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PROJECT
Contemporary
Historical
Evaluation of
Combat
Operations
REPORT

HERBICIDE OPERATIONS
IN
SOUTHEAST ASIA

July 1961-June 1967

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Prepared by:
Captain
Charles V. Collins
SEAsia Team

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Highway 1 and the railroad between Saigon and Nha Trang. Operations began 30 October 1964 and continued through 29 January 1965. Forty sorties were flown in one 14-day period during January 1965. Some 36,600 gallons of herbicide were dispensed and two hits from ground fire received during the operation. ^{46/}

A similar project included targets along the main shipping channel from Saigon to the ocean. It was hoped that defoliation would decrease VC sniper activity and minelaying operations. If the banks of the channel were cleared, increased surveillance of the area would be possible. This project began on 1 March and ended on 19 March 1965. Forty-two sorties were flown and 27,000 gallons of chemicals delivered. Hostile ground fire caused only two hits during the period. ^{47/}

Project "Sherwood Forest"

Planning for Project Sherwood Forest began in December 1964 and was to involve the RANCH HAND crews in a new type of operation, combining the spray aircraft with other C-123 cargo crews in a massive attempt to burn out a section of the Boi Loi Woods. This area, approximately 26 miles north-northwest of Saigon and extending to within a few miles of the Cambodian border, had long been a VC stronghold. The target area included a 48 square mile section of the jungle which had a very heavy canopy cover. This had permitted the VC to use the area for the past ten years with little fear of observation and to develop it into the center of their operations in SVN. It was occupied by regular VC troops, who had devised an intricate system of caves and trenches hidden under the heavy canopy of

the jungle. Supplies for this stronghold were readily obtained by the VC through easy access to the Ho Chi Minh Trail, a major infiltration route to the south. Because reconnaissance of the area had previously been futile, it was hoped that Project Sherwood Forest would expose the key locations so that airstrikes could be pinpointed against specific targets. ^{48/}

The plan, presented by Brigadier General Robert R. Rowland, Chief of the Air Force Advisory Group, was to heavily bomb the area, then to defoliate using the spray aircraft of RANCH HAND. After the chemicals had killed and dried the target vegetation the 48 square mile section was to be "bombed" with 50-gallon fuel drums loaded on pallets. Each aircraft would carry 24 drums. The pallets had M-6 night flares attached and rigged to ignite the fuel after dropping. The hope was that the defoliant would have sufficiently dried the area so that when the fire bombs were dropped, a huge fire storm, aided by strong surface winds, would be created. To insure development of the fire, A-1E aircraft from the 34th TAC Group were to follow the C-123 cargo aircraft with strikes of incendiary. ^{49/}

RANCH HAND personnel defoliated the area after two days of intensive bombing by the A-1E and A-1H Skyraiders, which dropped 800 tons of explosives on target in 139 sorties. This was the first time prestrike missions had been approved and was effective in decreasing the ground-fire hit ratio. Initial spraying of the target area covered the period 22 January-18 February 1965. On this project, the largest undertaken to date in the RVN, 102 sorties were flown and 78,800 gallons of defoliant delivered over 7,500 hectares of forest. Spray aircraft received 79 hits from ground-fire, with

injuries sustained by three crew members. ^{50/}

By the end of March, the chemicals had taken effect, the dry season was almost over, the winds were favorable and success was anticipated. The C-123s of the Air Commando Group, led by Col. Fleming, came in to drop the flare-rigged fuel barrels. Following were the A-1Es and B-57s loaded with tons of incendiary and incendiaries. Soon a huge circle of flame and a tall column of smoke marked the target area. Secondary explosions indicated enemy presence in the jungle, although warning had been given and over a thousand civilians had left the area. ^{51/}

The project ended in disappointment, however. The operation had been carried out as planned, but a huge rain cloud formed over the target. The rain quenched the fire, which did not spread as predicted due to unexpected slow surface winds. By morning the fire was out. ^{52/}

Although the project was not completely successful, the Boi Loi woods were no longer the safe haven they once had been. Vertical visibility had been increased by the defoliation missions. These missions were made difficult because, after bombing the area for two days, the element of surprise was gone and the RANCH HAND aircraft were prime targets for the VC infantry company left in the area. Nevertheless, the operation marked another development in the use of herbicides in the war in RVN. Defoliants were again to be used in this type of operation later in the war. ^{53/}

Following Sherwood Forest, crop destruction missions continued with Project "Yankee" which covered targets in and around the An Lao Valley.

