RPAs FOR ALL

By Rebecca Grant

Department of Homeland Security photo

Here: A Hermes-450 remotely piloted aircraft owned by US Customs and Border Protection takes off on a mission. Below: A sequence of video stills from 2008 shows a Russian MiG-29 as it shoots down a Hermes-450 belonging to Georgia.

Video stills via Georgian Ministry of Interior

USAF doesn't have

Late on April 20, 2008, a remotely piloted Georgian aircraft was patrolling that nation's border when a Russian MiG-29 appeared. The fighter, using an air-to-air missile, blasted the Israeli-made Hermes-450 out of the sky.

Russia had been aiding two breakaway Georgian regions in their war against Tbilisi. The shootdown deprived Georgian forces of important aerial capabilities against the rebels.

The MiG-29 was not the first fighter to down an RPA. On the eve of the Iraq War of 2003, an Iraqi aircraft destroyed a USAF Predator. An Israeli F-16 shot down a Hezbollah RPA over the Bay of Haifa in 2006.

Still, the 2008 incident was notable because it suggested that the "counter-RPA" mission was becoming routine in the tussle for air superiority. Indeed, neutralizing an enemy's RPAs is becoming a critical task. Battles against drones are likely to pose challenges to air, sea, and land forces in years ahead.

Today, the US Air Force is starting to build counter-RPA strategies. "We all recognize that RPAs are important to foreign nations and nonstate actors," said Lt. Gen. Larry D. James, deputy chief of staff for ISR. "It's an area where we want to use our capabilities [as well as] deny adversaries the ability to use their RPAs."

Operations to counter drones date to World War II. In June 1944, Nazi

a monopoly on remotely piloted capabilities.

Germany began launching dreaded V-1 buzz bombs at London, forcing Royal Air Force officers to develop tactics for shooting them down with Tempest, Mosquito, Spitfire, and Mustang fighters. Special proximity fuzes on anti-aircraft artillery helped, too. The RAF destroyed 1,771 of the weapons.

In the postwar years, the Soviet Union and China tried to develop their own drones for offensive use, but they never became more than curiosities. Limitations on guidance and performance kept early RPAs subordinate to manned aircraft. Iraq and a few others also made attempts. For the most part, though, development of RPAs bumped along slowly until fairly recently.

By the 2000s, many of the technical barriers to reliable RPAs had dissolved. Lighter and cheaper cameras allowed designers to put effective payloads on small RPAs. Many potential adversary RPAs still rely on line-of-sight data links for control, but the availability of GPS signals made it possible to add preprogrammed routes for autonomous flight.

As a result, dozens of nations are at work on short-range RPAs. Iran is a prime example. Development programs begun in the 1980s bore fruit recently. The Iranian Ababil has a 10-foot wingspan, range of 150 miles, and endurance of 90 minutes.

RPA work has now split into two developmental streams.

The dominant one centers on low-altitude battlefield surveillance. Dozens of nations operate RPAs such as the ill-fated Georgian one. In the other stream, China and a few other nations are developing high-altitude, long-endurance RPAs with theater potential. The current crop of adversary RPAs also includes many designs geared toward significant high-end capability in long-range surveillance, signals intelligence, and all the other desirable qualities pioneered by the US.

The Left Hook

These developments virtually assure that adversary RPAs will pose a growing challenge for joint air operations.

It is true that few of these RPAs will be technical peers of American systems. However, the RPA mission rarely requires highly advanced technology.

Iran, for example, claims its new Shaparak RPA can fly for more than three hours at 15,000 feet with a 17-pound payload. Such RPAs are viewed by regional militaries and rogue states alike as a possible means for striking against technologically superior forces and landing disruptive blows.

As the skies fill with such RPAs, US and other allied airmen will first face the challenge of clearing the airspace.

Israel's Air Force got a taste of the mission during the 2006 war with Iranian-supplied Hezbollah forces based in Lebanon. Hezbollah forces attempted to scout Israeli targets with an Iranian-made Ababil RPA. They did not succeed. Israeli forces spotted the Hezbollah RPA and sent out an F-16C, which shot down the drone with a Python 5 air-to-air missile.

Undaunted, Hezbollah has acquired as many as a dozen replacement Ababils from Iran.

Border surveillance RPAs—like the one shot down over Georgia—are becoming standard equipment around the world. Their surveillance powers will provide at least a sporadic opportunity to detect movement around borders. That will make it hard for US forces to blind adversary nations, as the coalition did with Iraq in 1991.

