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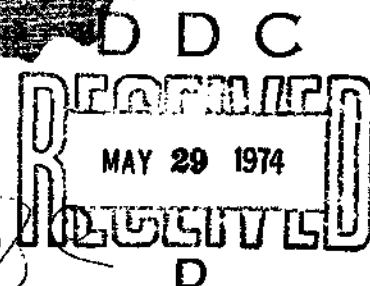
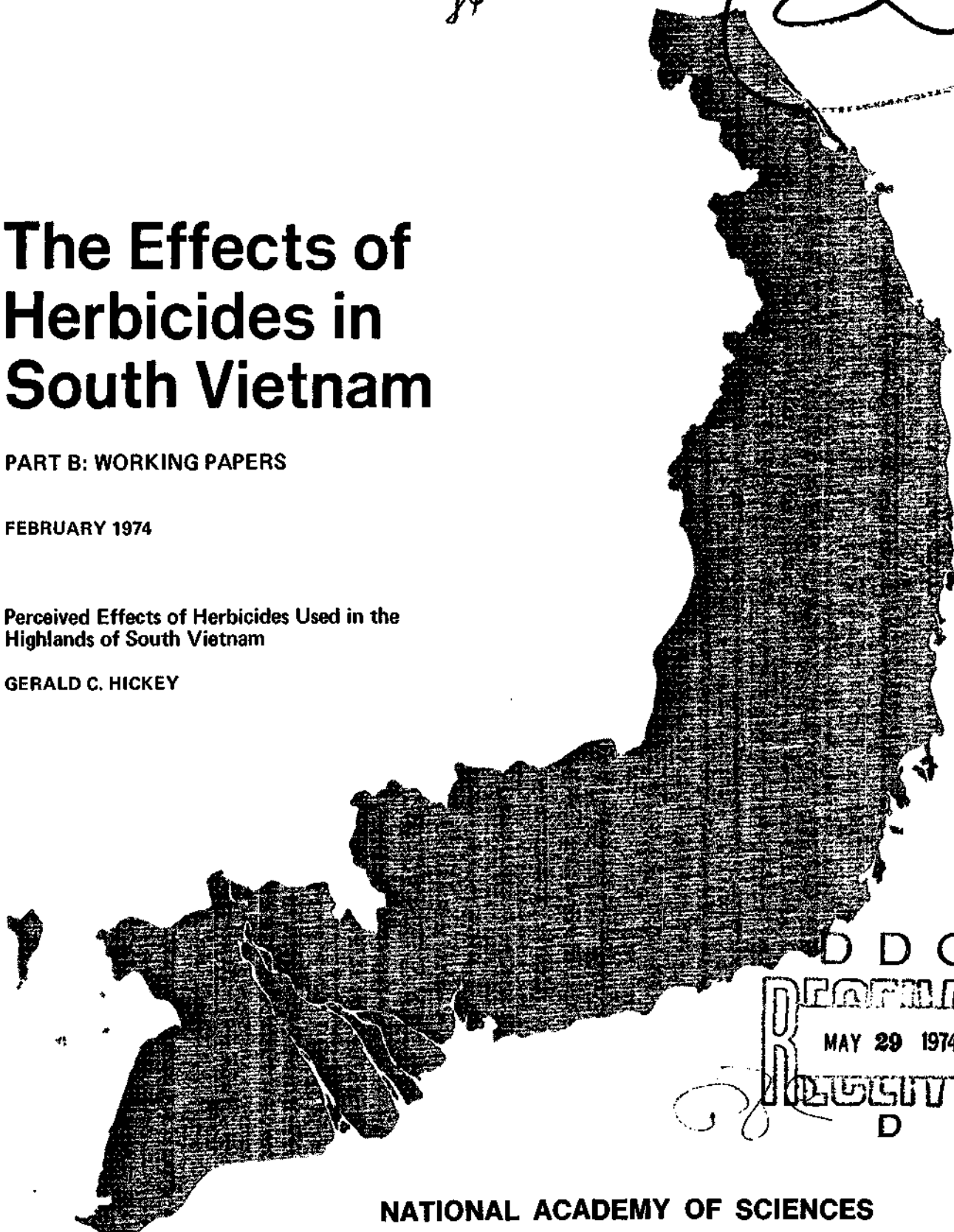
# The Effects of Herbicides in South Vietnam

