



Far From Battlefield, Marines Lose One-Third of Harrier Fleet

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TIMES STAFF WRITERS

YUMA, Ariz. — Though many had died flying the Harrier, Marine Corps pilot Peter E. Yount never thought it would let him down.

He knew the attack jet well and was devoted to it. In the entire U.S. arsenal, only the compact, muscular-looking Harrier could lift straight up off a runway, hover like a hummingbird, then blast off in search of targets.

“Difficult but honest” is how Yount described it.

But on a clear spring day in 1998, the Harrier would betray him. At 14,500 feet over the Southern California desert, the plane’s engine quit. Yount twice tried to restart it. No response.

“I’m losing control of this thing,” Yount radioed to his wingman in a firm voice. “I’ve got zero hydraulics. I’ve got nothing. I’m getting out of this thing. Get out of my way!”

He veered the aircraft away from farmhouses and highways in the Imperial Valley below, then pulled the ejection handle. And there, at 7,500 feet, the Harrier failed him again.

As Yount shot out of the cockpit, his seat rotated out of position. When his parachute unfurled above him, its harness straps smacked violently against his helmet, whipsawing his head. The 42-year-old lieutenant colonel and father of two young girls died instantly of a broken neck.

For the Marines, the ensuing rituals were painfully familiar. Notify the widow. Remove the wreckage. Investigate the causes.

They know this drill all too well because the Harrier is the most dangerous airplane flying in the U.S. military today.

Over the last three decades, it has amassed the highest rate of major accidents of any Air Force, Navy, Army or Marine plane now in service. Forty-five Marines have died

in 143 noncombat accidents since the corps bought the so-called jump jet from the British in 1971. More than a third of the fleet has been lost to accidents.

The toll has been little noted by the public and the media because the Harrier tends to kill pilots one at a time. In contrast, the V-22 Osprey, a problem-plagued troop transport plane, has killed as many as 19 Marines in a single crash.

The Harrier and the Osprey are the first two planes the Marine Corps has acquired in pursuing its long-range vertical vision. A third plane is under active development and several others are being conceived.

In the future, according to the vision, all Marine aircraft will combine the best traits of helicopters and fixed-wing planes, making the corps' flying force sharply distinct from those of the Navy, Air Force and Army.

The price to be paid for that vision was first seen in the Harrier. The officers who died in it ranked among America's most accomplished aviators. They typically finished near the top of their flight school classes, often aspiring to become squadron commanders, generals or astronauts.

Many of their deaths were preventable. The Marines have known for years they were flying a plane bedeviled by mechanical problems and maintenance mistakes. Yet they moved haltingly to fix known shortcomings that threatened pilots' lives.

In Yount's case, a mechanic incorrectly installed a part that led to failure of the temperamental engine. The ejection system that fractured Yount's neck had previously killed two pilots.

The Marine Corps initially sold the Harrier to Congress and the Pentagon for its ability to launch from a clearing as small as a tennis court, or a damaged runway near a remote battlefield, and then roar to the rescue of troops in trouble.

In 31 years of flight, however, the Harrier's vaunted ability to take off vertically has never been used in combat -- only in training exercises, air shows and the 1994 film "True Lies," when Arnold Schwarzenegger commandeers a Harrier to save Miami from a terrorist attack.

Instead, the planes have used their powerful thrusters for short, rolling takeoffs from runways and Navy assault ships, mostly flying missions that could have been handled by safer, more conventional aircraft.

Many of the Harrier's ailments can be traced directly to its innovative vertical-thrust technology. But despite the investment of tax dollars, aircraft and pilots' lives, there is little evidence that the Harrier's noncombat deaths have been redeemed in any significant way on the battlefield.

"If the Harrier had been decisive many times in battle, we would all still regret horribly the tragedies of the pilots who have been killed, but at least you'd be able to say that the Harrier made a difference," said Philip E. Coyle, the Pentagon's chief weapons tester from 1994 to 2001.

"What makes this situation so difficult is that we just don't have that kind of battlefield record to support the accidental deaths."

In the Persian Gulf War in 1991, the hot thrust-producing nozzles in the heart of the fuselage -- the devices that allow the Harrier to rise and balance in the air -- made the plane a magnet for heat-seeking missiles. Its loss rate was more than double that of the war's other leading U.S. combat jets. Five Harriers were shot down and two pilots died.

