

# CHAPTER 6



An MQ-9 Reaper sits on a ramp in Afghanistan. The Reaper is remotely operated by pilots and sensor operators at Creech Air Force Base, Nevada.

*Courtesy US Air Force*

# The Modern Air Force

## Chapter Outline

### LESSON 1

#### The Development of Rotary-Wing Aircraft

### LESSON 2

#### The Significance of Stealth Aircraft

### LESSON 3

#### The Air Force of the Future

“Despite the actions of our enemies, we must remain a moral force for good on the globe. Regardless of pressures that may come in terms of the nature of the campaign or what the enemy is doing, we can never back away from our values when we go into conflict.”

General David Goldfein, Air Force Chief of Staff

## LESSON 1

# The Development of Rotary-Wing Aircraft



### Quick Write

After reading the vignette about Lieutenant Colonel Charles Kettles, why do you think it's important for members of a unit to know their fellow team members will support them? Is this true only for the military?



### Learn About

- the development of early helicopters before World War I
- the further development of helicopters during the 1930s
- the use of helicopters in US military conflicts
- the helicopter's expanded role in military and civilian search-and-rescue operations

**O**N 15 MAY 1967, Soldiers from the 101st Airborne were battling hundreds of North Vietnamese in a rural riverbed near Duc Pho, South Vietnam. They were seriously outnumbered, and needed help fast. They needed helicopters to bring in reinforcements and to take the wounded to safety. Then-Major Charles Kettles volunteered his UH-1H "Hueys."

Around 9 a.m., the company of helicopters approached the landing zone. When the pilots and crew looked down, instead of a stand of green trees, they saw a wall of green enemy tracer bullets coming at them. Soldiers were killed before they could even leap off the choppers. But under withering fire, Major Kettles landed his helicopter and kept it there, exposed, so the wounded could get on and he could fly them to safety.

Kettles returned to the riverbed several times to evacuate his fellow Soldiers—all the time facing intense enemy fire and damage to his helicopter. The Army credits him with saving the lives of 44 Soldiers that day.

Kettles was originally awarded the Distinguished Service Cross for his heroism that day. He retired as a lieutenant colonel. Then on 18 July 2016, President Barak Obama upgraded the award to the Medal of Honor. On the same day, he tweeted out, "44 Americans came home because Chuck Kettles believed that we leave no man behind. That's America at our best."

Kettles dedicated his Medal of Honor to all the pilots and crew serving on his team that day. "I didn't do it by myself. There were some 74 pilots and crew members involved in this whole mission that day.... They did their job, above and beyond. So the Medal is not mine. It's theirs."



**Then-Major Charles Kettles standing next to a UH-1H helicopter during his second tour of duty in Vietnam in 1969**

*Courtesy US Army*

## Vocabulary



- rotor
- rotary-wing aircraft
- torque
- boom
- outrigger
- medevac



## The Development of Early Helicopters Before World War I

One of the last aircraft invented before World War I is one you can still see almost every day. You've seen these aircraft in action movies or caught a glimpse of them during the traffic report of your local television news station. They are helicopters.

Helicopters are different from the aircraft you've been studying in two important ways. First, they don't have fixed wings. Their wings rotate. Second, they take off and land vertically.

All aircraft need lift to remain in the air. Biplanes and monoplanes rely on their wings and forward motion to maintain lift. But what's to keep an aircraft in the air when it rises straight up the way a helicopter does?

Helicopters have rotors. A **rotor** is a set of rotating horizontal airfoils (wings). A rotor is very much like the propeller of a fixed-wing aircraft. Rotors are made up of blades, each of which acts as a wing. As the blades rotate, they lift the helicopter. That's why another name for helicopters is **rotary-wing aircraft**.

Rotary flight is different from fixed-wing flight. The early inventors didn't understand the forces facing the helicopter. And so it took them years to figure out how to design machines to address these forces.

