan for the defense of Okinawa.

Zeke, Zero - Japanese fighter aircraft, commonly used as kamikazes or kamikaze escorts.

APPENDIX C

APPENDIX C

SOURCES

INTRODUCTION

A variety of sources have been examined in the preparation of this study. All are secondary in the sense that they are based on examination and analysis of basic documents. The best of these sources in the sense of completeness, quality of reconstruction, and relevance to the subject under review, are Samuel Eliot Morison's monumental history of United States naval operations in World War II, the product of almost 20 years' scholarship, and the efforts of the massive United States Strategic Bombing Survey (USSBS), completed in the years immediately following the war.

Morison has done an admirable job of reconstructing individual kamikaze attacks, with the aid of ships' action reports, survivor accounts, and, where possible, Japanese records. However, these reconstructions do not generally allow a complete determination of the outcomes of individual raids, except in the case of very small attacks. Overall statistics are thus best interpreted as crude indicators of activity. It would seem, at this time, that only the most painstaking historian would seek again among individual action reports and other primary sources for estimates of kamikaze effort and results. The aggregated values presented in this study represent, in most cases, the consensus of the more reliable secondary sources. For the purpose, such estimates seem sufficient.

Sources are of 4 types: principal sources (Morison and the USSBS), supplementary sources (often of the quality but not always the relevance of the primary sources), special sources (of somewhat lower reliability), and analyses conducted within the United States defense establishment (often on the basis of fairly limited samples). Full references and some remarks on the nature of the sources are presented below in these categories.

References throughout the study are in an abbreviated form (e.g., Morison, I, is the first volume of reference (a)); an index to the abbreviations is given in table I-1.

PRINCIPAL SOURCES

- (a) Morison, Samuel Eliot, History of United States Naval Operations in World War II: Vol. III, The Rising Sun in the Pacific, 1931-April 1942 (1960), Vol. IV, Coral Sea, Midway, and Submarine Actions, May 1942 - August 1942 (1949); Vol. V, The Struggle for Guadalcanal, August 1942 - February 1943 (1960); Vol. VI, Breaking the Bismarcks Barrier, 22 July 1942 - 1 May 1944 (1950); Vol. VII, Aleutians, Gilberts, and Marshalls, June 1942 - April 1944 (1951); Vol. VIII, New Guinea and the Marianas,

March 1944 - August 1944 (1953); Vol. XII, Leyte, June 1944 - January 1945 (1958); Vol. XIII, The Liberation of the Philippines: Luzon, Mindanao, and the Visayas, 1944-1945 (1959), and Vol. XIV, Victory in the Pacific, 1945 (1959), and Vol. XIV, Victory in the Pacific, 1945 (1960), Boston, Little, Brown. (See also The Two-Ocean War: A Short History of the United States Navy in the Second World War, Boston, Little, Brown, 1963.)

- (b) United States Strategic Bombing Survey, (Pacific), Military Analysis Division, Japanese Air Power, July 1946; and Japanese Air Weapons and Tactics, January, 1947; Aircraft Division, The Japanese Aircraft Industry, May 1947; Military Supplies Division, Japanese Naval Shipbuilding, 15 November 1946; Oil and Chemical Division, Oil in Japan's War, February 1946.

In the volume on air power (p. 29), USSBS states:

"The Japanese Navy did not burn all its records, but up to the present time few documents have been uncovered which assist materially in reconstructing the aircraft strength of the Japanese Navy Air Force. As was the case with the Japanese Army, statistical control was in a primitive state of development, and the best estimates of strength in tactical units must be made on the basis of the history of those units checked against Allied intelligence. Figures furnished by the Navy statistical officers are perhaps more reliable than corresponding figures from the Japanese Army, but they must be treated with reserve. Several Navy officers were found who had an intimate connection with particularly spectacular operations, and their estimates of the numbers of aircraft taking part in those operations are believed firm. In this category fall figures given by an officer who flew with the first wave of planes over Pearl Harbor, the commander of one of the air groups which sank the REPULSE and PRINCE OF WALES, and Admiral Yamamoto's personal representative in charge of planning offensive air operations against Guadalcanal."