PART B: WORKING PAPERS

FEBRUARY 1974

Perceived Effects of Herbicides Used in the  
Highlands of South Vietnam

GERALD C. HICKEY



NATIONAL ACADEMY OF SCIENCES

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Perceived Effects of Herbicides Used in the  
Highlands of South Vietnam

GERALD C. HICKEY<sup>a</sup>

The objectives of this research were threefold. First, an effort was made to determine whether highland villagers in affected areas had actually observed aircraft spraying herbicide and, if observed, the month and year of occurrence. Second, an effort was made to probe into the Highlanders' perception of what happened following the spraying--whether they noticed any changes in the physical surroundings or any unusual occurrences such as an abnormally large number of people falling ill or dying, and similar developments among animals and fish. Third, the inquiry was directed at the villagers' evaluation of the effect of the spraying--whether they saw any relationship between the herbicide and some or all of the perceived changes.

DATA ON INFORMANTS

Location of Informants

One of the difficulties in gaining information on the effects of the use of herbicides in the highlands is that for the most part the spraying missions took place in relatively remote areas that have been

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inaccessible to investigators. Since the beginning of the NVA/VC offensive at the end of March 1972, however, there have been massive movements of villagers from the more distant areas into highland urban centers, notably Kontum, Pleiku, and Ban-Me-Thuot, thus making available some residents of sprayed areas in Kontum and Pleiku Provinces.

Finding the residents of sprayed areas, however, proved to be a time-consuming task, particularly in the sprawling refugee centers in Kontum and Pleiku. A comprehensive analysis of the sprayed areas, correlated with administrative units (provinces, districts, and villages), population, and ethnic groups involved, was not available. A listing of sprayed areas with the administrative units and ethnic groups involved was available, but it proved to be of very limited value since some pertinent districts (such as Dak To in Kontum Province) were not included, some village names were obviously incorrect, and some villages in the sprayed areas were not included. (Some of these shortcomings are more than likely due to the errors in the mapping and the population shifts that have taken place in the past decade.) In order to approximate locations of sprayed areas in the districts from which the refugees had come, it was thus necessary to make a series of correlations using 1:100,000 scale spray overlays and maps.

By using the names of villages found in regions believed to have been affected, we located residents of sprayed areas in Dak To and Kontum Districts of Kontum Province and the western districts of Pleiku Province living in refugee camps in Kontum, Pleiku, and Darlac Provinces. Just outside Kontum City, another group of villagers was found from sprayed

areas west of the city. Still another group of villagers from Dak-Siang, victims of an accidental spraying, was located in a refugee center in Kontum Province.

Additional information on the effects of herbicides was provided by a Hroy Highlander from Phu-Yen Province trained as an agricultural engineer. He witnessed some spray missions while carrying out his assignment. Three long interviews were conducted with this informant.

#### Characteristics of Informants

1. Dam San Refugee Center, Darlac Province (November 1972)
  - a. Long Djon Village located in the vicinity of Dak To District Headquarters, Kontum Province. Sedang informants. Principal informants were two young men and an older woman.
  - b. Dak Rosa Village located in the vicinity of Dak To, Kontum Province. Sedang informants. Principal informant was an older man.
  - c. Dak Tang Plun Village, located near Tan-Canh, Dak To District, Kontum Province. Halang informants. Principal informants were several older men, several women, and two younger men.
  - d. Plei Ro-O Village, located in the vicinity of Polei Kleng, some 30 km west of Kontum City. Jarai Arap informants. Principal informants were a young man (VC defector) and several women.