The Wright brothers get most of the credit for developing the airplane. Developing the helicopter was another story. It involved several inventors in different countries and even over different centuries.

Leonardo da Vinci (1452–1519) designed a rotary flying machine (see Chapter 1, Lesson 1). In 1842 W. H. Phillips built a model of a steam-powered helicopter. But many improvements were needed to create a practical helicopter.

The first two manned attempts at helicopter flight were in 1907. Frenchman Louis Bréguet flew a helicopter that year. But he needed the help of four assistants to hold it steady. His countryman Paul Cornu also got a helicopter to lift off. Then in 1919 an American father-son pair, Emile and Henry Berliner, also built and piloted a helicopter.

The problem all these men faced can be stated in one word: torque. **Torque** is a turning or twisting force. It makes helicopters hard to balance. That's why Bréguet needed four assistants to steady his aircraft. Its rotating blades created torque. Torque means that while the blades were turning in one direction, the body of the aircraft spun in the other. Any truly successful helicopter design would have to take this into account and adjust for it somehow.

No one would find a solution for 30 years. But then aircraft designers came up with two answers. The first was to use two rotors and to make them spin in opposite directions. The second was to place a small rotor at the end of a long tail boom. A **boom** is the section of the helicopter that connects the tail with the main body. The tail rotor spins in a direction opposite that of the main rotor.



**1932 Kellett K-2/K-3 Autogiro**

*Courtesy US Air Force*

Some inventors who experimented with helicopters early in the 20th century gave up on them for a time. But 9 January 1923 marked another milestone flight. On that day, a Spanish Army pilot made the first successful flight in an autogiro. Juan de la Cierva of Spain built this aircraft. A front engine and propeller made the autogiro move forward.

But Cierva's machine had serious drawbacks. For example, it couldn't move in all directions. So during the 1930s, Cierva and other designers in Spain, France, and Germany continued to experiment.

The Frenchman Louis Bréguet was among this group. He'd turned away from helicopters, despite some early success. But by the early 1930s, he was thinking about them again. He established the Syndicate for Gyroplane Studies and hired a young engineer named René Dorand.

Bréguet didn't want to get people's hopes up too soon. He named his new aircraft the Gyroplane-Laboratoire. Using the French word for *laboratory*, he thought, would let people understand that the helicopter was experimental. His was another attempt to solve the problems of stability and control.

## The Further Development of Helicopters During the 1930s

It took years of experimenting, but by the late 1930s, aircraft designers had finally figured out how to control the helicopter in flight. They found answers to the problem of the rotor blade's torque.

The first helicopter a pilot could completely control was the Focke-Achgelis (FA-61). A German, Dr. Heinrich Focke, built it in 1937. This helicopter used the two-rotor approach to controlling torque. Its two rotors were mounted side by side on outriggers from the fuselage. An **outrigger** is a frame extending laterally beyond the main structure of an aircraft. It stabilizes the structure.

The world's first female helicopter pilot, Hanna Reitsch, demonstrated the FA-61 in 1938. She flew it inside a stadium in Berlin, Germany. She was able to hover and make 360-degree turns. She could fly backward, forward, and sideways.

The first practical helicopter, however, was Igor Sikorsky's VS-300. This design solved the problem of torque using a main rotor and a tail rotor. This is the basic design that most people picture when they hear the word *helicopter*. And as you continue through this lesson, you'll read about helicopters that have some form of this design.

The VS-300 made its first vertical takeoffs and landings in September 1939. The helicopter could carry a useful load and perform work. The pilot could control it well. The early experiments were tethered flight, or flights in which the aircraft was tied to the ground by cables. The helicopter's first free flight was 13 May 1940. Its top speed was 50 mph. It weighed 1,150 pounds.



**Focke-Achgelis FA 61 in flight**

*Courtesy National Air and Space Museum, Smithsonian Institution, NASM 2002-19905*



Even once the main problem with torque had been resolved, Sikorsky worked hard to overcome problems with vibration and control. At first, his helicopter flew “like a bucking bronco,” according to an Army project officer.