Binh Dinh Province. It was hoped the villagers would leave their homes and seek new ones in areas controlled by the GVN, thereby causing logistics problems for the Cong by eliminating the immediate supply of food. Operations started on 27 March 1965 and ended on 18 April 1965. Thirty-seven sorties were flown, during which 27,300 gallons were delivered. Nine hits were taken by RANCH HAND aircraft. ^{54/}

Increased Fighter Support

Project "Swamp Fox" was to become the largest defoliation project, to date, in South Vietnam. Targets included areas in Bac Lieu, Box Xuyen, and Vinh Binh Provinces. The VC stronghold in these areas contained arms factories, repair shops, hospitals, and training camps, all operating without fear of harassment. Defoliation operation would help aerial surveillance and permit observation of supply and troop movements in the area. These operations started on 30 April 1965. A-1E aircraft from Bien Hoa prestruck each target area and provided cover for the 84 RANCH HAND sorties. A Forward Air Controller was also used. The project was terminated on 25 May 1965. Spray aircraft sustained 124 hits and dispensed 77,600 gallons of defoliant. Five crewmen were slightly injured as the result of ground fire. The project was about 70 percent complete when it was terminated because of the heavy ground fire. ^{55/}

Following the termination of "Swamp Fox", a reevaluation of defoliation was conducted by MACV-J2. Herbicide operations were considered to be of great tactical use and a desirable weapon, although 2AD and PACAF expressed

concern for the safety of the crews. A tactical study indicated the need for an increase in the ratio of fighters to spray aircraft and concluded that more time on target for the fighters was desirable. As of 30 June 1965, RANCH HAND aircraft were to fly cargo missions until more A-1E aircraft at Bien Hoa finished their training to fly cover for spray operations. ^{56/}

The A-1E had several advantageous features in its use as a support aircraft for spray missions. It had the necessary airspeed and maneuverability and could carry the ammunition required to suppress ground fire during spray operations. ^{57/} As an example of their use in the IV Corps area, four A-1Es were generally used per mission. Each was armed with mixed loads of bombs and 20mm ammunition. The fighters pre-struck VC gun installations, based on reports from the FAC working in the area, followed three to five minutes later, by the C-123s. ^{58/}

During the summer and early fall of 1965, crop destruction missions were flown in the Kontum and Binh Dinh Provinces. On 20 October 1965, operations commenced in War Zone D. This project continued until 17 December, with 163 sorties being flown and 137,650 gallons of chemicals being delivered. Fighter support for the C-123s now included F-100, F-5, and A-4 aircraft in addition to the A-1E. ^{59/} Also, during September and October, three more C-123 aircraft were being modified for spray operations by the Fairchild-Hiller facility at Crestview, Florida. These three aircraft were brought to Tan Son Nhut by newly trained crews and were in place by 13 November 1965. In November, the designation of the spray-configured aircraft was changed from C-123 to UC-123. Other changes in the RANCH HAND

operation included the use of flying helmets with a clear, extended visor. This was done to minimize the effects of shrapnel and other flying debris in the cockpit as the result of ground fire. ^{60/}

Tactics were also changed to prevent the number of hits from increasing. Spray aircraft flew in a close-up, nose-to-tail echelon formation on straight targets where undisciplined forces were found. This was not done, however, where fire was concentrated or where troops were highly disciplined and trained in firing at aircraft. Fighter tactics still included pre-strike, poststrike, or a combination of both. There existed some question whether fighter prestrike to gain ground security was of more value than the natural element of surprise. The complex process of target acquisition was also becoming a problem about this time. The coordination process required as much as a year, at times, and as a result, the backlog of RANCH HAND work had occasionally dwindled to a single project. ^{61/}

