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PREFACE

This Commando Hunt III Report documents the interdiction campaign conducted by the United States against the North Vietnamese government's efforts to supply the North Vietnamese Army and the Viet Cong forces in Laos, Cambodia and South Vietnam via the roads in southern Laos from November 1969 to April 1970. (The North East Monsoon Season).

This campaign was conducted under the direction of COMUSMACV, by the Deputy COMUSMACV for Air -- the Commander 7AF. 7AF tactical air elements, U.S. Navy and U.S. Marine air elements and Strategic Air Command forces participated. These forces also provided air support to the Royal Laotian government in northern Laos and met air support requirements, in conjunction with Vietnamese and other Free World Forces, in the Republic of Vietnam. These diverse requirements were met with a declining commitment of United States resources. The North Vietnamese increased the forces and the effort expended in northern and southern Laos over the previous (1968-1969) North East Monsoon Season.

This report describes these increased enemy efforts, the conduct of the interdiction campaign, and the results. Trucks and supplies were destroyed, enemy resources were tied down, and enemy supply flow was reduced, all at increasing cost to the enemy. The report shows the interaction between the opposing forces, and demonstrates once again that there is no panacea target or weapon system. The results were obtained through good intelligence and constant pressure on the entire resupply system.

GEORGE S. BROWN, General, USAF
Commander, Seventh Air Force

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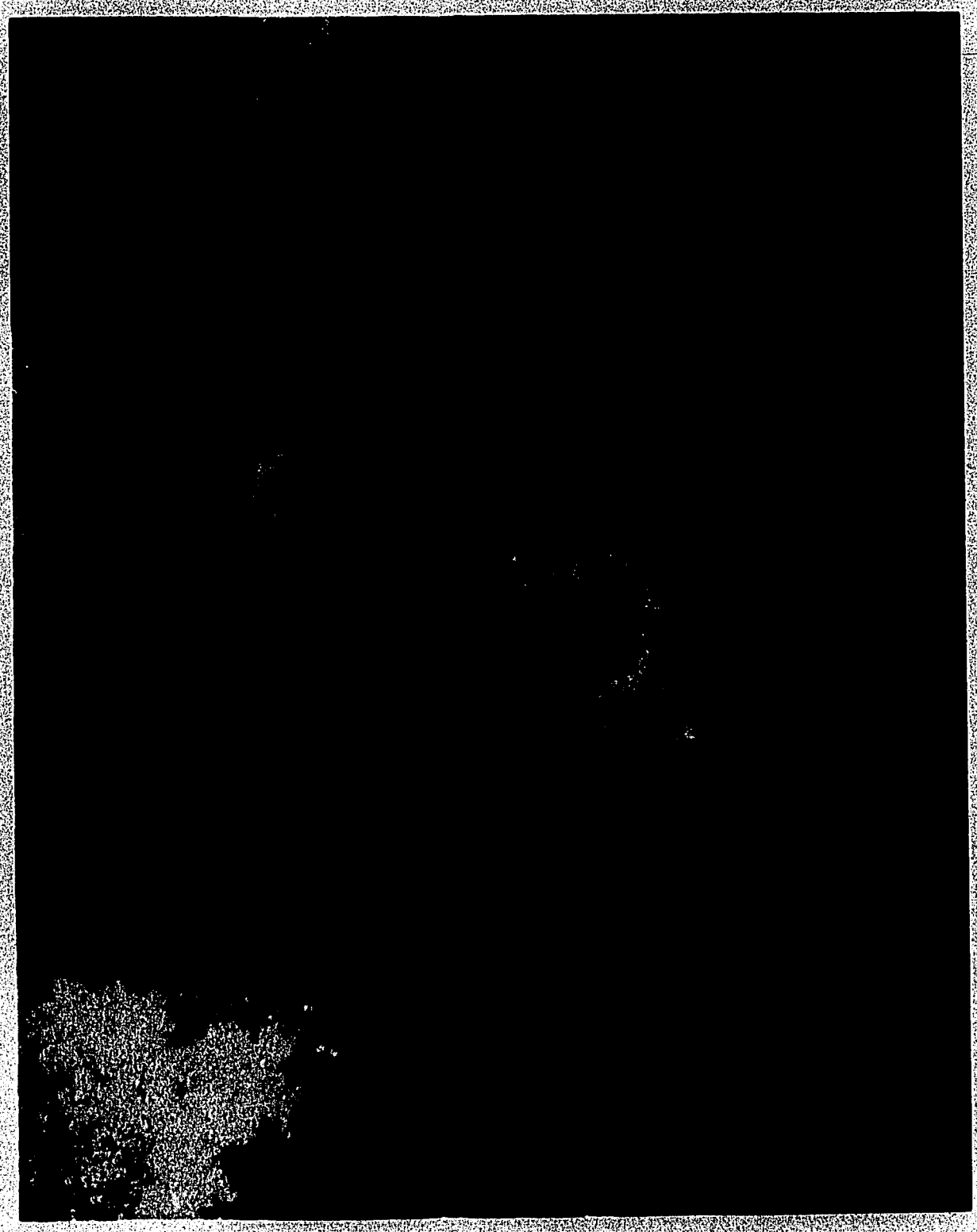
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AFSC 22-178

Our air strikes have destroyed weapons and supplies over the past four years which would have taken thousands of American lives....Our first priority for such operations is to interdict the continued flow of troops and supplies across Laotian territory on the Ho Chi Minh Trail. As Commander-in-Chief of our armed forces, I consider it my responsibility to use our air power to interdict this flow of supplies and men into South Vietnam and thereby avoid a heavy toll of American and allied lives.

President Richard M. Nixon
6 March 1970

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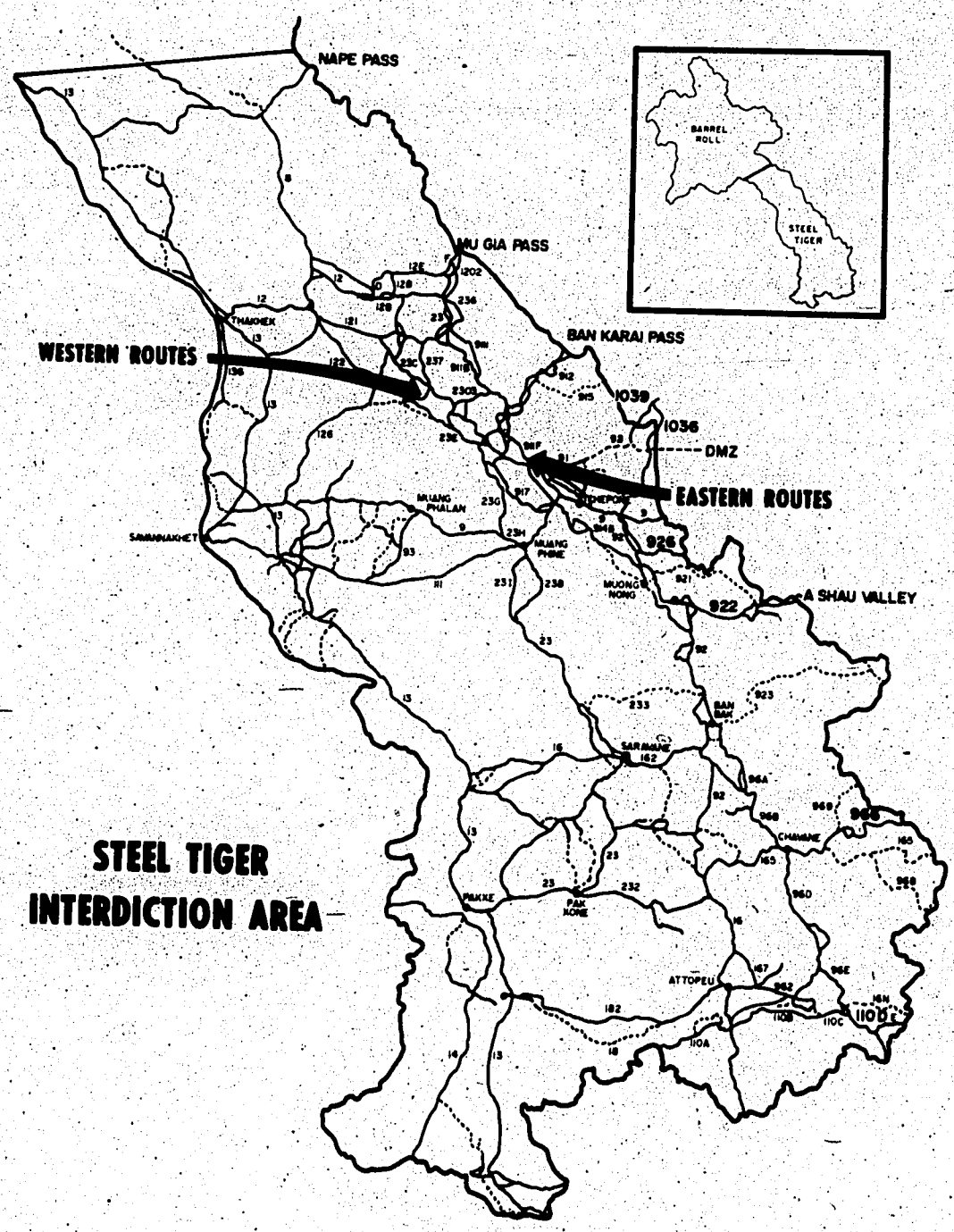
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SUMMARY

OBJECTIVE

The Commando Hunt III interdiction campaign was conducted to reduce the North Vietnamese Army's flow of men and materiel into the Republic of Vietnam and to increase the cost to North Vietnam of continuing aggression and support of insurgencies in RVN and Laos. The objective was achieved by building on past experience, adjusting as necessary based on good intelligence, and maintaining constant pressure on all elements of the enemy's logistic system through southern Laos.

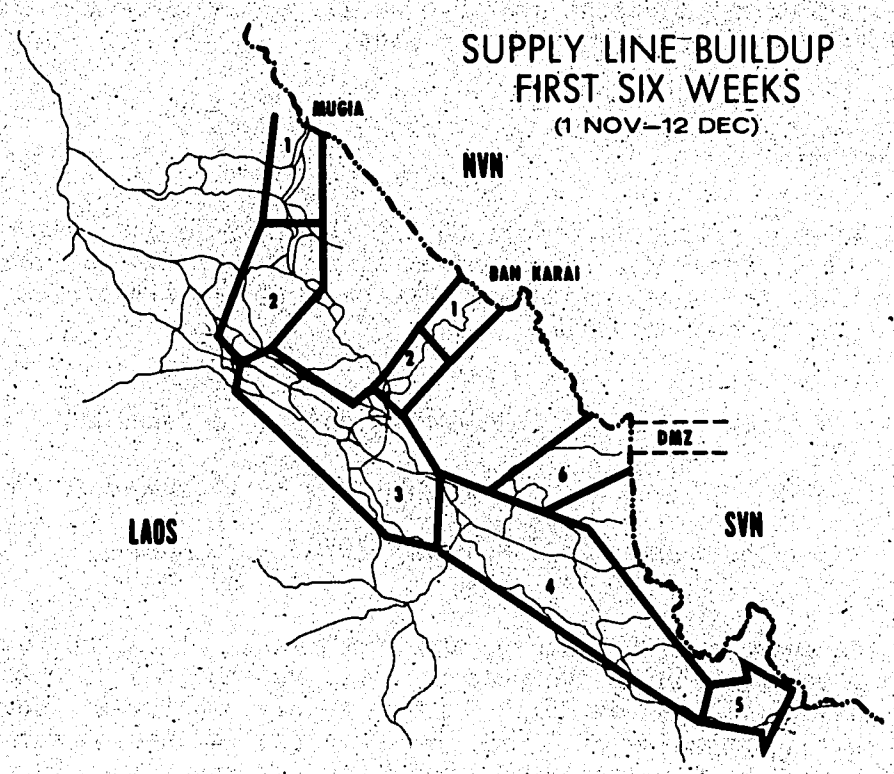
THE CAMPAIGN

The enemy resupply effort during the 1969-70 dry season in Laos was divided into three phases of activity. During the first two, the enemy proceeded according to his timetable. The third was forced upon him.

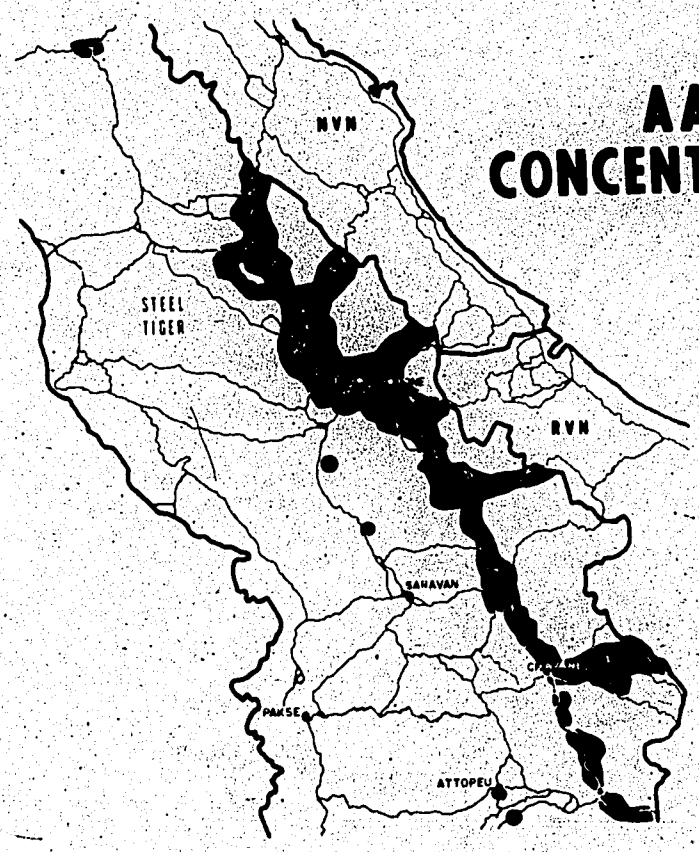
Buildup	-	1 November 1969	-	6 January 1970
Surge	-	7 January 1970	-	25 February 1970
Retrenchment	-	26 February 1970	-	30 April 1970

The enemy's effort during the first weeks of the dry season emphasized rebuilding the road network, replenishing stockpiles, and reinforcing AAA defenses. Large supply depots were developed within the sanctuary of North Vietnam along the Lao border for a logistics push-when the roads dried out. As the rains slackened, the enemy intensified road construction and repair activities.

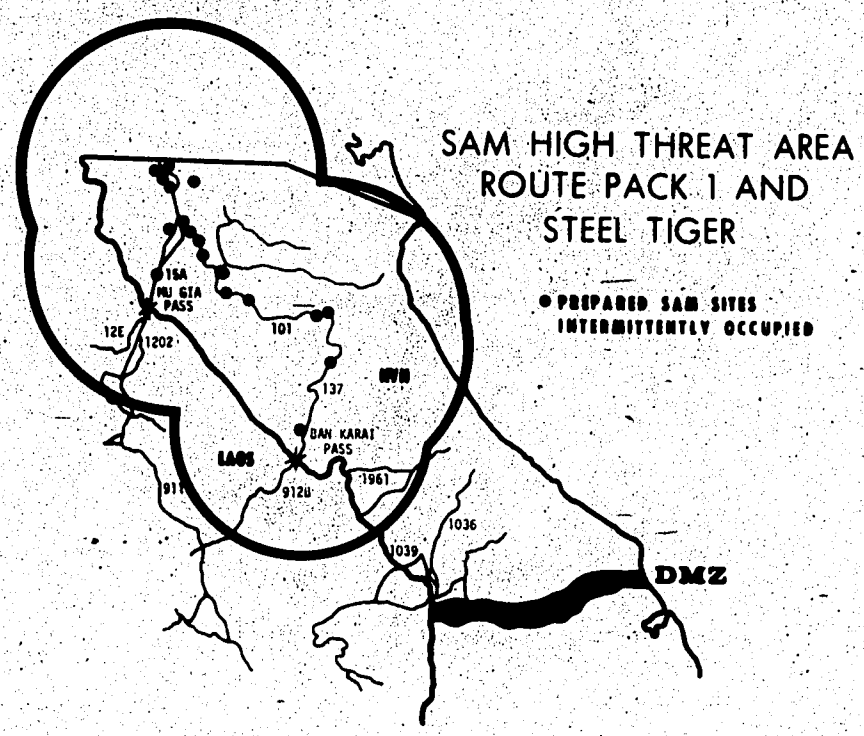
Truck traffic during November 1969 was 23 percent greater than during November 1968, as the enemy restocked his storage areas. He moved by increments from north to south, filling his storage areas during the first six weeks. Initially, Mu Gia and Ban Karai passes were used as the input gates. The route around the DMZ began to develop during December.



A substantial AAA force was already in Laos when Commando Hunt III began. Guns from the previous dry season had been stored in caves and were readily available. More weapons were added so that by the end of December there were twice as many guns along the Lao lines of communication (LOCs) as during the previous year.



During the first two months of the campaign, the enemy's air defense threat was further strengthened by active Surface-to-Air Missile (SAM) sites in North Vietnam adjacent to the major passes leading into Laos. These sites fired missiles at aircraft over the southern panhandle of North Vietnam (Route Package I) and at B-52s in the interdiction area of Laos. The SAM deployment broadened the struggle and challenged U.S. freedom of action over Route Pack I and Laos.

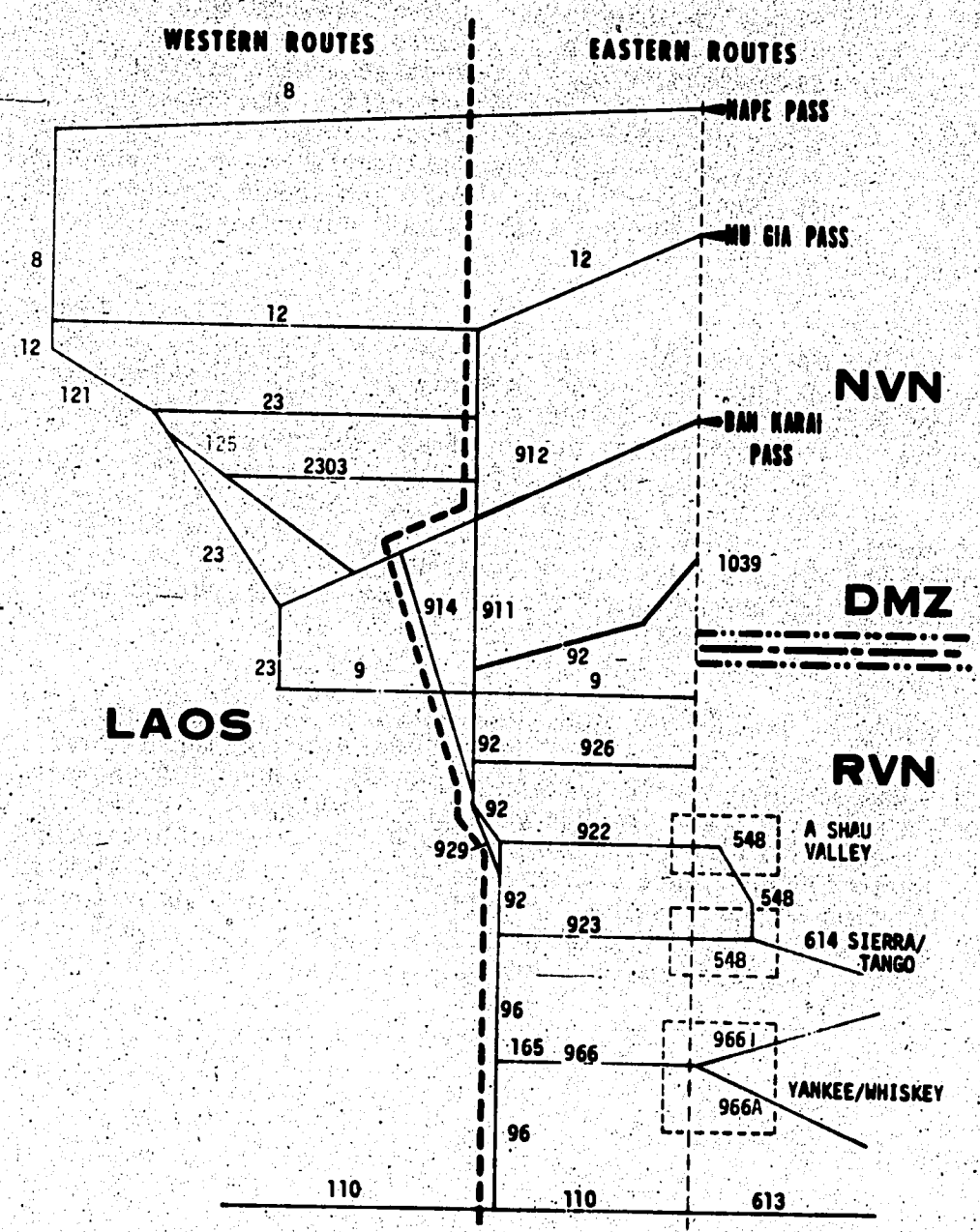


Interdiction operations during the first phase of the enemy's activity emphasized daytime attacks against the LOC network and road repair equipment, gradually increasing nighttime strikes against truck traffic, and day and night attacks against AAA. Initially, the truck hunters were primarily fighter and attack aircraft working with forward air controllers and were supplemented by four AC-130 gunships. As more gunships became available, they assumed the primary truck-attack role, escorted and supplemented by fighter and attack aircraft. The remaining strike effort was directed against truck parks and storage areas. All-source intelligence--including photo, visual, and electronic reconnaissance, the Igloo White seismic and acoustic sensor system, and the reports of road watch teams--was used to develop these targets.

During the transition from the enemy's first phase of resupply to his logistics surge in early January, the allocation of strike sorties among target categories became increasingly important. Budget considerations caused the placement of a ceiling on 7AF strike sorties effective 1 September 1969. The Navy task force in the Gulf of Tonkin was reduced from three to two carriers, further decreasing available sorties by 50 per day. During the first two months of Commando Hunt III, 305 tactical strike sorties per day were flown, 114 fewer than during the same period in Commando Hunt I.

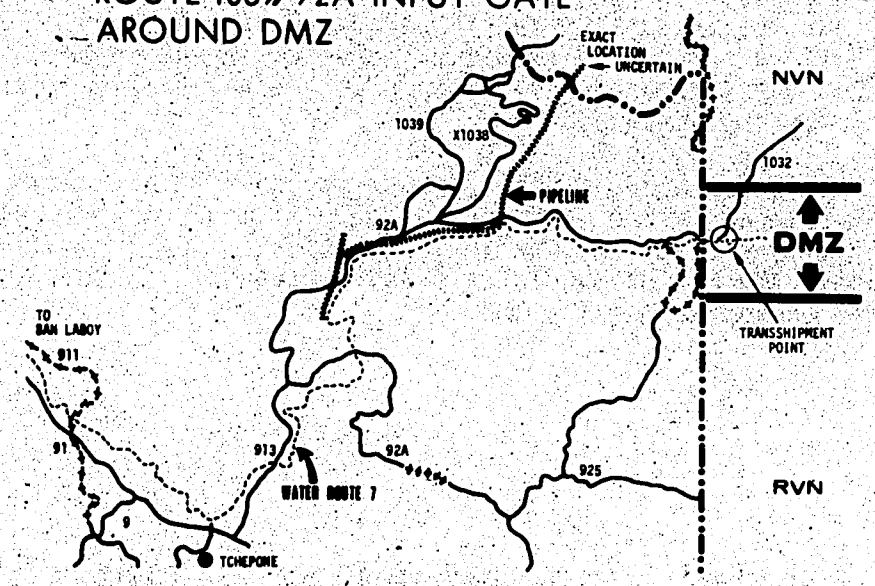
Early in January the enemy began his anticipated logistics surge. The cumulative effect of his LOC construction and repair, the buildup of his storage areas, and about a 50 percent increase in his truck inventory in Laos enabled him to raise his throughput into RVN to 131 tons per day, three times his December performance. Input was doubled and the truck traffic reached an all-time high. The input traffic split approximately two to one between Ban Karai and Mu Gia passes, the two principal entry gates into Laos from North Vietnam.

STYLIZED PRESENTATION OF PRIMARY ROUTE STRUCTURE IN LAOS



During January and February, it became evident that the enemy was placing increased emphasis on preparing a shorter route from North Vietnam around the DMZ into South Vietnam. This route came to be known as the 1039/92A route complex.

ROUTE 1039/92A INPUT GATE AROUND DMZ



Enemy defenses continued at a high level. On 2 February a SAM was fired at an aircraft in Route Pack I. The site was struck and heavily damaged. Thereafter, the enemy kept his SAM equipment on the move and generally did not occupy one site for more than a few days.

The logistics surge succeeded in building throughput into RVN during February to an average of 216 tons per day. However, this was achieved at tremendous cost as the interdiction forces were marshalled to attrit the enemy's resources and force a retrenchment.

Interdiction planners countered the enemy's logistics surge by placing greater emphasis on direct attrition of his trucks and supplies. The trucks received first priority. Increasing the force which attacked trucks at night created control problems that were solved by realigning night FAC control areas. Traffic analysis matched the force to enemy movements and improved truck-killing efficiency. Interdiction of LOCs received proportionally less attention as more sorties were allocated to trucks and storage areas.

Despite a decline in total interdiction sorties during the enemy's logistic surge, truck kills rose to an all-time high of 72 per day in January and 76 per day during February. The high kill rate resulted from the increased strike opportunities and from the increased efficiency of the truck-killing force, especially the gunships.

In late February, traffic dropped to half its January-February level as the enemy backed away from his high level of activity and its accompanying attrition. He practically abandoned the use of Mu Gia pass and increased his use of the shorter routes around the DMZ.

DISTANCES BETWEEN ENTRY POINTS AND EXIT POINTS IN KILOMETERS

THROUGHPUT GATES FOR ROUTES:	INPUT GATES		
	MU GIA	BAN KARAI	1039/92A
925	244	182	95
926	255	196	119
921B	284	225	149
922	331	272	195
966D	482	422	346
110D	543	482	408

As the enemy shifted his traffic to the shorter routes and the number of trucks moving on any given night decreased, airstrikes were concentrated south of Ban Karai where traffic was heaviest. The number of trucks destroyed and damaged decreased as the enemy activity decreased, but the decrease was less than proportional. The enemy's effort to decrease his losses was only partially successful as large numbers of trucks continued to be killed in both Steel Tiger and Barrel Roll.

TRUCKS DESTROYED AND DAMAGED IN LAOS DURING COMMANDO HUNT III

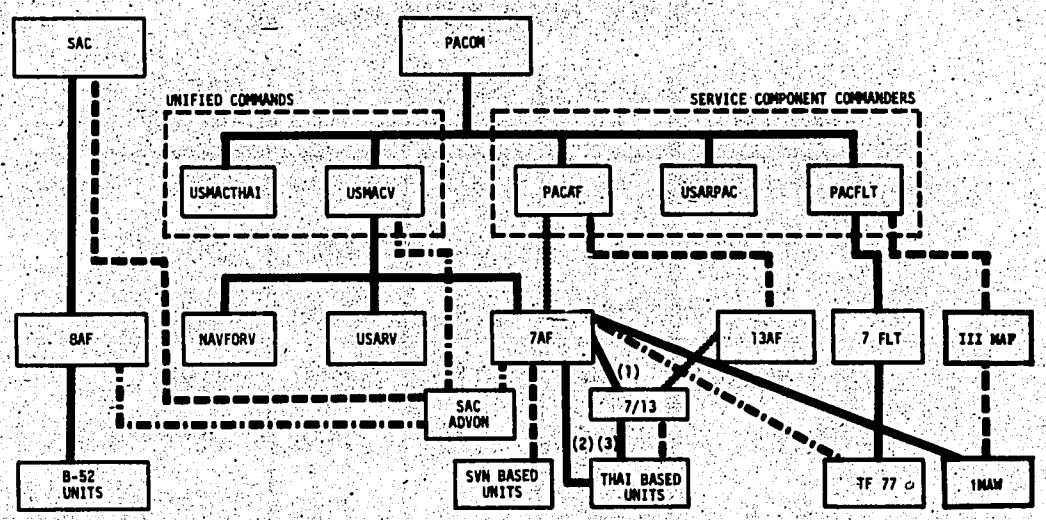
MONTH	BARREL ROLL	STEEL TIGER	TOTAL	CUMU-LATIVE
NOVEMBER	110	869	979	979
DECEMBER	202	1295	1497	2476
JANUARY	168	2231	2399	4875
FEBRUARY	199	2119	2318	7193
MARCH	205	1779	1984	9177
APRIL	268	1739	2007	11,184
TOTALS	1152	10,032	11,184	

These losses, along with destruction of supplies in storage areas and the heavy cost of maintaining and defending LOCs under constant attack, forced the enemy to retrench from his high level of activity in January and February. Traffic, input, and throughput continued to decrease during March and April as constant interdiction pressure was maintained on the enemy's resupply activities.

COMMAND AND CONTROL

U.S. interdiction operations, the responsibility of COMUSMACV, were conducted by the Deputy COMUSMACV for Air who was also the Commander, Seventh Air Force. In this capacity the Commander, Seventh Air Force, was the single manager of all air operations in Laos, RVN, and specified areas of NVN.

COMMAND RELATIONSHIPS



LEVEL OF EFFORT

Over 53,000 strike sorties were flown during Commando Hunt III campaign. The Air Force flew 58, the Navy 36, and the Marines 5 percent of the total.

STRIKE SORTIES IN STEEL TIGER
(NOVEMBER 1969 - APRIL 1970)

SERVICE	AIRCRAFT	SORTIES	PERCENT OF TOTAL	SERVICE	AIRCRAFT	SORTIES	PERCENT OF TOTAL
AIR FORCE	F-4	19,452	36.5	NAVY	A-7	10,123	19.0
	F-100	4,084	7.7		A-4	4,367	8.2
	A-1	4,067	7.6		A-6	2,977	5.6
	F-105	2,049	3.8		F-4	1,863	3.5
	AC-130	807	1.5		TOTAL	19,330	36.3
	AC-119	501	.9	MARINE	A-6	1,254	2.4
	AC-123	151	.3		F-4	1,157	2.2
	A-26	69	.1		A-4	398	.7
	TOTAL	31,180	58.4		TOTAL	2,809	5.3
					TOTAL SORTIES	53,319	100.0

B-52s of the Strategic Air Command flew over 4000 sorties against interdiction targets.

ARCLIGHT SORTIES AND MUNITIONS LOADS STEEL TIGER 1 NOVEMBER—30 APRIL

BASE	SORTIES	BOMB LOAD		
		MK 82	M117	TOTAL
U TAPAO	2557	84	24	108
KADENA	1093	24	42	66
ANDERSEN	489	24	42	66
	SORTIES		BOMBS	
TOTALS	4139		380,568	

The strike operations imposed a heavy cost on the enemy.

OBSERVED TARGET DAMAGE

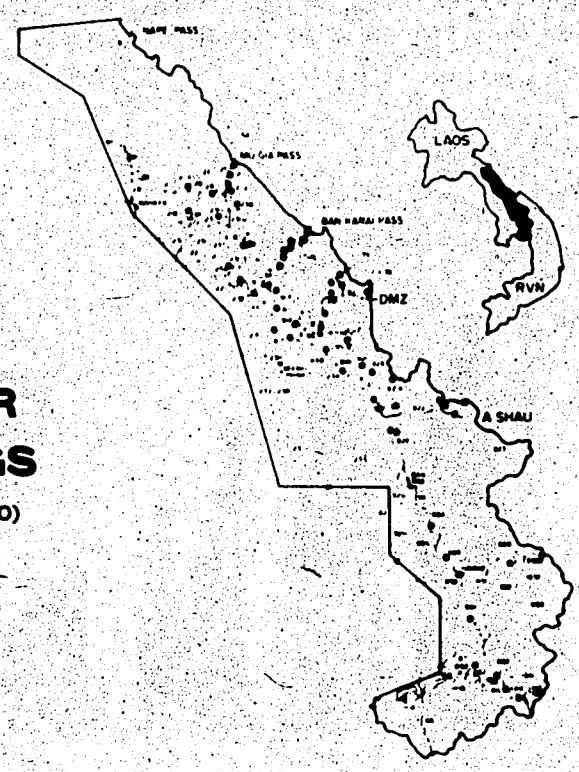
	NOV	DEC	JAN	FEB	MAR	APR	TOTAL	DAILY AVERAGE
	TRUCKS							
DESTROYED	613	731	1462	1426	1136	1060	6428	35.5
DAMAGED	256	564	769	693	643	679	3604	19.9
SECONDARY FIRES AND EXPLOSIONS	2597	2623	4130	4369	4256	4024	21999	121.5
	TRUCK PARKS AND STORAGE AREAS							
SECONDARY FIRES AND EXPLOSIONS	2934	2728	3174	4698	5459	2289	21282	117.6
	LINES OF COMMUNICATIONS							
CUTS, SLIDES, AND CRATERS	984	390	475	572	880	452	3753	20.7
EQUIPMENT DESTROYED AND DAMAGED	6	9	5	9	17	14	60	0.3
	DEFENSES							
GUNS DESTROYED AND DAMAGED	60	179	140	105	151	115	750	4.1
SECONDARY FIRES AND EXPLOSIONS	202	741	678	615	985	476	3697	20.4
	OTHER							
STRUCTURES DESTROYED AND DAMAGED	258	221	896	228	272	223	1698	8.8
EQUIPMENT DESTROYED AND DAMAGED	17	25	30	4	15	13	104	0.6
SECONDARY FIRES AND EXPLOSIONS	470	438	431	390	315	205	2249	12.4

Target development for the strike operations relied heavily on tactical reconnaissance and the Igloo White sensor system. There were over 7500 reconnaissance sorties flown in Steel Tiger during Commando Hunt III.