Nevertheless, all later Sikorsky helicopters have been refinements of the VS-300. From this small aircraft, the helicopter has developed into the workhorse of the skies.

The first mass-production helicopter was the Sikorsky R-4. A prototype, the XR-4, made the first cross-country helicopter flight in history in 1942. It flew from Connecticut to Wright Field in Dayton, Ohio.



**Igor Sikorsky and Orville Wright celebrate the first delivery of a Sikorsky XR-4 helicopter to the US government at Wright Field in Dayton, Ohio, in 1942.**

*Courtesy Federal Aviation Administration*

## The Right Stuff

### Igor Sikorsky and the First Practical Helicopter

A Russian who moved to France before settling in the United States, Igor Sikorsky (1889–1972) is best known as the man who developed the first practical helicopter. But that wasn’t Sikorsky’s first claim to fame. He’d already made two other contributions to aviation.

A mosquito—yes, an insect—led to Sikorsky’s first breakthrough. While a young flyer in the Russian Army, he produced a plane—the S-6A—that won the highest award in the Moscow air show. But on a later flight, a mosquito got caught in the fuel line, causing the engine to fail. Sikorsky had to make an emergency landing. That experience gave him the idea for an aircraft with more than one engine. This led him to build and fly the first successful four-engine aircraft, *Le Grand* (see Chapter 1, Lesson 4).

Sikorsky left his native country in 1918, after the Russian Revolution. In France, he won a contract to build a bomber for the Allies. But World War I ended soon after that. His bomber was not needed.

Sikorsky arrived in New York City in 1919. Unable to find a job in aviation, he lectured for a while. Then some friends and students who knew of his work in aviation pooled their funds to launch him in business. He formed the Sikorsky Aero Engineering Corporation.

Within a few years Sikorsky made his second major achievement. As you read in Chapter 2, Lesson 3, he designed a flying boat for mail service.

But Sikorsky still cherished a lifelong dream: to build a helicopter. When Igor was a child in Kiev, Ukraine (then part of Russia), his mother told him about Leonardo da Vinci’s helicopter designs. He became fascinated by the idea of rotary-wing flight. People told him it was an impossible dream. Some of his own staff called it “Igor’s nightmare.”

In 1940 he achieved his dream. Today, the name Sikorsky stands for excellence in helicopters.



## The Use of Helicopters in US Military Conflicts

The military first used helicopters in World War II. But the helicopter came into its own during the Korean and Vietnam wars. In both wars the US military used helicopters to carry the wounded and rescue downed pilots. They were well suited for the jungle warfare of Vietnam. There, the military used helicopters to place ground troops in battle areas and to outmaneuver enemy ground forces. Since that time, helicopters have been an important part of US military tactics.

### The Helicopter in Korea

If you have one mental picture of the Korean War, it might be from the opening sequence of the long-running television series *M.A.S.H.* It featured shots of wounded Soldiers being airlifted from the front lines by helicopter. This is referred to as **medevac**—*medical evacuation*—service. The aircraft in that sequence were H-13 Sioux helicopters. They played an important supporting role in that series—and even more so in the war it was based on.

The H-13 was a military version of the Bell Helicopter Model 47. The Model 47 was one of the most successful helicopters of all time. Its prototype first flew on 8 December 1945, just months after the end of World War II. Production began soon after, and continued for nearly 30 years. The Model 47, in various military and civilian versions, was used for all sorts of purposes around the world.



During the Korean War, patient litters were mounted on the exterior of the H-13 on skid racks.

*Courtesy US Army*

The H-13 Sioux was the first rotary-wing craft to be delivered in the Korean peninsula. It was also the first US Army helicopter to be named after an American Indian tribe (Sioux). This practice continues today in the names of aircraft such as the Boeing AH-64 Apache and the Bell OH-58 Kiowa.