In November and December 1965, targets included more "lines of communication" type of defoliation missions. On 25 November, a smaller project began along the banks of the Oriental River. In 18 sorties 24.2 square kilometers were sprayed with 14,000 gallons, with 34 hits being received. Cover was provided by F-100s with help from a FAC and with the "Jolly Green Giant" rescue helicopter standing by. ^{62/} Other projects in December included areas in Kien Hoa Province and Phuoc Tuy Province. These projects were larger and, in Kien Hoa, 70,450 gallons were delivered between 7 December 1965 and 31 May 1966. ^{63/} The Phuoc Tuy project began on 18 December 1965 and ran through 30 January 1966 with 60,000 gallons of defoliant delivered. ^{64/}

It might be mentioned, at this time, that a shortage of defoliant was noted. In a letter from the 309th ACS to 315th ACG, dated 12 November 1965, it was stated that aircraft were on standby for two days for lack of chemical. ^{65/} The shortage of defoliant in more recent times has grown to such proportions that it compares in magnitude to the munitions shortages reported earlier in the conflict. ^{66/}

Operations in Laos

In December 1965, herbicide operations were begun in Laos, with sorties being flown from Tan Son Nhut and Da Nang. Two UC-123 aircraft and crews had been deployed to Da Nang Air Base, with the first spray mission flown on the 6th of December. ^{67/} The purpose of the operation in Laos was the exposure of foot trails, dirt roads and other LOCs that crossed into SVN and made up the Ho Chi Minh Trail. This infiltration network leads from NVN, through the eastern portion of the Laotian panhandle, to the Cambodian border.

Weather, ground fire, and high mountainous terrain all combined to make these operations in Laos extremely hazardous. Strong surface winds dispersed the spray, making it less effective than normal, and requiring several missions to properly defoliate any given target. ^{68/}

Operations in this area continued into 1966 and, by late March, most of Routes 92, 922, 96, and 965 had been targeted and defoliation had commenced. The Forward Air Controllers in both Steel Tiger North (Cricket) and Steel Tiger South (Tiger Hound) also recommended targets as operations progressed. In early May, operations began north of the 17th parallel, in

Laos, with a concentrated effort being made in the Steel Tiger North area, where strong enemy opposition was first noted, with .50-caliber antiaircraft fire being encountered during at least five missions. ^{69/}

As of 30 June 1966, approximately 1,500 kilometers of roads and trails in Laos had been sprayed to a width of about 250 meters on either side of the road. During the operation, 220 sorties and over 200,000 gallons of herbicide had been used. Many fighter pilots and FACs attributed at least partial credit to RANCH HAND for the destruction of over 1,000 trucks on these roads. ^{70/}

Operations in the RVN - 1966

While missions were being flown in Laos during early 1966, other activity was taking place in SVN. During January, 130 sorties and 118,500 gallons of chemical were delivered by RANCH HAND in the Vung Tau, Bac Lieu, Saigon, Nha Trang, and Pleiku areas. The two aircraft at Da Nang had deposited 59,800 gallons against lines of communication and suspected VC supply and storage areas in Laos. ^{71/} In February, 45 defoliation and 48 crop destruction sorties were flown in the I Corps region, with 63 sorties in Laos. This amounted to 156 total sorties flown and 145,300 gallons of chemical dispensed during February. ^{72/}

One project of note involved a plan to fly missions near Tan Son Nhut without a navigator. This project was nicknamed "Mac's Folly," after the originator of the concept. The idea was to take off from Tan Son Nhut, fly a predetermined fixed heading until intercepting a Tacan position, then

turning onto the target based on the Tacan fix. This project (3-20-2-66) was started on 20 February and completed on 29 August 1966, but was not too efficient, with later observations of the target area revealing that the spray strips were somewhat randomly positioned. ^{73/}

Another project of interest, accomplished in early 1966, involved the use of RANCH HAND aircraft in another jungle burning project (Hot Tip I and II) on Chu Pong mountain. This 29 square kilometers of mountain area was covered with a thick canopy. Defoliation was performed by UC-123s, with 17,000 gallons of orange defoliant being delivered between 24 January and 6 February 1966. An additional 5,000 gallons were delivered on 22 and 23 February at the request of MACV. ^{74/} This project, however, was also doomed to failure. On 18 March 1966, during a MACV briefing, Major General C. E. Hutchins wanted to know the results of the Chu Pong defoliation project. He was told that weather, humidity, ordnance, and delivery methods were all satisfactory, but "the damned trees just wouldn't burn"...Only 5 percent, ^{75/} in fact, had burned.