2. Mary Lou (Ngok Long) Refugee Center, Kontum Province
  - a. Dak Mot-Khon Village, located west of Tan Canh, Dak To District, Kontum Province. Sedang informants. Principal informant was a village chief.
  - b. Dak Mot-Tri Village, located west of Tan Canh, Dak To District, Kontum Province. Sedang informants. Principal informant was a hamlet chief.
  - c. Dak-Siang Ranger Camp Dependents' Settlement, located northwest of Dak To District headquarters, Kontum Province. Halang informants. Principal informants were a young woman, her father, an older man, and an older woman.
3. Plei Don Village Refugee Group
  - a. Polei Krong cluster of villages located west of Kontum City. Jarai Arap, Halang, and Rengao informants. Principal informants were three men--Jarai Arap, Halang, and Rengao.
  - b. Polei Krong cluster of villages located west of Kontum City. Jarai Arap, Halang, and Rengao informants. Principal informants were Rengao and Jarai Arap older men. Several had participated in the above interview with villagers from Polei-Krong.
4. Prisoner of War Camp Refugee Center, Pleiku Province
  - a. Polei Kleng, west of Kontum City (further west than Polei Krong). Jarai Arap informants. Principal

informants were a young hamlet chief, an older woman, and an older man.

- b. Plei Jar Tum Village, located to the west of Polei Kleng in western Kontum Province. Jarai Arap informants. Principal informants were five adults--three women and two men.

5. Camp Enari Refugee Center, Pleiku Province

Plei Ea Tung Hamlet, Plei Ngol-Drong Village, located in the vicinity of the Edap Enang Resettlement Center, west of Thanh An District headquarters on Route 19. Jarai To-Buan informants. Principal informants were two men.

6. Highlander Agricultural Engineer

This respondent is a Hroy from highland Phu-Yen Province. As a young man he followed the Viet Minh. In 1954 he moved to the north and was subsequently trained as an agricultural engineer at Hanoi University. In 1969, he returned to the Phu Tuc District headquarters of Phu-Bon Province; he organized food production for the Viet Cong. At the time of the interview, he was a Viet Cong defector.

INTERVIEW METHOD

An interview technique with advice of interpreters was employed in gathering data. In the refugee camp in Darlac Province the interpreters were a Sedang villager who translated into French and Bahnar villager who speaks Sedang, and who translated into English. Both are refugee camp leaders. In the refugee camp in Kontum Province, the interpreter

was a Sedang villager who translated into English. In one Pleiku refugee camp, a Jarai villager translated from Jarai to English; in the other two camps a Rhade villager translated from Jarai into English. All of these interpreters are employed by the U.S. government. A Rhade villager acted as the translator in the interviews with the Hroy agricultural engineer. At times direct communication was achieved in Vietnamese.

A brief orientation was given each interpreter, and terminology was clarified. Initial questions concerned settlement patterns, particularly location of farming areas, type of crops grown, and such economic activities as hunting and fishing. Inquiry was then made into the informant's perception of the spraying--starting with whether he actually saw the aircraft--and its effects, described in his own words as much as is possible under these circumstances. Second interviews were conducted with informants in the Dam San Refugee Center in Darlac Province, and with the group at Plei Don in Kontum Province. All of the informants were very responsive, and although their quantitative information was vague, their perceptions regarding the effects of the spraying appear to have been very clear and well-articulated.

While some questions concerning farming and crops were posed, most of the information on the traditional agricultural practices of these groups already was contained in ethnographic notes compiled since 1965.

#### CONCEPTUAL FRAMEWORK

As farmers who rely for survival on successful exploitation of their physical surroundings, the highland people of SVN have acquired

extensive knowledge of the local flora, fauna, aquatic life forms, soils, and water. Their languages reflect this, with vocabularies containing a wide range of words for all of these categories. Their traditions, too, manifest the rich experience they have had in growing diverse crops, in gathering wild food, medicinal plants, bark, and roots, and in the selection of forest products for house construction and fabrication of artifacts.

Since they live close to nature, the Highlanders readily detect any changes in the physical ecology. Normally, such changes are much discussed among the villagers in the light of past experiences. The cause of a given change may be defined as physical (they can identify numerous kinds of blights) or occult (such as the wrath of the spirits), and these latter judgments usually rest with older, wiser members of the group. The observations of these individuals normally become knowledge shared with all members of the group.

#### AGRICULTURAL PRACTICES

Among the highland people of SVN a wide variety of agricultural practices is found, ranging from Vietnamese-style wet rice paddy farming to swidden<sup>a</sup> farming. All of the villagers interviewed in this study rely

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<sup>a</sup>This form of agriculture also is known variously as slash-and-burn, primitive horticulture, field-forest rotation, shifting-field agriculture, and brand tillage, as well as by such local names as ray (the term used in most French and Vietnamese literature on the highlands of Vietnam). The revived English dialect word swidden for "burned clearing" has been favored in a number of recent works; it has the dual advantage of being a general designation not linked to any particular region, and it can be used as a noun.

on the swidden technique, and this also was the method employed in Viet Cong food production in Phu-Yen Province as described by the Hroy respondent.