The H-13 had the classic early military helicopter design. It had a bubble canopy, providing good visibility for crew. It had the characteristic skeletal tail unit and skid undercarriage. It could seat two or three people. It had a Franklin or Lycoming engine, which drove its two-blade main rotor and two-blade tail rotor.

During World War II, helicopters had been used to scout or to search for submarines. But few helicopters—on either the Allied or Axis side—made it to the front lines.

That changed during the Korean War. H-13s, which had been serving as observation aircraft, were soon turned into flying ambulances.

The other primary rescue helicopter during the Korean War was the Sikorsky S-51. It could carry two crewmen plus a wounded Soldier. But there was so little room in the fuselage for the stretcher that the wounded man's legs would stick out the side of the aircraft from the knees down.

But helicopters were used in Korea for more than medevac service. The Sikorsky H-19 Chickasaw was an excellent multipurpose transport helicopter. It was used in later conflicts, as well. Versions of the H-19 have been adopted by armed forces around the world.

The H-19 had a distinctive stout appearance. Its flight deck sat on top of the passenger cabin. Sliding side doors made it easy for the troops aboard the copter to hit the ground. The cabin could carry 12 combat-ready troops or, in medevac mode, eight medical litters.

The US Air Force used the H-19 for search and rescue. The H-19 carried troops into combat but was unarmed itself. It didn't have quite the power needed to serve as an attack helicopter.



**SH-19A Chickasaw air rescue helicopter**

*Courtesy US Air Force*

## The Helicopter in Vietnam

The Korean War had a relatively fixed battlefront. This meant that M.A.S.H. (Mobile Army Surgical Hospital) units could be fairly close to the action. There was a line behind which they could feel reasonably safe. Air ambulances didn't have to fly far or long to get the wounded to well-equipped field hospitals.

But Vietnam was a different kind of war. There were no clear front lines. Medevac helicopters often had to fly into battles to retrieve the wounded. Then they had to fly much greater distances than in Korea to bring the wounded to safety and medical help.

And so Vietnam would require a different kind of medevac aircraft. Fortunately, the Army had already identified one: the Bell Model 204, HU-1A (later UH-1A) "Huey." (This aircraft had an Indian nickname too: "Iroquois." But it was never much used.)

The Hueys soon became the primary medevac helicopters in Vietnam. They kicked up so much dirt as they took off with their wounded warriors that they were known by the radio call sign "Dustoff." Later versions of the Huey, such as the UH-1H, could carry three stretcher patients and a trained medic inside the cabin. Most American Hueys were in the service of the Army, but the other services also used them for medevac flights.



**Air Force personnel on a combat assault mission over Southeast Asia in a UH-1 "Huey"**

*Sergeant Robert W. Ingianni/Courtesy US Air Force*



## The Right Stuff

### 1st Lieutenant James P. Fleming

On 26 November 1968, Lieutenant James P. Fleming and four other UH-1F helicopter pilots were returning to their base at Duc Co, South Vietnam, for refueling and rearming. Before they arrived, they received an emergency call for help from a Special Forces reconnaissance team.

The homebound force of two gunships and three transport helicopters immediately changed course and sped to the area without refueling. The six-man Special Forces team was pinned down by a large, hostile force not far from a river bank. As the gunships descended to attack the enemy positions, one was hit and downed. The remaining gunship made several passes, firing away with its miniguns, but the intense return fire from enemy machine guns continued. Low on fuel, the helicopters were being forced to leave and return to base.

Lieutenant Fleming, piloting the only remaining transport helicopter, descended over the river to evacuate the team. Unable to land because of the dense foliage, he hovered just above the river with his landing skids braced against the bank. The lone gunship continued its strafing runs, but heavy enemy fire prevented the team from reaching the helicopter. The leader advised Fleming by radio to withdraw.