STEEL TIGER RECONNAISSANCE SORTIES BY MISSION

TYPE	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
PHOTO	806	994	1032	796	858	673	5159
VISUAL	273	315	230	183	181	344	1526
INFRARED	60	21	66	71	190	33	441
WEATHER	30	33	49	45	34	29	220
SLAR	16	25	40	36	25	34	176
TOTAL	1185	1388	1417	1131	1288	1113	7522

There was an average of 74 Igloo White sensor strings maintained in Steel Tiger during the campaign.



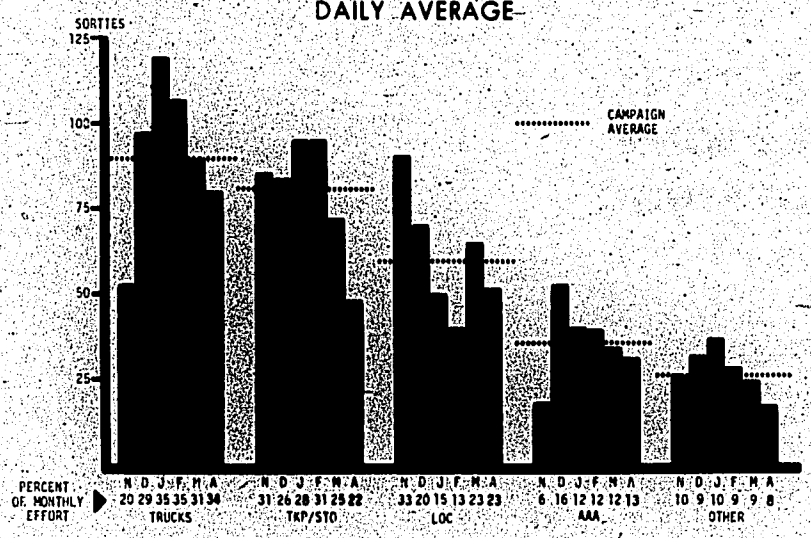
ACTIVE SENSOR STRINGS

(20 APRIL 1970)

The dynamic nature of the interdiction campaign was reflected in the allocation of tactical air sorties to the various target categories. The emphasis varied throughout the campaign as a result of interaction between enemy resupply activity and interdiction tactics. As enemy truck traffic increased to an all-time high in January and February, there was a corresponding sharp increase in sorties against trucks. The number of sorties assigned to lines of communication declined from a high early in the campaign as it became evident that attacks against LOCs were less productive than during

Commando Hunt I. Three reasons were the proliferation of the NVA road network in Laos, the complication of weather, and increased enemy defenses. The enemy's effort to move supplies into RVN during March and April, however, was met by increased attacks against interdiction points in southern Steel Tiger. The attacks reduced the quantity of supplies finally reaching South Vietnam. Sorties against enemy defenses reached a high in December when there were especially heavy attacks to destroy enemy AAA.

SORTIE TARGET DISTRIBUTION BY MONTH
DAILY AVERAGE

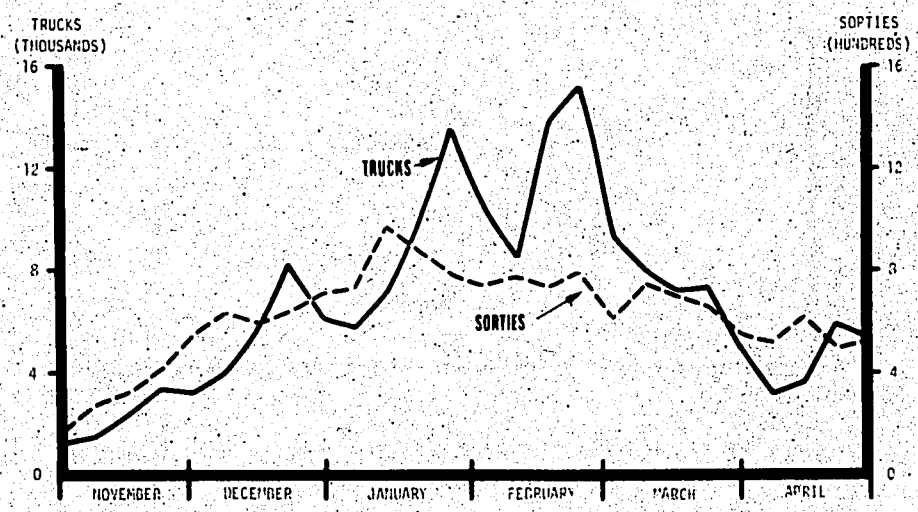


TRUCKS

Throughout the campaign, the principal emphasis was to attack enemy trucks whenever and wherever they could be found. From the beginning of the campaign until the second week in January, the sorties flown against moving trucks followed the general upward trend of sensor detected truck movements. The decrease in January and February shows the effect of the increased tactical air effort in Barrel Roll and generally poor weather in southern Laos.

SENSOR DETECTED TRUCKS AND SORTIES ATTACKING TRUCKS

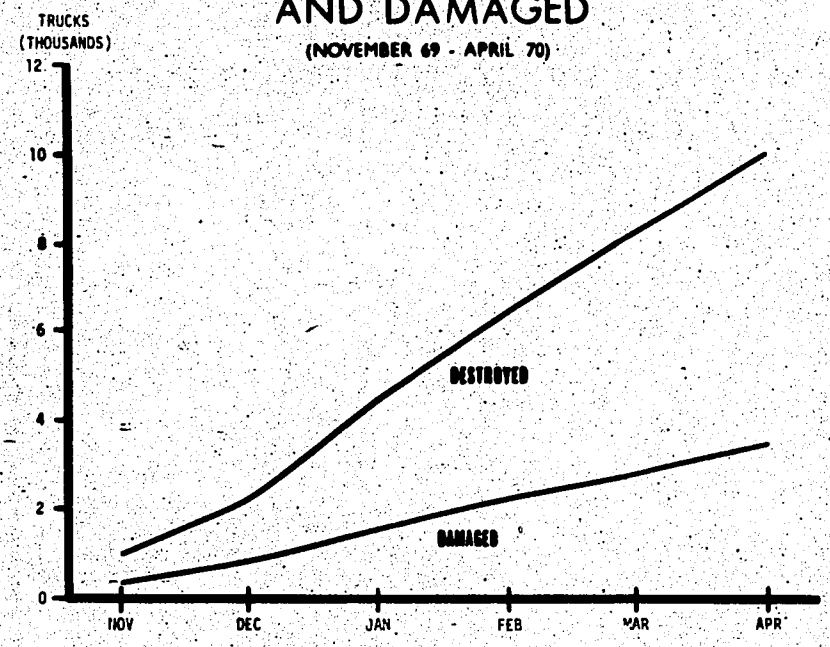
NOVEMBER 69 - APRIL 70



Following the record truck losses in January and February, there was a dramatic drop in truck movements throughout Steel Tiger late in February. These losses kept the enemy from continuing resupply operations at a high level during March and early April. The minor surge in April was the enemy's final effort to move supplies from storage areas prior to the impending wet season.

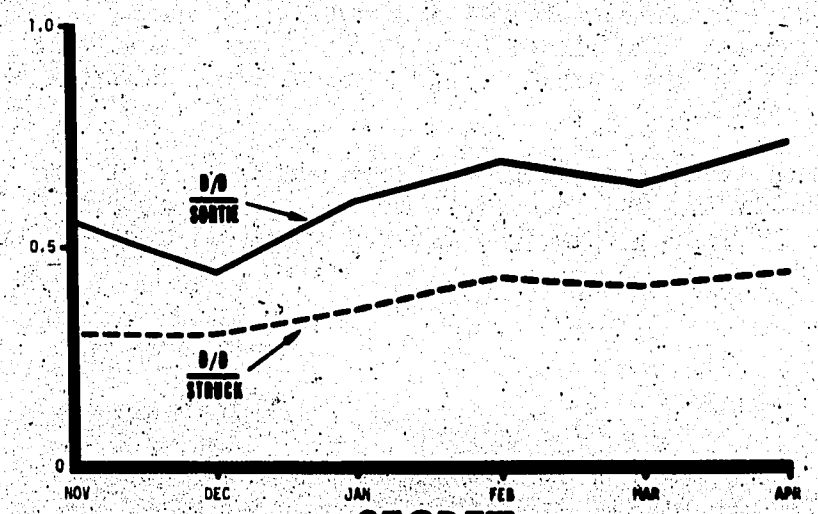
One measure of the success of Commando Hunt III truck killing operations in Steel Tiger was that the cumulative number of trucks destroyed and damaged there was over 10,000 for the campaign.

CUMULATIVE TRUCKS DESTROYED AND DAMAGED
(NOVEMBER 69 - APRIL 70)



The effectiveness of attacks against trucks improved by 30 percent as the campaign progressed.

TRENDS IN STRIKE AIRCRAFT EFFECTIVENESS AGAINST TRUCKS
(NOVEMBER 1969 - APRIL 1970)



The gunships were primarily responsible for the improved force effectiveness against trucks. However, the jet fighter and attack aircraft also accounted for a large number of truck kills.

AIRCRAFT EFFECTIVENESS
STEEL TIGER

AIRCRAFT	TRUCKS DESTROYED OR DAMAGED	SORTIES ATTACKING TRUCKS	TRUCKS STRUCK	TRUCKS DESTROYED OR DAMAGED PER SORTIE	TRUCKS DESTROYED OR DAMAGED PER TRUCK STRUCK
SURPRISE PACKAGE	822	112	1104	7.34	.74
OTHER AC-130	2562	591	4742	4.34	.54
AC-123	440	141	854	3.12	.52
AC-119	987	435	2005	2.27	.49
A-6	977	1486	2708	.66	.36
A-1	1271	2332	4602	.55	.28
A-7	959	3147	3866	.30	.25
F-4	1576	6310	11178	.25	.14
A-4	245	1223	1446	.20	.17
TOTAL	9839	15777	32505	.62	.30

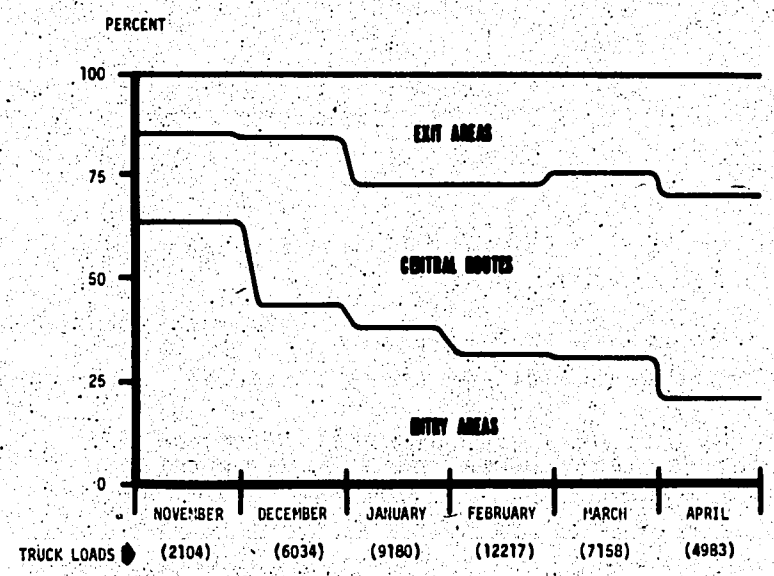
- Over 10,000 trucks were destroyed or damaged during the campaign.
- The probability that a truckload would be destroyed or damaged in transit was .59.
- Jet fighter and attack aircraft destroyed or damaged 3900 trucks, 39 percent of the campaign total.
- Gunships were the most effective truck killers, with 48 percent of the trucks destroyed or damaged while flying 8 percent of the sorties.

TRUCK PARKS AND STORAGE AREAS

As a result of his experience during Commando Hunt I, the enemy went to considerable expense to disperse his supplies. He stored them in smaller quantities further from the major roads and built additional protected facilities.

The shift in stockpile locations reflected the enemy's changing logistics activity. Operations in November were concentrated in the entry areas, as the enemy put supplies into the system and opened the roads. In December supplies were moved into the central routes and in January into the exit areas. During March and April the stockpiles in the entry areas were depleted as the enemy emphasized movement into the exit areas.

STOCKPILE LOCATION



The enemy's tactics were countered by improved targeting and operating procedures designed to rapidly exploit the most productive truck parks and storage area targets. Tactical air strikes accounted for 12,689 fires and explosions in attacks against these targets.

PRODUCTIVITY OF TACTICAL AIR STRIKES AGAINST TRUCK PARKS AND STORAGE AREAS

MONTH	FIRE & EXPLOSIONS	PER SORTIE	PER SORTIE LESS RNO
NOVEMBER	1973	.77	1.36
DECEMBER	1578	.60	1.17
JANUARY	1917	.65	1.24
FEBRUARY	2076	.78	1.38
MARCH	3349	1.49	2.43
APRIL	1805	1.22	1.97
TOTAL	12,698	.87	1.56

Arc Light attacks were responsible for 8,584 fires and explosions in attacks against storage areas.

PRODUCTIVITY OF ARC LIGHT STRIKES

		SECONDARIES	
MONTH	SORTIES	TOTAL	PER SORTIE
NOVEMBER	531	961	1.81
DECEMBER	616	1150	1.87
JANUARY	615	1257	2.04
FEBRUARY	919	2622	2.85
MARCH	893	2110	2.36
APRIL	565	484	0.86
TOTAL	4139	8584	2.07

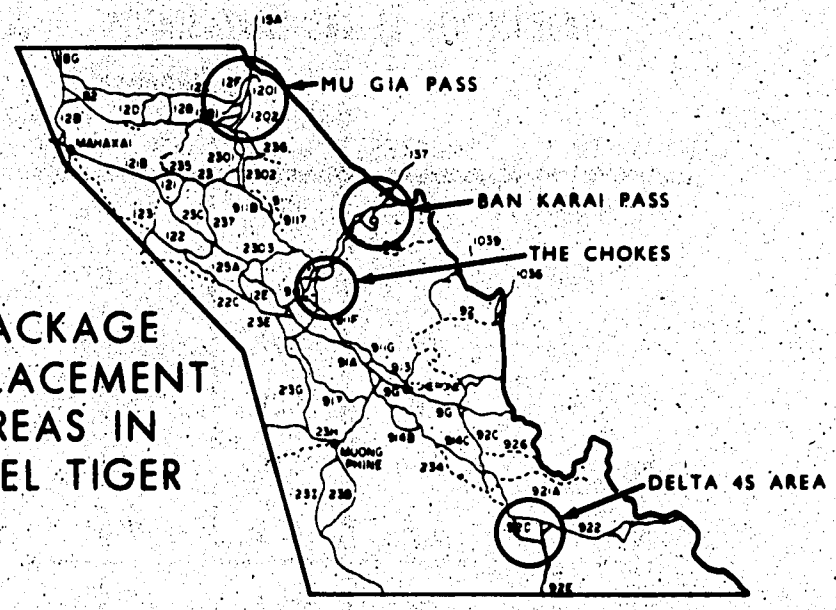
o The enemy dispersed and protected his stockpiles to reduce their vulnerability to air attacks.

o Attacks against truck parks and storage areas destroyed over 7900 tons of enemy supplies, approximately 25 percent of the total tonnage destroyed.

LINES OF COMMUNICATION

Strikes against interdiction points (IDPs) illustrate the interdependence of the target categories in the interdiction target system. Although these strikes caused little direct destruction of enemy supplies, their indirect effects were considerable. When an IDP was closed, congestion was created on the roads behind it. Traffic was channeled to alternate routes which were longer and more vulnerable to air attack, or the supplies were placed in temporary storage areas behind the IDP. An indirect result was increased damage to other target categories such as trucks, truck parks, and storage areas.

At the beginning of the campaign, munitions packages were concentrated in the vicinity of the Mu Gia and Ban Karai passes, the two major enemy input gates into Laos. As the enemy's operations moved south in December and January, the emphasis shifted to the "Chokes" area south of Ban Karai pass, where the route structure converged, and to the roads in the vicinity of Delta 45, where the routes to the A Shau Valley and southern Steel Tiger diverged.

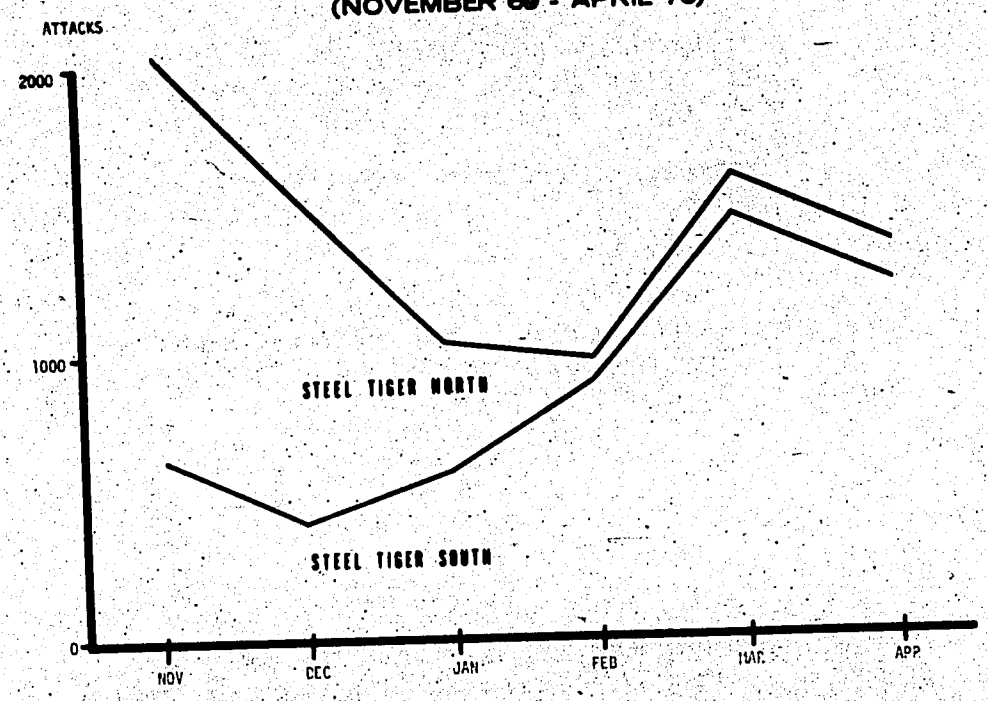


PACKAGE EMPLACEMENT AREAS IN STEEL TIGER

There was a general shift in emphasis in road cutting attacks from northern Steel Tiger to southern Steel Tiger as the campaign progressed. Early in the campaign, before truck traffic increased significantly, road cuts were emphasized in northern Steel Tiger. During the surge in December and January, attacks against roads decreased and the force was applied more directly against trucks. In March the attacks against LOCs rose as the interdiction effort in southern Steel Tiger increased.

ROAD CUTTING ATTACKS

(NOVEMBER 69 - APRIL 70)



The expanded route structure and increased repair activities by the enemy made attacks against lines of communication less productive during Commando Hunt III than during Commando Hunt I.

- o LOC interdiction provided interdiction forces a means of taking the initiative, forcing the enemy to react and shift his resources.
- o To be successful, munitions package emplacements had to be carefully planned and precisely executed. In many cases, multiple packages were required to block an area.

- The results of packaging were not universally accepted as a success. The contributing factors were:

  - Fewer strike sorties available during Commando Hunt III.
  - Inaccurate delivery of munitions packages because of weather and enemy defenses.
  - Ability of the enemy to bypass many interdiction points due to increased road construction.
  - Difficulty in obtaining measurable results.

- Road cutting attacks forced the enemy to expend significant resources on repairs and complemented the use of munitions packages.

DEFENSES

During the Commando Hunt III campaign, the enemy AAA order of battle followed the same overall pattern of numbers and locations as during Commando Hunt I, except that the buildup of AAA weapons occurred earlier in the campaign. By the first of November 1969, the NVA had almost 450 AAA weapons of all categories active in Steel Tiger. The guns were more active, firing about twice as often as during Commando Hunt I. The enemy had developed his defenses during the wet season, and well-qualified and well-equipped gun crews were ready for the beginning of Commando Hunt III.

STEEL TIGER AAA ORDER OF BATTLE COMMANDO HUNT III

(29 OCT 69 - 29 APR 70)

WEAPON	29 OCT 69	1 DEC 69	1 JAN 70	4 FEB 70	4 MAR 70	4 APR 70	29 APR 70
AW (12.7 & 14.5MM)	110	134	60	70	60	82	48
23MM	87	159	186	234	264	258	204
37MM	243	297	315	363	402	393	345
57MM	4	6	6	10	12	10	10
85MM	0	0	0	0	0	0	0
100MM	1	0	2	0	0	0	0
TOTALS	445	596	569	677	738	743	607

The enemy expended some four percent of the total tonnage brought into Steel Tiger in AAA ammunition alone--over three times the total ammunition he expended in all of the Republic of Vietnam during the same period.

ENEMY DEFENSE AMMUNITION EXPENDITURE (IN TONS)

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
RVN							
SMALL ARMS	63	55	61	43	59	39	320
HEAVY WEAPONS	59	47	51	43	35	72	307
TOTAL	122	102	112	86	94	111	627
STEEL TIGER							
SMALL ARMS	14	15	9	10	11	8	67
HEAVY WEAPONS	227	449	391	380	364	341	2152
TOTAL	241	464	400	390	375	349	2219

The aircraft loss rate per 1000 sorties was .74 as compared to .63 during Commando Hunt I. The number of sorties reporting firings during the campaign was nearly double that of Commando Hunt I. There were twice as many hits experienced.

INTERDICTION AIRCRAFT
- HIT AND LOSS EXPERIENCE DUE TO AAA

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
SORTIES							
FLOWN	13,332	15,391	15,365	12,309	13,848	11,171	81,416
REPORTING FIRINGS	1,464	2,715	3,284	3,139	2,952	2,710	16,264
AIRCRAFT							
HIT	65	52	51	33	61	48	310
LOST*	15	9	11	2	11	12	60
HIT/1000 SORTIES	4.87	3.38	3.32	2.68	4.40	4.30	3.80
LOST/1000 SORTIES	1.13	0.58	0.72	0.16	0.79	1.07	0.74
LOST/HIT	0.23	0.17	0.22	0.06	0.18	0.25	0.20

*DOES NOT INCLUDE ONE HH-53 RESCUE HELICOPTER SHOT DOWN BY A MIG IN JANUARY.

The enemy AAA buildup in Steel Tiger during Commando Hunt III required the diversion of strike resources from attacks on interdiction targets. Over 6400 attack sorties, 12 percent of the campaign total, were flown against AAA targets, compared to only six percent of the sorties allocated to these targets during Commando Hunt I.

SORTIES AND BDA AGAINST AAA SITES

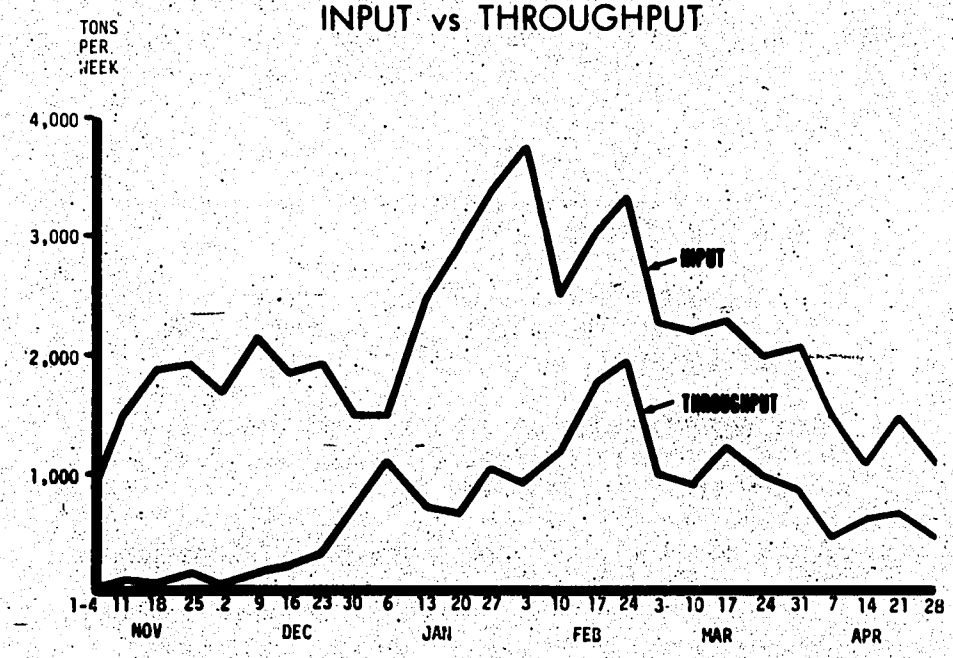
(NOVEMBER 69 - APRIL 70)

	SORTIES ATTACKING AAA	GUNS			SECONDARY	
		DESTROYED	DAMAGED	SILENCED	EXPLOSIONS	FIRES
NOV	507	43	17	121	117	85
DEC	1641	153	26	256	385	356
JAN	1269	100	40	313	295	383
FEB	1067	72	33	193	241	375
MAR	1069	103	48	214	537	443
APR	928	77	38	233	270	206
TOTAL	6481	548	202	1330	1845	1848

- The enemy used a large amount of resources to defend his LOCs in Laos.
- 37mm AAA was the cause of most of the losses, but small arms and automatic weapons caused most of the hits on interdiction aircraft.
- Enemy defenses degraded bombing accuracy and caused a diversion of strike resources from primary interdiction targets.
- Of the total strike sorties, 6481 or 12 percent were used to attack AAA.
- With 750 guns destroyed or damaged, the enemy had to replace essentially his entire active AAA inventory in Steel Tiger during the campaign.
- Emphasis was placed on suppressing AAA in the vicinity of strike operations.
- Gunships required 3207 escort sorties during the campaign.
- Paveway was the most effective gun killing weapon.

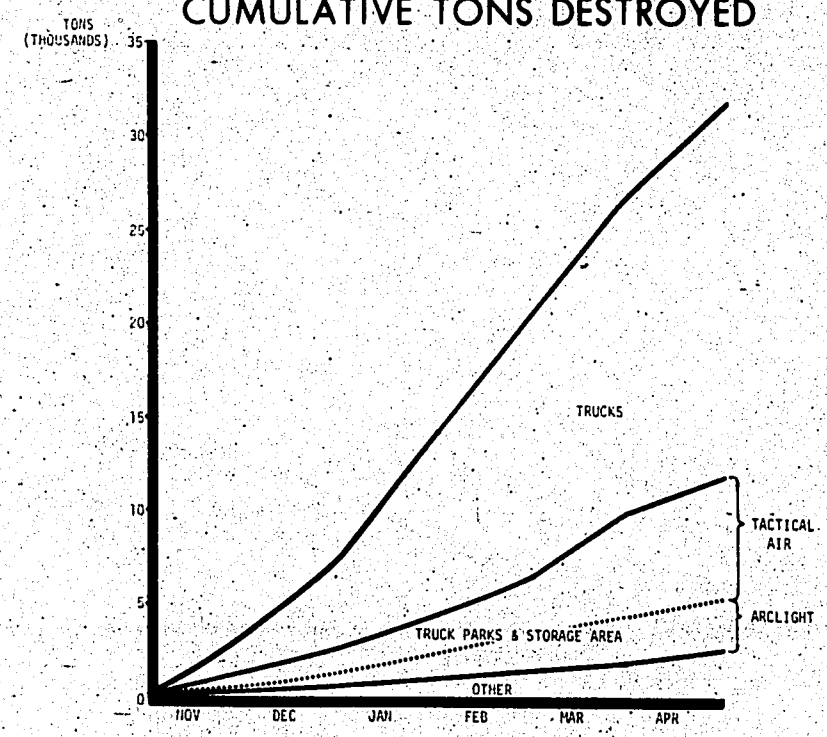
ENEMY'S LOGISTICS ACCOUNT

The enemy's accelerated throughput effort during Commando Hunt III was countered by attacks which destroyed or damaged 72 trucks per day during January and 76 during February. From the high point in February, both input and throughput declined starting in early March, due to the cumulative effect of the interdiction campaign.



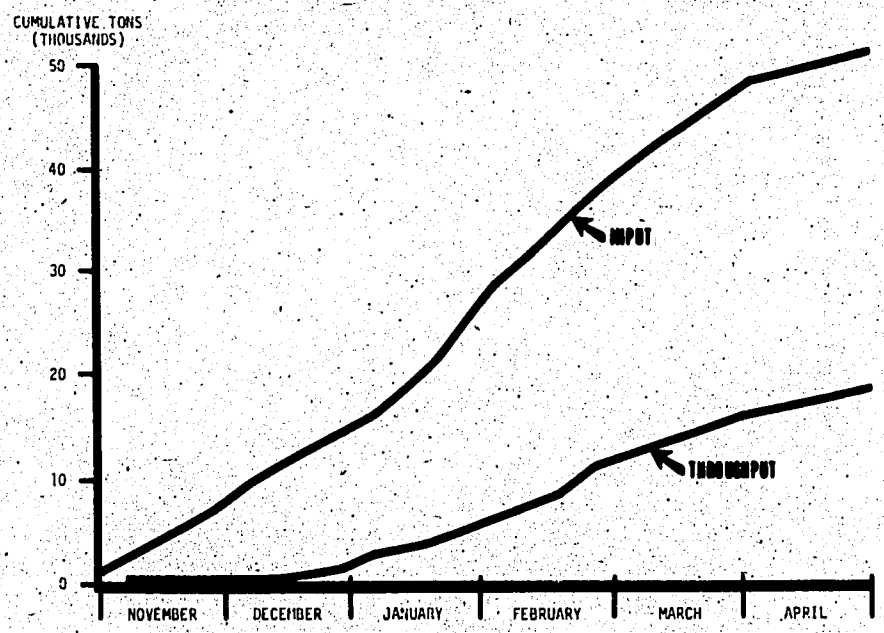
Attacks against trucks, which resulted in trucks destroyed and damaged and truck associated secondaries, accounted for the largest portion of total tonnage destroyed. The emphasis on trucks in the campaign paid off in limiting the enemy's ability to resupply his forces in South Vietnam. In addition to limiting resupply, the emphasis substantially increased the cost to North Vietnam of maintaining an adequate number of vehicles in Laos. This increasing cost forced the enemy to reduce his resupply operations in Laos.

CUMULATIVE TONS DESTROYED



During the campaign, the enemy was able to get through only one-third of the supplies that entered the Lao panhandle. Two-thirds of the supplies were destroyed or consumed in the operation of the logistic systems. Throughput was limited during the first two months as the enemy repaired roads and filled the pipeline. January and February were the months of greatest input and throughput before the accumulative effect of the interdiction attacks caused the enemy to reduce both input and throughput.

CUMULATIVE INPUT
AND CUMULATIVE THROUGHPUT



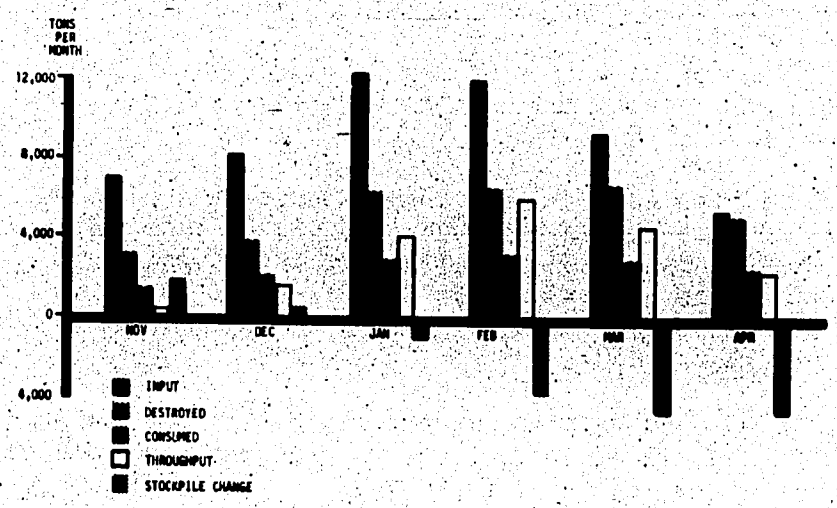
The enemy's logistics account was reconstructed for analytical purposes. To transport 18,976 tons of supplies to South Vietnam during Commando Hunt III, it cost the enemy 47,220 tons in supplies--31,954 tons destroyed by air and 15,266 tons for enroute consumption.

ENEMY LOGISTICS ACCOUNT IN TONS

INPUT FROM NVN	54,277
DESTROYED BY AIR	31,954
CONSUMPTION	15,266
CHANGE IN STOCKPILE	-11,919
THROUGHPUT TO RVN	18,976

A reconstruction of the logistics account by month shows a stockpile reduction after December. All elements of the account except stockpile change were independently estimated. Stockpile change was a residual that represented either actual change or errors in other elements of the account.

LOGISTICS ACCOUNT



Input estimates were the weakest element of the enemy's logistics account. Input was difficult to measure and may have been understated, even though every effort was made to obtain an accurate count. During Commando Hunt I, the enemy used three restricted mountain passes as input gates and they were well covered with sensors. During Commando Hunt III he used two of the passes and the proliferation of routes around the DMZ, plus two pipelines and at least one waterway which defied the relatively precise monitoring available with Igloo White sensors.

While the input count was approximately the same as during Commando Hunt I, analysis indicated that the enemy had increased his trucks and logistics resources in Steel Tiger. What apparently occurred was that the enemy used the pipelines, waterways, and sparsely monitored routes around the DMZ for considerably more input than was recorded. Such an interpretation is consistent with the heavier truck traffic in the central route structure during Commando Hunt III as compared to Commando Hunt I.