Although the swidden farming techniques vary from group to group, there are some common basic characteristics, particularly among the groups in Pleiku and Kontum. Essentially, swidden farming in highland SVN is a system of rotating agriculture wherein a given field is cleared, the cut wood burned, and the clearing then farmed for a duration of years that depends on the adjudged fertility of the soil. The field then is left fallow until a new growth of trees appears, and eventually it is farmed again.

Among the Jarai, Halang, Rengao, Sedang, and Hroy, the work of preparing the fields for farming usually begins in January or February. Men perform the heavier tasks such as felling trees (large trees normally are left standing) while women and children cut the brush. When the wood has dried, it is raked together and burned. The larger logs are set ablaze, and the fires are controlled as much as possible. When the rains begin, normally in mid-April or early May, the crops are planted; the men make holes in the ground with dibble sticks while the women follow up to plant the seeds.

The staple crop is upland dry rice, and several varieties with varying maturity periods (usually three to six months) are planted by all of the groups. Also, maize is cultivated in the swiddens as are a number of secondary crops. These include manioc (a major crop in the Phu-Yen

Province Viet Cong food production), sugarcane, bananas, pineapples, eggplant, onions, yams, cabbage, chili peppers, and various kinds of tuber plants. Papaya trees are planted around the edge of the swidden. Many of these same crops are grown in the village kitchen gardens, which may also contain tobacco, green leafy vegetables, and lemon grass. In some villages, coconut and mango trees are grown. Small temporary structures are built near the swiddens so the young men can guard the fields against marauding animals during the growing season.

#### PERCEPTIONS OF THE INFORMANTS

In most of the interviews the informants claim to have seen the actual spraying, although there were some vague responses concerning the timing of the operations. Informants from Dak Mot-Khon (Interview 2a listed in Characteristics of Informants) and Dak Mot-Tri (2b), discussing the same defoliated area in Dak To District to the northwest of their settlements, reported that they had not seen the aircraft spraying, but they gave similar accounts regarding the effects.

Those who did witness the spraying were able to describe the type of aircraft and the pattern of the spraying. In the Dak To area of Kontum Province, informants from Long Djon Village (1a) noted that there had been many spraying operations in the vicinity since 1967, and they had seen the "large aircraft, each with two engines" that passed over "three in a row." This was repeated by informants from Dak Rosa (1b), which is not far from Long Djon, as well as by villagers from Dak Tang Plun (1c), Poley-Krong (3a,b), Plei Jar Tum (4b), and Plei Ngol-Drong (5). The Hroy agricultural

engineer (6) was a more sophisticated informant, since he had been prepared in Hanoi for the possibility of herbicide missions against his food production, and he knew that the aircraft were C-123's. At Dak Siang Ranger Camp (2c), the informants reported the spraying had been done by a helicopter, and this was verified by a former U.S. Special Forces officer who had been stationed at Dak Siang and now is employed as a civilian with the USAID mission in Kontum. Villagers from Polei Kleng (4a) also reported that the spraying was carried out by helicopters.

Some informants were very explicit about seeing the spray leaving the aircraft. An elderly lady from Long Djon Village (1a) said that "it looked like smoke" and it came from both sides of the aircraft, and this was repeated by villagers from Dak Rosa (1b). Informants from Polei Krong (3a,b) reported that the spray looked like water, and one man from Plei Ro-O (1d) in the Polei Kleng area noted that "it looked like rain" but when it reached the ground they found it looked black. Informants from Dak Siang (2c) even noticed that a tube protruded from the helicopter, and it turned and began to spew a liquid. At Polei Kleng (4a) the villagers said that they watched the spray descend, and that they could smell it.