After pulling away, Fleming decided to make another rescue attempt before completely exhausting his fuel. He dropped down to the same spot and found that the team had managed to move closer to the river bank. The men dashed out and clambered aboard as bullets pierced the air, some smashing into the helicopter. The rescue craft and the gunship then returned safely to Duc Co, arriving with their fuel tanks nearly empty.

For this miraculous rescue, in which not a single life was lost, Fleming was awarded the Medal of Honor. He received this highest decoration for valor at the White House from President Richard M. Nixon 14 May 1970. Lieutenant Fleming remained in the Air Force, retiring in 1996 as a colonel.



**Then-Captain James Fleming**

*Courtesy US Air Force*

The Huey did so much more than medevac, however. It became the symbol of the American involvement in Vietnam. And it's been called the most famous helicopter in the world. It's been in use in 1956, in the armed forces of the United States and many other countries. Since 1960, commercial versions of the Huey have been available too.

The UH-1 makes a distinctive loud “whomp whomp” noise. In forward flight, the tip of the advancing rotor blade moves fast enough to create a small sonic boom. For those who know aircraft, its twin-bladed rotor and rounded nose make it easy to spot.

The Huey was developed as manufacturers were shifting from piston to turbine engines. Turbine engines were lighter and more powerful, but also more expensive. The Huey was the US military's first turbine-engine helicopter.

Many variations of the Huey were produced. The Marines, worried about crashes over water, asked for and got a dual-engine Huey, for instance.

The Huey was such a success because it had the perfect combination of cabin room, speed, and ability to lift. The earlier piston engines just didn't give helicopters the power they needed for many military missions. But the Huey, with its turbine engine and other features, proved itself a rugged, reliable aircraft.

Another important helicopter in Vietnam was the Sikorsky HH-3E “Jolly Green Giant,” which you read about in Lesson 3. Its long range made it invaluable in combat search-and-rescue missions.

Helicopters were the quiet stars of the Vietnam War. They found new roles to fill in the conflict. Units of helicopters transporting ground forces were referred to as *air cavalry*. This was a reminder of the fighting units on horseback from previous centuries.

The helicopter is a delicate aircraft, however, compared with fighters and bombers. It can be brought down by small arms fire. The military lost 5,000 helicopters in the war. Even so, they were very effective in the jungles of Vietnam. A helicopter could drop troops at the front lines so they wouldn't have to make long marches through thick undergrowth. It could hover while delivering supplies. In Vietnam's difficult terrain, its ability to land without a runway was more valuable than ever.

### **The Helicopter Since Vietnam**

The Sikorsky S-70 helicopters (H-60 in military use) are the most popular family of helicopters after the Bell Hueys, which they are gradually replacing. There are a number of variants of this design. These are intended to meet the special needs of the Air Force, Army, Coast Guard, Marines, and Navy. US Customs and Border Protection and the Drug Enforcement Agency also use S-70s.

Sikorsky developed the S-70 in response to a request from the Army. Generals wanted an aircraft with better “crew survivability.” This meant engines, rotors, and a transmission better able to withstand damage. It meant a crashworthy cabin “box,” and an armor-plated cockpit, among other features.

The S-70 has two engines instead of just one. It has widely separated *redundant* electronic and hydraulic systems. That is, one system backs another if it fails. The S-70 has four main rotor blades. Its tail rotor is tilted at an angle that gives it some additional lift.

### Sikorsky UH-60 Black Hawk

The Army’s version, the UH-60 Black Hawk, first saw in combat when the United States invaded Grenada in 1983. The Army said its performance there showed the copter could still fly even after being seriously damaged. Eight years later, nearly half the Army’s Black Hawks took part in the Gulf War. Only two were lost in combat. During the US mission to Somalia in 1993, though, several were lost. The Black Hawk proved vulnerable to rocket-propelled grenades fired from rooftops.

In the 1980s, the US Army started to replace the Huey with the Sikorsky UH-60 Black Hawk as a medevac aircraft. The Army wanted a helicopter that could carry more casualties at once. The Black Hawk had a larger fuselage and was faster than the Huey. These characteristics made it a valuable aircraft indeed during *Operation Desert Storm* in 1991.