In that war, the coalition mounted a major "left hook" swing of ground forces on the Saudi border, as coalition air forces masked the move. In the future, a handful of RPAs could detect the maneuver.

Future battles probably won't be limited to chasing one or two RPAs across the sky. Instead, air forces may be forced to engage multiple RPAs.

That's the scenario that emerged in Black Dart, a major US venue for experimenting with counters to adversary RPAs.

In the mid-2000s, the Air Force Research Lab at Wright-Patterson AFB, Ohio, participated in the Defense Intelligence Agency's Black Dart project. Its goal at that time was to experiment with asymmetric attack threats that could be posed by an adversary's use of commercial off-the-shelf technologies.

Photo via chinesemilitaryreview.blogspot.com

China's ASN-209s are tactical, medium-altitude RPAs. China has worked hard to catch up in the unmanned air game. Experts worry about "swarms" of small, light RPAs being used to harass ground troops or being used as "crop dusters" to deliver chemicals or bioagents.

Soon, however, Black Dart grew into an air battle test. In November 2010, a US Joint Forces Command unit at Nellis AFB, Nev., hosted a variation of Black Dart, dubbed Blue Knight. Blue Knight set up an environment in which USAF would fend off "red" adversary RPAs. Participants included aircraft as varied as the F-22 fighter and Predator RPA. The goal: Determine how joint forces could work together to detect, identify, track, and defeat adversary unmanned systems.

In 2011, Black Dart was moved to the Navy missile range at Point Mugu, Calif. Forty-seven RPAs flew 120 sorties during the exercise that year.

The United States will need more and better exercises to keep up with the growing threat, according to Army Maj. Darin L. Gaub, a planner on the 1st Infantry Division staff who has worked extensively on development of RPA applications and tactics.

Gaub, writing in *Armed Forces Journal* last December, criticized Black Dart for its predictable scenarios. "Opposing-force operators are often junior, with limited or even no experience with their systems," he wrote, "and are therefore unable to replicate the full range of potential adversary tactics."

Some planners fear the US may one day encounter a swarm of enemy RPAs over friendly ground forces. Guy Ben-Ari of the Center for Strategic and International Studies in Washington, D.C., once vividly described the swarm tactic.

"Unmanned aerial vehicles could be used asymmetrically, in ways we haven't even imagined," he told *Popular Mechanics* in 2009. "You could have something that's two generations behind our drones, but they're swarming with hundreds of UAVs at the same time or being used as 'crop dusters' to deliver chemicals or bioagents."

Soaring Dragon

One 2009 Air Force planning document touched on that possibility. Swarm capability, it said, begins when a single pilot directs "the actions of many multimission aircraft creating a focused, relentless, and scaled attack."

Other services agree. The US Army's 2010 RPA roadmap found "most states are also advancing their own UAVs and counter-UAV capabilities."

In a battlefield setting, adversary RPAs could focus on surveillance, harassment, and small, targeted strikes. Very small munitions packages, carried by lightweight RPAs, could be effective against dispersed ground forces conducting stability operations. In every case, recovery and reuse of RPAs will probably dominate adversary tactics.

Enemies still need to show that they can build sufficient numbers of beyond-line-of-sight RPAs with redundant controls. Low-flying enemy RPAs will be as vulnerable as American types. Thus, the ideal swarm tactic probably can't be executed until the participating RPAs reach higher levels of autonomy.

There also are many questions at the operational level. Low-end adversaries might use RPA swarms for harassment of bases or ground forces. High-end adversary RPA swarms will have much more difficult targets such as naval strike groups.

Still, the potential for RPA attacks is real in the near term. "The results of Black Dart and other counter-UAV exercises should be disseminated and incorporated at all levels in DoD," recommended Gaub. "Units training for deployment must understand what lessons come out of exercises such as Black Dart."

Some forecasters assign to RPAs various starring roles in high-end conflict.

China is hard at work on a range of RPAs. Unsurprisingly, many of their designs bear a striking resemblance to aircraft in the US Air Force inventory. In the past, China copied both the Firebee and the Pioneer. China's answer to the Predator is nicknamed "Pterodactyl."

A new concern is a Chinese RPA known by several names, one of which is Soaring Dragon. When it went on display at the Zuhai air show in 2006, this RPA struck many as resembling the Air Force's Global Hawk. It reportedly conducted high-speed taxi tests in 2008 and flew in November 2009.