In March, April, and May, more sorties were launched in the Kien Hoa and Phuoc Tuy provinces, as well as in Laos. March saw 116 sorties flown in SVN and 47 in Laos; a total of 148,450 gallons of defoliant had been delivered. ^{76/} April saw a 20 percent increase in sorties and a 4.4 percent increase in gallons dispensed. ^{77/} In May, 11 additional aircraft were programmed and were being modified for assignment to the Special Aerial Spray Flight in SEA within the calendar year. Chemical supplies were also being increased to meet the expanded activity. Sorties flown in SVN during

May were 218, with 199,450 gallons of herbicide being delivered. In Laos, 5,000 gallons had been dispensed in 26 sorties. ^{78/} Just two years previously, during May 1964, 20 sorties had been flown in SEA dispensing 11,075 gallons of chemicals. ^{79/} The growth of the herbicide concept in this brief period is apparent.

In May, the shortage of herbicide was again felt. On 14 May, two aircraft and crews were recalled from Da Nang due to unstable political conditions and lack of chemical. However, two UC-123s were redeployed to Da Nang shortly thereafter, arriving on 30 May. ^{80/} In June 1966, the first RANCH HAND aircraft to be lost during a tactical mission was downed by ground fire during a defoliation mission in Quang Tin Province in I Corps. The two spray aircraft involved had received sporadic ground fire and, on the fifth pass over the area, one lost an engine. It impacted in a hedge row near a rice paddy and subsequently burned. Six USMC helicopters responded to the May Day call. Two of these landed amid ground fire and rescued all three crew members. The pilot of the downed aircraft was seriously injured; the others suffered only minor cuts and bruises. ^{81/}

In July, major modifications of the spray aircraft were undertaken. A new spray tank and a 20-hp pump, capable of delivering 400 gallons per minute, were added. The complete system is known as the A/A 45Y-1 Dispenser System. A 10-inch dump valve was installed, replacing the five-inch valve previously used. A new tail boom, 20 feet long and weighing 120 pounds, was fastened on the aircraft with Hayes mounts. This new system could spray at a rate of 250 gallons per minute (3 gallons/acre)

and the entire 1,000 gallons could be dispensed by the new pump in four minutes of spray time. ^{82/}

During the summer 1966, the first spray missions over NVN were flown. Two missions, starting in NVN, continued southward through the Mu Gia Pass into SVN. In August, crop destruction targets were scheduled in the A Shau Valley, which became a very "hot" target area during the month of September. ^{83/}

Area defoliation in War Zone D began in August under a low priority. Many sorties during August and September were also flown in the Iron Triangle region, also a priority target at the time. War Zone C defoliation began around the first of September and continued throughout the fall of 1966, with many smaller targets along roads also being struck from time to time. Activity in IV Corps, under project 4-20-1-66, began in August, in the Mekong Delta area. In short, the herbicide operations were now being performed in all areas of the RVN with hostile fire expected in most of them. ^{84/}

Since November 1965, RANCH HAND had been using seven aircraft. In April, COMUSMACV had decided to defoliate War Zones C and D and had requested 11 additional UC-123s to assist in this task. ^{85/} Three aircraft arrived in August, four in September, so that by 10 October 1966, 14 UC-123 aircraft were in place at Tan Son Nhut. ^{86/} In September, scheduling commenced for defoliation missions in the area just south of the DMZ. Clear weather in the area sometimes permitted as many as four sorties per aircraft during a single day. So many missions were flown that, again, the

supply of herbicide ran low and maintenance began to fall behind. The crews had to slow down to let things catch up. ^{87/}