SUPPLEMENTARY SOURCES

- (c) Churchill, Winston S., The Second World War, Vol. 6, Triumph and Tragedy, Boston, Houghton Mifflin, 1953
- (d) Roskill, S. W., The War at Sea 1939-1945, (4 vols.) (in Butler, J. R. M. (ed.), History of the Second World War: United Kingdom Military Series), London, H. M. Stationery Office: Vol. III, The Offensive, Part I, 1st June 1943 - 31st May 1944 (1960), and Part II, 1st June 1944-14th August 1945 (1961)
- (e) U.S. Air Force, USAF Historical Division (Craven, Wesley Frank, and Cate, James Lea, ed.) The Army Air Forces in World War II, Vol. 5, The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945. Chicago, University of Chicago, 1953

- (f) U. S. Joint Army-Navy Assessment Committee (RAdm. Jerauld Wright, Chairman), Japanese Naval and Merchant Shipping Losses During World War II by all Causes, Washington, Government Printing Office, February 1947 (NAVEXOS P - 468)

SPECIAL SOURCES

- (g) Fuchida, M., and Okumiya, M., Midway, the Battle that Doomed Japan, Annapolis, United States Naval Institute, 1955 [Edited by Kawakami, Clarke H., and Pineau, Roger]

Roger Pineau, now with the Smithsonian Institution, participated in the USSBS and was an assistant to Morison in compilation of several volumes of his history. Fuchida and Okumiya were responsible officers in Japanese Naval Aviation in World War II.

- (h) Inoguchi, Rikihei; Nakajima, Tadashi; and Pineau, Roger: The Divine Wind: Japan's Kamikaze Force in World War II, Annapolis, United States Naval Institute, 1958

Capt. Inoguchi was a senior officer on the staff of Adm. Ohnishi, originator of the kamikaze attacks, but his account suffers somewhat from the very closeness which makes it so valuable.

- (i) _____, "The Kamikaze Attack Corps," (translated and condensed by Chikaya, Mosataka, and Pineau, Roger), United States Naval Institute Proceedings, Vol. 79, No. 9 (Sept 1953), pp. 933-945
- (j) Kuwahara, Yasuo, and Allred, Gordon T., Kamikaze, New York, Ballantine Books, 1957

A first-person narrative of kamikaze training and indoctrination by a man who was Japanese glider champion in 1943, at the age of 15, and who subsequently became a fighter pilot and kamikaze escort. The work is popular and sensational and, in places, lurid and unconvincing.

- (k) McMurtrie, Francis E., ed., Jane's Fighting Ships, 1941, New York, Macmillan, 1942 (1943)

The standard current reference is less than authoritative when compared, in retrospect, with references (b) and (f).

- (l) Okumiya, Masatake; Horikoshi, Jiro; and Caidin, Martin, Zero!, New York, E. P. Dutton, 1956

A popular but responsible account, which agrees well with the more reliable sources.

- (m) Potter, Elmer Belmont, and Nimitz, Chester W., (ed.), The Great Sea War: the Story of Naval Action in World War II, Englewood Cliffs, N.J., Prentice-Hall, 1960
- (n) Potter, John Deane, Yamamoto: The Man Who Menaced America, New York, The Viking Press, 1965
- (o) Roscoe, Theodore, United States Destroyer Operations in World War II, Annapolis, United States Naval Institute, 1953

Incident narratives and some data in a popular format.

- (p) Tansill, Charles Callan, Back Door to War: The Roosevelt Foreign Policy, 1933-1941, Chicago, H. Regnery Co., 1952

Describes events leading to Pearl Harbor, and asserts thesis that President Roosevelt forced Japan into war with the United States.

- (q) Yokoi, RAdm. Toshiyuki, "Kamikazes and the Okinawa Campaign," United States Naval Institute Proceedings, Vol. 80, No. 5 (May 1954), pp. 504-513

ANALYSES

- (r) Davidson, S. R., Effect of Ship Maneuvers and Certain Enemy Tactics on Success of Suicide Planes, SPECORG Study No. 5, (LO) 2090-45, 14 July 1945

On p.1, Davidson notes:

"Two distinct campaigns...from 21 Oct 1944 to 31 Jan 1945...The Philippines Campaign, and that...from 1 Feb 1945 to 20 May 1945...the Iwo-Jima-Okinawa Campaign...have been analysed separately, and then, since no inconsistencies were apparent, lumped together...in the tables of this report."