If the stockpile change was actually missed input, then the enemy supply account would show that he put in more than three tons to get one through to South Vietnam during Commando Hunt III.

Evaluation of the enemy resupply account in Commando Hunt III indicated that:

- The intensive interdiction effort caused the enemy to shift to southern input gates to minimize the time that supplies were exposed to air attack.

- The cumulative effect of the interdiction effort resulted in a marked decline in enemy activity during March and April.

- It cost the enemy 47,220 tons in supplies--31,954 tons destroyed by air and 15,266 tons for enroute consumption--to transport 18,976 tons of supplies to South Vietnam.

CAMPAIGN IMPACT

The interdiction campaign made a major contribution to the overall U.S. and Allied objective of preventing the enemy from maintaining a level of activity that would permit him to impose

his will on the people of the Republic of Vietnam. As documented in this report and elsewhere, interdiction operations forced the enemy to extraordinary and costly measures to get a limited amount of supplies through to RVN. These measures included:

- o. The deployment of large logistic and AAA defense forces.
- o The construction of widely dispersed and protected storage areas.
- o The construction and repair of roads through the jungle.
- o The floating of supplies down waterways.
- o The construction of pipelines.
- o The construction of roads around the DMZ to take advantage of movement of supplies through the sanctuary of NVN for as long as possible.
- o The building of SAM sites in NVN border areas to restrict U.S. air operations over Laos.

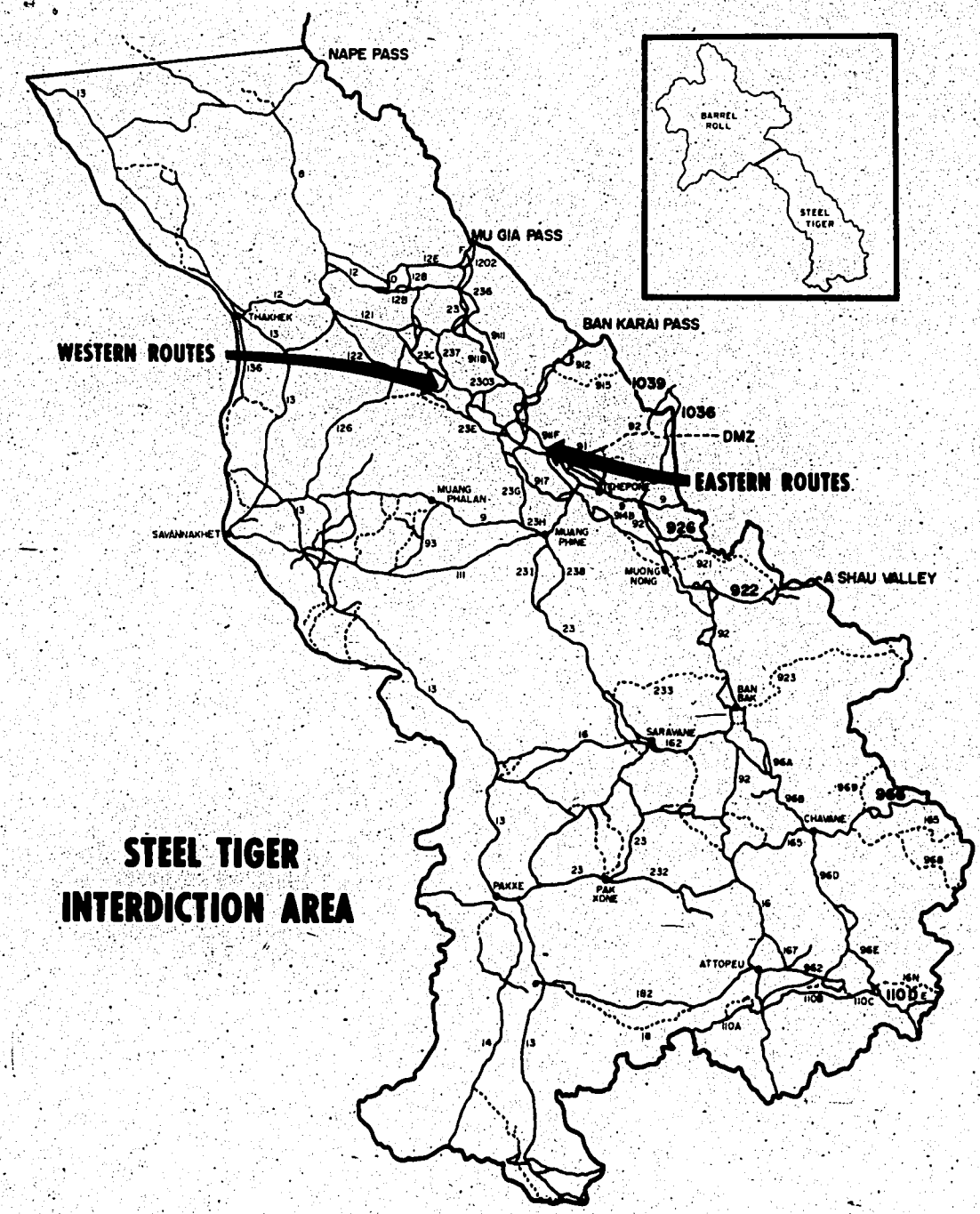
The interdiction campaign imposed a ceiling on enemy resupply activity which, in conjunction with ground and air operations in the Republic of Vietnam, restricted his ability to take the initiative in RVN.

The supplies, trucks, construction equipment, and trained personnel employed in Laos could not be used to rebuild the North Vietnamese industrial plant. This diversion of resources had a significant impact on North Vietnam's rate of economic recovery and growth. The substantial nature of these costs was confirmed by the political pressures the enemy exerted to stop the bombing and by his ground offensive in Northern Laos which placed pressure on the Royal Lao government to withdraw its support of the interdiction campaign.

The enemy's logistics program during the Commando Hunt III campaign did not meet his objectives. Intelligence reports show that some enemy units suffered from shortages of ammunition, medical supplies, equipment, and food. These shortages repeatedly caused the enemy to cancel or postpone planned operations.

Interdiction costs of destroying enemy equipment and munitions enroute were clearly less in both lives and dollars than the cost of eliminating the enemy capability when deployed on the battlefield. The interdiction campaign contributed significantly to the relatively low level of U.S. and Allied casualties in RVN.

SECRET



SECRET

CHAPTER I

CAMPAIGN NARRATIVE

BACKGROUND

During the period 1 November 1969 to 30 April 1970, the third Commando Hunt interdiction campaign was conducted in Laos. The Commando Hunt campaigns were directly tied to the seasonal changes in enemy activity brought on by the area's monsoons. The first campaign, designated Commando Hunt I, began with the northeast monsoon or dry season in November 1968. It was the first concentrated interdiction campaign of the Vietnam war to be confined to Laos without associated quasi-strategic bombing in North Vietnam. Prior to Commando Hunt I, many of the interdiction attacks in Laos had been the result of diversions from primary targets in North Vietnam (NVN).

During Commando Hunt I both sides adjusted to the initiatives and countermoves of the other. Continual modification of tactics by both parties resulted in a dynamic interaction between resupply and interdiction. The results of Commando Hunt I were achieved by interdiction attacks in Laos in conjunction with ground combat operations and vigorous searches for caches in South Vietnam by U.S. and Allied ground forces. The campaign achieved its goal, according to General Creighton W. Abrams, COMUSMACV, because "when the dry season was over, he [the enemy] did not have enough supplies in South Vietnam to meet his purposes during the wet season." As a result, the enemy's supply situation was desperate when the 1968-69 northeast monsoon season ended.

As Commando Hunt I drew to a close in April 1969, the Seventh Air Force Operations Plan (OPLAN) for the southwest monsoon season was put into effect. The campaign was designated Commando Hunt II. The wet season forced both sides to change their tactics and priorities. As the road system in Laos became a quagmire, the enemy shifted his emphasis to stockpiling materiel in the NVN border areas to prepare for a logistics surge through Laos during the next dry season. Interdiction forces took advantage of the weather by attacking the enemy lines of communication (LOCs) to increase the destructive effects of the rains. The northeast monsoon arrived on schedule in the fall of 1969, and both enemy logistic activity and U.S. interdiction efforts increased. Commando Hunt III was launched on 1 November 1969 under the provisions of 7AF OPLAN 512-70 as the 1969-70 Northeast Monsoon Campaign. The bombing halt of 1 November 1968 had

stopped attacks on the roads and supply depots in NVN, so the enemy was able to improve his logistic system for an immediate push into Laos as soon as the 1969-70 dry season began. In effect, the enemy had a running start in the Commando Hunt III campaign.

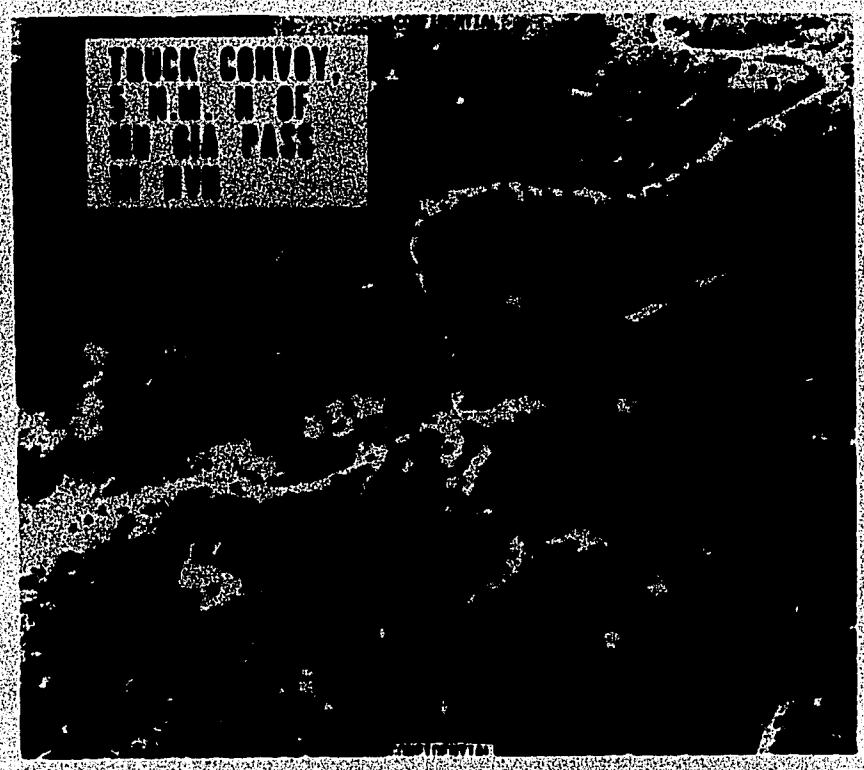


FIGURE I - 1

The philosophy of the Commando Hunt III Operations Plan was to

> continue to build on experience by providing a recapitulation of the most successful tactics of the past and project, where possible, modifications and refinements.

The objective of the campaign was

> to reduce the flow of men and materiel into the RVN and to increase the cost to North Vietnam of continuing aggression and support of insurgencies in the RVN and Laos.

The enemy was expected to

> follow traffic patterns of the past with main reliance on the natural pass entry points along the Laos/NVN border; further increase antiaircraft defenses; improve existing road nets and construct new areas with emphasis on dispersion and passive defense measures such as increased use of revetments, caves, trenches and camouflage; and increase the number and training of explosive ordnance disposal teams.

In the resupply-interdiction battle, the strategic initiative rested with the enemy. Interdiction operations were necessarily reactive. There were three discernible phases of enemy logistics activity during Commando Hunt III.

Buildup	-	1 November 1969 - 6 January 1970
Surge	-	7 January 1970 - 25 February 1970
Retrenchment	-	26 February 1970 - 30 April 1970



FIGURE I - 2

THE CAMPAIGN

Enemy Logistics Buildup

The enemy's effort during the first weeks of the dry season emphasized rebuilding the road network, replenishing stockpiles, and reinforcing AAA defenses in Laos. As the rains slackened, the enemy intensified road construction and repair activities. Many sections of road were given a gravel or corduroy surface (Figure I-2). Bulldozers were observed from Mu Gia pass as far south as route 96. By mid-December the entire LOC system had been made motorable through Laos into South Vietnam. As new roads were interconnected and old ones became motorable, the enemy spread out his truck traffic, making it less vulnerable to attack. The expansion of the LOCs from 1966 to 1970 is portrayed in Figure I-3.

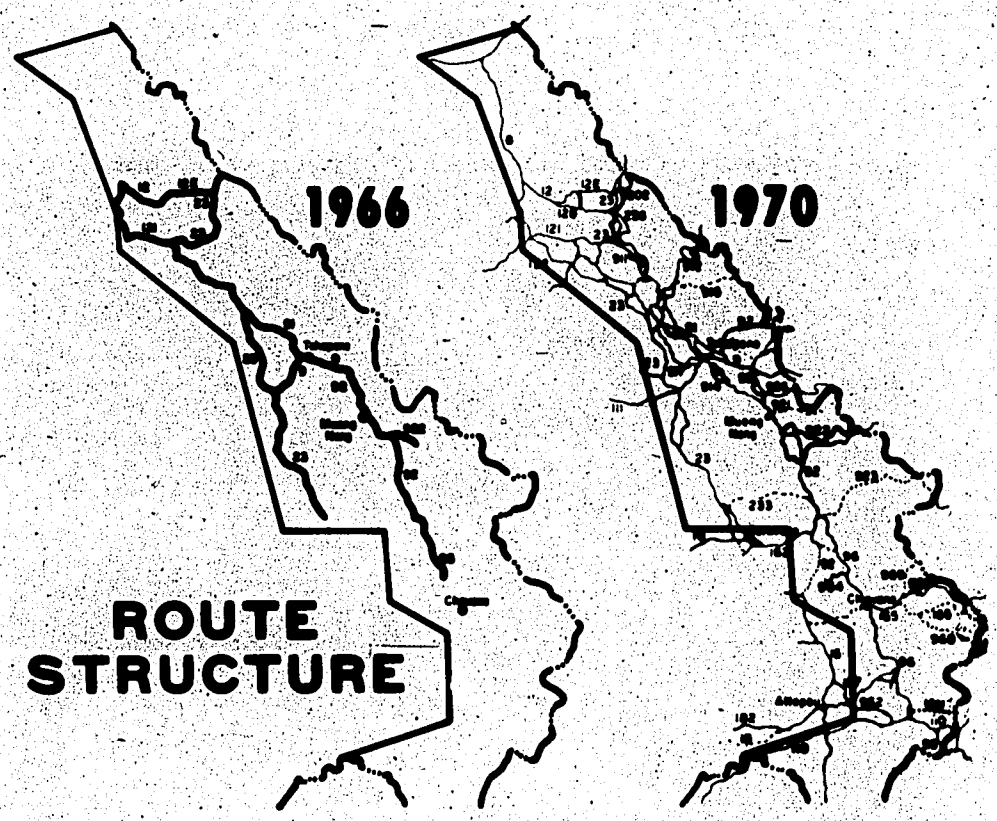


FIGURE I - 3

Truck traffic during November 1969 was 23 percent greater than during November 1968 as the enemy rapidly restocked his storage areas in Laos. Well stocked storage areas were essential to the shuttling procedures forced upon the enemy by interdiction attacks. Since there was no ground threat to his resupply operations in Laos, he developed extensive cave and underground storage areas and used elaborate techniques to camouflage his equipment and supplies.



FIGURE I - 4

A substantial AAA force was already in Laos when Commando Hunt III began. Guns from the previous dry season had been stored in caves and were readily available. More weapons were added so that by the end of December there were twice as many guns along the Lao LOCs as during the previous year. The overall experience level of the gunners was also higher.

During the first phase of the campaign, the enemy's air defense threat was further strengthened by active Surface-to-Air Missile (SAM) sites in North Vietnam adjacent to the major passes leading into Laos. These sites fired missiles at reconnaissance aircraft over the southern panhandle of North Vietnam (Route Package I) and at B-52s in the interdiction area of Laos. The SAM deployment broadened the struggle and challenged U.S. freedom of action over Route Pack I and Laos. Monitoring of the SAM sites

was complicated by weather, the number of sites, and the ease and frequency with which missiles were moved. The rules of engagement prescribed that the SAM sites could be attacked only if missiles were fired from them at U.S. aircraft. The rules of engagement pertained to all interdiction operations. They required the mutual concurrence of CINCPAC, COMUSMACV, and the American Ambassador in Laos and were adjusted as the ground and air situations changed.

The enemy filled his supply line during the first six weeks from north to south as indicated in Figure I-5.

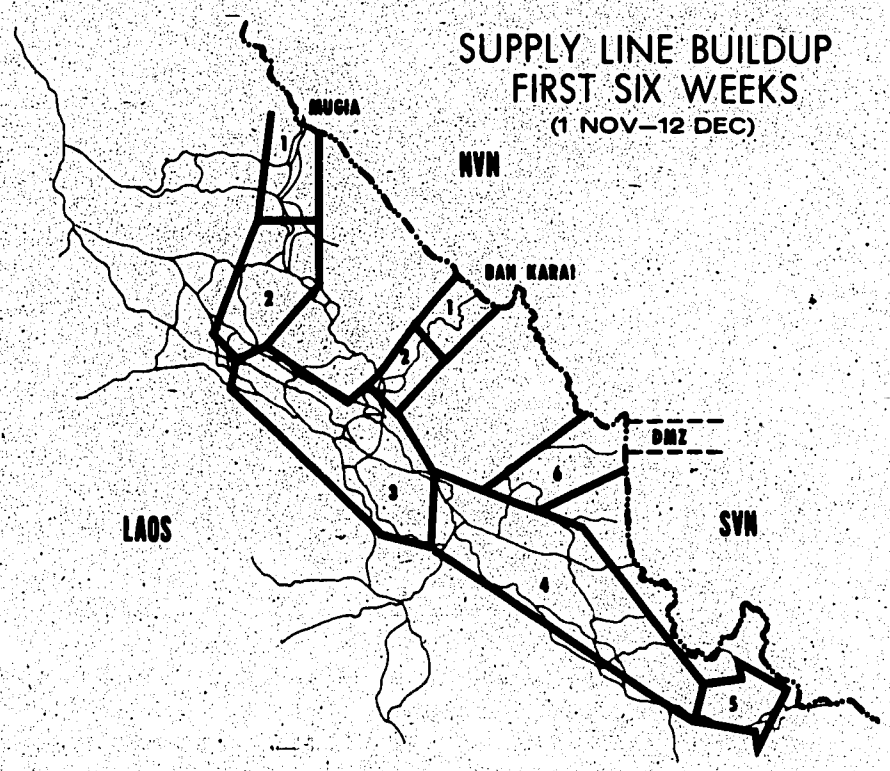


FIGURE I - 5

Delaying the Buildup

Interdiction operations during the first phase of the enemy's activity emphasized daytime attacks against the LOC network and road repair equipment, gradually increasing nighttime strikes against truck traffic, and day and night attacks against AAA.

The two primary tactics used against LOCs were emplacement of area denial munitions packages and the cutting or blocking of roads by bombing. Munitions packages were emplaced on the LOCs leading from the entrance passes, Mu Gia and Ban Karai, into Laos. The objective was to block traffic from moving into the Lao LOC system for as long as possible. A special F-4 operation, Night Owl, dropped flares and CBU bomblets on the LOCs in the Mu Gia area to discourage enemy road repair crews from clearing the munitions packages. The gains from this program were not in proportion to the effort invested; therefore, the operation was curtailed during December and used only very selectively thereafter.

A combination of heavy defenses and adverse weather limited the number of munitions packages that could be emplaced in the Ban Karai area. As traffic moved into the system, packages were used farther south at such critical points as the route 922/92 intersection to force the trucks onto more circuitous routes. The extensive use of interdiction packages continued through the first phase of enemy activity.

There were points on some routes which were difficult to repair and not easily bypassed. These points were cratered with strings of general purpose bombs or with precision ordnance such as the 2000 pound laser-guided Paveway bomb. Paveways were also used to create landslides and to cut fords, particularly in the Ban LaBoy area south of Ban Karai pass. In strikes against LOCs the initiative rested with the interdiction forces, and the enemy was forced to change his plans and react.

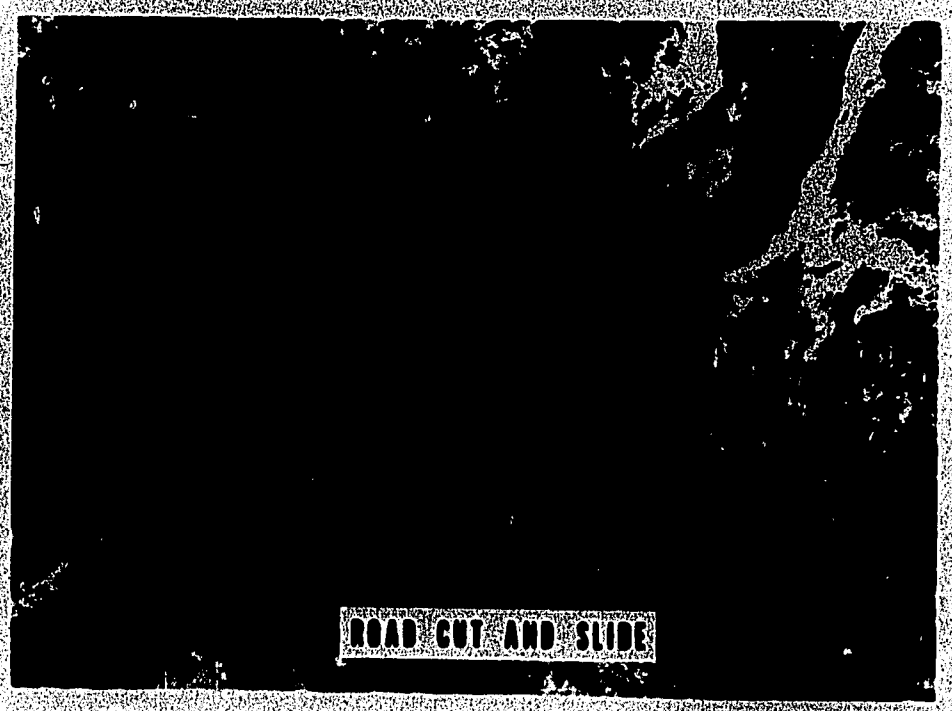


FIGURE 1 - 6

At night the emphasis was on seeking out and destroying trucks. The force allocated to truck killing increased as the enemy truck traffic increased. Initially, the truck hunters were primarily fighter and attack aircraft working with forward air controllers and were supplemented by four AC-130 gunships. As more gunships became available, they assumed the primary truck-attack role, escorted and supplemented by fighter and attack aircraft.



FIGURE I - 7

In the area of Ban Karai pass and along route 912, where weather often precluded visual operations, a special all-weather strike operation, using the Igloo White sensor system (Appendix A), was inaugurated. The operation was designated Commando Bolt (Appendix B). Through a sensor by sensor analysis of traffic flow, personnel of the Infiltration Surveillance Center (ISC) at Task Force Alpha (TFA), Nakhon Phanom RTAFB, Thailand, determined an estimated time trucks would arrive at specified intercept points and directed Loran-equipped F-4s and AMTI-equipped A-6s to strike them. This technique permitted attacks without acquiring the target visually and had the value of surprise, since the strike took place without warning. If traffic was not detected in the Commando Bolt area, the aircraft were assigned to other targets by the Airborne Battlefield Command and Control Center (ABCCC).

Enemy defenses were attacked day and night to suppress AAA firings. The heavy concentrations of enemy defenses not only caused battle damage and losses but also forced evasive maneuvers that degraded bombing accuracy. An increasing number of strike aircraft were diverted from interdiction to AAA targets. Fighters escorted gunship and sensor-emplacement aircraft for flak suppression. Strikes were scheduled daily against occupied AAA sites located by photo and visual reconnaissance. However, the enemy was not gun limited and replacements were readily available from North Vietnam. As stated in the OPLAN, the primary emphasis, therefore, was on

> . . . suppression of enemy gunfire in the vicinity of strike operations. In addition, priority will be given to the destruction of any 57/85/100mm or radar controlled antiaircraft weapons discovered in Laos. Preplanned missions will be scheduled against enemy AAA defenses when flak traps are discovered or occupied AAA sites are detected. Strike flights will carry suitable flak suppression ordnance which will be used against any gun position that fires on an aircraft. F-105 (Iron Hand) and EB-66 (EW) aircraft will be used to search out EW/GCI/gunlaying radar sites.

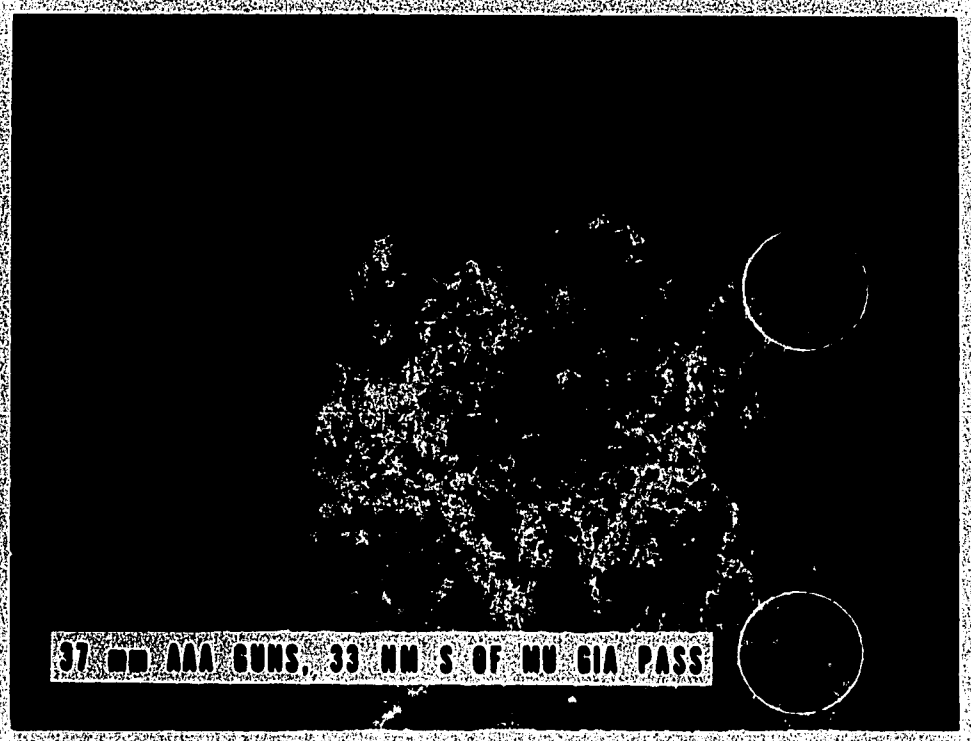


FIGURE 1 - 8

When AAA became particularly intense and restrictive to interdiction operations in a specific area, special concentrated attacks called "gun days" were scheduled. These efforts destroyed and damaged guns and inhibited AAA firings in the area for measurable periods following the attacks. The pressure maintained on the enemy defenses caused him to divert valuable resources from his resupply activities. Thousands of men were required to man the weapons. Trucks were required to transport ammunition and spare parts. The enemy also had to spend considerable time and resources camouflaging and moving his weapons from site to site to avoid detection and destruction. He maintained four to five times as many sites as guns.

The remaining strike effort was directed against truck parks and storage areas. All-source intelligence--including photo, visual, and electronic reconnaissance, the Igloo White seismic and acoustic sensor system, and the reports of road watch teams--was used to develop these targets. Because these attacks were not as time sensitive as those against trucks or LOCs, truck parks and storage areas could also be used as buffer targets to which attacks could be diverted depending on the tactical situation or weather. Truck park and storage area targets, therefore, provided an important operational flexibility.

During the transition from the enemy's first phase of resupply to his logistics surge in early January, the allocation of strike sorties among target categories became increasingly important. Budget considerations caused placement of a ceiling on 7AF strike sorties effective 1 September 1969. The Navy task force in the Gulf of Tonkin was reduced from three to two carriers, further decreasing available sorties by 50 per day. During the first two months of Commando Hunt III, 305 tactical strike sorties per day were flown, 114 less than during the same period in Commando Hunt I.

Enemy Logistics Surge

Early in January the enemy began his anticipated logistics surge. The cumulative effect of his LOC construction and repair, the buildup of his storage areas, and a 50 percent increase in his truck inventory in Laos enabled him to raise his throughput into RVN to 131 tons per day, three times his December performance. Input was doubled and the truck traffic reached an all-time high. The input traffic split approximately two to one between Ban Karai and Mu Gia passes, the two principal entry gates into Laos from North Vietnam. The Mu Gia traffic followed LOCs farther to the west (western routes) and parallel to the eastern routes used by the Ban Karai traffic. By using both eastern and western route structures, the enemy dispersed his traffic which facilitated

the movement of a large volume of supplies and forced the reduced interdiction forces to cover a wider area. A great deal of shuttle activity was observed as the enemy kept transshipment points filled.

Meanwhile in northern Laos (designated the Barrel Roll operating area), the enemy was attempting to recoup his wet-season loss of the Plain of Jars (PDJ) by increasing pressure on the forces of the Royal Lao guerrilla leader, General Vang Pao. The enemy had chosen to surge simultaneously in southern Laos (Steel Tiger operating area) and Barrel Roll.

Except for a drop during the Tet holiday, traffic in Steel Tiger continued to rise. The enemy complicated the interdiction process by expanding his road network. He operated his trucks individually or in small widely spaced convoys, reducing their vulnerability to air attack. Additional truck parks and storage areas were built along the new roads. Located farther from the main LOCs and more widely dispersed than previously, these areas were hard to find and difficult to destroy.

During January and February, it became evident that the enemy was placing increased emphasis on preparing a shorter route from NVN around the DMZ into South Vietnam. This route came to be known as the 1039/92A route complex.

ROUTE 1039/92A INPUT GATE AROUND DMZ

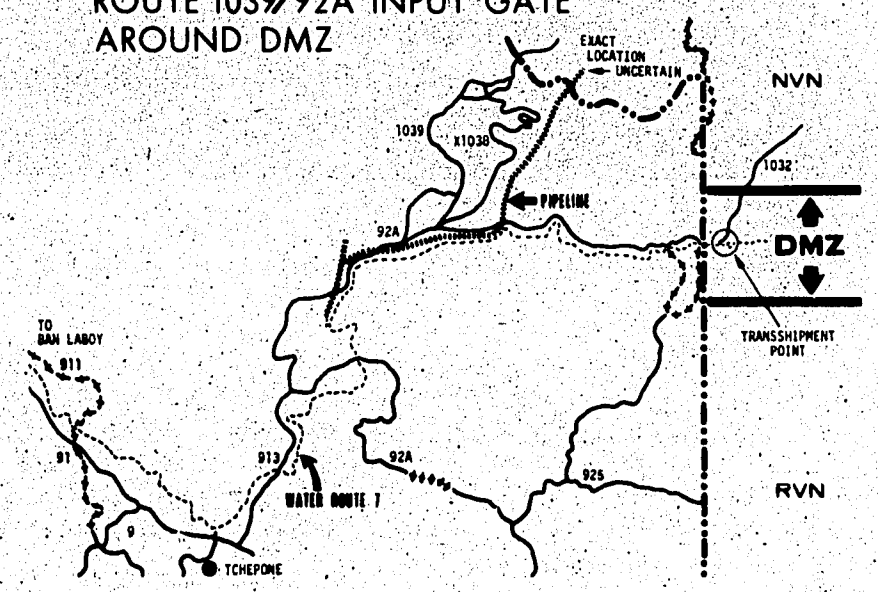


FIGURE 1 - 9

The 1039/92A complex included the Xe Banghiang river which the enemy converted into a supply waterway. The river had earlier been designated waterway 7. It had numerous channeling walls and coffer dams to speed the flow of the river and to direct supplies to transshipment points. The exact amount of tonnage moved was difficult to estimate because the operation continued 24 hours a day, regardless of weather, under natural rain forest cover. These supplies were difficult to destroy.

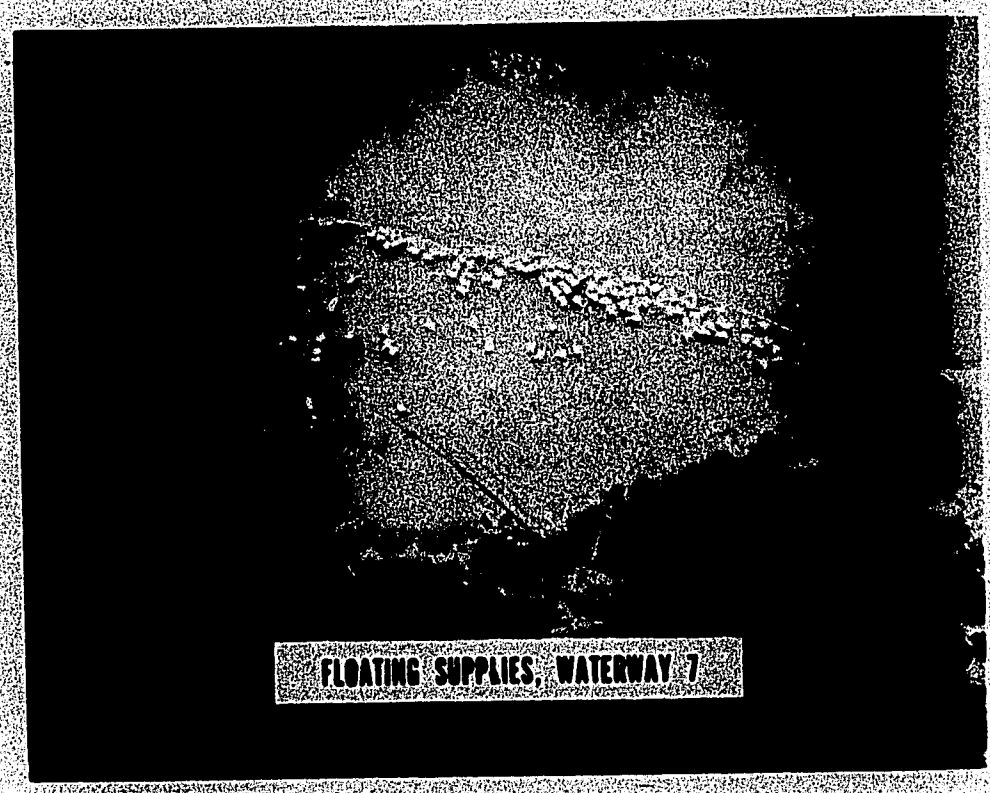


FIGURE I - 10

The 1039/92A complex also featured a POL pipeline (Figure I-11). Along with the line constructed earlier through Mu Gia pass, it was used by the enemy to reduce his exclusive dependence on trucks to transport POL. Attacks against the pipelines cut them a number of times. The effects of the attacks were difficult to assess, since the enemy did not pump continuously and he generally bypassed pipeline cuts with new line segments.