"It's the most vulnerable plane that's in service now," said Franklin C. "Chuck" Spinney, who evaluates tactical aircraft for the Pentagon. "You can't hit that thing without hitting something important."

In the last decade, the use of laser-guided ordnance from highflying bombers and unmanned drones has diminished the need for the Harrier's brand of close air support.

Afghanistan provided precisely the kind of austere battlefield where the Marines had maintained the Harrier would make a crucial difference. Yet U.S. commanders held the Harrier out of the first four weeks of combat last year.

As other planes pummeled Taliban and Al Qaeda targets, Harriers based on the Navy's amphibious assault ship Peleliu practiced attack maneuvers over the Arabian Sea, hundreds of miles from the action.

"Other squadrons were going north to the war and we were flying south for more training," recalled Capt. Matthew Parker, a Harrier pilot. "It was very frustrating."

Today, the Marines hope the Harrier will play a more dramatic role in a potential war with Iraq. But given the plane's limitations, many defense officials and military analysts deem that unlikely.

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'Answer to a Prayer'

To the Marine Corps' ranking generals, the Harrier has been a major step toward realizing a dream that germinated during World War II in the bloody jungles of Guadalcanal and Tulagi. As Marines battled Japanese forces and malarial mosquitoes on those South Pacific islands, the Navy withdrew and initially left them to fend for themselves without air cover and supplies. The Marines lost more than 1,000 men in the campaign, and their resentment has endured for 60 years.

The precept that Marines in the air should protect Marines on the ground has been central to the corps' ethos ever since. By 1957, Marine leaders had proclaimed the bold vision of creating an entire wing of aircraft with the vertical ability of helicopters and the speed and range of airplanes, a goal they now hope to reach by 2020.

Their breakthrough plane was the Harrier. It was, said one general, "an answer to a prayer."

The Marines are now testing the tilt-rotor V-22 Osprey, designed to speed troops into combat. Its revolutionary technology also has had deadly side-effects, killing 23 Marines in two crashes in 2000 alone.

The Pentagon, meanwhile, is developing the Harrier's replacement, the Marine version of the next-generation Joint Strike Fighter, a plane that will imitate the Harrier's abilities to take off after a short roll and land vertically.

As the military's smallest branch, the Marines have long feared their air wing would be absorbed by the Navy or that the corps itself would be folded into the Army. In waging the political battle to remain a self-sufficient fighting force, they have sought over the years to make their combat role distinctive.

The Marine Corps' generals are painfully aware of the Harrier's shortcomings. Many can rattle off the names of pilots they have buried. But they say that accidents are the price of technological progress, and that the Harrier has proven its value in combat while paving the way for a superior successor. They deny they have needlessly jeopardized Marines in pursuit of their vision of an independent air wing.

"I would resist with all my moral fiber the idea that we would willingly or knowingly try to bring aboard a program -- V-22 or anything else -- and so fall in love with the program that we would put people at risk to ride in those vehicles," Marine Corps Commandant James L. Jones said at a military forum last year.

If the Harrier's problems have lingered, some current and former Marine officials contend, it is because the Navy has once again let them down. As the financial

contingency, it is because the Navy has once again let them down. As the financial overseer of the corps' aviation program, the Navy hasn't always provided enough money to maintain a plane flown only by the Marines, they say -- a charge Navy officials vigorously dispute.

Undaunted by past failures, the Marines have pressed on. Some survivors of Harrier pilots say that is as it should be, that their husbands and sons knew the risks but believed in the cause. Others are less forgiving, convinced that the corps has been more faithful to its vertical vision than to its pilots. They say the corps has taken unreasonable risks with the lives of their loved ones.

"They deserve the best chance we can give them if we're going to stick them out there to stretch the envelope," said Jim E. Dale, whose brother, 1st Lt. Kerry D. Dale, died in a 1988 Harrier crash after his flaps jammed. "They deserve honesty. They deserve integrity. They deserve the very principles from the corps that we think the corps stands for."

Many of the Harrier's victims left behind adoring wives and children too young to comprehend. Long after their deaths, their parents grasp for memories, adorning their sons' bedrooms with ceremonial swords, plastic airplane models and flags folded neatly into tri-corner boxes.

Twelve years after Maj. Roland P. Wheeler died in a Harrier crash, his widow, Brandi, still drives her white Toyota Camry with his call sign -- "Wheels" -- stamped on her license plate. Even within the macho culture of military aviation, she said, Harrier pilots hold a certain swaggering cachet: "If you flew the Harrier, you walked on water and glowed in the dark."