In none of the interviews did it appear that there was a deliberate attempt to spray the settlements themselves, although in some instances the villagers' swiddens appear to have been targets. In most cases, however, the spray drifted into the settlements. Informants from Long Djon (1a) noted that during one of the many missions in that area (Dak To District, Kontum Province), their swiddens were sprayed, and herbicide was carried into the settlement. Villagers from Dak Rosa (1b) complained that they and villagers from neighboring Kon Briong farmed about 30

swiddens in the area, and all were sprayed several times over a period of several months. The villagers from Dak Siang (2c) described the way some of the spray drifted into their housing area following the accidental spraying of their fields.

One informant from Polei Kleng (4a) noted that the spraying took place over a thickly-forested area northwest of the village and farming area. It was an area the villagers avoided because it was known to be VC-controlled. Villagers from Polei Krong (3a,b) watched the aircraft spray both sides of the Dak Bla River near the settlements. Informants from Plei-Ngol-Drong (5) reported that the spraying was along Route 19. According to the agricultural engineer (6), the first spraying took place in September 1969, and was aimed at the swiddens in the area, some of which were being farmed by villagers. Most, however, were part of an area where there was concentrated food production for the VC. The second spraying in March 1970 was along a trail used exclusively by the VC.

With the exception of two villages--Dak Mot-Khon (2a) and Dak Mot-Tri (2b)--where no spraying was observed by the residents, the first effects reported concerned humans, domestic animals, and aquatic life.

#### Perceived Effects on Humans

There was a definite pattern in the perceptions regarding the effect of the herbicides on those residing in or near the sprayed areas. The most common symptoms reported were abdominal pains and diarrhea. Informants from Long Djon (1a) also reported that in addition to these

symptoms, the villagers complained of experiencing a stinging sensation in their nasal passages just after the spray drifted into the settlement. Many developed coughs that lasted more than a month. At Dak Rosa (1b), according to some residents, many villagers went into the swiddens following the spraying, and in addition to the common symptoms noted above, these people broke out with skin rashes that lasted many weeks. Dak Tang Plun (1c) residents also reported widespread skin rashes, cramps, diarrhea, and fevers. A Plei Ro-O (1d) informant reported these same symptoms, noting that some villagers coughed blood.

Polei Krong (3a,b) informants stated that the villagers suffered these same ailments, and that the skin rashes looked "like they had been burned, with small blisters all over the red areas." Dak Siang (2c) informants noted that after some of the villagers drank from the stream which was in the sprayed area, they became ill with abdominal pains and diarrhea that lasted for days. They also reported that some villagers had eaten bamboo shoots from the sprayed area, after which they became dizzy "like you feel when you have drunk too much from the wine jar," and this was followed by vomiting. Polei Kleng (4a) residents, according to one informant, fell ill with abdominal pains, diarrhea, vomiting, and fever within one day after the spraying, and Plei Jar Tum (4b) villagers with the same symptoms went to get medical assistance at a local dispensary.

The agricultural engineer (6) had been prepared in his Hanoi training for the possible use of herbicides by the U.S. and the South Vietnamese. The principal propaganda theme was that the Americans have

no regard for human life, and they were using dangerous chemicals to kill plant and animal life. He had been instructed what to do if herbicides were sprayed; he was told to obtain a gas mask, and, if one were not available, to cover his face with a wet cloth. To save some of the food crop he was to instruct the villagers to cut the manioc roots as soon as possible and wash them well before cooking them. When the spraying did occur he followed the instructions regarding salvaging the manioc roots, and the only villagers who became ill with abdominal cramps and diarrhea were those who had not been told what to do. Some of the VC cadre who came into the area after the spraying ate some manioc roots and drank water from the affected areas, and they also developed abdominal pains and diarrhea.

A difficult area of inquiry concerned possible deaths due to the herbicides. Sickness and death are common occurrences in highland villages, and infant mortality is particularly high. Some of the informants expressed the opinion that there was an unusually high number of deaths, particularly among children, following the spraying. However, they were very cautious in concluding that the spraying affected childbirth.