**US Army UH-60 Black Hawk helicopters operating in Iraq in 2010**

*Specialist Brandon D. Bolick/Courtesy US Army*



The Black Hawk also fit in well as the Army changed its tactics for bringing the wounded to safety. Medevac helicopters no longer flew into firefights to retrieve the wounded, as they had done a generation before in Vietnam. Rather, the wounded would be brought out by the same aircraft that had delivered them to the front. Alternatively, dedicated search-and-rescue helicopters would pick up the wounded. In either case, casualties would be taken to a staging area. Some would be treated there, and from there, medevac helicopters would take the most seriously wounded to field hospitals.

The UH-60 has an unusual shape: long and low-set. It was designed to be able to fit inside a C-130 Hercules cargo plane with its rotors attached. Six can fit within a C-5 Galaxy.

### **Sikorsky HH-50 Pave Hawk**

The HH-60 Pave Hawk is the Air Force version of the Army's UH-60 Black Hawk. It's been modified, however, for aircrew search and rescue in all weather situations. It was introduced in 1991. Its special missions are rescuing downed airmen and dropping special forces behind enemy lines. But it does more than that. It's been used in disaster rescue, notably in the US Gulf region after the hurricanes of 2005.



**An Air Force HH-60 Pave Hawk takes off in a rescue exercise near Kotzebue, Alaska.**

*Staff Sergeant Edward Eagerton/Courtesy US Air National Guard*

The Pave Hawk has a number of systems that make it distinctly an Air Force helicopter. These include night vision, forward-looking infrared, and automatic flight control. Its two engines drive two four-blade rotors. It can fly 184 mph and reach an altitude of 14,000 feet. It has room for two pilots, a flight engineer, and a gunner. Seating for passengers or room for medical litters is found in the cabin.

### Boeing AH-64 Apache

Another important aircraft of the post-Vietnam period is the Boeing AH-64 Apache helicopter. The military doesn't use helicopters only for medevac or search-and-rescue missions. The Apache is designated as an attack helicopter. It officially began service in 1986. It has seen action in Panama and in the Persian Gulf region (*Operation Desert Storm*), when it took out Saddam Hussein's armored formations. More recently, the Apache has had a role in the Kosovo War as well as Iraq and Afghanistan.

But the Apache was developed in the waning years of the Cold War, to meet a perceived need in Europe. American military leaders wanted a "tank-killing" helicopter that would stand up to the rigors of ground combat in Europe, if Soviet and Warsaw Pact forces ever rolled through Germany's Fulda Gap to invade NATO territory.

That scenario never played out, fortunately. But today, despite the feats of high-altitude bombers and other fixed-wing aircraft, military planners still see helicopters like the Apache as essential to any plan for a ground battle.



**AH-64 Apache helicopters**

*Courtesy US Army*



## The Right Stuff

### Bronze Star for Pararescue Crew

On 3 June 2010, three American Soldiers were badly injured by the explosion of a roadside bomb in Afghanistan. A pararescue crew from the Air Force's 58th Rescue Squadron was sent to their aid.

Staff Sergeant Asher Woodhouse, Technical Sergeant Ryan Manjuck, and Technical Sergeant Jeffrey Hedglin all received the Bronze Star with valor for putting their lives at risk under enemy fire to rescue the wounded that day.

During his first deployment after recently training in pararescue, Sergeant Manjuck made an immediate impact. While under enemy fire, he provided hoist evacuations for wounded Soldiers and gave medical treatment to a critically injured patient.



**Airmen congratulate Air Force Technical Sergeants Jeffrey Hedglin and Ryan Manjuck, and Staff Sergeant Asher Woodhouse after they received the Bronze Star at Nellis AFB, Nevada, 13 April 2011.**

*Courtesy US Air Force*



"I didn't really know what to expect with it being my first deployment," Sergeant Manjuck said. "I quickly realized that the training I received really helped. Every scenario we faced during our search-and-rescue missions had previously been addressed in the training I received over the last two years. Even though it was my first deployment, it really didn't feel that way."