There was some question as to the military requirement for defoliation in or near the DMZ. On 27 August 1966, COMUSMACV explained to CINCPAC that political considerations for defoliating in this area appeared to conflict with the military requirement. ^{88/} However, in October 1966, COMUSMACV requested permission to defoliate into the northern section of the DMZ and adjacent infiltration routes in NVN. The response to this request was that only the southern portion of the DMZ should be authorized for defoliation. Northern projects would wait for an evaluation of the military/political results evolving from the approved program in the southern portion. MACV would conduct a qualitative assessment of the southern DMZ defoliation operation in support of this evaluation. ^{89/}

In the period from September to November 1966, an attempt was made to insure fighter cover for RANCH HAND sorties. There were cases of aborting the mission when air cover could not be obtained--especially true in the III and IV Corps areas. The policy of flying only with air cover is still in existence. ^{90/}

On the 15th of October, the Special Aerial Spray Flight, 309th Air Commando Squadron, was discontinued and the 12th Air Commando Squadron was administratively formed, retaining the code name RANCH HAND. Lt. Col. Robert Dennis was assigned as the first commander of the 12th ACS, whose primary mission remained unchanged. ^{91/} Although temporarily organized

under the 14th ACW, ^{92/} it was permanently established under the 315th ACW, Troop Carrier.

On 31 October the second RANCH HAND aircraft was lost in the Iron Triangle region. All crew members were rescued, although the aircraft was totally destroyed. ^{93/} On 1 December 1966, the 12th ACS was moved to Bien Hoa. By the end of December, there were 14 aircraft on hand, two en route from the States, and two in modification in the Zone of Interior, ^{94/} which accounts for the 18 aircraft authorized.

Activity in Laos was increasing during the month of October 1966, primarily because of the weather conditions near the DMZ and the A Shau Valley, at this time of year, which hampered defoliation activities. Laos targets were relatively "cool" and only small amounts of hostile fire were received. Further south, in the Rung Sat Special Zone, defoliation activity had begun during October and November. A test, using 1 1/2 gallons of orange per acre, was being conducted on the mangrove trees in the area. A similar test was also tried at the same time in project 4-20-1-66 in the delta region. Both tests showed that the reduced rate was ineffective ^{95/} as many areas had to be redone at a later time.

During December, January and February, the main areas of activity were in War Zones C and D, with as many as 29 sorties a day being flown. The mission at Da Nang was halted temporarily during January because of weather but, in February, sorties from Da Nang were again flown into Laos and inside the southern portion of the DMZ. ^{96/} Authority to defoliate the southern portion had been granted on 27 November by the Secretary of

State. ^{97/}

Ground fire activity was beginning to pick up making the missions over Laos more hazardous for the vulnerable UC-123s. The roads and infiltration routes in Laos were drying out and traffic was increasing. The third RANCH HAND aircraft to be lost during a tactical mission went down over Laos on 31 January 1967. This time the entire crew was lost. ^{98/}

Project "Pink Rose"

Project Pink Rose was the third time defoliation aircraft were used in a jungle burning program. The tests, based on the previous projects "Sherwood Forest" and the burning of Chu Pong Mountain, were not completely successful to say the least. ^{99/} Pink Rose was to be a full-scale test program with 7AF coordinating the efforts of the U.S. Forest Service personnel, RANCH HAND crews and SAC B-52 ARC LIGHT forces stationed in Guam. The target areas (one in War Zone D and two in War Zone C) were selected on 6 November. ^{100/} Each target was a square box, seven kilometers on each side, which contained about 12,000 acres of heavily canopied jungle. During the first discussions CINCPAC suggested Orange dessicant be used, followed by a second application some two months later. Finally, this could be followed by an application of Blue delivered several days before ignition. ^{101/} The operation plan directed the initial treatment of the targets be accomplished by the following dates: Area A-14 November 1966; Area B-16 November; and Area C-18 November. All areas were, in fact, completed by 27 November 1966. Orange dessicant was planned for Areas A and B while

Area C was to get White. Rate of delivery was the normal three gallons per acre. In January 1967, a second application of the same herbicides was completed. The agent Blue was to be applied ten days before ignition, at the rate of three gallons/acre in Areas A and C and $1\frac{1}{2}$ gallons/acre in Area B. No operational problems were encountered as the defoliation of these areas was accomplished in accordance with the procedures specified by the Chemical Division, MACV-COC7. Aerial reconnaissance of the target areas indicated that results were equal or better than expected. Ground parties inspected the areas and confirmed good drying throughout the forest. Approximately 225 sorties were flown and 255,000 gallons of herbicide were delivered in these three target areas. 102/