Informants from Long Djon (1a), had reported a stinging in the nasal passages just after the spray drifted over the settlement, and this was followed by villagers being afflicted with coughs. They added that more children than adults were affected, and that "many children died." The victims developed skin rashes, and those with rashes that did not clear up died. One elderly lady noted that she knew of one stillborn

case following the spraying, but she could not say whether it was due to the herbicide (she, like other informants, always pointed out that stillbirths were not unusual in their villages). At Dak Rosa (1b), informants attributed the outbreak of skin rashes to the fact that many villagers went into the swiddens following the spraying. They also noted that some women carried their small children on their backs in the fields, and they brushed against leaves containing the "medicine" that had been sprayed. Some of these children subsequently developed bad rashes all over their bodies. They looked, the informants said, "like insect bites," and all the victims died. One informant knew of three such deaths. Another informant reported knowing of five stillbirths after the mothers, during pregnancy, had worked in the sprayed swiddens. The informants felt that there was an unusually high number of such deaths following the spraying.

Dak Tang Plun (1c) informants reported that "many children" became ill with abdominal pains, diarrhea, fever, coughs, and skin rashes after the spraying, and they estimated that 30 had died. A Plei Ro-O (1d) informant described all of these symptoms, with the exception of the skin rash, as having affected many children in the settlement following the spraying. He claimed that 38 children died, and villagers thought that they had eaten plants from the sprayed areas.

Informants from Polei Krong (3a.b) reported that a higher than usual number of children in their villages died in the period following the spraying, but they could not say how many. One Rengao village chief said that in the week after the spraying, "two children died one day and

two died the next day." Their symptoms were abdominal cramps, diarrhea, and skin rashes, which, as noted above, were described as having the appearance of burns "with small blisters." Dak Siang (2c) informants felt that the children who died were the ones who drank from the stream following the spray mission. They fell ill the first day and died the following day. "Their skin was the color of green in the leaves," one woman noted, and another added that their faces swelled "as if they had been in a fist fight."

Informants from Polei Kleng (4a) reported that many villagers of all ages fell ill with abdominal pains, diarrhea, and vomiting within one day after the spraying. They estimated that around 40 people--adults and children--died after manifesting these symptoms. One old woman said that she had seen four children die. Plei Jar Tum (4b) villagers described these same symptoms, and they claimed that five residents--four children and one adult--died. At Plei Ngol-Drong (5), according to informants, some people died within two days after the spraying. They could not say how many, but they had the symptoms noted above, and they broke out with skin rashes that resembled chicken pox.

#### Perceived Effects on Animal Life

Most of the informants interviewed reported widespread deaths among their domestic animals following the spraying. The Long Djon (1a) informants noted that since they were refugees they had few animals, but most of their chickens and pigs died shortly after the spraying, and the Dak Rosa (1b) villagers reported the same thing. Informants from

Dak-Tang-Plun (1c) said that all of their chickens, most of their pigs, and some of their cattle died, and the young man from Plei Ro-O (1d) reported the same thing, specifying that this occurred within four or five days after the spraying. He also noted that villagers found a number of dead wild animals, particularly wild boar, in the nearby forests. Polei Krong (3a,b) informants also pointed out they found dead wild boar in the forest. They, too, saw all of their chickens, pigs, dogs, and small cattle die, although the big cattle survived. Both the Polei Kleng (4a) and the Plei Jar Tum (4b) villagers said that their pigs, dogs, and chickens died, and the latter added that they also lost cattle. Plei Ngol Drong (5) informants reported that all of their pigs, chickens, dogs, goats (they noted that goats are "very strong"), and cattle died. One man observed that the cattle that died first were afflicted with sores around the mouth. They also said that they found dead deer and wild boar in the nearby forests.

#### Perceived Effects on Aquatic Life

Highland villages normally are located near streams or rivers from which the residents draw water for drinking and cooking. They also wash clothes and bathe and water their domestic animals in the nearby water courses, which also provide fish, an important part in the Highlander's diet. Responses concerning perceived effects on the aquatic life in the streams varied more than did those regarding the effects on humans and animals.