After watching so many colleagues die, some pilots and their families have decided the risk is too great. Gary Pheasant left the Marine Corps in 1988, with 1,800 flight hours in the Harrier, when his wife decided she could no longer live with the dread.

"When I'd go fly," he said, "she'd make sure the house was clean. She figured the chaplain could be coming over at any moment."

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Love at First Sight

No wonder the Harrier enthralled the Marines when they first saw it at a British air show in 1968. With wings distinctively swept back and angled downward, the plane is a technological marvel when it is flying well.

Named after a low-flying marsh hawk, the Harrier has a massive Rolls-Royce engine that supplies 23,800 pounds of thrust through four nozzles that pivot down to produce a shimmering blast of hot air. The thrust can propel the plane off the ground and into a hover, a process that pilots compare to balancing an elephant on the head of a pencil.

The British developed the Harrier in the 1960s to counter the threat of a Soviet attack. If allied air bases were destroyed, a dispersed fleet of Harriers could counterattack from glens or roads.

Marine pilot Thomas H. Miller, then a colonel, was one of the first two Americans to fly the British Harrier. "If I had my way, I'd have a squadron of those things tomorrow," he told his superiors upon his return. "I think we can save an awful lot of young people's lives."

The Marines got their first jump jets in 1971. Over the ensuing 31 years, the corps received 397 Harriers, first from Hawker Siddeley Aviation Ltd. and British Aerospace Inc., and then from McDonnell Douglas Corp., lead contractor on the second version of the plane.

The Marines now have 154 Harriers. The plane is no longer in production but is

scheduled to remain in service another 13 to 17 years.

Despite its early billing, the Harrier turned out to have a crippling flaw: It crashed at an alarming rate.

Other military planes have killed more pilots because there are more of them, and they log more hours in the air. But by the accepted standard of U.S. military aviation safety -- major accidents per 100,000 flight hours -- the Harrier has no peer among active planes today.

Major accidents are known in the military as Class A mishaps if they cause death, permanent injury or at least \$1 million in losses (the dollar figure has increased over time).

The Class A mishap rate for the first model of the Harrier, the AV-8A, was astronomical -- 31.77 accidents per 100,000 hours. Notoriously unstable, it had a propensity for rolling over and slamming into the ground. Well over half were lost to accidents. One tragedy-scarred squadron dubbed the plane "the Widow-Maker."

Promising dramatic improvement, the Marines replaced it with the more stable and capable AV-8B model in the mid-1980s.

"Any safety problems, perceived or real, with the AV-8A have been specifically designed out of the AV-8B," Col. Harold Clark, a Harrier program officer, proclaimed in 1981.

But by 1996, nearly a quarter of the new planes had crashed.

The lifetime accident rate for the Marines' AV-8B is 11.44 per 100,000 hours of flight, well over the combined rates for other attack and fighter planes flown during those years by the Marines, the Navy and the Air Force.

It is more than twice the lifetime accident rate of the Air Force's F-16 Fighting Falcon, a single-engine tactical aircraft like the Harrier that has been in service since 1979. It is nearly five times higher than the A-10 Warthog, an Air Force attack plane that has been flying since 1976. And it is more than 3 1/2 times the rate of the F/A-18 Hornet, a twin-engine combat plane flown since 1980 by the Navy and Marines that, like the Harrier, operates largely off ships.

The Harrier Review Panel, a Marine commission that issued a 1998 report on the AV-8B's problems, wrote that the Harrier's accident rates "seem always to have been a decade or more behind the rest of the tactical aviation world."

All told, Harriers have been involved in more than 300 accidents and 900 less serious incidents, according to the Naval Safety Center's aviation database. The loss to taxpayers exceeds \$1.8 billion. And those figures don't include the plane's calamitous first decade.

The Marines had a glimmer of hope in 2001. The Harrier earned its lowest Class A mishap rate ever: 2.74 per 100,000 hours of flight. That prompted Commandant Jones to say last February that "the Harrier is flying unbelievably well."

Two weeks later, a Harrier crashed off the coast of Mexico. Two more went down in North Carolina in June and July. All three pilots ejected successfully. The financial losses totaled \$90 million. And the Class A mishap rate for 2002 shot back up to 9.66 through Oct. 1.