Sergeant Hedglin acted as the Guardian Angel team leader during the incident. He organized and led the team into the high-threat combat area. Placing the lives of the wounded above his own, he managed to carry a wounded soldier more than 27 yards across open terrain while under fire to a helicopter for evacuation.

"During the incident, I was lucky to have the training that we do...", said Sergeant Hedglin. "That training helped me to know what to do and how to instinctively react in a high-stress combat situation."

Sergeant Woodhouse was able to spot and alert the aircrew of the HH-60 Pave Hawk, which was on the way to evacuate wounded personnel, of incoming surface-to-air missiles. Due to his situational awareness, the wounded individuals were safely evacuated from the hostile area.

"...we are constantly training," Sergeant Woodhouse said. "That training is what makes what we do become second nature and helps us to effectively accomplish the search-and-rescue mission."

Sergeant Woodhouse was also able to lead his element back into the hostile area to evacuate two injured Soldiers who were critically wounded by an improvised explosive device.

"Members of the rescue community and, more recently these three individuals, provide great comfort to families and military members in the fight knowing that there are such professionals willing to enter the hostile conditions to evacuate them if they are injured," said Navy Admiral Mike Mullen, chairman of the Joint Chiefs of Staff, in presenting the medals.

Even after receiving the Bronze Star, the recipients mostly gave credit to the individuals serving with them in Afghanistan.

"I'm accepting this award on behalf of the rescue community as a whole," Sergeant Hedglin said. "Without the whole rescue community working together so often, we wouldn't have the cohesiveness to be effective in our mission to save lives. It's humbling to be able to hear about my brethren in the rescue community and how they helped save people's lives."

## Sikorsky MH-53 Pave Low

The MH-53 helicopters were originally HH-53 “Super Jolly Green Giants” used by the US Air Force in the Southeast Asia War. Over the years, however, they received many upgrades and improvements. After the 1960s, their skins were completely reworked. Their engines and rotors were also replaced. Along with these improvements came a new designation, MH-53 (*M* for Multi-mission and *H* for helicopter).

The most significant enhancement to the Super Jollies was the Pave Low program, which modified them for operating at night or during bad weather. Equipped with forward-looking infrared (FLIR) sensors, inertial global positioning systems (GPS), radar navigation systems, and terrain-following and terrain-avoidance radar, the MH-53 could fly clandestine or secret, low-level missions in any weather—day or night.

The MH-53M Pave Low IV has a system that greatly increased the aircraft’s capabilities. This system gave the aircrew instant access to the total battlefield situation on a color, digital map screen that was compatible with night vision goggles.

In 2008 the Air Force Special Operations Command (AFSOC) retired the MH-53 from active service.



**Sikorsky MH-53M Pave Low IV on display at the National Museum of the US Air Force**

*Courtesy US Air Force*



## Bell V-22 Osprey: Unlike Any Aircraft in the World

The V-22 Osprey is a joint-service combat aircraft that can fill many roles. It uses tiltrotor technology to combine the vertical abilities of a helicopter with the speed and range of a fixed-wing aircraft. With its rotors in vertical position, it can take off, land, and hover like a helicopter. Once airborne, it can convert to a turboprop airplane capable of high-speed, high-altitude flight. This combination results in global reach capabilities that allow the V-22 to fill an operational need unlike any other aircraft.

The Marines' MV-22 was the first to reach full operational capabilities in 2007.

The Air Force CV-22 was delivered to Air Force Special Operations Command's 1st Special Operations Wing at Hurlburt Field, Florida, becoming operational in 2008.