- (s) Fine, R., Anti-Aircraft Action in the Philippines Campaign, 17 Oct 1944-13 Jan 1945, AAORG Study No. 4, (LO) 1632-45, 1 Jun 1945
- (t) Fine, R. and Little, J. L., Memorandum on Suicide Attacks, Anti-Aircraft Study No. 3, Anti-Aircraft Operations Research Group, Headquarters of the Commander in Chief, United States Fleet, (LO) 376-45, 3 Feb 1945
- (u) Kip, A. F., Anti-Aircraft Actions in the Okinawa Campaign, 18 Mar-15 Aug 1945, SPECORG Anti-Aircraft Study No. 13, (LO) 3514-45, 12 Oct 1945
- (v) Memorandum for Director, Southeast Asia Combat Analysis Group (Op-O3G), (OEG) 469-69,

- (w) Morse, Philip M., and Kimball, George E., Methods of Operations Research, Operations Evaluation Group Report No. 54, Washington, D.C., 1946

- (x) Office of the Secretary of Defense, Weapons Systems Evaluation Group, WSEG Staff Study No. 4, "Operational Experience of Fast Carrier Task Forces in World War II," Unclassified 15 Aug 1951. (Forwarded by Op-504F ltr ser 0577P50 of 19 Oct 1951)

This study was based on information in the files of the Aviation History Section of the Deputy Chief of Naval Operations (Air).

TABLE C-I
INDEX TO SOURCES

<u>Abbreviation</u>	<u>Reference</u>
AAORG Study 3	(t)
AAORG Study 4	(s)
Churchill	(c)
Craven	(e)
Fuchida	(g)
Inoguchi, <u>Divine</u>	(h)
Inoguchi, <u>Kamikaze</u>	(i)
JANAC	(f)
Jane's + year	(k)
Kuwahara	(j)
Morison + volume number	(a)
Nimitz	(m)
(OEG) 469-69	(v)
OEG Report 54	(w)
Okumiya	(l)
Potter	(n)
Roscoe	(o)
Roskill + part number	(d)
SPECORG Study 5	(r)
SPECORG Study 13	(u)
Tansill	(p)
USSBS, <u>Air Power</u>	(b) <u>Japanese Air Power</u>
USSBS, <u>Air Weapons</u>	(b) <u>Japanese Air Weapons and Tactics</u>
USSBS, <u>Aircraft Industry</u>	(b) <u>The Japanese Aircraft Industry</u>
USSBS, <u>Shipbuilding</u>	(b) <u>Japanese Naval Shipbuilding</u>
USSBS, <u>Oil</u>	(b) <u>Oil in Japan's War</u>
WSEG	(x)
Yokoi	(q)

C-6

None

Security Classification

DOCUMENT CONTROL DATA - R & D		
<i>Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified</i>		
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		2b. GROUP None
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5. AUTHOR(S) (First name, middle initial, last name) Timenes, Nicolai		
6. REPORT DATE November 1970	7a. TOTAL NO. OF PAGES 113	7b. NO. OF REFS 0
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11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY Office of Naval Research Department of the Navy Washington, D.C. 20350
13. ABSTRACT This study examines the experience of the United States Navy in countering attacks by Japanese suicide aircraft (kamikazes) in World War II, and provides an analytical history of the kamikaze program and develops estimates of the effectiveness of the kamikaze and of efforts to counter it. This study begins with a history of the early encounters between Japanese and American carrier aircraft and shows how the patterns of aircraft losses by both sides changed during the war. The effect on Japan of losing aircraft, pilots, aircraft carriers, and other resources is discussed as a background to the decision to employ the kamikaze tactic. A brief chapter addresses the philosophical environment which made the kamikaze tactic acceptable. Then the history of the employment of the kamikaze is discussed in terms of 2 major campaigns-- the Philippines and Okinawa. In the discussion of the Okinawa campaign, where the majority of kamikazes were expended, the tactics used by the American Navy in defense are described. Finally, statistics on results in the Philippine and Okinawan campaigns are used to establish estimates of the effectiveness of defense at various stages-- attack at the source, defense by interceptors, defense by anti-aircraft guns, and the like. These estimates are used to provide a crude model of overall effectiveness.		

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KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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