Experts estimate the Soaring Dragon may have a service ceiling of 57,000 feet and a speed of about 470 mph. Its range may be limited to the Asia-Pacific region, but in that environment, it can accomplish a great deal.

Photo via chinesemilitaryreview.blogspot.com

China's Soaring Dragon bears a striking resemblance to USAF's Global Hawk. In the past, China has openly copied other USAF drones, including the Firebee and the Pioneer.

A prime use for Chinese RPAs could be to search for precise locations on US and other allied naval vessels, for example. In a crisis, airmen in the Pacific may have to hunt and chase RPAs such as Soaring Dragon in order to defend the airspace and gain air superiority. That job almost certainly would fall to top-end air superiority fighters such as the F-22 and F-15.

The prospect is not far-fetched. In June 2011, a P-3 Orion flown by the Japanese Maritime Self-Defense Force over the East China Sea observed a group of 11 Chinese warships passing Okinawa on a homeward course. Suddenly the P-3 crew spotted a Chinese RPA in flight over one of the Chinese frigates. It was the first evidence of integrated warship-RPA operations. The RPA appeared to be about 15 feet long with a camera ball slung under its nose.

Propaganda, posturing, precision attack, and surveillance all are potential missions for these RPAs. The proliferation of RPAs at the low and high end has reached a point where taking steps to counter adversary RPAs is already becoming part of the routine for the air component.

Dealing with threats from enemy RPAs means going back to the basics in air superiority. "It's just another platform," explained James, the USAF head of ISR. "Why is an RPA different from a piloted aircraft? It's not a different mission."

Step 1 is sorting and characterizing the threats. In the Black Dart exercises, fighters had trouble seeing and identifying "red" RPAs. Intelligence agencies will have their hands full in keeping track of new types of adversary RPAs and providing that information for targeting purposes. Building the enemy RPA order of battle will be a vital task.

The next step is to ensure aircraft crews can identify enemy RPAs by type. Part of that job will fall to manned fighters. "The F-35 Joint Strike Fighter, for example, should carry a signature library for its radar that will allow it to spot and identify most classes of UAVs," suggested Gaub.

Photo by Piotr Butowski

One of Russia's entries into the RPA sector, Yakovlev Pchela, on its launcher. A short-range tactical aircraft, its primary use is battlefield surveillance.

If fighters encounter enemy RPAs, they can shoot them down with missiles or guns. Moreover, USAF remotely piloted aircraft could be used to counter RPAs, too. That's what the Predator was attempting to do a decade ago when it was shot down by an Iraqi MiG.

Swarming RPAs

Air defense against enemy RPAs will depend to a large extent on a flexible and technically capable fighter force structure adapted to this additional task. US fighters in the Asia-Pacific region need the latest in links, intelligence-gathering systems, and weapons for the mission.

Enemy RPAs also can be attacked from the ground or at sea. Some years ago, the Defense Advanced Research Projects Agency began evaluating exotic tools for defending against smaller air systems. One such concept was RAP-CAP, which stood for the Rapid Capture and Disablement of RPAs. Press reports described RAP-CAP as a gun-launched projectile using an infrared proximity sensor to burst out foam and netting around the RPA. Conductive carbon could disable the RPA's communications.

Many experts believe laser weapons could be effective against swarming RPAs. Fast-firing solid-state lasers carried on surface vehicles or aircraft could target numerous RPAs at once as long as they were soft enough to be vulnerable to the laser's output power. For example, Boeing's Laser Avenger shot down a target RPA with a six-foot wingspan during tests in 2009.

In 2010, the Navy splashed four target RPAs using a Phalanx close-in weapon system modified to fire a solid-state laser system with an output of 32 kilowatts.

"One of the Navy's problems is that the bad guys have UAVs now; they can give away ships' positions," Raytheon's Michael W. Booen told the press after the test. "The targets came in over the ocean, and it was a good day for lasers, bad day for drones."

The Office of Naval Research plans to mount solid-state lasers on operational surface combatant ships within the next few years in part to handle swarm attacks from remotely piloted aircraft.

At the higher end of combat, the Patriot air defense missile system and its successors will have to incorporate an ability to detect, discriminate, and target small enemy RPAs.

The Air Force almost certainly will have to be deeply involved in the theater air defense architecture bringing all these systems together. The threat will only get more advanced with time. ■

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