Long Djon (1a) villagers were not sure whether the dead fish floating on the neighboring stream were caused by the spraying, because the many

soldiers in the area commonly threw grenades in the streams to get fish, so the abundance of dead fish was not an unusual sight. Dak Rosa (1b) residents said they did not perceive any changes in the nearby stream. The interview with Dak Tang Plun (1c) villagers was interrupted before any questions could be posed regarding fish. One Plei Ro-O (1d) informant, however, reported that there were a great many dead fish seen in streams close to the settlement following the spraying. Most of the fish appeared to be swollen, and after villagers ate them they became ill with abdominal pains and diarrhea. Residents of Dak Mot-Khon (2d) had not witnessed any spraying nor did they report an effect on humans and animals, but they did see an unusually large number of dead and dying fish in the Dak Kla River near the village. American military personnel from Tan Canh warned them not to eat the fish, and subsequently, they said, the Americans put some "medicine" in the water. Then they were informed they could eat the river fish, and they did so with no ill effects. Informants from Dak Mot-Tri (2b) had not seen any spraying nor did they experience any ailments or deaths among the villagers or their stock, but they, too, noticed a great many dead fish in the nearby river. Some villagers did cook and eat some of them but they reported no ill effects.

The informants from Polei Krong (3a,b) reported that after the spraying they noticed a large number of dead and dying fish floating on the surface of the Dak Bla River, and they specifically noted that the gills of some dead fish were blackened or reddish in color. Some villagers ate fresh dead or dying fish, and most of them became ill with swollen abdomens and diarrhea. Villagers at Polei Kleng (4a) said that

there was a small stream near the settlement but there were no dead fish in it following the spraying. Plei Jar Tum (4b) villagers, however, said that the aircraft sprayed the banks of the Dak Bla River near the village, and afterwards a very large number of fish began to float to the surface. They noticed blood and a reddish discoloration around the gills, and when some villagers cut into them there was a strange explosive effect which they likened to the striking of a match. This frightened them, and they did not eat these fish. Some villagers did eat fish that were dying, and they experienced no ill effects. Informants from Plei Ngol Drong (5) reported that dead fish appeared on the surface of the nearby stream, and those who ate them became ill with abdominal pains and diarrhea.

#### Perceived Effects on Plant Life

Responses regarding the perceived effects on plant life were highly patterned. Long Djon (1a) informants noted that over a period of weeks following the spraying they observed plants wilting and dying. Where the spray fell directly, all of the crops in the swiddens died, and in kitchen gardens where some herbicide drifted, the plants wilted and did not continue to thrive. They said they did not know what was causing this but they suspected it was the "medicine" that had come from the aircraft and stung their nasal passages. They only gathered wild roots and tubers from areas not sprayed, and they washed them before eating them.

Dak Rosa (1b) informants reported that some of the spraying occurred

over their swiddens, and very soon afterwards the banana plant leaves wilted, and the plants died. This also happened to the manioc plants and the eggplants as well. Some villagers dug up the manioc roots which seemed to be unaffected, but when they cut into them, they were "rotten." Some villagers gathered manioc leaves that had not wilted, and boiled and ate them, but they became ill with abdominal pains and diarrhea. Rice plants that had not died continued to grow, but they did not produce buds. At Dak Tang Plun (1c) the informants noted that there was spraying over some of the swiddens in which they cultivated upland dry rice, maize, manioc, eggplants, and pumpkins, and all of these crops died. One old man pointed out that in the forests to the west of the village, in the vicinity of the Ben Het Camp (had been Special Forces and converted to a Ranger Camp), there were "many Viet Cong" and the spray killed the smaller plants and brush, but while the leaves on the larger trees wilted and died, the trees remained alive. They had never seen anything like this before, and they decided that they could not eat any of the surviving plants (the rice had just begun to bud and the manioc was tall) or roots in the affected area.

The principal Plei Ro-O (1d) informant reported that the villagers grew upland dry rice, maize, manioc, eggplant, and cucumbers in their swiddens, and that all of the crops died where there had been air drifting of spray. At Dak Mot-Khon (2a) and Dak Mot-Tri (2b) there had been no spraying, but the area to the northwest of the villages had been sprayed, and the informants noted that all of the vegetation had "dried and died." It was an area where residents of both villages hunted and

gathered forest products, but following the spraying they avoided it. One elderly man from the Dak Siang (2c) dependents' settlement described how he had two swiddens in which he cultivated upland dry rice, manioc, maize, sugar cane, and banana trees, and with the spraying all wilted and died. All of the crops where the spray fell "dried and died." As noted previously, informants reported that some villagers ate bamboo shoots from the sprayed area and experienced dizziness followed by vomiting.