The actual ignition of the targets took place as follows: Target C was ignited on 18 January 1967; target A on 28 January; and target B on 4 April. This particular order was necessary to prevent conflict with current ground operations. Thirty B-52s from the 3rd Air Division units on Guam were used on each of the first two strikes to deliver the ignition units. On the third strike, only 15 B-52s were used and the target box was compressed to provide a density of incendiary bomblets three times greater than that used on the first two missions. The ignition units were comprised of M-35 bombs, M-14 tail fins, two M-152/AN-152A1 fuzes per bomb, and M23 Type B arming wires. Coordination between 7AF, 3AD, and MACVCOC was excellent. All strike aircraft were on target as scheduled and were properly spaced by the use of the MSQ-77 "Skyspot" radar, operating alternately from the Bien Hoa and Dalat sites. Target saturation with

the bomblets was satisfactory. The weather was good on the last two targets; the first had been slightly overcast with some surface winds, but this was not considered a major factor influencing the effectiveness of the fire storm. ^{103/}

The effectiveness of the operation varied with the area. In target C, the burning was ineffective. Only the well-drained grass areas burned freely, with most fires spreading no more than two feet from the point of ignition unit impact. Smoke was intense in the area, but very little damage was done by the fire. ^{104/}

Area A had much the same results. Open areas again burned well, but the fire under the canopy did not spread as desired. Under double canopy, the fire spread only about six feet from the ignition source, resulting in the burning of only three to five percent of the area. Under single canopy, spread was only slightly better. Burned area amounted to about nine to 12 percent of the available forest. Crown canopy removal was negligible. Again the smoke was intense and rose to about 9,000 feet, but subsequent flights through the area failed to reveal much change in canopy thickness or aerial visibility. ^{105/}

Target B, with the close-packed bombing, still had negligible results. About 50% of the fires did meet but, because of the thin canopy, did not burn. Overall damage to the forest was not appreciable. The major conclusions were that this technique was ineffective as a means of removing jungle canopy and that results did not warrant the high cost of resources to continue testing. ¹⁰⁶

Between February and June 1967, six more aircraft were received by the 12th ACS. Two arrived in February, one in March and three in June, bringing the total number of aircraft on hand up to 20. ^{107/} (As this report was being written, the fourth RANCH HAND aircraft was lost, with its entire crew, during a tactical mission.) ^{108/}

In the last four months, IV Corps targets have received many sorties. RANCH HAND has also been working II Corps and War Zones C and D. War Zone C projects were nearly completed as of May 1967, however. In II Corps, there are currently 10 active projects in support of Operations Francis Marion, Pershing, and Byrd alone, ^{109/} as well as other crop destruction projects. Certain areas near Cambodia in II Corps are being requested by the U.S. Army commanders rather than originating from the ARVN or province chiefs. Targets in these areas, as well as some small projects, are being flown at the present time. It is safe to say that RANCH HAND's current ^{110/} missions are scattered throughout all four combat zones.

The code name for "fragging" purposes is "Traildust"; the call sign for the UC-123s during the spray mission is "Hades." All RANCH HAND flights require fighter cover ^{123/} and are flown under the control of a FAC. ^{124/}

The mission itself may take 45 minutes or more in the target area because of the necessity to maneuver up and down the sides of mountains. The "spray-on" time is four minutes, which permits the 1,000 gallon tank to be emptied at the rate of three gallons per acre. The "Hades" aircraft fly as low as possible without sacrificing safety and delivery speed is at 130 knots. Each aircraft sprays a swath about 80 meters wide and 16 ^{125/} kilometers long.