**A CV-22 Osprey prepares to land as part of a training mission in northern New Mexico.**

*Courtesy US Air Force*

**A CV-22 Osprey over the canyons in northern New Mexico**

*Staff Sergeant Markus Maier/Courtesy US Air Force*





A Life Net Medical Life Flight Evacuation Helicopter sits on the helipad at Lower Keys Medical Center in Key West, Florida.

*Chuck Wagner/Shutterstock*

## **The Helicopter's Expanded Role in Military and Civilian Search-and-Rescue Operations**

Helicopters are used for medical transport, civilian police work, and to broadcast news and highway-traffic reports.

The National Park Service Branch of Aviation uses helicopters as well as fixed-wing aircraft in a broad range of programs within the parks. These include firefighting, law enforcement, resource management, and backcountry patrol.

Similarly, the US Forest Service relies on helicopters, particularly to fight fires. “The Forest Service uses tools in the air to manage fire on the ground,” as the saying goes.

Helicopters also play important roles in other sectors, such as the construction, timber, and offshore oil industries.

But perhaps nowhere do helicopters play a more crucial role than in search-and-rescue work. The Coast Guard relies on them to save fishermen and sailors in distress at sea. In the floods after Hurricane Katrina that hit the Gulf Coast in 2005, the Coast Guard, Air Force, and other agencies used helicopters to rescue more than 30,000 people.

Helicopter crews flew damage assessment teams over flooded areas so that officials could see how bad things were as well.

In May 2006, President George W. Bush honored the Coast Guard for its response efforts. Citing the thousands of Coast Guard personnel who took part, Bush spoke of the operation as “one of the finest hours in the Coast Guard’s 216-year history.” The president added, “When Americans were at their most desperate, they looked to the skies for help, and they knew their prayers were answered when they saw the rescue choppers from the United States Coast Guard.”

There would be a sequel to this story. And once again, the Coast Guard and its copters would play a strong supporting role.

In August 2016, Baton Rouge, Louisiana, was hit by some of the worst flooding in the city’s history. More than 10 local rivers reached flood stage.

It was all the more poignant because so many people there had come to Baton Rouge as refugees from New Orleans after losing everything during Hurricane Katrina in 2005. These people had fled to what they thought was safer ground and rebuilt their lives. And now they had to start over again.

But as in the aftermath of Katrina, the Coast Guard was there. Teams in boats as well as helicopters rescued 245 people and 71 pets. Most of the rescues involved the elderly, or infants and young children. In some cases people were plucked off their rooftops. The Coast Guard also assisted more than 3,000 people in distress. Helicopters from the Louisiana National Guard and the Louisiana State Police flew food and water to motorists stranded along Interstate 12.

One grateful woman, who clearly felt she owed her life to the Coast Guard swimmer who whisked her into the helicopter that took her to safety, said later, “Because of him I get to celebrate weddings, births of grandchildren, great grandchildren....”



**Coast Guard performing a rescue demonstration at Seafair on Lake Washington 5 August 2007**

*Philippe Ancheta/Shutterstock*

## CHECKPOINTS

### Lesson 1 Review

Using complete sentences, answer the following questions on a sheet of paper.

1. What problem did all early helicopter designers face?
2. What are two solutions to the problem of torque?
3. Who was Juan de la Cierva and what did he accomplish?
4. What did Dr. Heinrich Focke accomplish?
5. Who was Hanna Reitsch and what did she do?
6. When did Igor Sikorsky's VS-300 make its first takeoffs and landings?
7. What was the first rotary-wing aircraft to be introduced into the Korean War?
8. Why did Vietnam require a different kind of medevac aircraft from Korea?
9. Why does the S-70 have an unusual shape?
10. What are five ways helicopters are used, besides military work?
11. After Hurricane Katrina, how many people were rescued using helicopters?
12. In which Louisiana city hard hit by flooding in August 2016 did helicopters rescue people?

### APPLYING YOUR LEARNING

13. If you had to choose between learning to fly a helicopter and learning to fly a fixed-wing aircraft, which aircraft would you pick and why?



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