Across the Atlantic, planes in Britain's much smaller Royal Air Force fleet have been crashing at an even higher rate. Between 1990 and 2000, the models most similar to the Marines' AV-8B had cumulative major accident rates ranging from 12 to 19 when the U.S. military standard is applied.

Fifteen major accidents killed two British and one American pilot during that period.

In August, an RAF Harrier slammed into the sea as the pilot parachuted to safety in front of thousands of spectators at a Suffolk air show. The cause of the crash is under investigation.

A number of other countries, including Spain and Italy, have bought Harriers over the years. But Taiwan decided earlier this year not to lease nearly three dozen AV-8Bs from the Marines because of concerns about “maintenance, safety and performance,” said a Taiwan defense official.

The U.S. Navy has spent nearly \$9 billion since 1971 to buy and modify the Harriers and an additional \$4.1 billion since 1986 to repair and fly the aircraft. The Marines are rebuilding 74 AV-8Bs at a cost of \$28.2 million each, pushing the overall investment in some of those planes above \$50 million.

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Budget Battles

Many current and former Marine Corps leaders complain that the Navy has not always provided sufficient funding because the Harrier, unlike the F/A-18, belongs to the Marines alone.

In their budget battles with the Navy, the Marines portray themselves as the deprived stepchild in an institutional rivalry.

Former Navy secretaries and other senior officers deny that the Navy has shortchanged the Harrier program. But they said the Navy has been reluctant to provide extra money to the Marines for a jet that is more costly and less reliable than other combat planes.

“The fact that the Harrier turned out to be grossly more expensive than they thought, especially driven by the very high accident rate, was not the fault of the Navy,” said John F. Lehman Jr., who served as Navy secretary from 1981 to 1987. “That was their miscalculation.”

Because the Navy has been unwilling to pour extra money into a plane it regards as flawed, the Marines have chosen to make do with what they had.

Stephen E. Brooks, who flew the Harrier for four of his 10 years in the Marines before leaving in 2000, called it “a phenomenal aircraft when it’s being financed and maintained properly.”

But he said the Marines didn’t “want to acknowledge how expensive it would be to run it properly.... The Marine attitude would be: ‘We’ll make it work with what we’ve got.’ ”

The Harrier’s accidents cannot be traced to any single problem, but rather to an array of them.

In the last 12 years alone, the Marines have grounded parts of the Harrier fleet 31 times for periods ranging from days to months.

Failures of the cantankerous Rolls-Royce engine have been chronic, causing more than two dozen major accidents.

The Marines and the Naval Air Systems Command knew for nearly eight years that the wing flaps were prone to locking up, but it took three crashes, two of them fatal, before they decided to redesign the problem part.

The accident that killed Lt. Col. Yount highlights just how risky the Harrier can be.

Yount grew up close enough to Cape Canaveral, Fla., to watch rocket launches from his porch. A former test pilot venerated for his skill in the cockpit and his leadership in the ready room, he aspired to become a general. He had been selected to command

a Harrier squadron at the Marine Corps Air Station in Yuma.

Janet Yount never fretted much about her husband's safety. "When I'm in the plane, you don't have to worry," he had assured her. "I'm in control."

But he once confided that he never wanted to rely on the Harrier's ejection system. "That thing's dangerous," his mother, Bettye Yount, recalled him saying.

The accident inquiry concluded that a circlip, a semicircular fastener, was incorrectly installed by mechanics on the gas turbine starter, setting off a chain reaction that led to the engine failure.

Then, when Yount ejected, he was killed by the very system that pilots depend on when they run into trouble.

He became the third Harrier pilot since 1990 to die during an "in-the-envelope" ejection -- meaning the circumstances were such that survival would be expected -- according to the Harrier Review Panel.

A subsequent Navy examination cataloged other serious Harrier ejection injuries, including five previous "major neck injuries" sustained during otherwise normal ejections.

Nevertheless, the Marines say they had no reason to believe the ejection system was flawed before Yount's accident. In its aftermath, they made safety improvements to better protect against serious injuries.

Yount's death unnerved many in the Marine Corps because he seemed to have made no mistakes.

"Here was a guy who did every single thing correctly and still the airplane ended up letting him down," said retired Lt. Gen. Fred McCorkle, head of Marine aviation at the time.

The Marines acknowledge they have had a rough ride with the Harrier. But eight current and former Marine commandants and top aviation officers told The Times in interviews that it has been worth it.

Retired Maj. Gen. Charles F. Bolden Jr., who stepped down as commander of the 3rd Marine Aircraft Wing in August, said the Marines "don't stop flying airplanes because we have accidents."