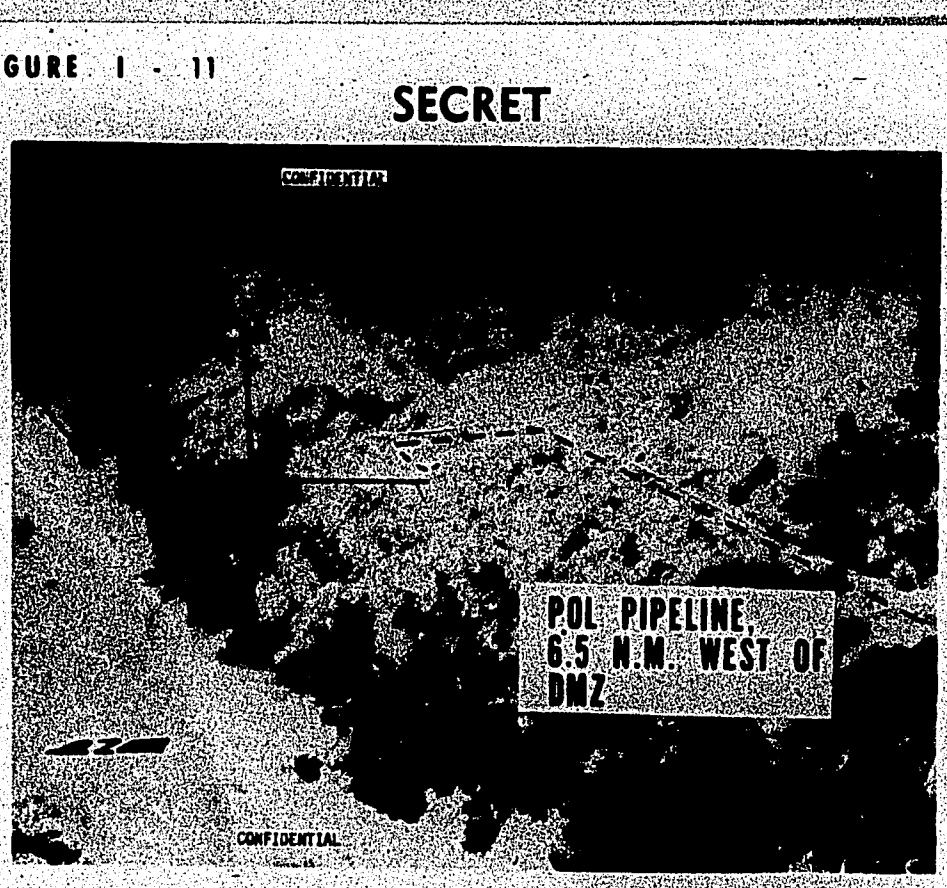


FIGURE I - 11

The enemy defenses continued at a high level. On 2 February a SAM was fired at an aircraft in Route Pack I. The site was struck and heavily damaged. Thereafter, the enemy kept his SAM equipment on the move and did not occupy one site for more than a few days.

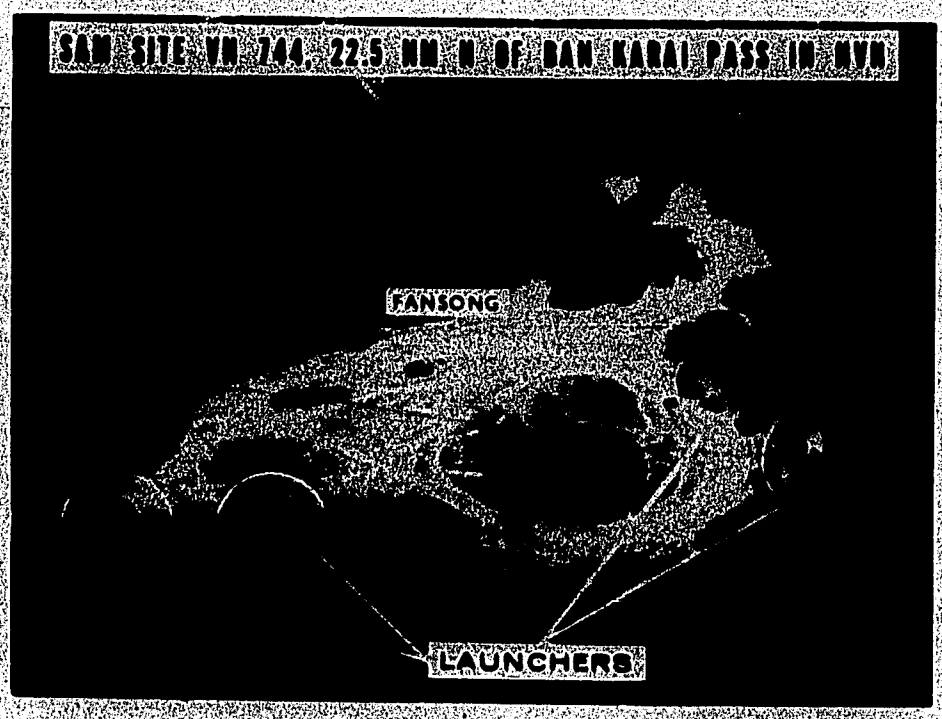


FIGURE I - 12

Another threat became evident when a MIG shot down a U.S. helicopter on a Search and Rescue (SAR) mission over Laos on 28 January. This incident served as a reminder that the enemy MIG threat had grown from about 50 aircraft in North Vietnam in June 1969 to over 130 in February 1970. The enemy's aim was clearly to restrict U.S. freedom of action in the air over both Laos and Route Pack I.



FIGURE I - 13

The SAM and potential MIG threat caused U.S. air planners to reassess the protection provided reconnaissance and strike aircraft operating within SAM and MIG threat areas. It was necessary to divert fighter aircraft from interdiction missions to escort duties. In addition, attacks against the SAM sites were planned,

but the rules of engagement permitted attacks only in response to enemy firings at U.S. aircraft.

The logistics surge succeeded in building throughput into RVN during February to an average of 216 tons per day. However, this was achieved at tremendous cost as the interdiction forces were marshalled to attrit the enemy's resources and force a retrenchment.

Counter Surge Operations

Interdiction planners countered the enemy's logistics surge by placing greater emphasis on direct attrition of his trucks and supplies. The trucks received first priority. Increasing the force attacking trucks at night created control problems that were solved by realigning night FAC control areas. Traffic analysis matched the force to enemy movements and improved truck-killing efficiency. Interdiction of LOCs received proportionally less attention as more sorties were allocated to trucks and storage areas. Munitions package emplacement and LOC cuts were planned and executed on a very selective basis.

On 23 January preplanned LOC attacks were suspended for two weeks. The sorties were shifted to storage area targets. Assessment of the results of the suspension led to a decision to reinstitute the use of munitions packages but to concentrate on a limited number of selected points. The suspension had demonstrated that although additional sorties against the storage areas produced a proportional increase in secondary fires and explosions, the absolute increase did not warrant foregoing the blocking and channeling benefits of LOC interdiction.

During the enemy's logistic surge, the interdiction planners were faced with a target rich environment of moving trucks, well dispersed and protected storage areas, an expanded road net, and increased enemy defenses. While the enemy surged his logistics drive, the interdiction effort was further reduced by 27 sorties per day when two Marine squadrons left Vietnam. The enemy pressures on General Vang Pao's forces in northern Laos necessitated the diversion of strike sorties from Steel Tiger to Barrel Roll. To partially balance this drain from the interdiction effort, strike sorties normally allocated to targets in RVN were diverted to Steel Tiger.

Despite the decline in total interdiction sorties during the enemy's logistic surge, truck kills rose to an all-time high of 72 per day in January and 76 per day during February. The high kill rate resulted from the increased strike opportunities presented by the highest level of enemy traffic ever observed and

from the increased efficiency of the truck killing force, especially the gunships.

For a brief period, a tactic of trying to block certain points by constant gunship presence was attempted; it was rejected when it became clear that the most efficient use of the gunships was to match them against heavy traffic wherever it occurred.

With refined procedures and increased numbers, the gunships accounted for over 40 percent of the trucks destroyed and damaged during January and over 50 percent in February.

As enemy traffic and throughput continued to increase, it was decided to emplace munitions packages on the input passes and on the southern LOCs, 922, 926, and 110, to take the initiative away from the enemy in determining LOC utilization. From 23 to 25 February three special LOC interdiction efforts were launched. The focal points of these attacks were primarily the throughput routes into South Vietnam. During the three days, over 450 LOC interdiction sorties were flown. Night LOC interdiction was also initiated with Paveway guided bombs. Traffic decreased in the areas of the interdiction points and throughput was reduced by about one-third.

In late February there was a general decrease in truck traffic. The enemy practically abandoned the use of Mu Gia pass as he backed away from his high level of activity and its accompanying attrition.

Retrenchment of Enemy Effort

Beginning 26 February the enemy traffic dropped to half its January-February level. Initially it was thought this drop was another temporary adjustment, similar to those that had occurred periodically during the logistics surge, but the drop proved to be permanent. There was also a drastic shift in traffic away from Mu Gia pass and increased use of the shorter route around the DMZ. Not only was this route shorter but it was under the influence of the on-shore air flows that kept the skies overcast but brought little or no rain to the Lao side of the mountains. The enemy continued his major construction effort to build a complete complex of roads in the area, even though it lacked a natural pass through the mountains. The new route allowed the enemy to use his road net in the NVN sanctuary and put his supplies at risk for a much shorter time than when using Mu Gia or Ban Karai routes. However, the route could not support the traffic the enemy required to meet his resupply objectives, so he continued to use Ban Karai but at a reduced level.

The general decrease in traffic throughout Steel Tiger continued during the first two weeks in April. The traffic began to rise on 13 April, primarily in the southern portion of Steel Tiger and on the throughput routes 922, 966, and 110. The increased activity never approached January or February levels. It was instead a moderate surge during a period of high moon illumination, during which it was the practice to move the gunships off the heavily defended routes. The enemy had a sizeable stockpile in Laos which he had to move before the rains made his LOCs impassable. He may have viewed the high moon period of mid-April as a last opportunity to increase throughput before the rainy season. When the gunships returned to the primary LOCs with the waning of the moon in late April, enemy truck traffic again decreased.

The movement of supplies through Ban Karai pass continued to decrease until, by the third week in April, the primary input route became the LOC complex west of the DMZ. Overall input also continued to decrease throughout the month. Reconnaissance revealed that the enemy was constructing new roads and graveling and corduroying portions of the existing roads to make them motorable during the rainy season.



FIGURE 1 - 14

New roads were constructed on higher ground for wet season use, adding an all weather capability to the ever expanding LOC network. The enemy was preparing to continue his resupply into the wet season so as not to be forced to reduce his activities in RVN as he had been during the 1969 southwest monsoon. Nevertheless, by the end of the month some route segments were impassable because of the combined impact of weather and bombing.

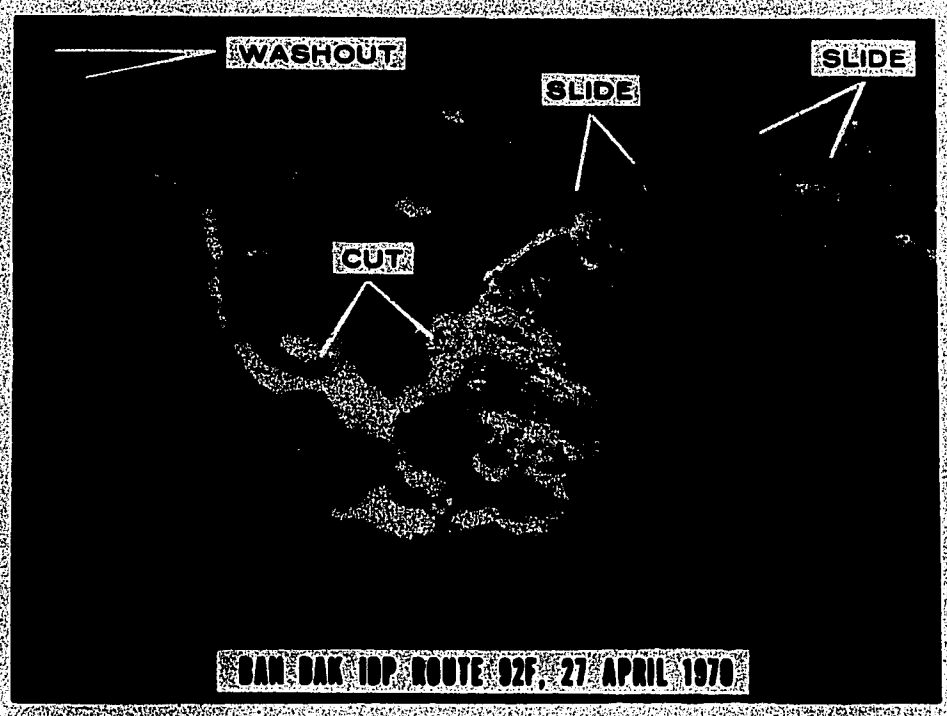


FIGURE I - 15

The shift in enemy logistic emphasis to the southern route structure was accompanied by a corresponding shift in AAA concentrations. Weapons were moved from the areas around Mu Gia and Ban Karai passes to the southern portions of Steel Tiger. The vigorous defense effort made by the enemy was evident when 8 aircraft were lost in the third week of April, a high for the campaign. These losses included an AC-130 gunship, the first gunship to be shot down in the campaign.

Approximately two-thirds of the input into Laos was being destroyed or consumed in transit. It was difficult for the enemy to forecast with any accuracy what would be destroyed and plan replacements to offset specific losses. Reports that shortages in specific items were being sustained by the enemy units within RVN testified to the disruptive impact of the interdiction attacks.

Continued Interdiction Pressure

As the enemy shifted his traffic to the shorter routes and the number of trucks moving on any given night decreased, the area of focus of U.S. airstrikes and gunship deployment was changed to concentrate on the LOCs south of Ban Karai where the traffic was heaviest. There was a continued emphasis on attacks against trucks. The number of trucks destroyed and damaged decreased as the enemy activity decreased, but the decrease was less than proportional. The percentage of trucks observed that were struck rose. The enemy's effort to conserve trucks and decrease his losses by changing their routing and exposure to attack was only partially successful due to the increased efficiency of the interdiction operations.

Throughout March and April, as the number of trucks operating on the LOCs remained low, U.S. aircraft were forced to adapt to a target-limited environment as opposed to the previous target-rich situation. This necessitated ever increasing attention to precise traffic analysis to match force allocations to enemy traffic. Most of the trucks moving during this period of retrenchment used the heavily defended eastern routes where gunship operations were restricted. Despite this situation the number of trucks destroyed and damaged in relation to those sighted continued to rise. During the first week in April over 500 trucks were destroyed or damaged, and gunships destroyed or damaged 55 percent of the trucks they observed. The use of interdiction packages and the seasonal improvement in visibility in Steel Tiger contributed to the improved force effectiveness.

There were three primary LOC interdiction areas emphasized during March and April. The first was the enemy's throughput routes into RVN, 922, 966, and 110. The program included daily LOC cuts and seeding with time delay bombs. The second was the transshipment area where materiel which floated down the waterway west of the DMZ was transferred to trucks. The third was a crucial road complex where the main LOC branched out toward the A Shau Valley and to other throughput routes of southern Steel Tiger. This complex was designated Delta 45. It was seeded daily with munitions packages from mid-March to the end of the campaign. During the third week of April, over 150 LOC interdiction sorties were flown against Delta 45.

Navy AMTI equipped A-6s were moved from the Commando Bolt area in late March to seed the Delta 45 area at night. As traffic backed up, the enemy increased the number of truck parks and storage areas behind Delta 45 and constructed roads in an attempt to bypass the interdiction points. Traffic south of the area decreased markedly.

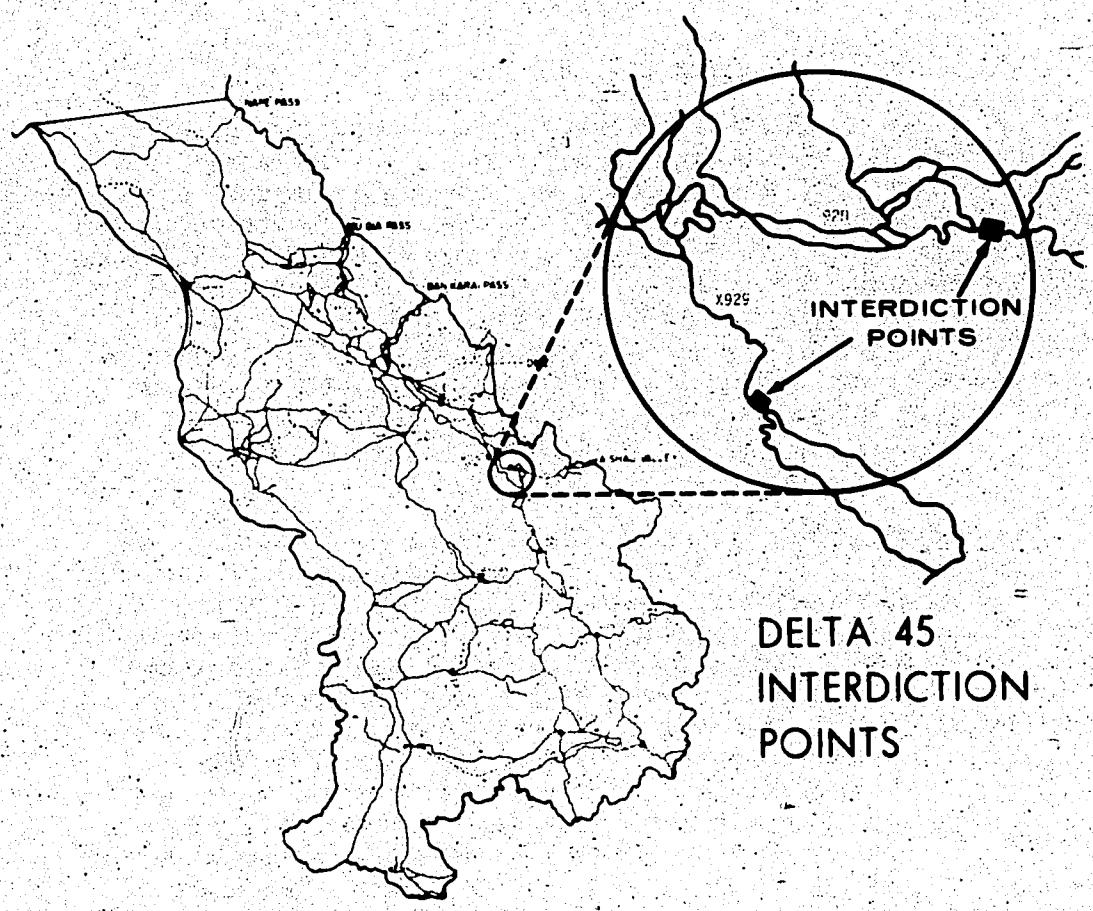
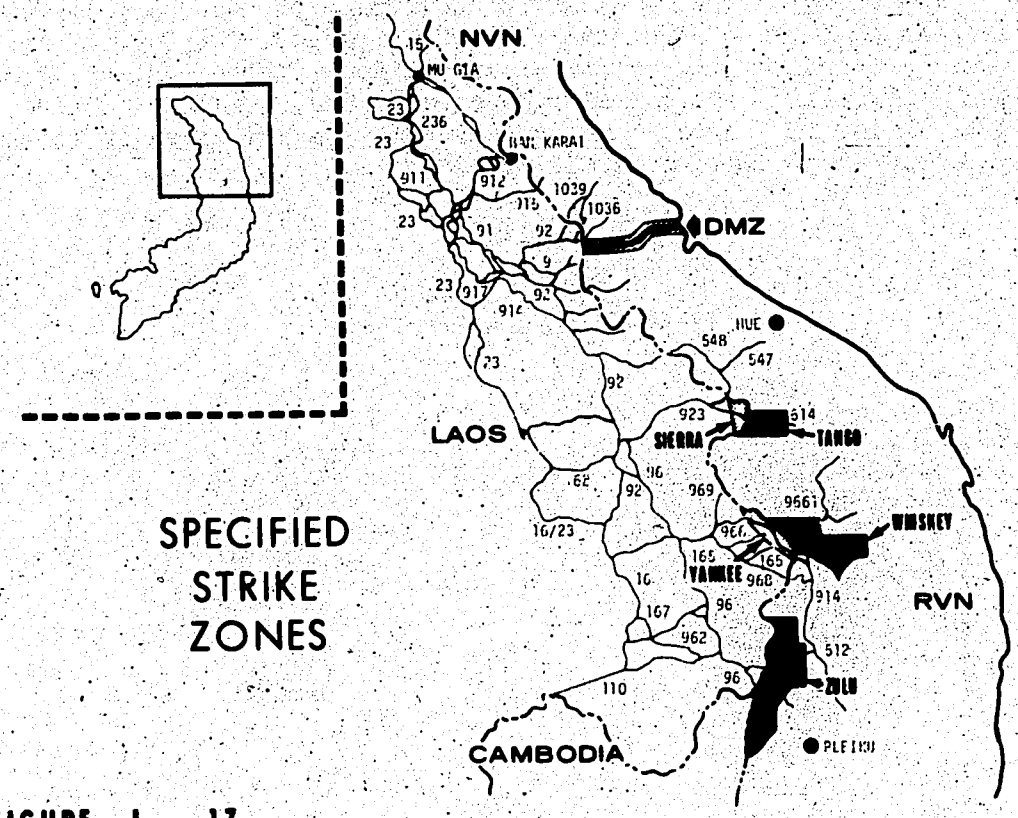


FIGURE 1 - 16

Interdiction attacks were also extended to specific zones in South Vietnam into which the main LOCs ran. Targets in these Specified Strike Zones (SSZs) were cleared for attack at anytime. There were five SSZs during Commando Hunt III: Sierra, Tango, Yankee, Whiskey, and Zulu. LOCs in these areas were cut daily and munitions packages were emplaced. FACs regularly patrolled the roads in the Specified Strike Zones, such as the extensions of route 966, looking for signs of activity, new road construction, and storage areas.

Gunship operations expanded to cover the short motorable portions of road that continued from Laos into RVN. Special attention was given to route 922 and its extension, route 548 in the A Shau Valley, and to SSZs Sierra and Tango. Route 966 and its RVN extension 9661 in SSZs Yankee and Whiskey also received attention. The southernmost throughput corridor, 110, and route 613 in RVN were also patrolled. In-country interdiction sorties, when unable to strike their primary targets in the SSZs due to weather, were diverted into southern Steel Tiger.



SPECIFIED
STRIKE
ZONES

FIGURE 1 - 17

In response to the increasing enemy activity west of the DMZ, a concentrated road cutting effort was launched in mid-April to make the LOCs more vulnerable to the ravages of weather. This effort continued to be hindered by cloud cover and low visibility so the Commando Bolt all-weather operation was expanded to include the area during the last week in April.

During most of the campaign, target acquisition had been difficult due to haze. The occasional rains that fell in late March and April and the seasonal changes in air flow cleared the air considerably with a resultant rise in visibility. The ratio of trucks sighted to those moving increased as did the ratio of those destroyed or damaged to those struck.

Shifts in AAA concentrations were met by increased employment of specialized munitions, such as Paveway. During the last week in April 28 guns were destroyed, the high point for the campaign.

The enemy offensive in Barrel Roll made it necessary to divert increasing numbers of sorties from Steel Tiger. During the last week of February, the number of Barrel Roll strike sorties exceeded 1200, over twice the normal allocation. Requirements in Barrel Roll during late March once again caused the diversion of sorties from the Steel Tiger interdiction effort.

ATTACK SORTIES
IN BARREL ROLL AND STEEL TIGER

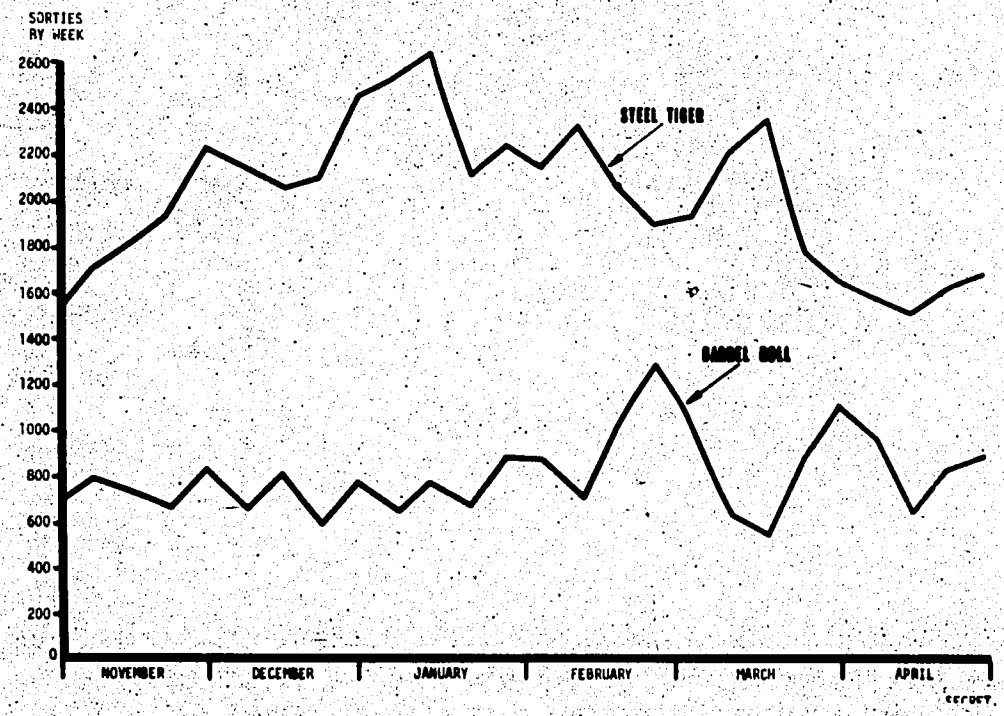


FIGURE I - 18

U.S. air operations in the Barrel Roll and Steel Tiger areas of Laos were competitive for limited strike sorties but, to a limited degree, reinforcing in their cumulative effect of attriting enemy resources. This effect is demonstrated by the total enemy trucks destroyed and damaged throughout Laos during the Commando Hunt III campaign.

TRUCKS DESTROYED AND DAMAGED IN LAOS DURING COMMANDO HUNT III

MONTH	BARREL ROLL	STEEL TIGER	TOTAL	CUMU-LATIVE
NOVEMBER	110	869	979	979
DECEMBER	202	1295	1497	2476
JANUARY	168	2231	2399	4875
FEBRUARY	199	2119	2318	7193
MARCH	205	1779	1984	9177
APRIL	268	1739	2007	11,184
TOTALS	1152	10,032	11,184	

TABLE I - 1

These losses along with destruction of supplies in storage areas and the heavy cost of maintaining and defending LOCs under constant attack, forced the enemy to retrench from his high level of activity in January and February.

SUMMARY

The enemy began his 1969-70 dry season resupply drive through Laos from a carefully prepared base area in his sanctuary within North Vietnam. He committed significantly more resources to his resupply drive during Commando Hunt III than he did during Commando Hunt I. At the same time, U.S. interdiction resources were reduced to a level below that of Commando Hunt I.

The enemy placed initial emphasis on repairing and expanding his road net in Laos while at the same time building up his AAA defenses and preparing dispersed storage areas. Supplies were moved southward by stages from the input areas to fill the supply line so as to maintain a high level of throughput into South Vietnam for the remainder of the season.

Enemy throughput into South Vietnam illustrates the pattern of his resupply drive. In November and December, as he concentrated on the build-up of facilities and supplies in Laos, his

daily throughput was low, averaging 14 tons in November and 48 tons in December. These figures were lower than the Commando Hunt I experience for the same months, 25 tons per day in November and 65 in December.

In January he initiated his logistics surge, and throughput averaged 131 tons per day. The surge continued into February with throughput increasing to 216 tons per day. These tonnages were achieved at a heavy cost as 72 trucks were destroyed and damaged per day in January and 76 in February. As a result, throughput fell to 148 tons per day in March and 80 in April.

U.S. interdiction tactics reflected a dynamic response to the enemy's efforts. Initially, emphasis was on delaying his LOC repair and construction while at the same time maintaining pressure on truck traffic, AAA defenses, and storage areas. When the enemy traffic surged, control and sortie allocation procedures were refined, permitting a larger portion of the force to be used to attack trucks.

A delicate balance was maintained between the competing requirements for strike sorties in RVN, Steel Tiger, and Barrel Roll. The total effect was that U.S. air operations made a major contribution to limiting enemy initiatives. The enemy did not mount his traditional sustained dry season offensive in RVN. His equally traditional dry season offensive in northern Laos was delayed for three and a half months and ground to a halt during early April.

Finally, the enemy was forced to reduce his resupply activity drastically in the middle of the dry season due to the cumulative effects of U.S. interdiction operations. The chapters that follow describe in detail the resources and tactics used by both sides and provide a quantitative analysis of the campaign.

CHAPTER II

RESOURCES AND OPERATIONS

The North Vietnamese committed more resources to the 1969-70 resupply drive than in previous dry seasons. The enemy maintained a truck inventory in Laos of about 2400 trucks, 50 percent more than during Commando Hunt I. He expanded the road network to approximately 3100 kilometers of mortorable roads complete with storage areas, refueling stops, repair facilities, and maintenance crews; deployed over 1000 AAA weapons, up to 743 of which were active at any one time, consisting mostly of 37mm guns but ranging from automatic weapons to 100mm; and committed large numbers of troops, truck drivers, mechanics, road repair crews, communications specialists, AAA gun crews and laborers to his logistic effort. He built at least 80 kilometers of pipeline and developed 150 kilometers of waterways for free floating supplies.

Against this massive enemy logistics effort, U.S. forces committed about 500 aircraft, ranging from O-2 light observation aircraft to B-52 heavy bombers. These aircraft flew or supported 295 tactical air and 23 B-52 Arc Light sorties per day. This level of effort was approximately 26 percent less than during Commando Hunt I.

ENEMY RESOURCES AND OPERATIONS

Personnel and Organization

Most of the personnel operating and defending the North Vietnamese Army's logistics network in Laos were assigned to the NVA 559th Transportation Group. The 559th operated and repaired the trucks, manned the AAA sites, repaired the roads, loaded and unloaded the cargo in truck parks and storage areas, and in general provided the manpower to operate and defend the logistics system.

The 559th was an all encompassing logistics organization which had more than doubled its capability over the previous year. The group's subordinate battalions increased from 62 during the 1968-69 season to 96 during Commando Hunt III. Truck battalions--the core of the 559th Transportation Group--increased from 16 battalions to 24. Other types of units subordinate to the transportation group were engineering, ordnance, AAA, infantry, medical, signal, rear service, civilian labor, and voluntary youth. The 559th operated and controlled NVA logistic, defense, and support

units from Mu Gia pass south to the tri-border region of Laos, Cambodia, and the Republic of Vietnam.

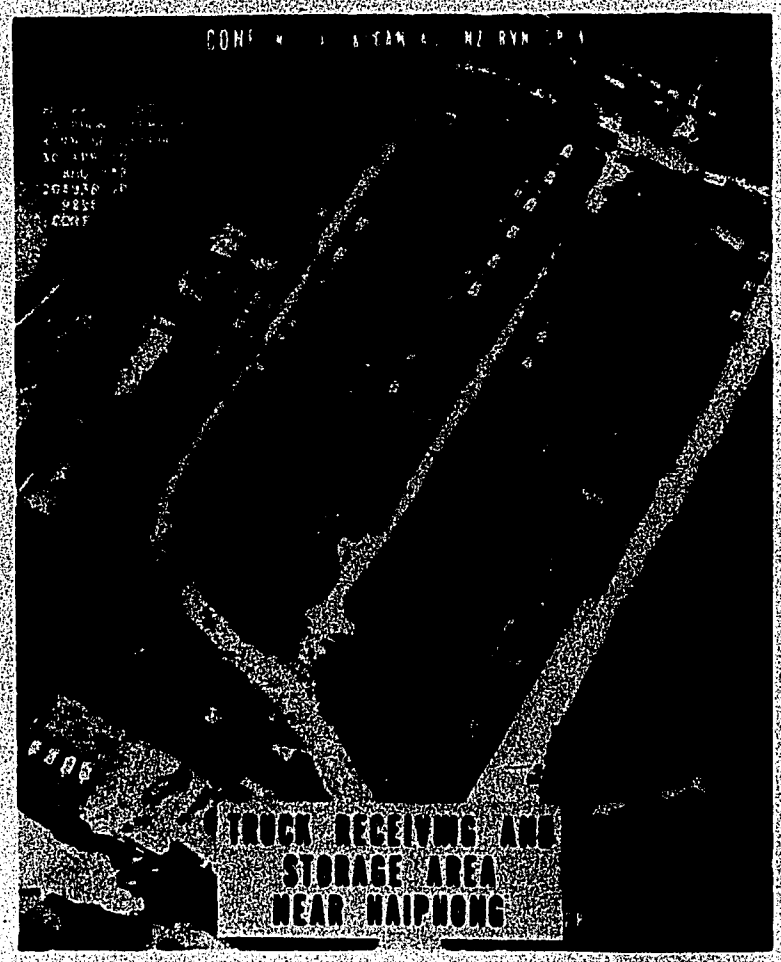


FIGURE II - 1

Lines of Communication

On 1 November 1969 the enemy road network through southern Laos consisted of 2500 kilometers of motorable roads. By the end of April 1970, an additional 650 kilometers had been added. Three passes through the Annam range provided natural entry points from NVN into the Lao panhandle. Route 8 through Nape pass, route 15 through Mu Gia pass, and route 912 through Ban Karai pass were used extensively during Commando Hunt I. During Commando Hunt III, the enemy used Mu Gia and Ban Karai and a new entry gate around the end of the DMZ (routes 1039 and 92A).