Between 18 and 27 sorties are flown daily, six being scheduled out of Da Nang. The number of aircraft flying each mission varies with the target, but generally three or four aircraft spray each target in loose trail formation. Each has a crew of three (pilot, co-pilot, and flight mechanic), except the lead aircraft which has four crew members, the fourth being the navigator for the mission. In the past, these crews were made up of volunteers who received C-123 training at Hurlburt Field (Eglin AFB, Fla.), after which special spray training was given for three-four weeks at Langley AFB. As of 1 July 1967, all training will be conducted at ^{126/} Hurlburt.

The tactics used on spray missions vary with target type and depend, generally, on weather, target terrain, and the amount of ground resistance expected. If the weather is clear, the spray aircraft will remain at altitude (3,000 feet AGL) and then rapidly descend at about 2,500 feet per

minute to spray altitude. If ceilings are low, a low-level approach may be made to reach the "spray-on" point. If terrain permits, one long straight run will be made. Other spray patterns include flying a race track pattern or a "Plum Tree" tactic, which involves making 90 - 270 degree turns at the end of the target area. If the target is discovered to be "hot," the spray aircraft can make one pass and then divert to another target for the rest of the mission. On all spray missions, regardless of the tactics used, a FAC can be very helpful in directing the UC-123s after observing the previous spray run. ^{127/}

In mountainous country, such as Laos, special tactics have been developed. The roads were overgrown with foliage and the path was hard to follow. Sometimes a lead aircraft would fly at a slightly higher altitude, where visibility was greater, and thus be able to lead the other spray aircraft along the road. At the end of one run, a different aircraft would take the lead. Another technique involved throwing smoke grenades to mark the road before starting the spray run. In this case, the procedure is to fly from smoke-point to smoke-point, thereby following the road. A third tactic, not as effective as the other two, is to have the navigator DR the path of the spray aircraft along the road. This technique requires a prior knowledge of the road, however. Along the sides of the mountains, ^{128/} a contour-type of spraying is employed.

Fighter tactics are also important to the success of the RANCH HAND mission. On a "cool" target, fighters may fly top cover for the "Hades" aircraft and conserve their fuel for a more lucrative target. On some

other targets, low-level dry runs are sufficient to keep the guns quiet. On hot targets, in a free bomb zone, a prestrike may be called for. This involves the use of CBUs, napalm, 20-mm, or all three. ^{129/} Two different kinds of CBUs are currently used: CBU-2 (anti-personnel) or CBU-12 (white phosphorus). ^{130/} The spray aircraft start their run shortly after the prestrike to take advantage of the ordnance effects. Many times, the FAC will call a post-strike after the spray mission is completed. ^{131/} The effectiveness of the fighter cover can be seen by the declining hit/sortie ratio. For example, in April 1967, 164 hits were taken by 499 sorties. In May, only 88 hits were received while flying 519 sorties. Finally, in June, ^{132/} 67 hits were received by 581 sorties.

When ground fire is received, the flight mechanic, who sits in a bullet-proof box at the rear of the aircraft, will throw a smoke grenade out the rear door. This will generally emit a red smoke, but can be any color. At the same time, the pilot will make a radio transmission to the effect that ground fire was received from the right or left, as the case may be. Due to the lag time associated with the smoke grenade, an accurate strike will be obtained if the FAC will direct the fighters to a point ^{133/} about 300 meters behind the smoke.

At the present time RANCH HAND has a secondary mission, that of spraying insecticide for the control of malaria-carrying mosquitoes. An insecticide test program started on the 14th of October at Bangkok, Thailand, and on 17 October, a combined test and treatment program was started in the RVN. One aircraft currently being used is the UC-123 that made the

"round-the-world" flight, "patches." This aircraft is not camouflaged because the insecticide has a corrosive effect unless the aircraft is coated with an alodine treatment.