He added: "We try to find out what the problem was and then we fix it. And we tried to do that with the Harrier."

McCorkle, who retired from the Marines last year after 35 years in the service, said, "I've heard a lot of people who were very, very attuned to caring for their troops say that's the cost of doing business."

Retired Commandant Charles C. Krulak, who convened the Harrier Review Panel, which generated a six-year infusion of funds for the program, said the Marines have made many efforts to improve the plane's safety.

All military pilots accept a certain level of risk. And Harrier pilots in particular have been willing to commit themselves to a plane they know is perilous, out of devotion to the Marines.

Many adore the plane because it handles like a hot rod. They express confidence in their ability to fly it despite the ominous nicknames it has earned, including "the Scarier" and "the lawn dart."

Like Capt. Richard F. Davis, who got a pilot's license before he could drive, many had wanted to fly since childhood. And like Capt. Manuel Rivera Jr., who challenged friends to play handball while he hopped on one foot, they were fit, disciplined and

brimming with bravado.

Davis, 27, died when his AV-8A rolled over during a vertical takeoff in 1975. Rivera, 31, died when his AV-8B smashed into the Omani coastline during a Gulf War training mission in 1991.

For the pilots, it is a measure of their intense loyalty to the plane and to the corps that even those who have suffered incalculably from its crashes tend to remain unflinching advocates.

Retired Gen. Richard. D. Hearney, a member of the first Harrier squadron, was the head of Marine aviation in 1994 when his second son, Brenden K. Hearney, 29, flew a British Harrier into the ground while on an exchange program with the RAF in England.

"I've got my lifeblood tied up in the program, literally," Hearney said in an interview. Did his son's death change his commitment to the Harrier? "Not a bit," he said.

In 1993, John O'Brien, a 28-year-old Marine pilot with only 152 hours in the Harrier, smashed his plane into a grove of trees during a tricky "rolling vertical landing."

Pinned inside the flaming wreckage, he suffered burns over more than a third of his body and ultimately lost part of an arm and a leg.

Without a trace of bitterness, O'Brien said the Marines need the combat flexibility the Harrier provides.

"Advancements in technology don't come without sacrifice," O'Brien said, surrounded at his Pennsylvania home by his wife and three young daughters. "Advancements in technology are sometimes written in blood."

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Combat Record

It would be one thing if the Harrier's unique design had produced unique results. But in two wars and a number of lesser conflicts, the plane has not made a distinctive mark.

It is telling that Marine leaders, when defending the Harrier's record, tend to point back two decades to another nation's conflict.

In Britain's Falkland Islands War with Argentina, Royal Navy Sea Harriers won a nation's reverence by defending the short-deck ships on which they were based. Armed with cannons and heat-seeking missiles, they proved too much for Argentina's Mirage fighters and other jets in air-to-air combat.

The Marine Corps' Harriers have never faced a similar mission and are not outfitted to do so. The Marines obtained the plane primarily to support troops on the ground. As a result, the corps accepted many trade-offs for an aircraft that relies on powerful blasts of hot air to propel it into the sky.

The superheated column of thrust can liquefy asphalt, while its huge intakes can ingest pebbles and other engine-shredding debris.

The Harrier has to be light enough for the engine's thrust to lift it straight off the ground, so it carries a relatively small amount of fuel, which limits both its range and payload. Its maximum external load, including bombs and fuel, is 9,000 pounds.

By contrast, the Marines' own F/A-18 can handle 15,500 pounds and the Air Force's A-10 up to 16,000 pounds, according to Jane's All the World's Aircraft.

To keep its weight down, the Harrier has no protective armor. It carries no flame-retardant foam in its fuel tanks because the foam displaces fuel. The fuel tanks are

not equipped with self-sealing membranes to plug bullet or shrapnel holes.

The Marine Corps spent a lot of money to test such survivability systems in the late 1990s but ultimately rejected them because of their weight, said the Naval Air Systems Command, which oversees Marine aircraft safety.

Moreover, the plane's single engine gives it little margin for error. It is neither supersonic nor stealthy, which means it cannot fly especially fast or easily elude enemy radar.

And the hottest of its thrust-producing nozzles are in the middle of the fuselage, a design anomaly required to balance the Harrier for vertical flight. In other aircraft, the hot spot is near the tail, where a hit by a heat-seeking missile is less likely to be fatal.