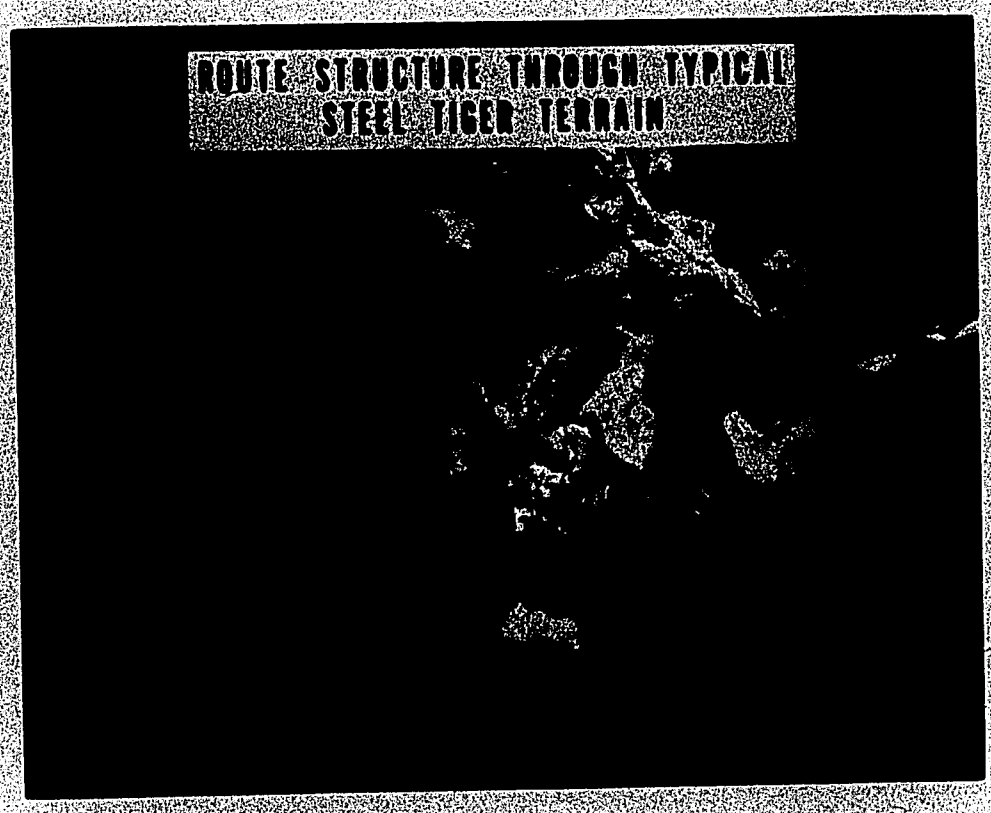


FIGURE II - 2

The road network extended from Mu Gia pass southward along the heavily forested western slopes of the Annam range to a series of exit points ranging from south of the DMZ and the A Shau valley to the tri-border region. Although the road net was initially confined to the western slopes of the Annam range, continued expansion of the system pushed additional miles of motorable routes farther westward into Laos, providing the enemy an increasingly wide choice of routes along which he could channel supplies. The enemy used the eastern routes most frequently since they were the most direct through Laos from North Vietnam to South Vietnam. The average distances from entry points into Laos to the exit routes into RVN are given in Table II-1.

In spite of constant improvement, the roads were still primitive by Western standards. They consisted primarily of eighteen foot wide tracks carved out of the jungles. Although both gravel and corduroy surfaces were used to strengthen some sections, the roads were chiefly dirt and were nearly impassable

during the wet season. The roads were originally built by hand labor, but the Commando Hunt III campaign saw increased use of bulldozers, roadgraders, and other heavy equipment.

DISTANCES BETWEEN ENTRY POINTS AND EXIT POINTS IN KILOMETERS

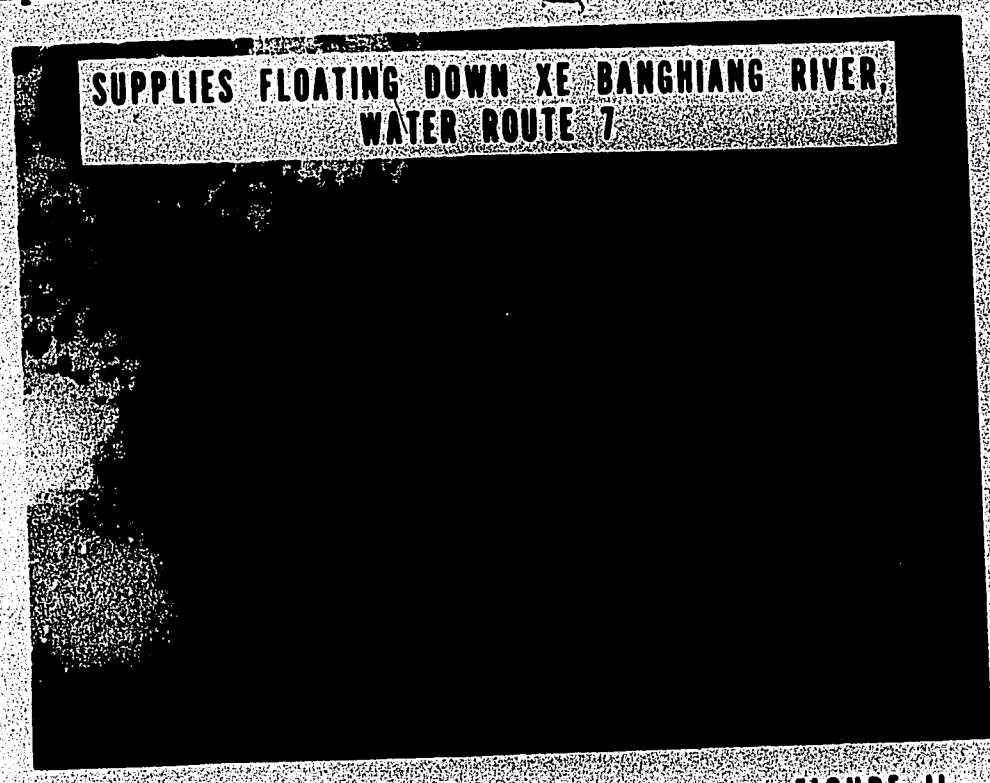
THROUGHPUT GATES FOR ROUTES:	INPUT GATES		
	MU GIA	BAN KARAI	1039/92A
925	244	182	95
926	255	196	119
921B	284	225	149
922	331	272	195
966D	482	422	346
110D	543	482	408

TABLE II - 1



FIGURE II - 3

The river network of Laos was another important transportation resource for the enemy, particularly waterway 7 at the western end of the DMZ. The NVA used dams and bamboo and cable guides to speed and direct supplies in drums or plastic bags downstream from the end of route 1032 within the DMZ to transshipment areas near route 92A in Laos.



SUPPLIES FLOATING DOWN XE BANGHIANG RIVER, WATER ROUTE 7

FIGURE II - 4

Two POL pipelines, one through Mu Gia pass and the other parallel to route 1039, added to the enemy's LOC capacity. They were Soviet tactical four-inch pipelines with pressure differential shutoff valves at intervals throughout the system. The two lines had a theoretical capacity of about 2400 tons per day. However, the actual input was probably closer to the enemy's POL requirement of 60 tons a day.

Defenses

During the Commando Hunt III campaign, the enemy AAA order of battle followed the same overall pattern of numbers and locations as during Commando Hunt I, except that the buildup of AAA weapons occurred earlier in the campaign. By the first of November 1969, the NVA had almost 450 AAA weapons of all categories active in Steel Tiger. The guns were more active, firing about twice as often as during Commando Hunt I. The enemy had developed

defenses during the wet season, and well-qualified and well-equipped gun crews were ready for the beginning of Commando Hunt III.

Based on aircrew reports of firings and on visual and photo reconnaissance, an estimate of the number of active guns in Steel Tiger is given in Table II-2.

STEEL TIGER AAA ORDER OF BATTLE COMMANDO HUNT III

(29 OCT 69 - 29 APR 70)

WEAPON	29 OCT 69	1 DEC 69	1 JAN 70	4 FEB 70	4 MAR 70	4 APR 70	29 APR 70
AW (12.7 & 14.5MM)	110	134	60	70	60	82	48
23MM	87	159	186	234	264	258	204
37MM	243	297	315	363	402	393	345
57MM	4	6	6	10	12	10	10
85MM	0	0	0	0	0	0	0
100MM	1	0	2	0	0	0	0
TOTALS	445	596	569	677	738	743	607

TABLE II - 2

The above table reflects active guns, not the entire inventory. All-source intelligence indicated that the enemy AAA inventory in Steel Tiger reached over 1055 guns.

Weapon characteristics were:

12.7 and 14.5mm Automatic Weapons. These rapid fire, relatively short range weapons posed a threat to low flying aircraft. The 12.7 was effective to 3000 feet and the 14.5 to 4500 feet.

23mm AAA. This weapon had a rate of fire of up to 800 rounds per minute and had an effective range of 6600 feet.

37mm AAA. This most widely deployed of all the NVA antiaircraft guns was the principal AAA threat. It was very mobile,

had a range of 8200 feet, and fired a shell weighing 1.6 pounds in five-round clips at a rate of 80 rounds per minute.

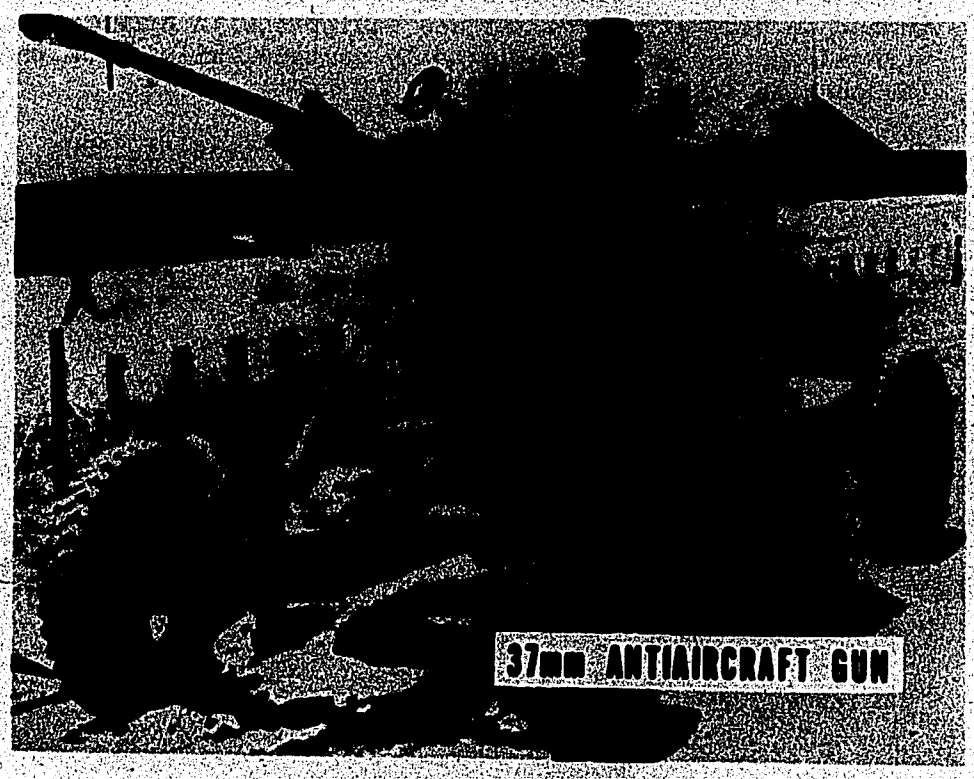


FIGURE II - 5

57mm AAA. This weapon was able to deliver 70 high explosive rounds a minute to a range of 19,700 feet. The projectile weighed 6.18 pounds and used a point detonating fuse.

85mm AAA. Although this weapon was present in the NVA inventory, it was not deployed in Laos during the Commando Hunt III campaign. It was fired from the NVN sanctuary at U.S. aircraft operating in Laos and had a rate of fire of 15 rounds per minute and an effective range of 27,500 feet.

100mm AAA. Only a few of these weapons were deployed in Steel Tiger. It was primarily used to fire across the NVN-Laos border. It had a rate of fire of 15 rounds per minute and an effective range of 39,000 feet.

140mm Unguided Rocket. This rocket was used to harass U.S. aircraft, particularly gunships. It had an effective range of 8500 feet.

SA-2 Surface to Air Missile. The SA-2 was not deployed in Steel Tiger, but its presence in Route Pack I posed a threat to U.S. aircraft. It was equipped with a 420 pound warhead and was effective up to 19 nautical miles from the launch site to an altitude of 90,000 feet.

The enemy concentrated his defenses to protect his LOCs, trucks, and supplies. Particularly strong concentrations of AAA were developed in areas of heaviest logistic activity. The immediate areas of the input passes and the major road intersections, where traffic was necessarily channeled and constricted, were the most heavily defended.

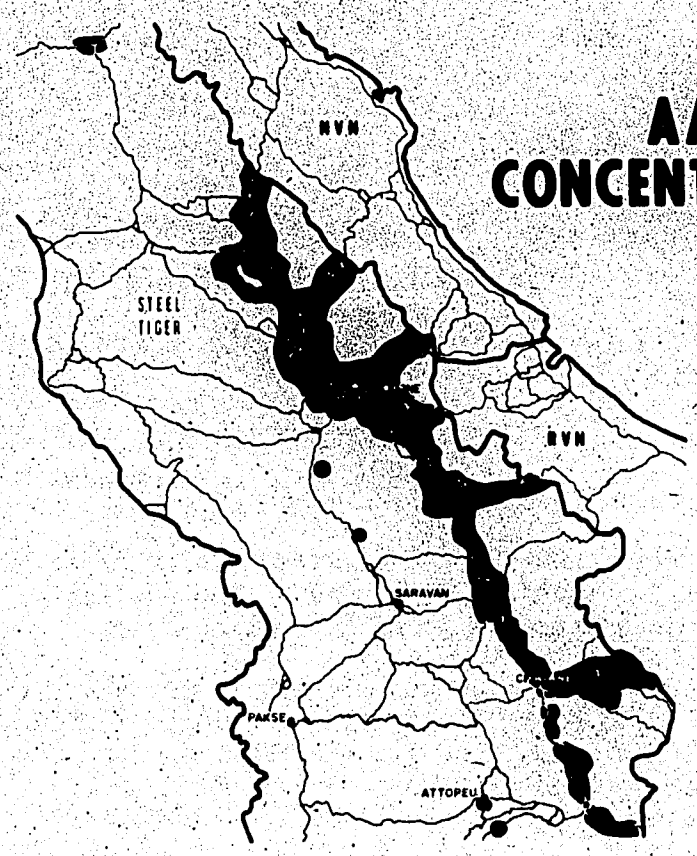


FIGURE II - 6

To provide a flexible AAA relocation capability, the North Vietnamese prepared from four to five gun positions for each gun they had in operation. This proliferation permitted the enemy to vary his gun locations and made it exceedingly difficult to locate occupied positions and plan attacks on them. His adept use of camouflage compounded the identification problem. Photographs of AAA sites in Laos showed that the enemy simulated actual weapons by inclining logs resembling 37mm barrels in empty emplacements.

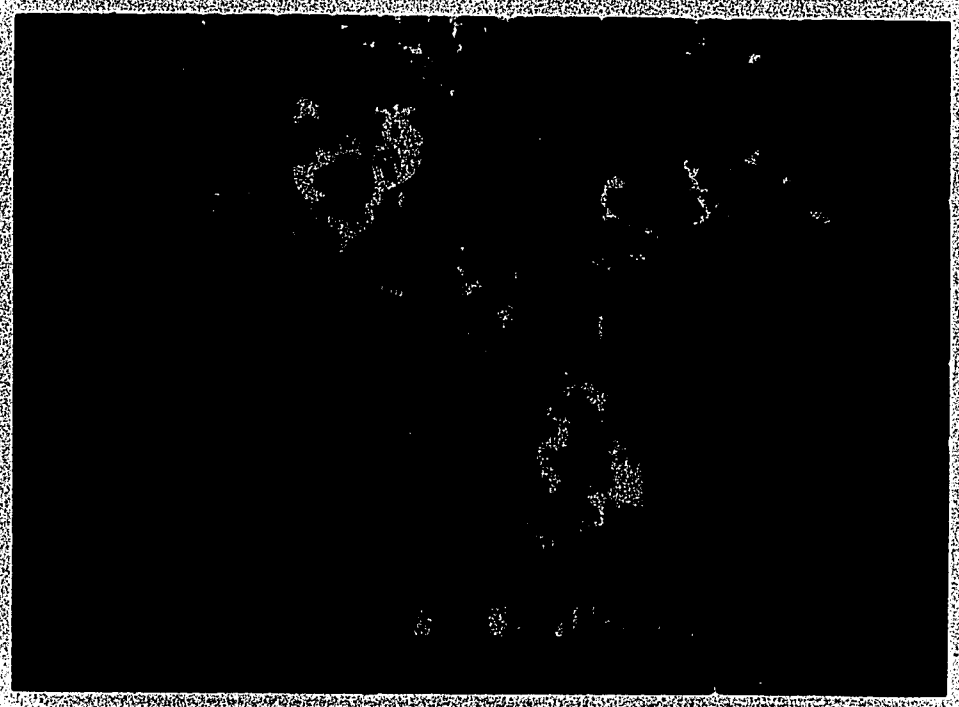


FIGURE II - 7

Another attempt at deception was the construction of decoy AAA sites in open areas near tree lines. When friendly aircraft attacked these unoccupied decoy sites, concealed weapons among the trees opened fire. Captured documents revealed that the enemy developed this tactic to counter flak suppression attacks against known AAA sites prior to a strike on a nearby target.

Enemy heavy machine guns were widely distributed, and some isolated emplacements were found in relatively inaccessible jungle areas. These sites were a threat to low-flying aircraft and to aircraft that had not pulled up following a strike on a distant target. Hillsides and mountain ridges were favored for 12.7mm sites.

There were 30 incidents of cross-border firings during the campaign, most frequently during November and December. Most AAA weapons used to fire across the border were 57mm and larger due to the longer range required to hit aircraft operating in Steel Tiger, and some were equipped with target tracking radar. The general decrease in incidents after 1 January may have been due to attacks against the guns engaged in cross-border firings. In one instance on 2 February, strike aircraft reacted to a AAA cross-border firing of the previous night. During the strike, a SAM site became active and fired a missile. The site was immediately struck and heavily damaged. Intelligence sources indicated that the enemy subsequently withdrew his heavy and medium AAA guns and SAM equipment from the immediate vicinity of the passes. A further decrease in cross-border firings accompanied the withdrawal and there were only two incidents in March and April.

The enemy expended some four percent of the total tonnage brought into Steel Tiger in AAA ammunition alone--over three times the total ammunition he expended in all of the Republic of Vietnam during the same period. Table II-3 presents the monthly ammunition expenditure for November through April.

ENEMY DEFENSE AMMUNITION EXPENDITURE (IN TONS)

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
RVN							
SMALL ARMS	63	55	61	43	59	39	320
HEAVY WEAPONS	59	47	51	43	35	72	307
TOTAL	122	102	112	86	94	111	627
STEEL TIGER							
SMALL ARMS	14	15	9	10	11	8	67
HEAVY WEAPONS	227	449	391	380	364	341	2152
TOTAL	241	464	400	390	375	349	2219

TABLE II - 3

The AAA defenses developed by the NVA during the Commando Hunt III campaign were tough, mobile, and flexible. The enemy was not gun-limited and he had no difficulty in maintaining over 600 active guns.

Trucks

At the heart of the enemy's logistics system were his trucks. Although he placed increased emphasis on logistic movement by waterway and pipeline, the bulk of his supplies moved by truck.

The movement of supplies through Laos was a complicated process requiring coordination between various transportation elements and numerous transfers of cargo in and out of vehicles and wayside storage areas. Almost all movement was by a series of short shuttles rather than long distance hauling. Drivers drove their trucks over the same routes night after night, becoming thoroughly familiar with their assigned segments. These tactics, developed by the enemy through his years of operation in Laos, were the most effective way of moving large quantities of supplies through a hostile environment.

The principal truck used by NVA forces was the ZIL 157, a six-wheel drive vehicle capable of carrying a 5500 to 9900 pound payload at speeds up to 41 miles per hour over the Lao roads. The tires could be inflated or deflated while the vehicle was moving enabling the driver to adjust to road or trail conditions ranging from mud to hard surface.

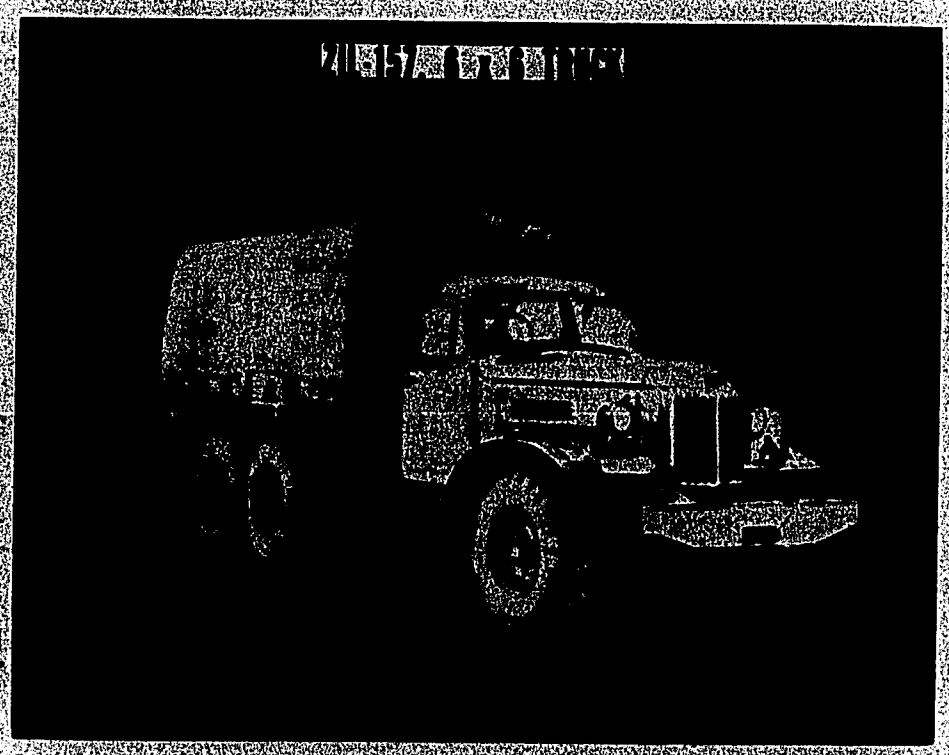


FIGURE II - 8

The truck inventory in Steel Tiger built up to about 2400, of which about 72 percent were operable at any one time. From 200 to 800 trucks operated during a single night and an average of 450 per night operated throughout the campaign. Many damaged, and in some cases destroyed, trucks were removed from the roads before daylight and cannibalized for parts.

Each of the 24 truck battalions in the Steel Tiger area operated a series of light repair stations, and there were medium and heavy repair stations scattered throughout the area. During peak traffic periods or when losses were heavy, trucks from AAA and engineer units were pressed into service to supplement the transportation battalions.

Additional details on the enemy truck movement tactics are discussed in Chapter III in conjunction with the quantitative analysis of attacks against this most important target category.

U.S. RESOURCES AND OPERATIONS

Command and Control

U.S. interdiction operations, the responsibility of COMUSMACV, were conducted by the Deputy COMUSMACV for Air who was also the Commander, Seventh Air Force. In this capacity the Commander, Seventh Air Force, was the single manager of all air operations in Laos, RVN, and specified areas of NVN. He was the coordinating authority of COMUSMACV with the Navy carrier force (CTF-77), First Marine Air Wing (1MAW), and SAC forces supporting MACV operations and acted as the single point of contact for coordination with external agencies supporting the interdiction campaign. Figure II-9 shows these command relationships.

COMUSMACV provided broad general guidance on the allocation of tactical air resources between in-country (RVN) and out-country requirements. The allocation during Commando Hunt III was 55 percent out-country and 45 percent in-country. Within this broad guidance, the Commander, 7AF, through his Deputy Chief of Staff, Operations, planned and directed the tactical air operations of the interdiction campaign.

Control of the forces was centralized. The DCS/Operations planned and published the fragmentary operations orders, drawing on intelligence sources in 7AF, TFA, 7/13AF, and others. The 7AF Command Center (Blue Chip) controlled and directed combat and support forces through subordinate command and control centers including airborne battlefield command and control centers and Task Force Alpha. Figure II-10 shows these control relationships.

COMMAND RELATIONSHIPS

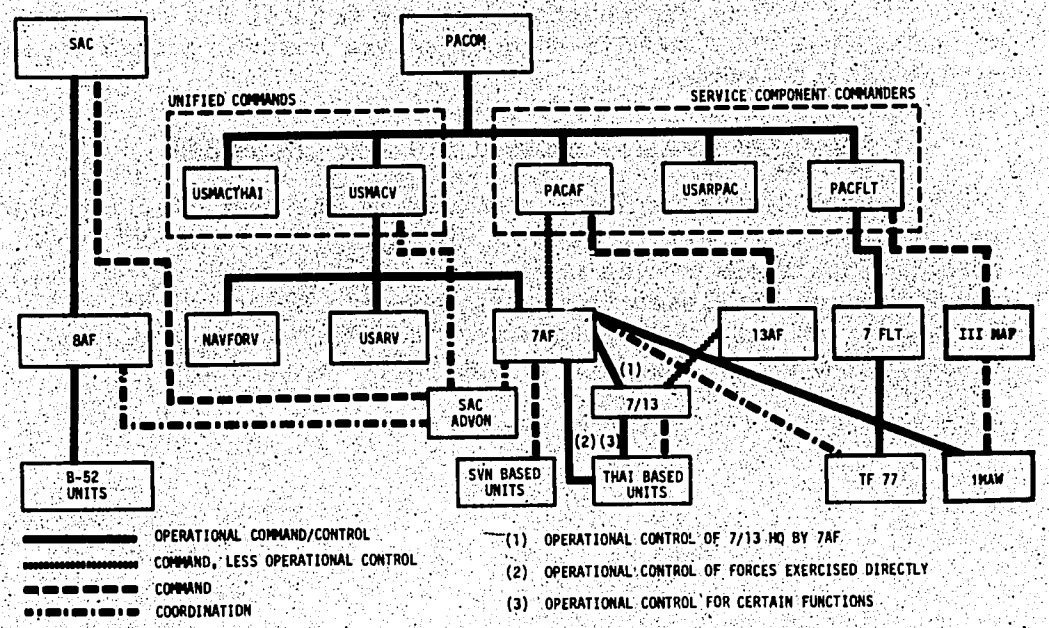


FIGURE II - 9

OUT-COUNTRY TACTICAL AIR OPERATIONS

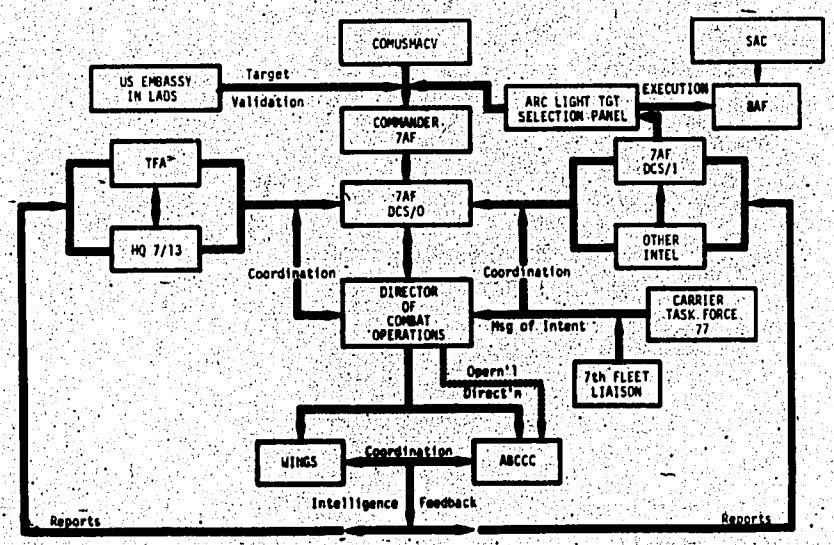


FIGURE II - 10

Tactical Unit Operations Centers (TUOC) and Forward Air Controllers (FAC) were further extensions of the command and control system. Whenever possible, strike control was exercised directly from the subordinate command and control center to the strike flight leader.

Airborne Battlefield Command and Control Center

Each ABCCC directed air activity in its zone of responsibility. Four orbits were flown each day by C-130s based at Udorn RTAFB. Two of the orbits were responsible for the Barrel Roll operating area--Cricket in the daytime and Alley Cat at night. The other two were responsible for the Steel Tiger operating area--Hillsboro in the daytime and Moonbeam at night.

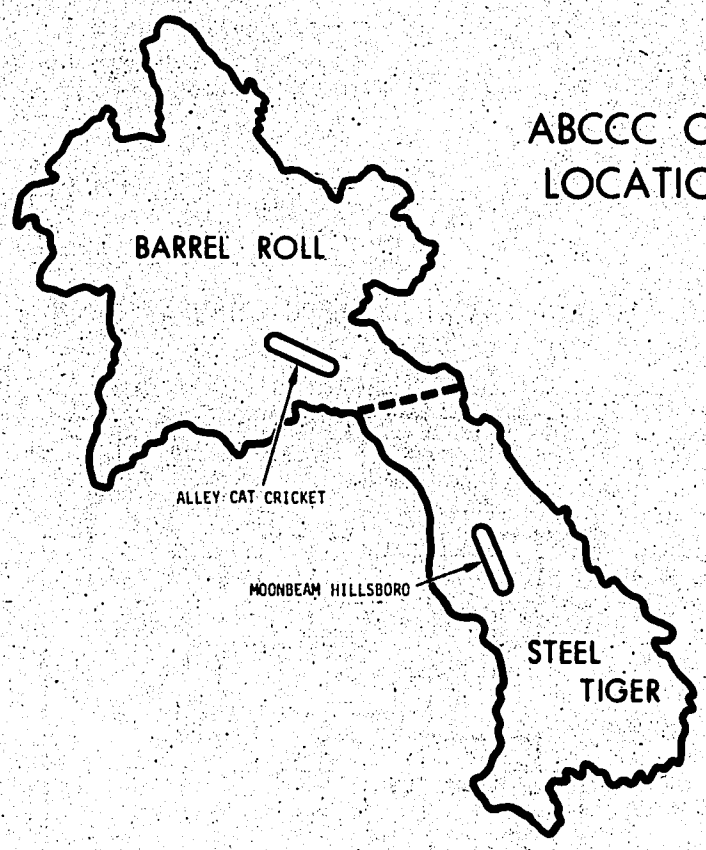


FIGURE II - 11

All aircraft entering or leaving a zone were cleared and directed by the ABCCC. The controllers granted clearance for movement within the zone and assigned radio strike frequencies. Two controllers on each orbit, one for low speed and one for high speed aircraft, maintained a situation map to assist them in managing the traffic. They diverted aircraft when necessary because of weather or when more profitable targets developed. A portion of the strike force was assigned to the ABCCC for use against targets of opportunity discovered by FACs. Dedicated communications channels, including secure teletype, were maintained between 7AF Command Center and ABCCC and other control elements. The communications links are shown in Figure II-12.