At Polei Krong (3a,b), according to the informants, villagers cultivated upland dry rice, maize, manioc, bananas, sugarcane, and pineapples in their swiddens. In kitchen gardens they grew tobacco, chili peppers, eggplants, papaya trees, and orange trees. The spray drifted over the fields and gardens, reaching them in varying degrees of strength. Where it was strongest, all of the plants and trees died within about one month. The leaves on the fruit trees "rolled up," while the plants appeared to be drying up, in both swiddens and gardens. In the swiddens and gardens where the spray was not strong the rice did not thrive as it normally would have, and the fruit trees did not bear edible fruit. It was indicated previously that some villagers went into the fields to cut manioc roots and bamboo shoots, which they ate, and subsequently they got diarrhea. At first the villagers thought a natural blight was affecting the plants but a highland soldier from Kontum informed them that the Americans and the government were spreading "medicine" from aircraft to kill forest where the VC were hiding and crops the VC were growing.

Polei Kleng (4a) informants report the same pattern as that noted above; where the spray was strong all of the crops in the swiddens and kitchen gardens died, but plants survived in the less affected areas. Still, the rice did not flourish, and ripening fruit fell from the trees. Informants from Plei Jar Tum (4b) simply reported that all of the crops in the fields on which the spray fell died.

Villagers from Plei Ngol-Drong (5) reported that they cultivated upland dry rice, maize, manioc, yams, pineapples, bananas, and papaya in the swiddens, and in kitchen gardens they grew chili peppers, several varieties of green leafy vegetables, and cabbage. Where spray fell directly, the leaves on the trees and plants "rolled up" and died, and then the plants died. One man noted that in some swiddens the yams died but some of the rice plants did not wither, although they produced no buds. Rahlan-Soa (5) reported that in the sprayed areas all of the trees were affected, and the first change was that their leaves died. He added that the low brush survived. Big trees, however, died, and later they were cut for firewood. All or most of the crops in the sprayed swiddens died; this even precipitated a serious food shortage for the VC. They moved further to the north where there was a manioc crop, but it caused a delay in some of their planned operations.

#### Adjudged Effects

Responses concerning the adjudged effects on the soil varied considerably. Villagers from Long Djon (1a) said that about one month after the spraying they noticed sprouts appearing in affected areas where

the plants had died. They were not convinced, however, that this meant they could replant, so they shifted their farming to new swiddens. Dak Rosa (1b) informants saw the sprouts appear in "two or three months" and they felt that it was a sign that they could farm the swiddens again. Some of the Dak Tang Plun (1c) villagers tried to re-farm their affected swiddens, but the leaves that sprouted on the plants were shriveled, and they know that such plants do not produce good fruit or vegetables. Most villagers, they said, felt that since all of the crops had died in some fields, the soil would not be good for a long time. One Plei Ro-O (1d) informant reported that the villagers judged that since the effects were so bad, the soil could not be good, so they shifted to new farming sites.

Polei Krong (3a,b) informants reported that the villagers, who had been told the source of the spray by a highland soldier from Kontum, in some cases did replant their swiddens. The crops were not good, but some still replanted again. When the March 1972 Offensive began, however, they had to abandon their fields.

The agricultural engineer informant had done some study in Hanoi on the chemicals being used in the herbicides, and he said he knew which affect plants and which affect humans and animals. He judged that the chemicals being used in the food production area in which he was located were intended for plant destruction, and while some people became ill, it would only be a temporary event without lasting effects. He thought that one type of herbicide being used contained a chemical that actually had a beneficial effect on the soil. It remained in the soil as a residue and broke down so that the soil fertility increased.

## RECOMMENDATIONS

The deleterious effects of the use of herbicides strongly indicated in the informants' response patterns were totally unanticipated in this research effort. These patterns suggest that there were some harmful effects on humans, animals, and fish. This research study has been preliminary, however, and considerably more investigation should be conducted.

- (1) This further research should cover a wider geographical area, and hopefully the cease-fire areas hitherto inaccessible would be open to investigators.
- (2) A team of Highlander interpreters could be formed, and they should be given more extensive preparation. This would facilitate probing more deeply into the effect of the herbicides on specific types of plants and fish. These teams should include individuals capable of speaking several Highlander languages, so that they could be used regionally.