Until recently, the Harrier's vulnerability was magnified because it was intended to fly close to the ground as it swooped down on enemy troops.

In its first significant U.S. combat role, during the Persian Gulf War in 1991, it paid a heavy price.

On the war's final day, Capt. Reginald C. Underwood and other Harrier pilots were flying below the cloud cover at about 8,000 feet so they could see their target, a convoy of Iraqi military vehicles.

"We were flying way too low," said his squadron commander, Lt. Col. Jerry Fitzgerald. An Iraqi missile went straight up the left hot nozzle of Underwood's jet. "He never saw it coming," Fitzgerald said.

Underwood was killed, one of two Harrier pilots to die in Gulf War combat. Five of the seven Harriers that took enemy fire were destroyed. Two ejecting pilots were captured by the Iraqis.

The Harrier's attrition rate of 1.5 planes for every 1,000 sorties flown contrasted with a rate of 0.5 for the A-10, a sturdy and inexpensive attack jet that flew many dangerous missions. The F-16 had an even lower rate, 0.2, and the Marine Corps' F/A-18 suffered no losses.

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Postwar Praise

The Marines nevertheless point to the Gulf War as the Harrier's proving ground. The corps' commandant at the time, Alfred M. Gray Jr., told the Senate Armed Services Committee in March 1991 that its support for the AV-8B "paid off in spades" in the Gulf.

Marine officials and other Harrier proponents note that Gen. H. Norman Schwarzkopf, commander of U.S. forces in the Gulf, cited the Harrier in a postwar report as one of several weapons that gave "standout performances."

The Harrier did fly early and often. But it required an enormous transport and supply operation to keep it provisioned with bombs, fuel, parts and distilled water for cooling the engine, a far cry from its originally stated mission of operating from remote locations.

It took about 2,000 Marines to support an air group based at King Abdul Aziz Air Base near Dhahran, Saudi Arabia, that included 66 Harriers and 20 OV-10 Bronco observation planes, said retired Col. John R. Bioty Jr., who commanded the group.

During the last 10 days of the war, some planes also operated from a short runway at Tanajib, a rearming and refueling base about 35 miles south of the Kuwaiti border that put them closer to the enemy than any other airplane.

The Harriers bombed Iraqi artillery, armored vehicles, troops and air defense units, Bioty said. And while other planes flew far more sorties, the smaller Harrier fleet flew a substantial number: 3,349.

“Because the aircraft was able to base closer to the forward edge of the battle area, it could respond quicker and didn’t require air refueling,” Bioty said. “It can do things other airplanes can’t do and can go places other airplanes can’t go.”

In the end, retired Air Force Gen. Charles A. Horner, the U.S. air commander in the Gulf, said the decision to stack aircraft over the battlefield “negated the need for quick response” from AV-8Bs.

The General Accounting Office, the investigative arm of Congress, omitted the plane from its 1997 report on the Gulf air war, pointing to its “relatively few strikes against strategic targets.”

Though the Harrier proved effective at what it did, “trying to justify it based on the Gulf War is tenuous at best,” Horner said. “In terms of payload, range and suitability for close air support,” he added, “the A-10 is a much better platform.”

Even some Marine generals agreed. Given the loss of five planes, the Harrier in the Gulf “wasn’t a failure, but it wasn’t a great success,” said retired Lt. Gen. Charles H. Pitman, chief of Marine aviation from 1988 to 1990. “I don’t think they did anything spectacular.”

The Marines say they have since reduced the Harrier’s vulnerability by tripling the number of flares and other decoys that the plane can fire to divert missiles.

But the primary reason the plane is safer in war today is that the advancing technology of laser-guided missiles and bombs has allowed all combat planes to fly at higher altitudes. In the process, the Harrier has become less relevant.

“You can find missions the Harrier can perform,” said Michael O’Hanlon, a defense analyst at the Brookings Institution, a nonpartisan think tank based in Washington, “but I question whether any of them are missions only the Harrier can perform.”

In future conflicts, unmanned drones like the one that killed suspected Al Qaeda operatives in Yemen last month are expected to fly missions that had been the exclusive province of combat planes like the Harrier.

And American commanders now routinely assign various aircraft to essentially loiter over the battlefield, reducing the value of basing planes up front near the troops.

Some critics even argue it is unwise to put planes so close to the enemy because it leaves them vulnerable to attack.