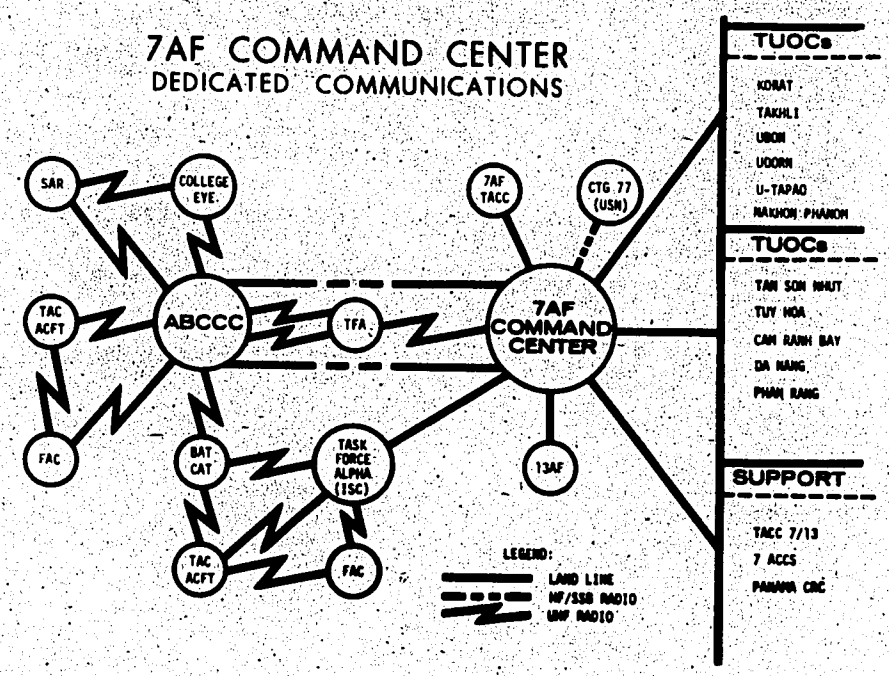


FIGURE II - 12

Forward Air Controllers

The FACs were the last link in the command and control net. They performed a number of essential roles including visual and weather reconnaissance, target acquisition, and control of strike aircraft. FAC reports were frequently the first indication of a change in enemy activity. Seven types of aircraft were employed in the FAC role.

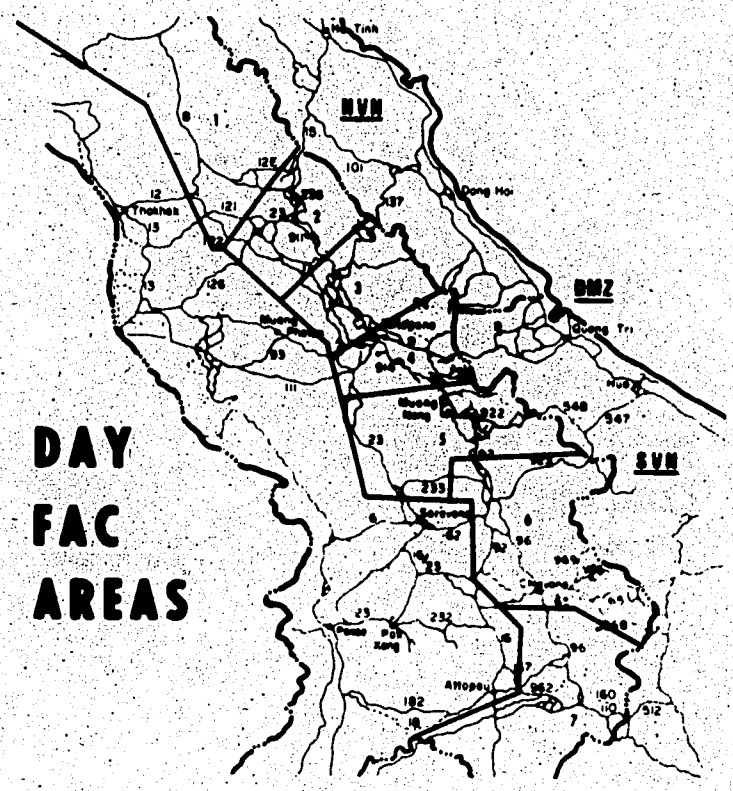
FAC AIRCRAFT SUMMARY

FAC	NORMAL WORKING TIME (HOURS)	NORMAL OPERATING ALT. (MSL) (1000 FT)	SPECIAL EQUIPMENT
C-130 BLINDBAT	6.0	7.5-11.5	DOOR MOUNTED AN/AVG-3A NIGHT OBSERVATION SIGHT (NOS). 4 ACFT W/LASER TARGET DESIGNATORS. 2 ACFT W/BLACK CROW CARRIES FLARES & GROUND LOGS.
C-123 CANDLE-STICK	3.5	7.0-10.0	AN/AVG-3A NIGHT OBSERVATION SIGHT-BELLY MOUNTED. OPTION FOR SECOND NOS-DOOR MOUNTED. CARRIES FLARES & GROUND LOGS.
OV-10 NAIL & COVEY	2-4	1.5-5.5	3 ACFT W/AN/AVG-3A NOS IN BELLY-REMAINDER W/HAND HELD STARLIGHT SCOPES. CARRIES 14 WP ROCKETS.
O-2 NAIL & COVEY	2-4	1.5-5.5	HAND HELD STARLIGHT SCOPES. CARRIES 4 AIR FLARES, 2 LOGS 7 WP ROCKETS.
F-100 MISTY	.8	4.5	NO VISUAL DEVICE 18 WP ROCKETS AND 20 mm GUN.
F-4 TIGER, WOLF, STORMY	.5	4.5	NO VISUAL DEVICE 20 WP ROCKETS AND 20 mm GUN.
TA-4 PLAYBOY	.5	3.0	NO VISUAL DEVICE 8 WP ROCKETS AND 20 mm GUN.

TABLE II - 4

Steel Tiger was divided into seven FAC areas for daytime operations. The visibility during daylight permitted a single FAC to cover a large area. His mission was to maintain constant surveillance of enemy activity. Because the enemy stayed off the roads during the day, most day strikes were directed against fixed targets.

During the first half of the campaign, FACs operating at night were assigned specific route segments for surveillance and strike control. Their main targets were moving trucks.

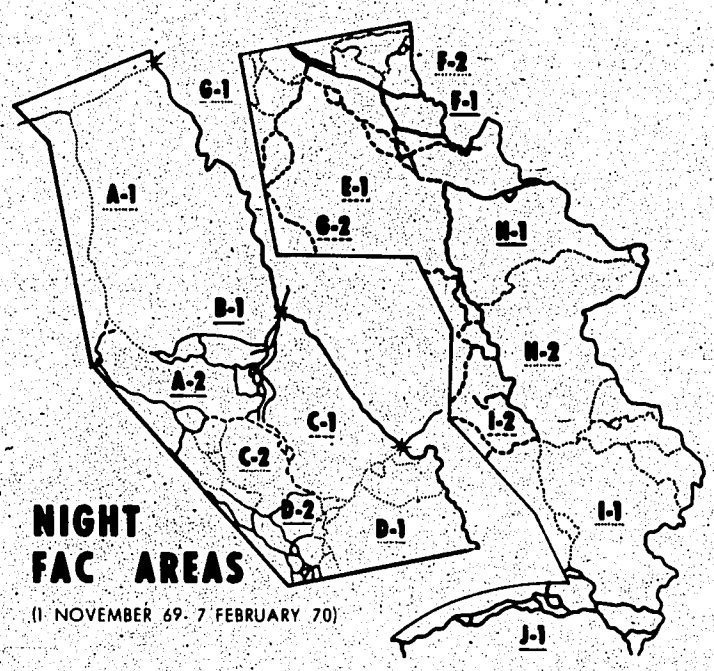


DAY FAC AREAS

FIGURE II - 13

The route segment system was cumbersome. Surveillance flight paths overlapped and numerous radio transmissions were necessary to maintain safe separation between aircraft. The congestion interfered with both surveillance and strike control.

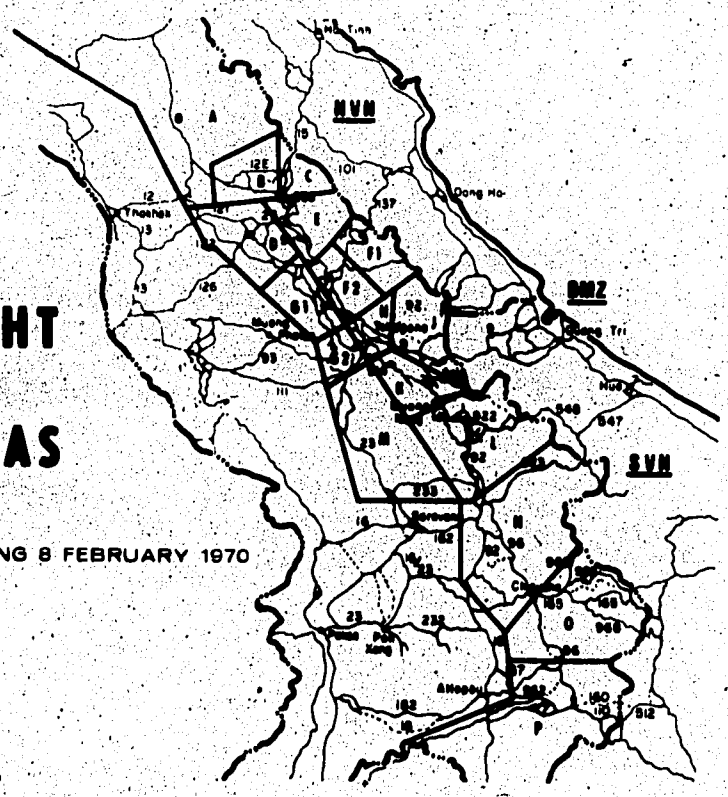
On 8 February, the night FAC areas were changed to geographic areas, with one FAC in charge of each area. The boundaries were established by analysis of enemy truck traffic flows.



NIGHT FAC AREAS

(1 NOVEMBER 69- 7 FEBRUARY 70)

FIGURE II - 14



NIGHT FAC AREAS

STARTING 8 FEBRUARY 1970

FIGURE II - 15

The night FAC areas were smaller than the day areas because of the density of enemy traffic and reduced visibility. Each night area was assigned to either a FAC or a gunship. The gunships were assigned to the areas with the heaviest travelled routes. Blindbats and Candlesticks were given priority over the lighter Nail and Covey FACs because of their greater capability for detecting and marking trucks for strike.

Some 14,000 FAC sorties were flown in Steel Tiger during Commando Hunt III. There were about twice as many day sorties as night sorties. The primary concentration of the day sorties was over the route structure from south of the Ban Karai area to the exit gates into RVN.

DAY FAC SORTIES FLOWN

NOVEMBER 69 - APRIL 70

AREA	OV-10	O-2	F-4	F-100	TA-4	OTHER
1	480	51	62	0	1	2
2	446	38	21	3	1	0
3	597	45	9	1	0	0
4	1020	302	65	2	57	5
5	800	244	8	2	10	1
6	838	322	1	46	10	32
7	766	265	1	77	1	12
1&2	169	11	429	3	1	0
2&3	56	11	19	0	0	0
4&5	12	41	458	6	564	0
5&6	1	5	1	2	0	0
6&7	11	32	9	719	3	0
OTHER	17	8	86	8	2	5
TOTAL	5213	1375	1169	869	650	57

TABLE II - 5

Night FAC sorties, which included the C-123s and C-130s with their longer on-station times, were concentrated over those routes not assigned to gunships. Before 8 February, night FACs concentrated on the input gate areas, the western route structure, and the southernmost routes.

NIGHT FAC SORTIES
(1 NOVEMBER 69 - 7 FEBRUARY 70)

AREA	O-2	C-123	F-4	OV-10	C-130	AREA	O-2	C-123	F-4	OV-10	C-130
A-1	59	25	1	42	0	C-2	47	50	0	14	9
B-1	106	148	139	47	5	D-2	24	53	16	5	5
C-1	68	100	209	55	31	F-2	33	57	0	11	40
D-1	29	80	37	21	6	G-2	1	0	0	9	0
E-1	21	2	3	7	58	H-2	2	0	0	3	1
F-1	7	19	0	14	25	I-2	5	0	0	1	1
G-1	13	59	104	64	41	A1-B	0	1	1	0	0
H-1	13	11	1	14	69	C1-D	0	3	0	0	0
I-1	299	2	53	25	4	F1-E	0	0	1	0	0
J-1	368	0	0	20	5	H1-I	3	0	15	2	7
A-2	17	1	7	10	0						
						TOTAL	1115	611	587	364	307

TABLE II - 6

The distribution of night FAC sorties after 8 February is shown in the following table.

NIGHT FAC SORTIES
(8 FEBRUARY 70 - 30 APRIL 70)

AREA	O-2	C-123	C-130	OV-10	F-4	OTHER	AREA	O-2	C-123	C-130	OV-10	F-4	OTHER
A	17	20	-	11	-	-	M	5	-	14	9	-	-
B	50	90	1	5	1	-	N	10	-	25	4	-	-
C	5	4	-	7	9	-	O	155	1	1	4	-	1
D	15	81	12	14	-	-	P	248	-	-	16	2	-
E	22	106	1	43	-	-	A&B	1	2	-	1	4	-
F-1	124	-	-	7	3	-	B&C	35	46	1	-	-	-
F-2	-	-	-	-	-	-	J&M	-	-	1	-	-	-
G-1	37	18	24	16	2	5	H&K	-	-	1	-	-	-
G-2	-	-	-	-	-	-	K&L	-	-	1	-	-	-
H	66	88	11	11	1	1	K&M	-	-	1	1	-	-
J	53	33	40	18	1	3	M&O	29	-	1	2	-	-
K	8	2	69	6	-	1	M&J	-	-	1	-	-	-
L	4	-	82	6	-	-	M&N	-	-	1	-	1	-
							TOTAL	884	491	288	181	24	11

TABLE II - 7

Tactical Air Reconnaissance

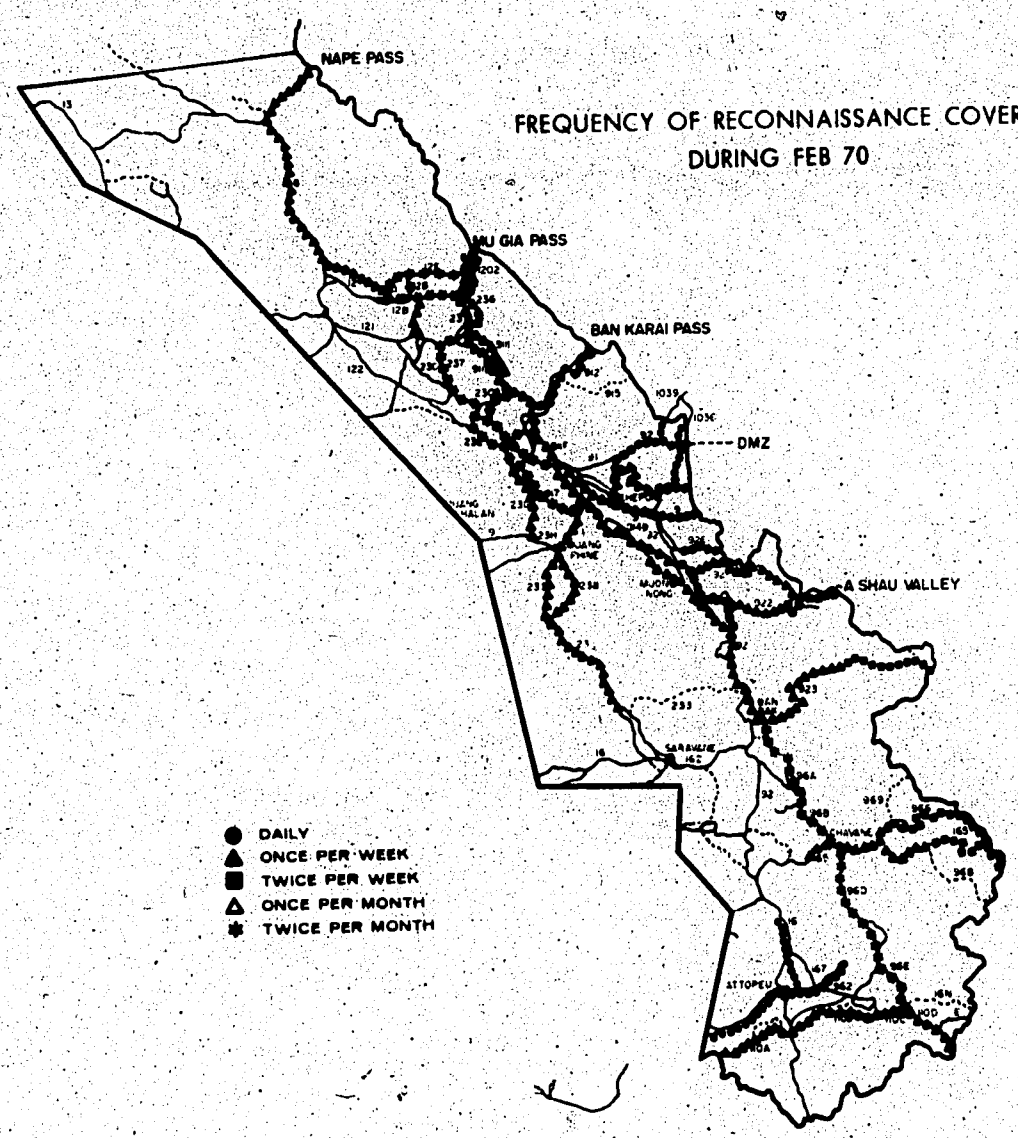
Tactical air reconnaissance in Steel Tiger had two primary tasks: surveillance of enemy activity for strike planning and collection of information on which to base post-strike evaluations of damage. Ten types of tactical reconnaissance aircraft were used.

RECONNAISSANCE AIRCRAFT SUMMARY

AIRCRAFT	WORKING TIME (HOURS)	OPERATING ALTITUDE (1000 FT.)	EQUIPMENT
RF-4C	DAY PHOTO 1.5	4.5 - 9.0	KA-55 PANORAMIC-HIGH ALTITUDE KA-56 PANORAMIC-LOW ALTITUDE KS-72 18" - SPLIT VERTICAL KS-72 12" - SPLIT VERTICAL KS-72 6" - VERTICAL
	NIGHT PHOTO 1.5	1.5 - 2.5	AN/AAS 18" INFRARED KS-72 18" SPLIT VERTICAL KS-72 6" VERTICAL
	DAY VR 2.5 - 3.5	4.5	SAME AS DAY PHOTO
RF-101	1.5	15.0	KA-1 36" SPLIT VERTICAL KA-1 36" VERTICAL
RB-57	1.5 - 2.3	10.0	KS-82 12" PANORAMIC KS-83 24" PANORAMIC
RA-5	1.0 - 2.0	1.5 - 9.0	AN/AAS-21 INFRARED AN/APD-7 SLAR KA-50 VERTICAL KA-51 FORWARD OBLIQUE KS-68A,-69A PANORAMIC
RF-8	1.0	4.5 - 9.0	KA-45 FORWARD OBLIQUE KA-46 OBLIQUE/VERTICAL KA-53 OBLIQUE/VERTICAL KA-56 PANORAMIC CAX-120 OBLIQUE/VERTICAL
OV-1	2.5 - 4.0	1.5 - 10.0	AN/AAS-14 INFRARED AN/APS-94 SLAR KS-61 VERTICAL OBLIQUE
F-4	1.0 - 3.0	4.5	VISUAL RECON
F-100	.5 - 1.5	4.5	VISUAL RECON
A-4	1.0 - 2.0	4.5	VISUAL RECON
WC-130	5.0	19.0	VISUAL RECON, WEATHER RADAR, DROPSONDE, TEMP.-HUMIDITY INSTRUMENTS
EC-47	3.0 - 6.0	9.5	ALR-34 (CC) ALR-35/38 (CCZ)

TABLE II - 8

Surveillance of Enemy Activities. The roads, waterways, pipelines, and trails in Steel Tiger were scheduled for regular reconnaissance coverage. The frequency was determined by consolidating the requirements of MACV, 7/13AF, TFA, and 7AF. Special reconnaissance objectives were accomplished either in conjunction with recurrent coverage or separately.



FREQUENCY OF RECONNAISSANCE COVERAGE
DURING FEB 70

TYPICAL ONE DAY RECONNAISSANCE PLAN

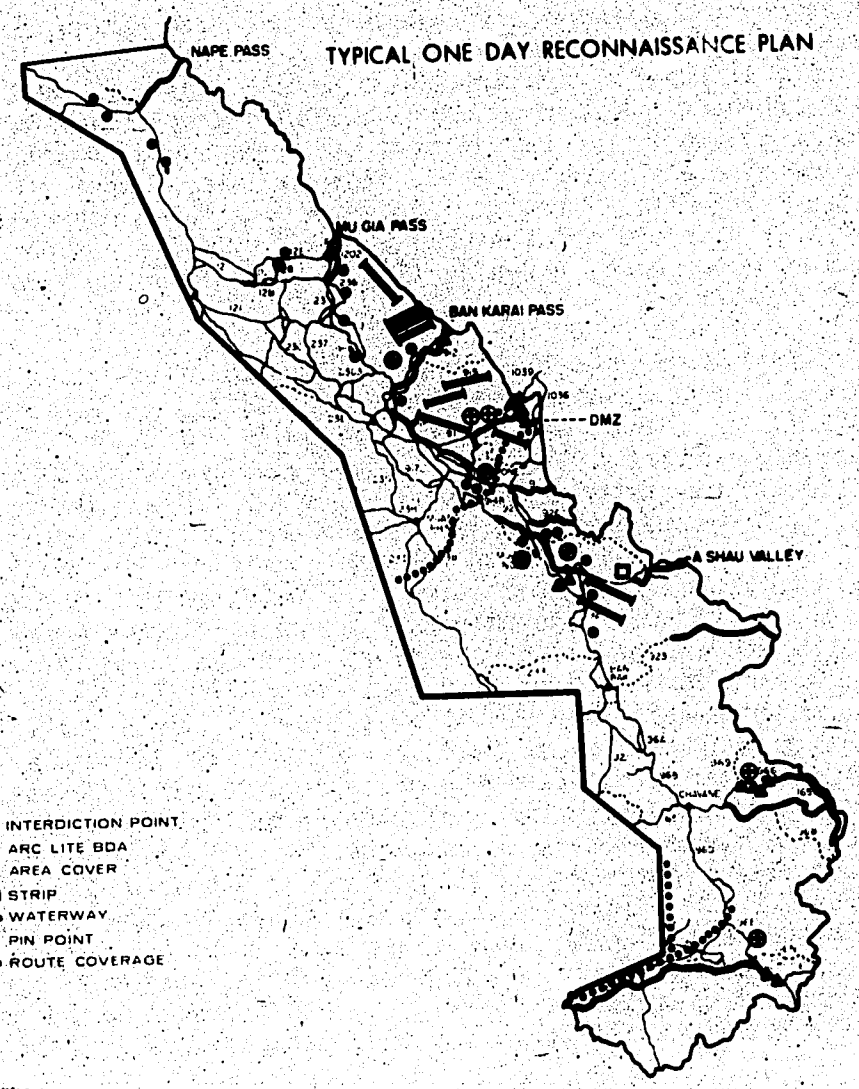


FIGURE II - 17

Reconnaissance requests specified the essential elements of information (EEI) desired. The requests were first evaluated to determine if they could be satisfied by prior coverage; if not, they were validated and assigned a priority. There were four priorities based upon mission purpose. Priority I was reserved for requests concerning an immediate threat to the national security of South Vietnam or support of troops in contact. Priority II was for support of operations beginning within 48 hours of the request time. Most requests were Priority III, which included target development and operational planning surveys of enemy units or activities capable of posing a future threat. Priority IV was for use after all other requests were met (e.g., terrain studies and mapping). The four types of coverage were photo, infrared (IR), Side-Looking Airborne Radar (SLAR), and laser.

The photo processing facility attached to the wing that performed the reconnaissance conducted initial processing and exploitation. There were three stages of exploitation. First phase interpretation identified whether or not scheduled objectives were covered and provided a brief description of intelligence obtained from the interpretation. Interpretation reports from the first phase, called Immediate Photo Interpretation Reports (IPIRs), were distributed within 12 hours of aircraft touchdown. Second phase interpretation supplemented and expanded on intelligence derived from the first phase. Supplemental Photo Interpretation Reports (SUPIRs) were transmitted within 24 hours of completion of first phase interpretation. A third phase readout performed at 7AF was a detailed study of successive photo coverage over a period. Photo interpretation reports included mission number, date flown, percentage of target coverage, film quality, success (the criterion for successful coverage was 65 percent of a route, 85 percent of an area, or 100 percent of a pinpoint target), type of film (black and white, color, camouflage detection, or stereo), camera system, camera position (split, vertical, or oblique), frames covered, and distribution listing. This information was stored in the Southeast Asia Imagery Reconnaissance File (SIRFA).

Approximately 3300 separate reconnaissance objectives were processed during Commando Hunt III. Approximately three-fourths of the objectives were requested by TFA and 7AF.

Reconnaissance equipment used during Commando Hunt III included the KA-55 high panoramic camera, the KS-72, T-11 and KA-1 vertical and split vertical cameras, the KA-56 low panoramic camera, the AAS-18 infrared system, and the AN/AVD-2 laser system.

The latter two systems had to operate within 1000 feet of the ground to obtain usable imagery, but the AAA enemy defenses in most of Steel Tiger prevented operations at such a low altitude. Attempts to use infrared and laser systems at higher altitudes produced low resolution imagery of insufficient quality.

Reconnaissance identified new infiltration routes, located truck parks, AAA sites, storage areas, and personnel concentrations. Photographs of hot targets were distributed to tactical fighter wings for strike mission planning.

FAC and strike as well as recce crews performed continual visual reconnaissance (VR) while over the interdiction area. VR was a mainstay of target development. A particularly effective VR program was the Recon-FAC team. RF-4 aircraft with a jet FAC were assigned surveillance of a day FAC area. Targets discovered by the RF-4 crew were immediately relayed to the FAC for strike. Areas considered suspicious and worthy of further study were photographed by the RF-4. These procedures eliminated time consuming request and approval networks. The film from the Recon-FAC mission was processed immediately on return to base, and the recon and FAC crews assisted with the initial photo interpretation. The results of this interpretation were passed directly to the FAC unit for use by follow-on FACs, so that time-sensitive targets were quickly brought under attack.

The VR support of the RF-4 freed the FAC to determine strike requirements, mark targets, control strikes, and make damage assessments. The detailed knowledge of their regular areas developed by the Recon-FAC teams proved valuable. The results of the program were so successful that it was increased from four team sorties a day early in the campaign to ten per day.

A "Hunter-Killer" team of Army OV-1 Mohawks equipped with side-looking radar (SLAR) worked with Air Force AC-119 gunships. Beginning in January 1970, this reconnaissance program used Mohawks of the 131st Surveillance Airplane Company under operational control of MACV J-2 and scheduled by 7AF.

Post Strike Reconnaissance. A cumulative assessment of truck damage was essential for validating strike tactics and weapons systems and for evaluating the total effect on enemy capability. In general, night photo reconnaissance was impractical because of air traffic congestion. Infrared and low light level devices were tried but provided imagery of insufficient resolution. Therefore, post-strike reconnaissance started at first light.

Confirmation of trucks destroyed or damaged was difficult. The enemy removed or camouflaged destroyed or damaged trucks. Reported locations of strikes were not precise. Jungle canopy, weather, and enemy defenses restricted post-strike reconnaissance. In spite of these difficulties, nine percent of the trucks reported destroyed or damaged were confirmed by photography. A regression analysis showed that the number of new destroyed and damaged trucks photographed correlated with the number of total reconnaissance sorties flown in Steel Tiger. Although approximately nine sorties per day were devoted to post-strike reconnaissance, most of the confirmations were obtained from recurrent reconnaissance photography.

Throughout the campaign, post-strike reconnaissance for AC-130 gunships was supplemented by film of truck kills taken through the night observation device and, in the case of Surprise Package, the FLIR and LLLTV. This film positively confirmed numerous trucks destroyed or damaged even though later photography of the area failed to locate the trucks.

A special reconnaissance program was initiated in early March to document the AC-130 Surprise Package truck kills. An RF-4C flew photo-escort to obtain night photocartridge and infrared coverage of strikes against trucks. The AC-130 crew took film of their FLIR and TV sensor imagery for correlation with the photographic reconnaissance. A second RF-4C was scheduled to photograph the location of each reported truck kill as early in the morning as light and weather permitted. If this follow-up photo reconnaissance confirmed the report, the area was photographed for three consecutive days. It was found that the enemy exerted considerable effort to move, conceal, and salvage destroyed and damaged trucks.

The truck kill confirmations obtained were consistent with the amount of reconnaissance resources invested. Given the difficulties of obtaining photographic confirmation of truck kills; however, it was decided not to devote a greater portion of the reconnaissance resources specifically to post-strike damage assessment. Reconnaissance emphasis continued on gathering information on enemy activities to improve targeting. There were a total of 7522 reconnaissance sorties flown in Steel Tiger during Commando Hunt III.

Igloo White System

A unique feature of the Commando Hunt campaigns was the Igloo White system which used seismic and acoustic sensors to monitor enemy truck traffic. The information was used on a real-time basis to position the force and on a longer term basis to analyse trends, compute enemy input and throughput tonnage, and

assist in the location of truck parks, storage areas, and new roads.

STEEL TIGER RECONNAISSANCE SORTIES BY MISSION

TYPE	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
PHOTO	806	994	1032	796	858	673	5159
VISUAL	273	315	230	183	181	344	1526
INFRARED	60	21	66	71	190	33	441
WEATHER	30	33	49	45	34	29	220
SLAR	16	25	40	36	25	34	176
TOTAL	1185	1388	1417	1131	1288	1113	7522

TABLE II - 9

These sensors were air delivered devices which detected enemy activity by noting acoustic or seismic disturbances within the range of the sensor. Both types were dropped from F-4 aircraft in level flight at low altitude (500-2000 feet) and at high speed (550 knots). There were five types of sensors. The Acoubuoy was an acoustic sensor dropped in areas where triple canopy jungle allowed the parachuted sensor to hang high in the trees. The Spikebuoy acoustic sensor was implanted in the ground in areas where the jungle was less dense. The ADSID and FADSID were seismic sensors implanted in the ground. The Acousid was a combination acoustic and seismic sensor. Sensors were usually deployed in strings of six to eight sensors.

An average of 72 operational sensor strings were used in Steel Tiger during the campaign. Seismic sensors detected enemy traffic by sensing seismic vibrations caused by truck movements. They constituted 88 percent of the sensors used. Acoustic sensors were used to detect truck noise and sounds associated with storage areas and construction efforts. Average sensor life was 45 days for the seismic sensors and 14 days for the acoustic sensors. Each sensor had a self-destruct feature which was activated by a timer or an anti-tamper device.

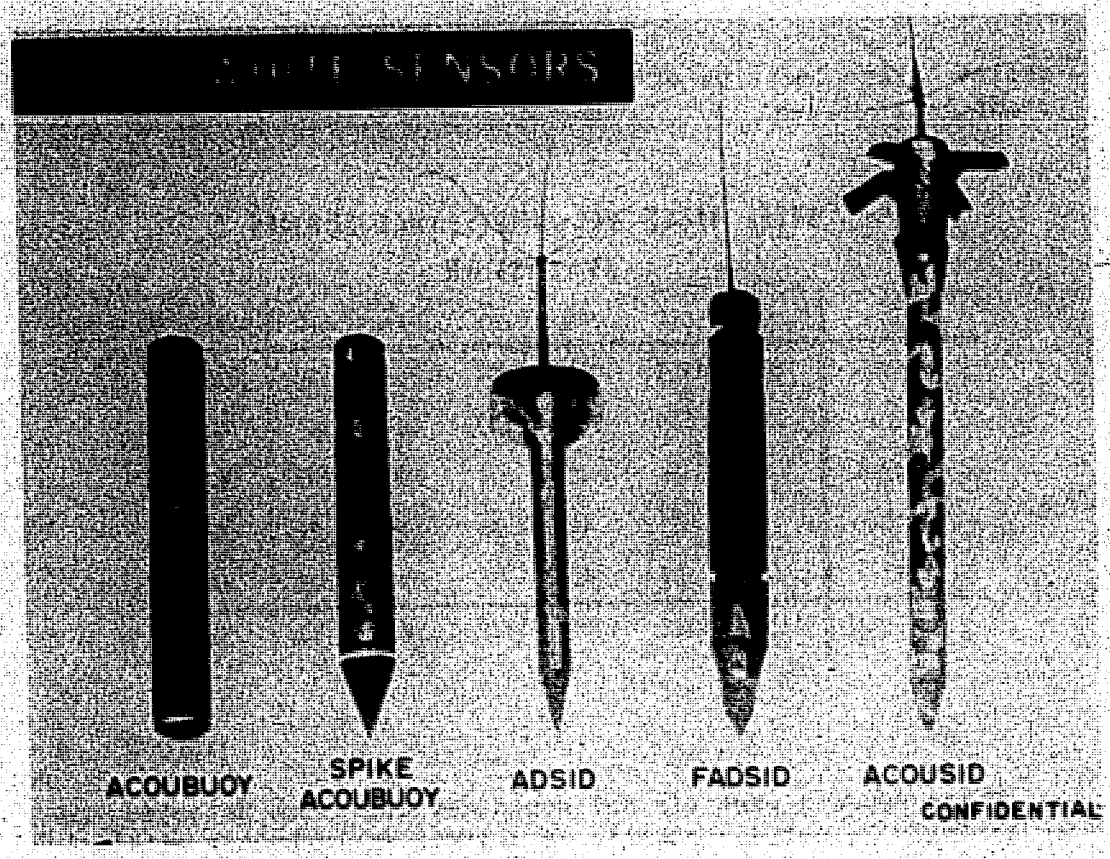


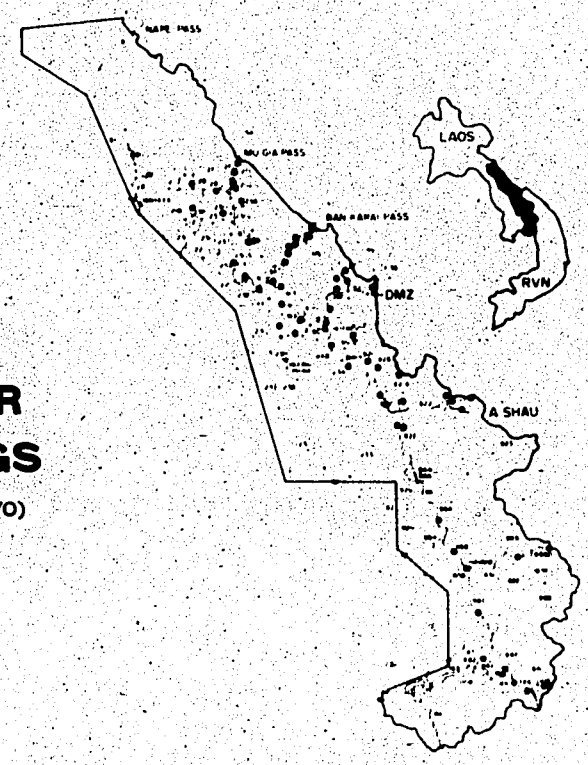
FIGURE II - 18

EC-121 aircraft received sensor activations and relayed them to the ISC at Nakhon Phanom RTAFB. The sensor relay aircraft flew specified orbits designed to keep them in range of sensor transmissions and had a manual backup capability to process sensor data in the event the ISC was unable to accept sensor information.