Insecticide spraying involves longer missions and the conservation of fuel becomes critical. On the other hand, it is not as vital to spray along exact coordinates because mosquitoes are migratory insects. NAMCH BAMD currently flies about 20 sorties per month, dispensing 12,000-13,000 gallons at the rate of 8 ounces of insecticide per acre. At this rate, one tank of insecticide will cover about 15,000 acres. ^{134/}

The insecticide aircraft and 15 other C-123s used for the defoliation and crop destruction missions are stationed at Bien Hoa Air Base. The other three aircraft are deployed to Da Nang Air Base. The operation at Da Nang is limited to flying crews and maintenance personnel, with very little administrative work being done there. The targeting officers maintain target folders and working charts for each project. Other records are kept at Bien Hoa, where the 12th ACS has its headquarters. ^{135/}

One of the main jobs at both Bien Hoa and Da Nang is that of targeting officer. He is responsible for preparing "frag" requests, attending project coordination and planning meetings, going on the survey flights, preparing and maintaining the project folders, recording and reporting mission results, and maintaining a project chart or log. Frag requests are called in to TACC five days in advance of the mission. In these requests are included the project and target number, fighter rendezvous coordinates, FAC rendezvous coordinates, the time over target, and special requests such

as flak suppression artillery fire, etc. After the mission, a DAAR is completed and relayed to TACC on a daily basis. ^{136/}

Two modifications in equipment have recently been made to improve the operation. One of these has been the addition of an orange stripe across the top of the aircraft to aid in fighter recognition. Prior to this addition, fighters would have trouble locating the camouflaged spray aircraft until the spray was turned on. The second modification includes a change in ground handling equipment. To facilitate refilling the MC-1 spray tanks, a group of old F-6 refueling trailers have been jointed in tandem. A system of high capacity pumps and manifolds has made it possible for four aircraft to be filled with any of the three herbicides currently in use at the same time. At Da Nang, 12 of these F-6 trailers have been hooked up, providing a storage capacity of 60,000 gallons. At Bien Hoa, 18 trailers are available, giving a storage capacity for 90,000 gallons of herbicide, although only half of the system is hooked up for use. ^{137/}

Characteristics and Availability of Herbicides

The types of herbicides currently in use are Orange, White, and Blue. Orange is composed of 2,4,D (dichlorophenoxyacetic acid) and 2,4,5T (trichloro phenoxyacetic acid) and is used on broad-leaf vegetation and also on mixed targets. It is the best suited for the foliage found in RVN. White (Tordon 101) is composed of trichloropicolinic acid and 2,4,D. It is most effective against broad-leaf vegetation and, because of its low volatility, is used on targets where the spray line is critical. Blue

positioning of more F-6 refueling trailers at various places in-country to facilitate reloading of aircraft with herbicide. Suggested spots include Pleiku, Nha Trang, Qui Nhon, and Phu Cat. Spray aircraft may also be deployed to different areas in I Corps and II Corps. In addition, the Surgeon General has expressed a desire to acquire two additional spray aircraft for use in the insecticide program. ^{215/}

CBU-19 (tear gas) may be used by the fighters in the future as a means of securing the target area before spray activity. Army gas masks may be supplied to the RANCH HAND crews for their protection and other protective equipment has been proposed. Aerospace Medicine is concerned with neck protection for the crew and is developing a flak-resistant collar to be worn during the mission. A ceramic vest is also being purchased for the crews. Lastly, as an additional safety feature, the RANCH HAND aircraft have been equipped with locally designed windshield washers. ^{216/}

In the past six years, the herbicide concept has grown from a research and development test program into an effective tactical operation. Statements from the enemy confirm that operations are producing the desired results. Military and government leaders from both the United States and GVN have consistently evaluated the herbicide program as an effective tactical weapon and expressed the desire for continued and expanded activity in both defoliation and crop destruction projects.

While the immediate result of herbicide activity is the destruction of crops and vegetation, Lt. Col. Dennis points out there may be some long-range

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FOOTNOTES

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35. (S) Defoliation and Ranch Hand Report.
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37. (C) Herbicide Program in RVN, 18 December 1964, Doc. 4.
38. (S) Draft, Herbicide Operations in RVN, 1 June 1965; in files of 12th ACS.
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40. (C) Herbicide Program in RVN, 18 December 1964; Doc. 4.

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- 43. Ibid.
- 44. (S) Msg, COMUSMACV to CINCPAC, 161020Z January 1967, Doc. 5.
- 45. (C) Herbicide Program in RVN, 18 December 1964, Doc. 4.
- 46. (S) Summary of Defoliation Operations from 1 January 1965 to 8 March 1965, undated; also,
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- 47. (S) Defoliation and Ranch Hand Report.
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