All of those factors conspired to make the Harrier a marginal player last year in Afghanistan, where highflying bombers and fighter planes inflicted considerable damage before the Harriers were even called into action.

“Close air support in Marine terms was not what was happening there,” said Col. Thomas D. Waldhauser, commanding officer of the 15th Marine Expeditionary Unit, which included the Harrier squadron aboard the Peleliu. “Close air support in Afghanistan was a B-52 dropping bombs from 30,000 feet.”

The six planes on the Peleliu were sent into combat only after their frustrated pilots complained to Commandant Jones about their idleness.

When the war began, the Harriers in the region lacked a laser targeting system. Lt. Gen. Michael A. Hough, chief of Marine aviation, said Harriers were cleared to join the war only after military leaders agreed that other aircraft with laser systems could pinpoint targets for the AV-8Bs. (The laser systems are now being installed in 98 Harriers at a cost of nearly \$1.7 million each.)

“This is the sort of conflict in which Harrier proponents typically would expect to see the Harrier prominently used, especially early on,” said Christopher Bolkcom, a military aviation analyst for the Congressional Research Service. “I don’t think it’s lost on many people that the Harriers were not the first airplanes used in that war.”

By the time the Harriers entered the fray, targets were scarce. In November and December, the busiest months for the Harrier, the aircraft dropped only 161 bombs during 342 sorties. The 400 allied aircraft in Afghanistan never included more than 12 Harriers. Until Dec. 31, the Harriers flew exclusively from ships, just like safer and more effective Navy and Marine planes.

On that day, after the fall of Kandahar, the Marines dispatched two Harriers to a partly destroyed airstrip there. Marine leaders touted this as evidence that the planes were operating where others could not.

But the two planes stayed only one night, flying four sorties and dropping no bombs, according to the Marines.

Capt. Chris Raible, who piloted Harriers in Afghanistan, said the flights “were like photo ops.”

When medals were awarded for Operation Anaconda, the major battle in eastern Afghanistan in March, the honors went to the Marine helicopter pilots who provided low-level fire for ground troops while the Harriers circled above.

Harriers have been operating alongside A-10s at a high-altitude air base at Bagram since October, where the Marines say they have provided “essential support to ground units.” But the thin air and a torn-up runway have restricted vertical flight.

In two important respects, the Harrier performed impressively: reliability and bombing accuracy. Pilots said the plane held up remarkably during extended sorties and that their bombs almost always hit their mark.

Gen. Jones said the Harriers “acquitted themselves quite well” in Afghanistan. “They’ve proven themselves to be very worthy contributors.”

But a number of military officials and analysts question the value of the Harrier’s contribution.

“I think the reason the AV-8s were used at all in Afghanistan was a tendency by the U.S. military to give everybody their turn, whether you needed them or not,” said Anthony H. Cordesman, an analyst at the Center for Strategic and International Studies. “The AV-8B simply wasn’t competitive in terms of range, payload, survivability, target acquisition [or] communications capability.”

The Marines acquired the Harrier for a different type of war than is fought today, said Daniel Goure, a former director of the Pentagon’s Office of Strategic Competitiveness and now vice president of the Lexington Institute, a think tank in Arlington, Va.

“For that reason, they took all the attendant risk of mishap rates and all the rest,” he said. “In hindsight, I suspect they would have come up with a different answer.”

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Accident-prone

Both the AV-8A and the newer AV-8B Harrier have recorded substantially higher accident rates in their history than the combined totals for fighter and attack planes flown by the Air Force, Navy and Marines.

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Class A mishap rates

AV-8A lifetime mishap rate: 31.77

AV-8B lifetime mishap rate: 11.44

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The AV-8B's history

The Marines had a disastrous time with the first Harrier, the AV-8A, destroying 66 of 114 planes in accidents. They vowed that its successor, the AV-8B, would end the safety problems. The record improved, but the AV-8B is still the most dangerous military plane in service.

1981: "Any safety problems, perceived or real, with the

AV-8A have been specifically designed out of the AV-8B."--Col. Harold Clark, Harrier program official.

1984: The AV-8B enters the fleet. Accident rate falls dramatically from the AV-8A but stays high compared to other military planes.

1990: Col. James Hart, Harrier program manager, tells a House committee the AV-8B "is a significantly safer aircraft than its predecessors," even though 24 of the first 204 crashed.

1990: The AV-8B has 11 major accidents, two of them fatal. Marines hold a symposium to decide what to do.