The ISC analyzed the sensor detections and reported truck movements to the ABCCC and Blue Chip. Figure II-19 shows the sensor field in Steel Tiger. A more detailed account of the Igloo White system is given in Appendix A.

Road Watch Teams

Sensor detections were supplemented by reports from Lao road watch teams situated at key points on the LOCs. These teams radioed information on truck sightings to U.S. monitors who passed on information of particular interest to Blue Chip. Because strike operations in the vicinity of the teams were suspended, the presence of a road watch team sometimes prevented strikes against significant enemy activity.



ACTIVE SENSOR STRINGS
(20 APRIL 1970)

FIGURE II - 19

Strike Resources

Strike resources consisted of jet fighter and attack aircraft, the A-1 propeller driven attack aircraft, transports modified as attack aircraft, B-52 heavy bombers, and their associated munitions. These resources provided the capability to strike a wider spectrum of targets under a variety of delivery conditions. Visual bombing was the preferred and most effective attack mode, but nonvisual capabilities were also available and used. The Air Force flew the F-4, F-100, F-105, A-1, AC-119K, AC-123, and AC-130. The Navy and Marines flew the A-4, A-6, A-7, and F-4.

STRIKE AIRCRAFT

TYPE ACFT/RTS	FUNCTIONS	MOST USED WEAPONS
F-4 JET/600	FIGHTER-BOMBER, SENSOR DROP, ESCORT, FLAK SUPPRESSION, FAC (DAYTIME), HERBICIDE DAY, AND NIGHT MISSIONS, ON STATION TIME 10-15 MINUTES.	MK 82, M117, CBU-24/49, LAU-3, CBU-42, BLU-27, MK 84 PAVEWAY, ROCKEYE, 20MM GUN, FLARE.
F-105 JET/500	FIGHTER-BOMBER, IRON HAND, FLAK SUPPRESSION, DAY MISSIONS PRIMARILY, ON STATION TIME 10-15 MINUTES.	MK 82, M117, MK 84, CBU-24/49, LAU-3, AGM-12, 20MM GUN.
F-100 JET/460	FIGHTER-BOMBER, FAC (F-100F MODEL ONLY), DAY MISSIONS PRIMARILY, ON STATION TIME 10-40 MINUTES.	MK 82, M117, BLU-27, 20MM GUN, FLARES.
A-7 JET/460	DAY AND NIGHT TCP, STORAGE AREA, TRUCKS, ON STATION TIME AVERAGE 20 MINUTES.	2-20MM, MK 82.
A-4 JET/430	DAY AND NIGHT PERISHABLE TARGETS, TRUCKS (POUNCER), ON STATION TIME AVERAGE 20 MINUTES.	M117, BLU-27, MK 82, ROCKETS, ROCKEYE, 2-20MM.
A-6 JET/420	ALL WEATHER BOMBING, TRUCKS (POUNCER), ON STATION TIME AVERAGE 20 MINUTES.	MK 82, FLARES, ROCKEYE AND OTHER CBU.
A-1 PROP/250	ATTACK, TRUCK KILLER, SAR ESCORT AND CONTROL; DAY AND NIGHT MISSIONS, ON STATION TIME 2 1/2 - 3 1/2 HOURS.	MK 82, M117, M1A4, M36, BLU-27, BLU-32, CBU-24/49, CBU-25, 20MM GUN.
AC-130 TURBO-PROP/150	GUNSHIP II, TRUCK KILLER MOSTLY NIGHT MISSIONS, ON STATION TIME 3-3 1/2 HOURS, HAS IR, LLLTV, AND STARLIGHT SCOPE.	20MM AND 7.62MM GUNS, FLARES.
AC-130 TURBO-PROP/150	SURPRISE PACKAGE, TRUCK KILLER NIGHT MISSIONS, ON STATION TIME 3 HOURS, HAS FORWARD LOOKING RADAR, SIDE-LOOKING RADAR, INFRARED, LLLTV, AND BLACK CROW.	40MM AND 20MM GUNS.
AC-123 PROP/130	"GUNSHIP" TRUCK KILLER, HAS IR, ON STATION TIME 3 HOURS, LLLTV, MTI RADAR AND BLACK CROW.	12-CELLED DISPENSER: 36 CANISTERS OF BLU-26, BLU-3 BOMBLETS. (1 CELL: 531 BOMBLETS).
AC-119K PROP/145 JET	GUNSHIP III, TRUCK KILLER, NIGHT MISSIONS ON STATION TIME 3 HOURS, HAS NIGHT OBSERVATION SIGHT, INFRARED AND SIDE LOOKING RADAR.	20MM AND 7.62MM GUNS, FLARES.

TABLE II - 10

Over 53,000 strike sorties were flown during the Commando Hunt III campaign. The Air Force flew 58, the Navy 36, and the Marines 5 percent of the total.

STRIKE SORTIES IN STEEL TIGER

(NOVEMBER 1969 - APRIL 1970)

SERVICE	AIRCRAFT	SORTIES	PERCENT OF TOTAL	SERVICE	AIRCRAFT	SORTIES	PERCENT OF TOTAL
AIR FORCE	F-4	19,452	36.5	NAVY	A-7	10,123	19.0
	F-100	4,084	7.7		A-4	4,367	8.2
	A-1	4,067	7.6		A-6	2,977	5.6
	F-105	2,049	3.8		F-4	1,863	3.5
	AC-130	807	1.5		TOTAL	19,330	36.3
	AC-119	501	.9	MARINE	A-6	1,254	2.4
	AC-123	151	.3		F-4	1,157	2.2
	A-26	69	.1		A-4	398	.7
	TOTAL	31,180	58.4		TOTAL	2,809	5.3
				TOTAL SORTIES		53,319	100.0

TABLE II - 11

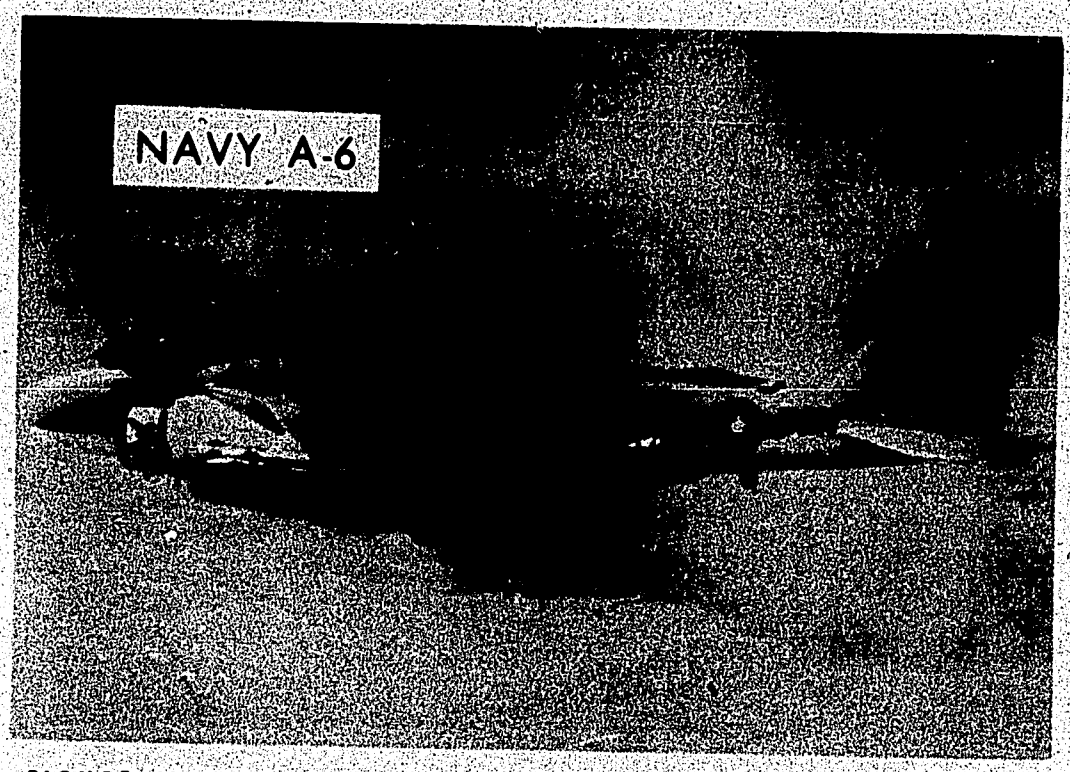


FIGURE II - 20

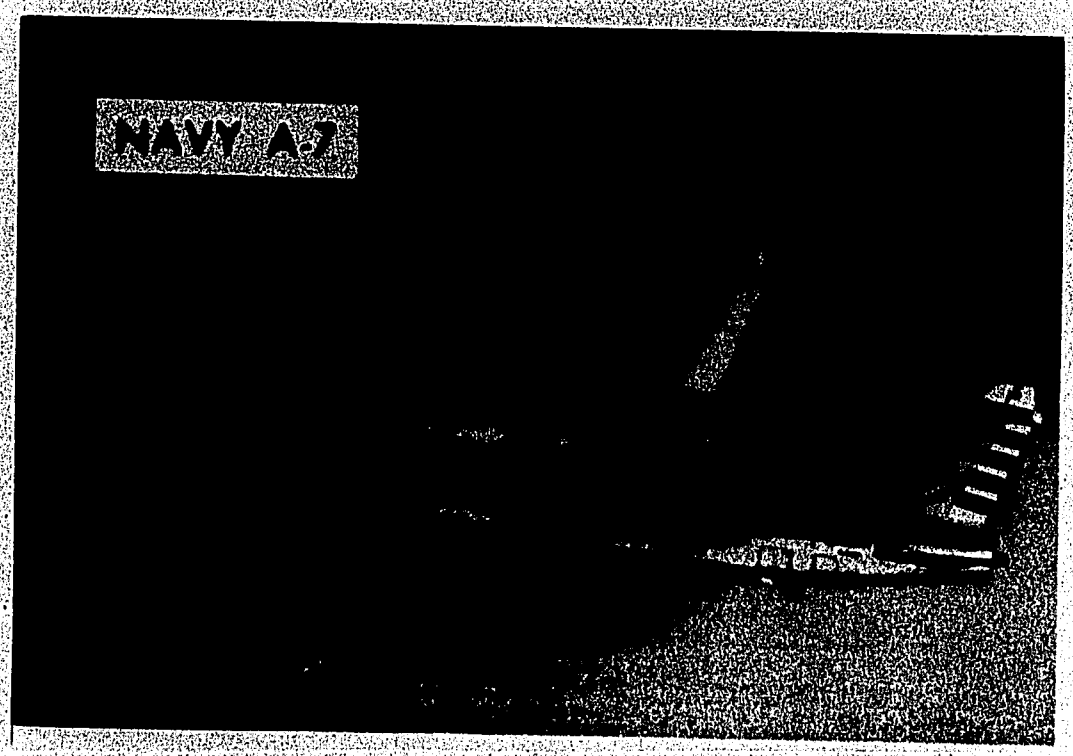


FIGURE II - 21

AIR FORCE F-4

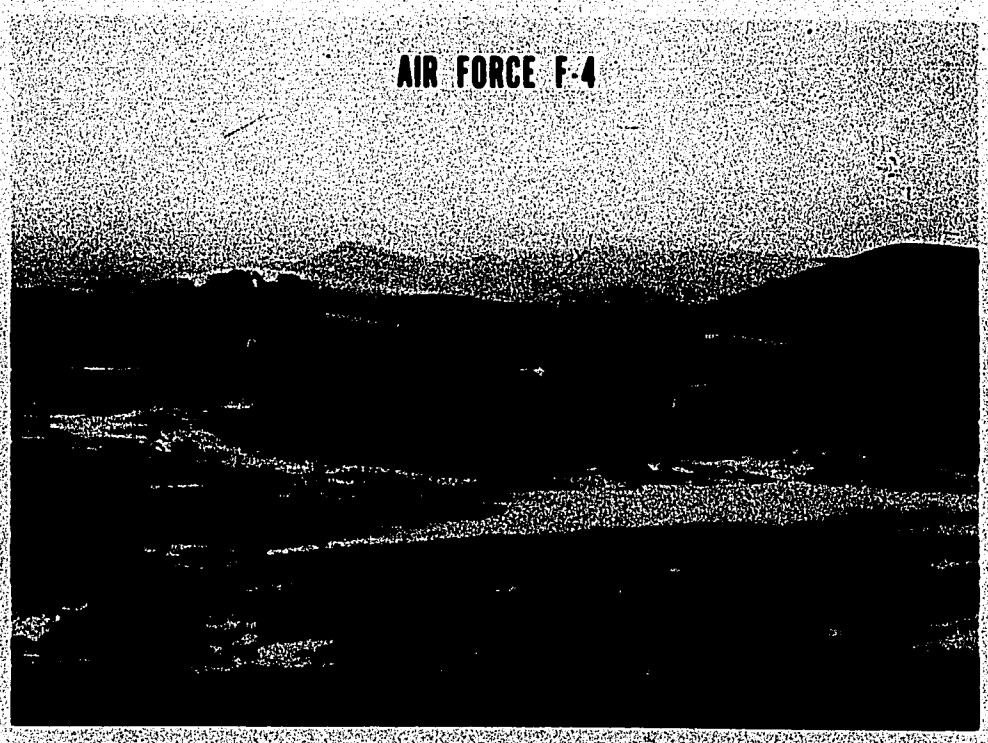


FIGURE II - 22

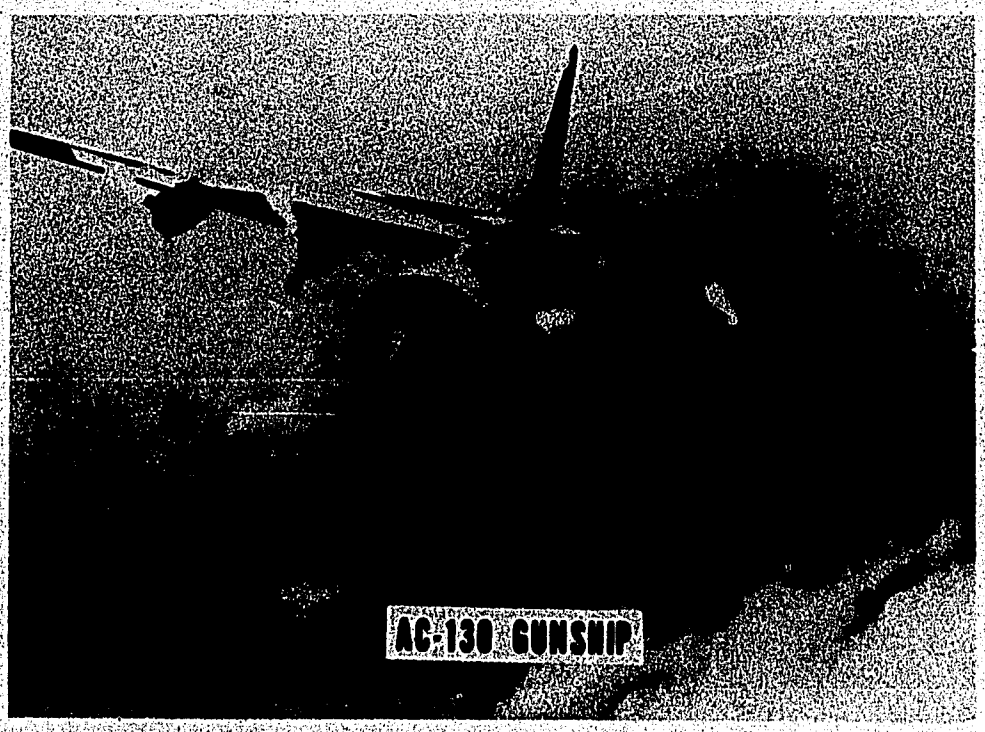


FIGURE II - 23

The variety of munitions available during Commando Hunt III matched the corresponding broad spectrum of delivery systems. Area denial munitions, time-delay fused bombs, fragmentation bombs, air-to-ground missiles, and incendiary weapons were used in combination with standard inventory general purpose bombs. Table II-12 shows munitions used against each target category.

A description of gunship technology and munitions is given in Appendix C. Weapons delivery parameters and bombing accuracy by aircraft and munitions type are discussed in Appendix D.

MUNITIONS AND INTERDICTION TARGETS

MUNITIONS	TARGETS				
	LOC	TKP/STO	TRUCKS	AAA	PERSONNEL
M1A4					X
M36		X	X		
MK 36	X				
MK 82	X			X	
MK 82 (FE)		X	X		
MK 84	X			X	
M117	X		X	X	
M117 (FE)		X			
BLU-23		X	X		X
BLU-27		X	X		
BLU-32		X	X		X
CBU-2		X	X		X
CBU-14		X	X		X
CBU-24		X	X	X	X
CBU-25					X
CBU-39	X				
CBU-42	X				
CBU-49		X	X	X	X
ADU-253			X		
ADU-272			X		
AGM-12	X				
ROCKEYE			X	X	
PAVEWAY I	X			X	
LAU-3		X	X	X	
FMU-72	X				
7.62MM					X
20MM		X	X		X
40MM			X		

TABLE II - 12

Arc Light

B-52 heavy bombers of the Strategic Air Command supplemented the tactical air strike resources. Designated Operation Arc Light, the B-52s flew from Kadena AB, Okinawa; Andersen AFB, Guam; and U Tapao RTAFB, Thailand against targets in both RVN and Laos. The bomb loads consisted of MK82 and M117 500 and 750 pound general purpose bombs.

ARCLIGHT SORTIES AND MUNITIONS LOADS STEEL TIGER 1 NOVEMBER—30 APRIL

		BOMB LOAD		
BASE	SORTIES	MK 82	M117	TOTAL
U TAPAO	2557	84	24	108
KADENA	1093	24	42	66
ANDERSEN	489	24	42	66
	SORTIES			BOMBS
TOTALS	4139			380,568

TABLE II - 13

The B-52s bombed specially selected area targets where there were concentrations of enemy supplies and equipment. The target nomination, selection, and validation process was designed to insure that only the highest priority targets were struck by the B-52s. The allocation of B-52 sorties to interdiction operations varied due to requirements within RVN. A total of 4139 B-52 sorties was flown in Steel Tiger during Commando Hunt III.

Target Development

Target selection involved a careful balancing of priorities, the rules of engagement (ROE), and responsiveness to changing enemy posture and tactics. The key to target development and selection was the application of near real-time intelligence. Information derived from the ISC sensor system and airborne multi-sensor reconnaissance made possible a quick response to shifting enemy tactics. The Tiger Out-Country Active Target List (TOCATL) was published weekly and updated daily. It contained all priority targets. The list was based on information

obtained from all intelligence sources: photo, visual, infrared (IR), side-looking radar (SLAR), and airborne radio direction finding (ARDF) reconnaissance; controlled American sources (CAS); sensor data analyzed by TFA; Daily Intelligence Summaries (DISUMs) submitted by FAC and reconnaissance units; special intelligence (SI); and visual sightings by strike crews.

The enemy activity reported by these sources was filed in a multi-source activity file and plotted on a wall map. If the reported activity was associated with a target on the Tiger target list and if the target had been validated for strike within the rules of engagement, it was passed to the operations planners for possible strike. If the activity was a new target and no photography was available, a reconnaissance request was initiated. If the target had not been previously validated, a request for validation was submitted to the American Embassy in Vientiane. The process is presented in Figure II-24.

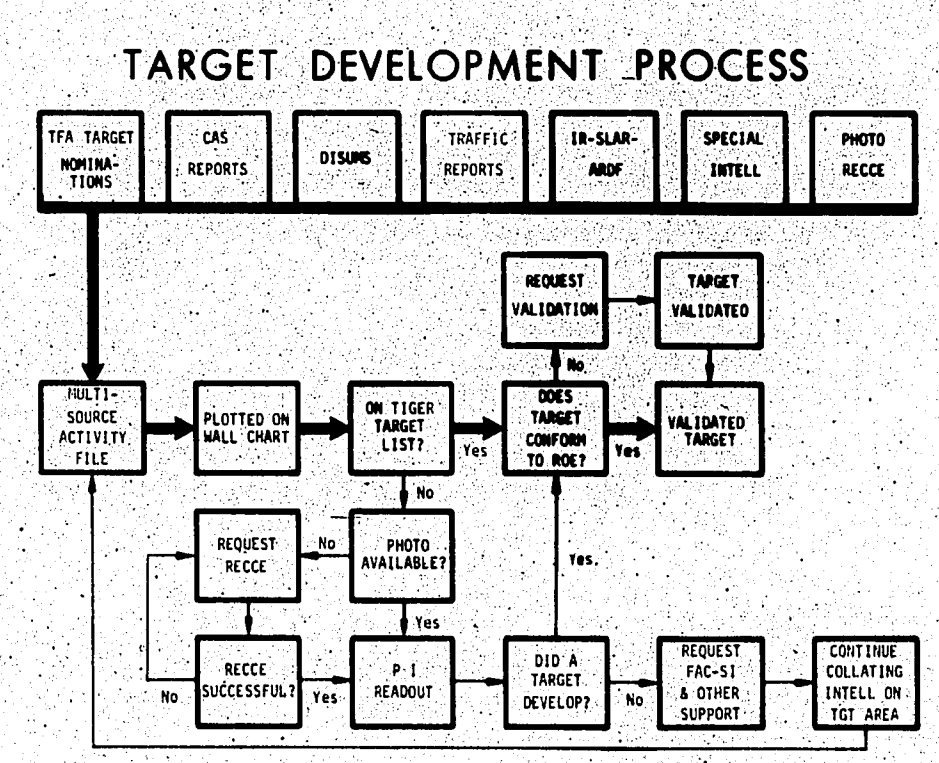


FIGURE II - 24

Strike Planning and Execution

The validated targets were examined jointly by intelligence and operations planners. They selected the targets to be struck following the priorities established by the commander in daily staff planning conferences. They considered the strike sorties, tankers, and ordnance combinations available in making a tentative force allocation to specific target categories. Weather forecasts were checked and target times were coordinated prior to publishing the daily fragmentary operations order 48 hours in advance of execution. Adjustments were made if required prior to execution. The planners analyzed strike results and scheduled additional strikes as necessary. This process is diagrammed in Figure II-25.

STRIKE PLANNING AND EXECUTION CYCLE

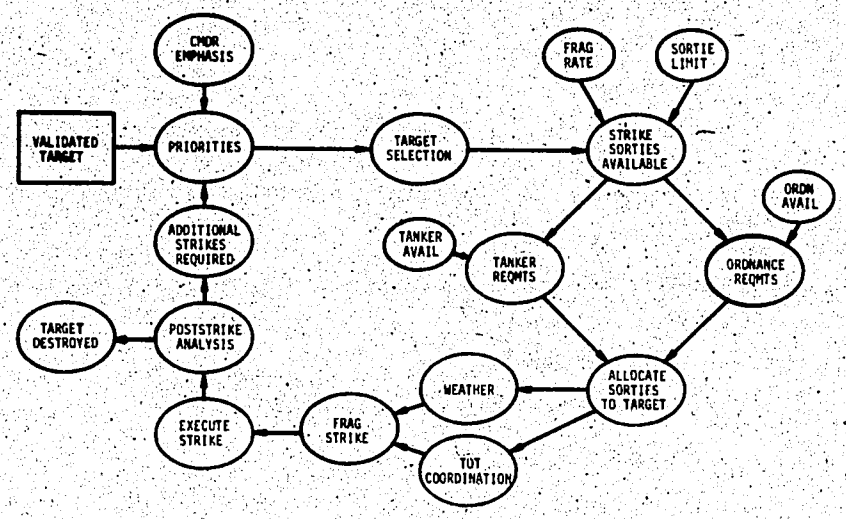


FIGURE II - 25

The end result of the process of data collection, target development and selection, and resource allocation was the operations frag order. Following is a summary of the 15 April 1970 allocation that resulted from the 13 April frag order.

SUMMARY, STEEL TIGER SCHEDULE

15 APRIL 70

STRIKE FORCE				SUPPORT FORCE	
DAY	SORTIES	NIGHT	SORTIES		SORTIES
● TRUCK PARKS AND STORAGE AREAS WEST OF DMZ, NORTH OF DELTA 45 IDPs, AND EASTERN PORTIONS OF ROUTES 922 AND 966	64	● ABCCC FOR TARGETS OF OPPORTUNITY	47	● FACs	73
● MUNITIONS PACKAGES, DELTA 45	34	● TRUCKS ON HIGHER THREAT ROUTES NOT COVERED BY GUNSHIPS	24	● PHOTO RECONNAISSANCE	29
● LOC ROAD CUTS WEST OF DMZ AND ON ROUTES 922, 966, AND 110	18	● FACs FOR TARGETS OF OPPORTUNITY	24	● TANKERS	22
● EARLY MORNING NAVY SORTIES TO ABCCC FOR TARGETS OF OPPORTUNITY	10	● GUNSHIP ESCORT	21	● ELECTRONIC RECCE, ECM, INTELLIGENCE	8
● AAA POSITIONS IN DELTA 45 AREA	3	● COMMANDO BOLT IN BAN KARAI AREA	15	● ARMY SLAR RECCE	7
		● TRUCKS ON ROUTES SUITABLE FOR GUNSHIP OPERATIONS	9	● SEARCH AND RESCUE AIRBORNE ALERT	4
		● MK-36s ON DELTA 45 IDPs	7	● SPECIAL OPERATIONS	7
		● LORAN STRIKE AIRCRAFT TEAMED WITH SURPRISE PACKAGE	2	● SENSOR RELAY	7
				● SENSOR DELIVERY	4
				● ABCCC	2
				● SAM RADAR SUPPRESSION	4
				● MIG COMBAT AIR PATROL	4
				● WEATHER RECONNAISSANCE	1
TOTALS	129		149		172
		TOTAL STRIKE	278	TOTAL STRIKE & SUPPORT	450

TABLE II - 14

Both 7AF and MACV J-2 nominated targets for out-country B-52 Arc Light strikes. Arc Light targets in Steel Tiger were validated by the U.S. Ambassador to Laos. Targets within specific geographic areas, called Special Arc Light Operating Areas (SALOAs), received continuing blanket validation. Arc Light target selections were made by the MACV target selection panel 24 hours in advance of execution. Chaired by the MACV Assistant Chief of Staff for Operations, the selection panel was composed of representatives of the MACV J-2 and J-3 with SAC ADVON and 7AF representatives acting as advisors. Eighth Air Force scheduled the missions and maintained operational control of the force. Execution orders came from Headquarters, Strategic Air Command. Figure II-26 illustrates the daily decision process and interagency coordination.

ARCLIGHT STRIKE PLANNING AND EXECUTION

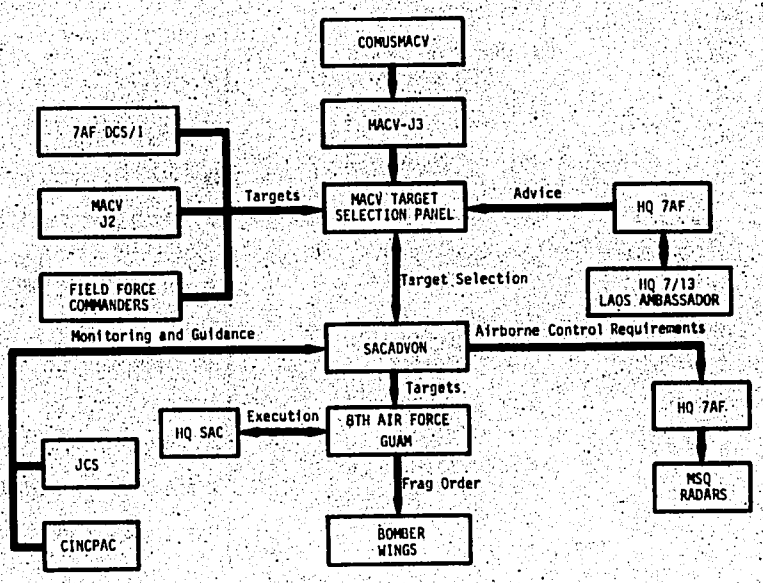


FIGURE II -26

SUMMARY

To resupply his forces in RVN through Laos, the enemy marshaled greater resources during the 1969-70 dry season than ever before. He used new entry routes, expanded his road net, truck inventory, and defenses, built POL pipelines, and converted rivers into supply channels.

The U.S. interdiction forces used tactics that had proven successful in the past, making adjustments where necessary. Total resources available for interdiction were reduced, but there were qualitative improvements within the force, principally the gunships and munitions.

There was emphasis on intelligence gathering in all aspects of interdiction planning to adjust targeting to enemy initiatives. The results of the campaign are summarized in the next chapter.

CHAPTER III

INTERDICTION RESULTS

OVERVIEW

The results of the interdiction campaign must be viewed as an entity. Attacks against each target category within the interdiction target system made a significant contribution to the objective of the campaign--to reduce the quantity of supplies reaching South Vietnam and to increase enemy costs.

Attacks against trucks destroyed both the trucks and the supplies carried in the trucks. Strikes against truck parks and storage areas destroyed additional trucks and supplies. Complementing these attacks were those against lines of communication and enemy defenses. Road cuts and area denial munitions packages emplaced on enemy lines of communication blocked truck traffic and channeled it onto roads where jungle cover and enemy defenses were less dense. Traffic was consequently exposed to air attack for longer periods. The suppression of enemy defenses reduced aircraft losses and permitted more effective attack tactics. Although each of these target categories is treated separately in this chapter, the cumulative effect of the interdiction campaign was the product of attacks against the entire enemy logistics system in southern Laos.

Following a description of results of attacks against each target category, this chapter discusses the disposition of enemy supplies that entered Laos and were either destroyed, consumed, stored, or transported to South Vietnam. The discussions provide a quantitative measure of the impact of the interdiction campaign.

Level and Allocation of Effort

Table III-1 summarizes the level of effort and allocation of tactical air strike sorties by target type during Commando Hunt III. The source of these statistics was the L and N Data Base described in Appendix E.

For the entire campaign, 53,319 tactical air sorties were flown for a daily average of 295--twenty-six percent less than the daily average of 401 flown during Commando Hunt I. The reason for the decrease is threefold. First, budget considerations forced placement of a ceiling of 14,00 tactical air strike sorties per month for 7AF operations, effective 1 September 1969. Sixty

TACTICAL AIR SORTIES FLOWN BY TARGET TYPE AND MONTH
STEEL TIGER

MONTH		TRUCKS	TKP/STO	LOC	AAA	OTHER	TOTAL	DAILY AVERAGE
NOV 69	SORTIES	1591	2556	2720	507	806	8180	273
	PERCENT	20	31	33	6	10		
DEC 69	SORTIES	3016	2651	2108	1641	981	10397	335
	PERCENT	29	26	20	16	9		
JAN 70	SORTIES	3647	2948	1525	1269	1061	10450	337
	PERCENT	35	28	15	12	10		
FEB 70	SORTIES	2983	2669	1118	1067	770	8607	307
	PERCENT	35	31	13	12	9		
MAR 70	SORTIES	2765	2247	2006	1069	748	8835	285
	PERCENT	31	25	23	12	9		
APR 70	SORTIES	2357	1474	1555	928	537	6851	228
	PERCENT	34	21	23	14	8		
TOTAL								
	SORTIES	16,359	14,545	11,032	6,481	4,902	53,319	295
	PERCENT	31	27	21	12	9		

TABLE III - 1

percent of these Air Force sorties were normally allocated to out-country strikes. Second, 7AF policy to conserve resources by carefully scrutinizing all requirements for sorties resulted in a monthly saving of approximately 300 sorties. Third, some 3450 sorties per month were required for support of Royal Lao Government Forces in northern Laos, as compared to 2000 per month during Commando Hunt I. The distribution of strike sorties between Steel Tiger and Barrel Roll is given in Table III-2. The Barrel Roll area of northern Laos required 28 percent of all out-country strike sorties.

The dynamics of the interdiction campaign are reflected in the allocation of tactical air sorties to the various target categories shown in Figure III-1. The emphasis varied throughout the campaign as a result of interaction between enemy resupply activity and interdiction tactics. As enemy truck traffic increased to an all-time high in January and February,

OUT-COUNTRY TACTICAL AIR SORTIES BY AREA

AREA		NOV	DEC	JAN	FEB	MAR	APR	TOTAL
STEEL TIGER	SORTIES	8179	10397	10450	8607	8835	6851	53,319
	PERCENT	73	76	76	68	72	66	72
BARREL ROLL	SORTIES	3079	3280	3415	4019	3458	3518	20,796
	PERCENT	27	24	24	32	28	34	28
TOTAL		11258	13677	13865	12626	12320	10369	74,115

TABLE III - 2

there was a corresponding sharp increase in sorties against trucks. The number of sorties assigned to lines of communication declined from a high early in the campaign as it became evident that attacks against LOCs were less productive than during Commando Hunt I. Three reasons were the proliferation of the NVA road network in Laos, the complications of weather, and increased enemy defenses. The enemy's effort to move supplies into RVN during March and April, however, was met by increased attacks against interdiction points in southern Steel Tiger. The attacks reduced the quantity of supplies finally reaching South Vietnam. Sorties against enemy defenses reached a high in December when there were especially heavy attacks to destroy enemy AAA.