1991: The AV-8B flies extensively in the Persian Gulf War, but the introduction of a new night-attack model is delayed after a crash in California reveals problems with Rolls-Royce engines. Casing flexed at high speeds and caused fires.

1992: Defense Department's inspector general reports the Harrier engine still "ranks low in reliability" after seven upgrades, yet concludes that the Navy and Marines are "taking appropriate actions" to reduce accidents.

1996: The AV-8B has the highest major accident rate of any active plane in the military. Lt. Gen. Harold W. Blot, Marine aviation chief, tells a House panel it "is still a safe plane to fly. We wouldn't fly an airplane that we feel is putting pilots at risk."

1996: Marine blue-ribbon panel on the AV-8B cites "significant progress" with engine modifications and makes recommendations to reduce accidents. Nearly one-quarter of all AV-8Bs have been lost.

1997: Two crashes in eight days prompt Marine Corps commandant to name a Harrier Review Panel to assess problems and recommend solutions.

1998: The review panel releases findings and makes more than 50 recommendations for wide-ranging improvements, many of which are later funded.

1999: Seven major accidents push the AV-8B's rate to a

12-year high.

2000: Investigators conclude an engine fire that led to a nonfatal crash was caused by an engine-bearing assembly failure. The same bearing assembly had failed at least four times previously in other Harriers. Many of the AV-8Bs are grounded for at least six weeks; some remain out of service for nearly a year.

2000: Marine Commandant James L. Jones meets with Sir Ralph Robins, Rolls-Royce chairman, to discuss how to improve handling of the engine. Both parties commit more resources.

2001: The AV-8B records its lowest annual accident rate.

“The Marines Corps’ AV-8B is one of the success stories of this past year,” Jones tells a Senate subcommittee. “It’s a wonderful story.”

2002: Three crashes push the accident rate back up.

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Note: A Class A mishap is an accident that causes death or permanent injury or \$1 million in damage (financial figure has increased over time).

*

Sources: Naval Safety Center, Air Force Safety Center, Defense Department and Marine Corps reports, Congressional Record, newspaper clippings and interviews

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Researched by Times staff writers Alan C. Miller and Kevin Sack, Times news researcher Janet Lundblad and Times graphics reporter Joel Greenberg

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About This Series

In reporting this series, The Times analyzed 87 judge advocate general investigation reports of individual Harrier accidents between 1971 and 2001, most of which were obtained under the federal Freedom of Information Act. The JAG office, a unit of the Navy, which oversees Marine Corps aviation, withheld portions of some reports, citing privacy and national security concerns.

The Times also based its findings on information from the Naval Safety Center’s aviation database, obtained under the Freedom of Information Act as well. The database includes voluminous records on Navy and Marine aircraft and crewmen involved in accidents from 1980 through mid-2002.

The Marine Corps provided information on Harrier safety, maintenance and combat records, including a breakdown of Harrier accidents and fatalities.

Comparative statistics about accident rates were provided by the Naval Safety Center and Air Force Safety Center. Harrier cost data came from the Naval Air Systems Command and the Navy Center for Cost Analysis.

The Marines did not provide the identity of pilots killed in crashes. The names and backgrounds of pilots who died in the Harrier were compiled through searches of the Marine Corps Historical Center, National Archives, news clippings and online databases, as well as interviews with other fliers and family members. The Times interviewed at least one relative of each of the 45 Marines killed in Harrier accidents.

The Times also interviewed scores of Harrier pilots, mechanics and commanders, as well as a dozen current and former Marine Corps generals, Pentagon officials and military analysts. Marine Commandant James L. Jones answered questions about the Harrier posed by a Times reporter earlier this year but declined to be interviewed for this series.

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PART I: “THE WIDOW-MAKER”

Times staff writers Alan C. Miller in Washington and Kevin Sack in Atlanta reported

and wrote this series. Director of computer analysis Richard O'Reilly provided database analysis. Substantial assistance was provided by researchers Janet Lundblad in Los Angeles, Lianne Hart in Houston and Robert Patrick in Washington; Also contributing were Times staff writers Tony Perry in San Diego, and Marjorie Miller and Janet Stobart in London.

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* Today

"The Widow-Maker": Deaths in training, disappointment in combat.

* Part II

Causes: What could go wrong has gone wrong with the Harrier.

* Part III

Casualties: One pilot's story. The Marines who have died in the Harrier.

* Part IV

Clout: The corps has fought hard to keep its

vertical vision alive.

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