SORTIE TARGET DISTRIBUTION BY MONTH
DAILY AVERAGE

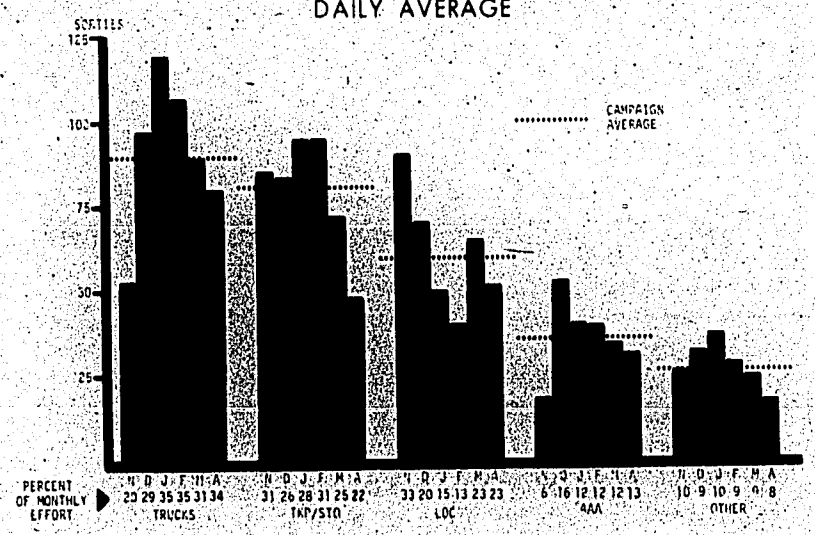


FIGURE III - 1

The absolute number of sorties flown per month varied, so that small changes in the daily averages from month to month within a target category in Figure III-1 should not be viewed as a shift in emphasis. The percentage of effort to each target type by month is given on the lower scale.

The L and N Data Base categorized sorties by the first target struck, even if aircraft made subsequent attacks against targets in other categories during the same mission. The distribution of attacks by target type for January is given in Figure III-2. The distribution of the first attack or sortie type is given at the top. The two center sets of bars give the distribution of second and succeeding attacks. The bottom set of bars gives the level of effort based on total attacks. The level of effort based on total attacks was more heavily weighted toward trucks and AAA than if based on the sortie or first attack distribution, showing the priority given these two targets.

LEVEL OF EFFORT BY ATTACKS
(JANUARY 1970)

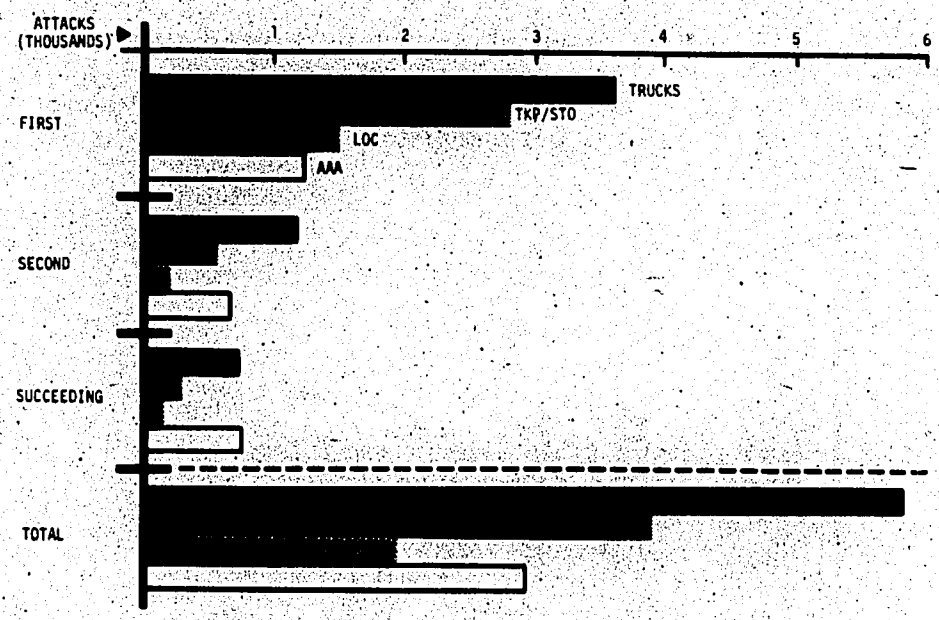


FIGURE III - 2

Table III-3 presents the number of tactical air sorties for the campaign broken out by target category and aircraft type. Gunships were used primarily against trucks whereas other aircraft struck a variety of targets.

TACTICAL AIR SORTIES FLOWN BY TARGET TYPE AND AIRCRAFT
STEEL TIGER

1 NOVEMBER 1969 - 30 APRIL 1970

AIRCRAFT		TRUCKS	TKP/STO	LOC	AAA	OTHER	TOTAL	DAILY AVERAGE
SURPRISE PACKAGE	SORTIES	112	-	-	-	-	112	0.8
	PERCENT	110	-	-	-	-		
OTHER AC-130	SORTIES	591	61	1	21	21	695	3.8
	PERCENT	85	9	-	3	3		
AC-123	SORTIES	141	2	-	-	8	151	1.0
	PERCENT	94	1	-	-	6		
AC-119	SORTIES	435	32	1	5	28	501	3.4
	PERCENT	87	6	-	1	6		
A-1	SORTIES	2332	417	72	381	865	4067	22.5
	PERCENT	58	10	2	9	21		
A-4	SORTIES	1223	1835	856	424	427	4765	26.3
	PERCENT	26	38	18	9	9		
A-6	SORTIES	1486	1222	1125	161	237	4231	23.4
	PERCENT	35	29	26	4	6		
A-7	SORTIES	3147	2894	2489	875	718	10123	55.9
	PERCENT	31	28	25	9	7		
F-4	SORTIES	6310	5928	4420	4067	1747	22472	124.2
	PERCENT	28	26	20	18	8		
F-100	SORTIES	300	1243	1897	248	396	4084	22.6
	PERCENT	7	30	47	6	10		
F-105	SORTIES	220	906	171	299	453	2049	11.3
	PERCENT	11	44	8	15	22		
A-26*	SORTIES	62	5	-	-	2	69	2.3
	PERCENT	90	7	-	-	3		
TOTAL	SORTIES	16359	14545	11032	6481	4902	53319	294.6
	PERCENT	31	27	21	12	9		

*A-26 SQUADRON DEACTIVATED IN NOVEMBER

TABLE III - 3

Supplementing these tactical air sorties were the B-52 Arc Light sorties shown in Table III-4 below. There was a gradual increase in Arc Light sorties over the first five months of

the campaign as fewer B-52 strikes were required in RVN because of reduced enemy activity prior to April. These sorties were used primarily against truck parks and storage areas and proved particularly effective.

ARC LIGHT SORTIES

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
TOTAL SORTIES	531	616	615	919	893	565	4139
DAILY AVERAGE	18	20	20	33	29	19	23

TABLE III - 4

Target Damage Survey

The target damage by tactical air and Arc Light sorties is presented in Table III-5. The target damage assessment information is based on data recorded in the Mission Summary File described in Appendix E.

The estimate of target damage was influenced by a number of factors. Results were hard to observe because of poor weather, dust, smoke, and foliage over the target. These conditions were particularly prevalent in truck parks and storage areas where thick foliage and tree canopies concealed much of the damage inflicted. In addition, enemy defenses often forced strike and FAC crews to leave the target area before a complete evaluation of damage could be made. During Commando Hunt III, results were not observed (RNO) for 35 percent of the total sorties flown. For this reason, the recorded damage assessment is a conservative estimate of the total damage from all air strikes.

Another factor influencing damage reports was the requirement to conform to specific definitions of damage. For example, if the observed damage did not meet the following criteria it could not be recorded:

A destroyed truck was one no longer visible after a direct bomb hit, one observed burning with flames visible, or a mass of twisted metal after a strike. A destroyed truck was one rendered unusable and irreparable after strike.

A damaged truck was one observed after the strike to have parts missing such as the hood, fenders,

OBSERVED TARGET DAMAGE

TYPE TARGET	NOV	DEC	JAN	FEB	MAR	APR	TOTAL	DAILY AVERAGE
TRUCKS								
DESTROYED	613	731	1462	1426	1136	1060	6428	35.5
DAMAGED	256	564	769	693	643	679	3604	19.9
SECONDARY EXPLOSIONS	1666	1165	1532	1961	1906	2232	10462	57.8
SECONDARY FIRES	931	1458	2598	2408	2350	1792	11537	63.7
TRUCK PARK/ STORAGE AREAS								
TACTICAL AIR								
SECONDARY EXPLOSIONS	1045	668	813	882	1975	1133	6516	36.0
SECONDARY FIRES	928	910	1104	1194	1374	672	6182	34.2
ARC LIGHT								
SECONDARY EXPLOSIONS AND FIRES	961	1150	1257	2622	2110	484	8584	47.4
LINES OF COMMUNICATION								
CUTS, CRATERS, SLIDES	984	390	475	572	880	452	3753	20.7
BRIDGES DESTROYED	7	5	5	5	1	3	26	0.1
BRIDGES DAMAGED	6	2	4	4	2	0	18	0.1
BULLOOZERS DESTROYED	4	4	2	3	11	6	30	0.2
BULLDOZERS DAMAGED	2	5	3	6	6	8	30	0.2
SECONDARY EXPLOSIONS	71	89	50	23	13	25	271	1.5
SECONDARY FIRES	117	105	64	30	83	19	418	2.3
AAA POSITIONS								
DESTROYED	43	153	100	72	103	77	548	3.0
DAMAGED	17	26	40	33	48	38	202	1.1
SECONDARY EXPLOSIONS	117	385	295	241	542	270	1850	10.1
SECONDARY FIRES	85	356	383	374	443	206	1847	10.2
PERSONNEL								
KILLED	25	54	122	186	388	104	879	4.9
WOUNDED	25	2	1	27	1	6	62	0.3
MISCELLANEOUS								
STRUCTURES DESTROYED	294	166	273	165	188	148	1234	6.8
STRUCTURES DAMAGED	51	48	114	54	81	72	420	2.3
WATERCRAFT DESTROYED	14	14	21	3	13	3	68	0.8
WATERCRAFT DAMAGED	3	11	9	1	2	10	36	0.2
SECONDARY EXPLOSIONS	78	98	77	48	75	47	423	2.3
SECONDARY FIRES	204	146	240	289	144	114	1137	6.3

TABLE III - 5

wheels, or portions of the undercarriage, one which was stopped and obviously unable to continue, or one overturned with no fire or explosion. Trucks determined as "possibly" destroyed were recorded as damaged. Trucks determined as "possibly" damaged were not recorded in the damaged truck count.

Secondary fires and explosions were reported as small, medium, or large, and by color and type (ammo, POL). A medium secondary explosion was defined as equivalent to the size of the detonation of a 750-pound bomb. A small secondary explosion was equivalent to one 10 times less than a medium size explosion, while a large secondary was equivalent to one 10 times greater. Secondary fires and explosions were only those which were caused as a result of the ordnance dropped and not the fire or explosion directly associated with the burst of the ordnance.

Any evaluation of the reliability of target damage data for the campaign as a whole must be considered in light of all these factors. The difficulty of observing all actual target damage and the possibility of misinterpreting evidence of target damage are obvious. If the RNO sorties, for instance, averaged the same target destruction as that reported on other sorties, the overall damage has been understated by 35 percent. This figure is probably an upper limit because one reason for sorties reporting RNO was that no damage occurred. On the other hand, if the RNO sorties averaged 50 percent of the actual damage inflicted by the other sorties, the reported damage could have been overstated by 27 percent and the published results would still be accurate (see the broken line in Figure III-3). The trade-off line between RNO sortie effectiveness and possible overestimates of reported damage is also plotted. To keep the figures conservative, this plot assumes an overestimate of target damage for RNO sorties to the same degree as that for other sorties. Offsetting any overestimate on some strikes is the fact that no damage was reported on others. On balance, the reported destruction is a reasonable estimate and the most accurate available, given the combat environment.

TRUCKS

One of the primary goals of the Commando Hunt III campaign was to make logistics movements as expensive to the enemy as possible. To that end, the interdiction campaign emphasized attacks against moving trucks--the target category yielding the greatest direct damage to the enemy's supplies and equipment.

TRADE-OFF BETWEEN DAMAGE ESTIMATES
AND RESULTS NOT OBSERVED

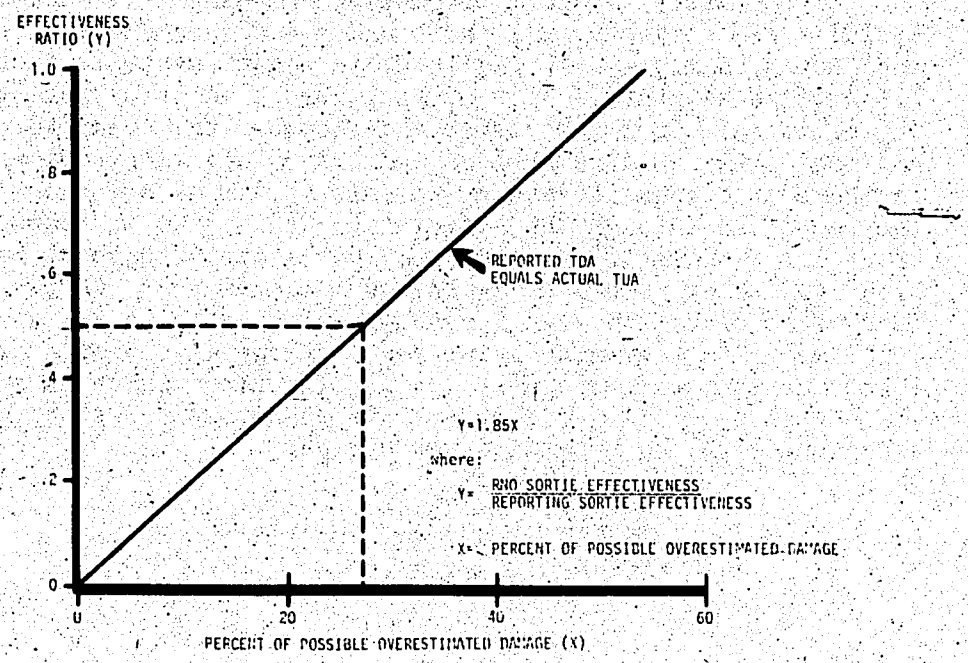


FIGURE III - 3

The results of the Commando Hunt III truck attacks presented in the following sections must not be viewed out of context. While not always obvious, the interplay between strikes against the various target categories is implicit in the results presented here. Gunships, for instance, required two or three fighter escorts for each sortie they flew. Since the escorts were normally reported as sorties against enemy defenses, their contribution to the truck kill operation might be overlooked. The attacks against LOCs produced little direct destruction of enemy supplies even though the indirect effects were significant. Road cuts caused trucks to back up and forced the enemy to use longer routes with greater risk from air attack. The interdependence of attacks against all target categories dictated a balanced interdiction program, and overemphasis on any one category would have been counter-productive. Attacks against trucks destroyed more tons of enemy supplies than attacks against all other target categories put together, but the effectiveness of strikes against trucks depended on the efficiency of attacks against other target categories. No part of the total interdiction campaign was separable from the whole.

Enemy Truck Movements

The sources providing information on enemy truck movements included FAC strike crews, photo and visual reconnaissance, road watch teams, and the Igloo White sensor system. Figure III-4 gives an overall view of enemy truck activity during the campaign. During November and December the enemy reopened his road networks through Laos and filled his supply pipeline. In the second week in January he initiated a major effort to push supplies through the system into RVN. Late in February there was a dramatic drop in truck movements throughout Steel Tiger following record truck losses in January and February. These losses, coupled with increased enemy activity in Barrel Roll, kept him from continuing resupply operations at a high level during March and early April. The minor surge in April was the enemy's final effort to move supplies from storage areas prior to the impending wet season.

DAILY TRUCK TRAFFIC

(NOVEMBER 69-APRIL 70)

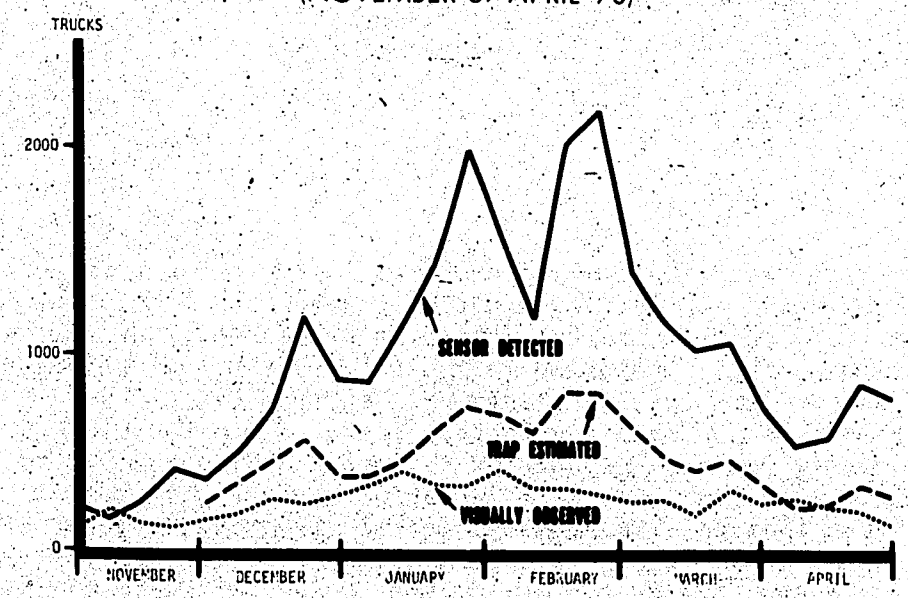


FIGURE III - 4

Truck movements detected by Igloo White sensors were a basic index of enemy truck traffic. The total, however, included duplicate counts of individual trucks which passed through more than one sensor string in a single night. The total of sensor detected trucks should not, therefore, be viewed in an absolute sense, but rather as a measure of changes

and trends in enemy activity over a period. The Traffic Analysis and Prediction Program (TRAP), used to estimate the actual number of trucks moving through the system, eliminated multiple detections within the TRAP area, which included about 70 percent of the total sensor strings. The results from the TRAP analysis were applied to the system as a whole in the following equation to determine the total number of moving trucks:

$$\frac{\text{TRAP ESTIMATED MOVING TRUCKS}}{\text{SENSOR DETECTED TRUCKS IN TRAP AREA}} \times \text{TOTAL SENSOR DETECTED TRUCKS} = \text{ESTIMATED TOTAL INDIVIDUAL TRUCKS MOVING DURING 24 HOURS}$$

The TRAP estimated statistics in Figure III-4 were calculated using this equation.

The number of trucks detected by the Igloo White sensor system was partially dependent on the size of the sensor field. A regression analysis (see Appendix E) covering the dry season operations between January 1969 and January 1970, during which both the number of sensor strings and truck detections varied markedly, indicated that each additional sensor string resulted in an increase of 90 sensor detected trucks a week, independent of the actual truck movement. The TRAP truck counts were relatively independent of sensor field size because duplicates were eliminated. A comparison between number of sensor strings and truck detections is shown in Figure III-5.

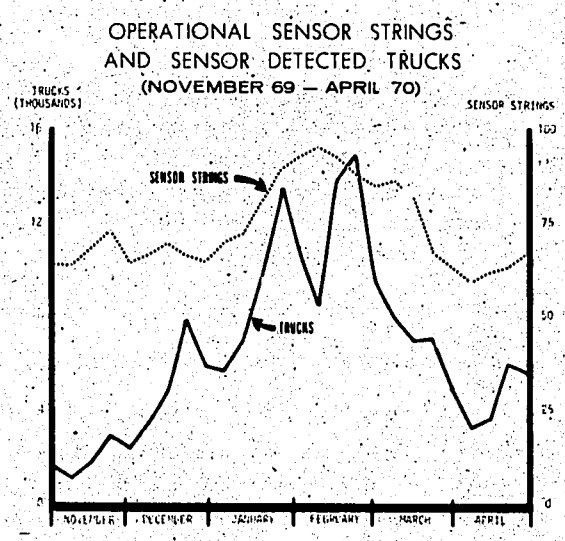


FIGURE III - 5

The number of visually observed trucks normally followed the same pattern as sensor detected trucks, especially if the trends were taken over a year's period. Visual sightings were always lower, however, because the number of trucks observed depended on the weather and the number of sorties flown.

The presence of FACs and jet fighters over Steel Tiger during the day restricted the enemy's use of the road network to hours of darkness. As illustrated in Table III-6, over 98 percent of the sensor detections were reported between 1700 and 0700 hours. The enemy's operation began as soon as the sun went down and terminated at dawn.

TIME OF SENSOR DETECTIONS

	DAILY AVERAGE SENSOR DETECTIONS						
TIME	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
0700 - 1700	3	18	15	24	14	7	13
1700 - 0700	267	715	1323	1674	948	669	926
TOTAL	270	733	1338	1698	962	676	939
PERCENT 1700 - 0700	98.9	97.5	98.9	98.6	98.5	99	98.6

TABLE III - 6

The enemy did not maintain an even flow of truck traffic during the night. A typical example of truck activity by hour is given in Figure III-6 for the period 21 to 27 January. Sixty-three percent of the traffic occurred before 2400 hours. This information was important in scheduling attack sorties, particularly gunships, over the routes at the most productive times.

Effect of Moon Illumination and Weather on Truck Traffic

Moon illumination and weather had a decided effect on the number of both sensor detected and visually observed trucks. The enemy took advantage of the phases of the moon to schedule his truck movements. As explained in Chapter I, gunships were not flown over the heavily traveled eastern route structure

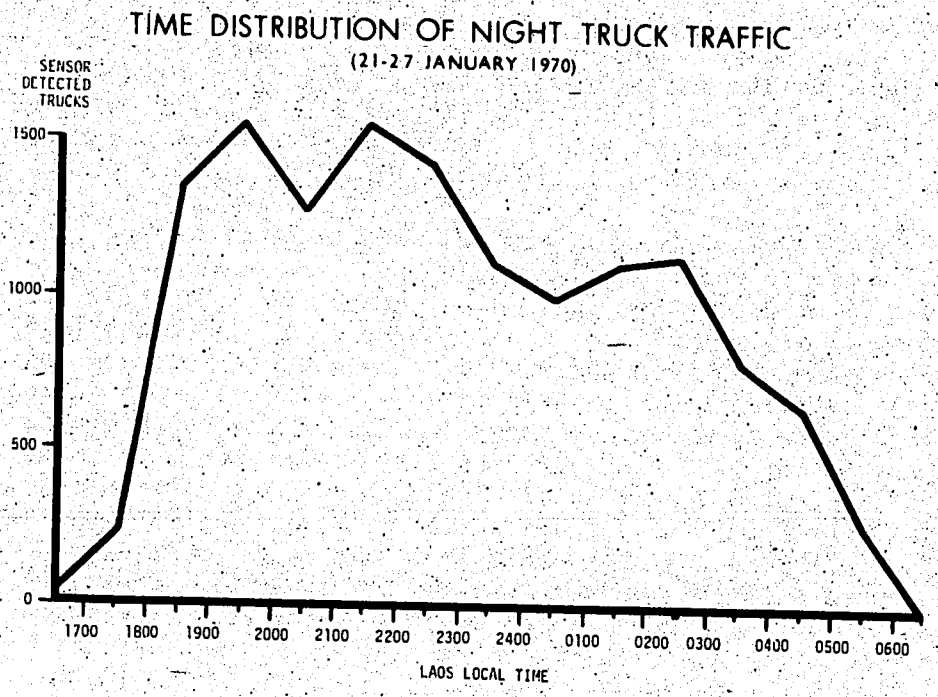


FIGURE III - 6

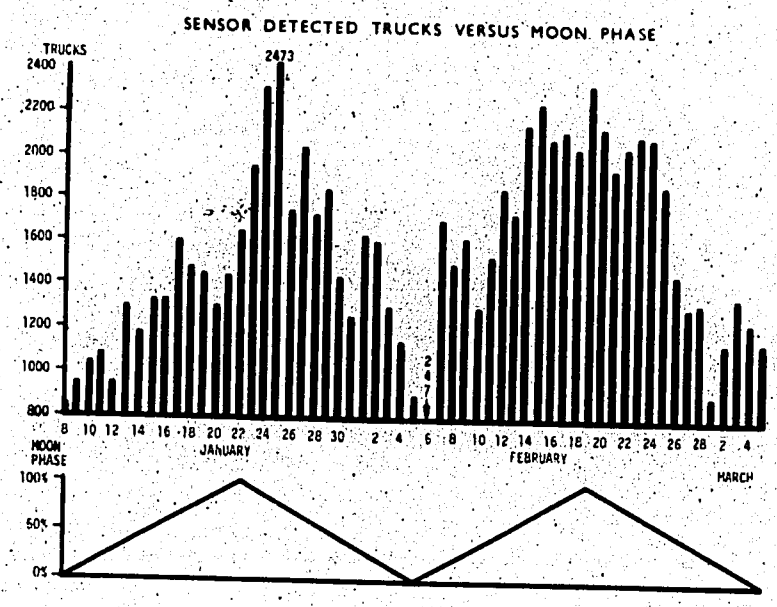


FIGURE III - 7

during periods of high moon phase because of the extensive AAA threat. Enemy trucks were also able to travel without lights when the moon illumination was high, reducing the probability that they would be observed. Such factors encouraged the enemy to increase his truck movement during periods of high moon. This increase is illustrated in Figure III-7, which compares the number of sensor detected trucks and the phase of the moon for January and February 1970.

The results of a regression analysis on the effect of the moon phase on enemy truck traffic from 1 November to 28 February are plotted in Figure III-8. The parameters of the regression equation were significant at the 99 percent confidence level. The results have been adjusted for the average increase in sensor detected trucks, three per day, which occurred during the period. The upward slope shows that the enemy truck movements increased during periods of high lunar illumination. There was an average of 617 additional sensor detected trucks as the moon phase went from 0 to 100 percent. A similar analysis on the effect of cloud ceilings shows that they were not a significant factor in the level of sensor detected truck movements. These results indicated that the enemy strategy was to move during periods of high moon illumination, but he did not attempt to adjust truck movements on the basis of more erratic weather factors.

THE EFFECT OF MOON ILLUMINATION ON TRUCK TRAFFIC

(NOVEMBER 69 - FEBRUARY 70)

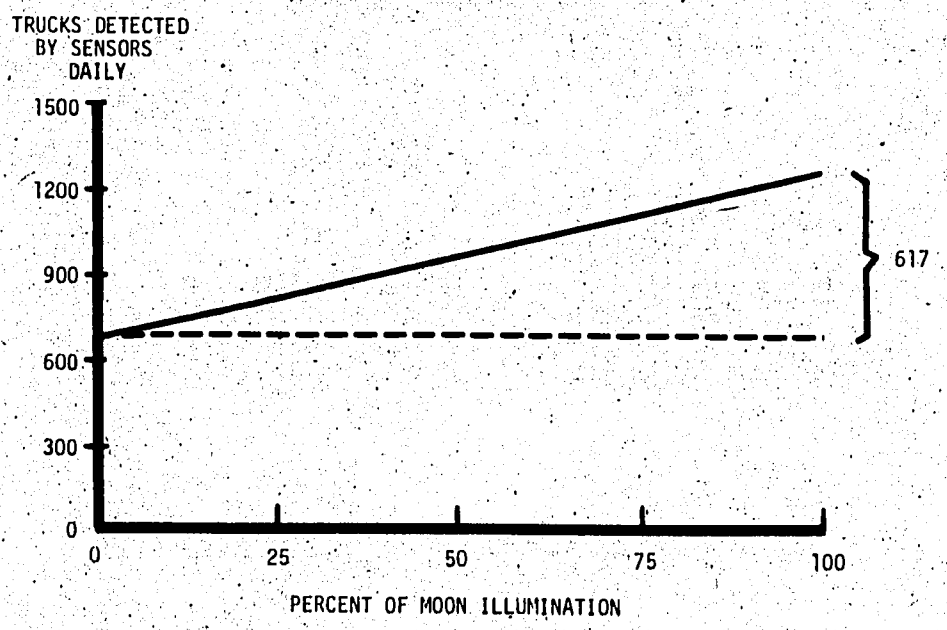


FIGURE III - 8

Figure III-9 shows the effect of moon phase and weather on visual observations. These curves have been adjusted for the average increase in visual observations. The upper curve represents observations in Steel Tiger when ceilings were greater than 5000 feet. The lower curve represents observations for ceilings 5000 feet or less. There was an average of 57 fewer trucks observed when ceilings were 5000 feet or below as measured by the distance between the two curves. A regression analysis of the influence of the moon phase on visual observation revealed that as lunar illumination increased from 0 to 100 percent, 39 fewer trucks were observed. This reduction was probably a consequence of the enemy operating his trucks without lights when the moon was high.

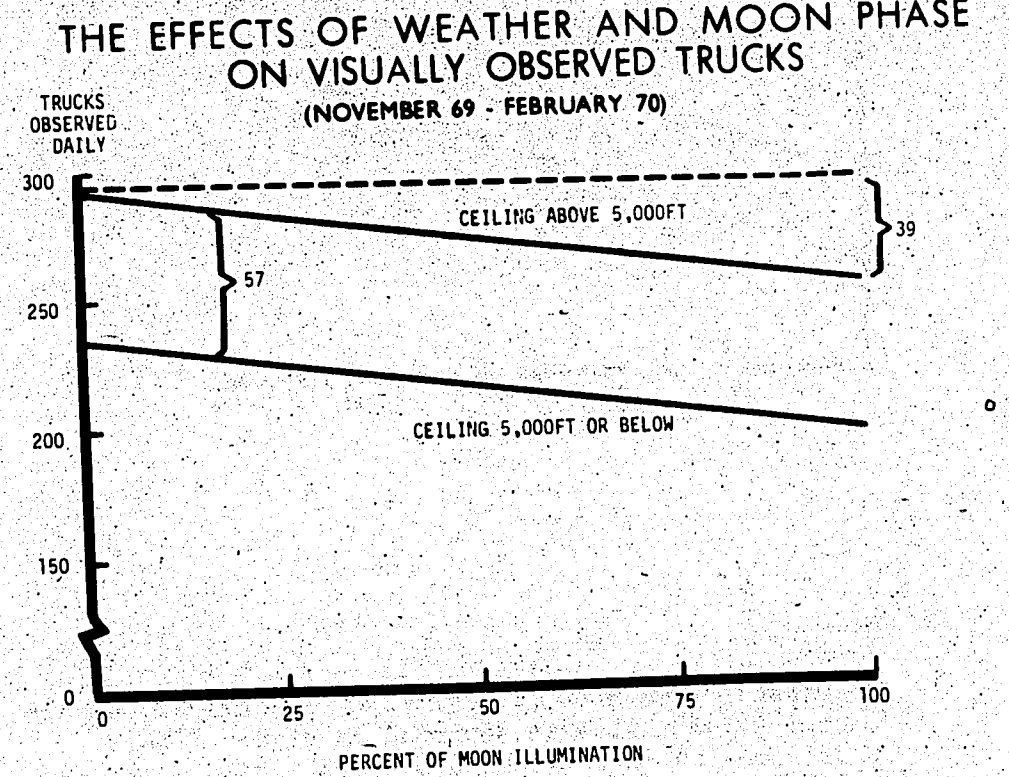


FIGURE III - 9

Weather also had a significant impact on the ability of air crews to acquire, strike, and destroy enemy truck traffic. The effect of visual observations and weather on trucks struck is depicted in Figure III-10. When ceilings were 5000 feet or below, an average of 18 fewer trucks was struck for each level

of visual observations. This effect was over and above the reduction of visual observations due to low ceilings. The triangle attached to the lower curve shows that for each additional truck observed, .49 trucks were struck.

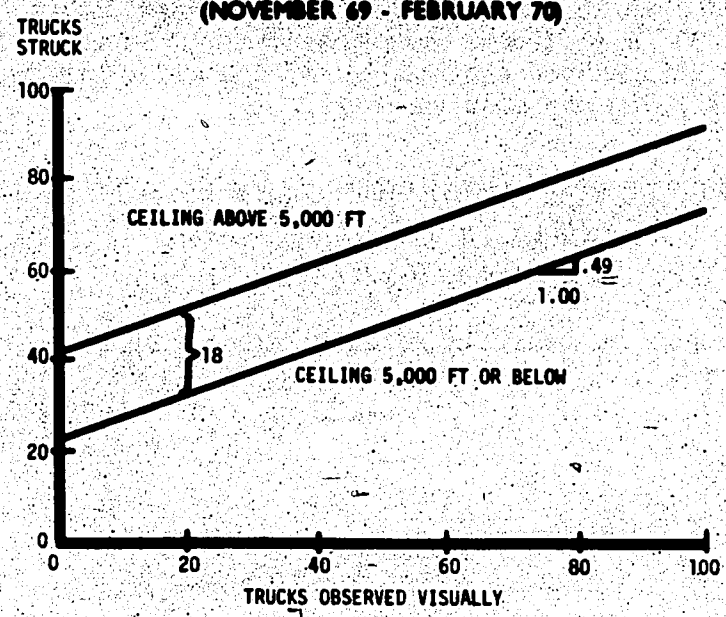


FIGURE III - 10

The relationship between trucks destroyed or damaged, trucks struck, and lunar illumination is depicted in Figure III-11. The upper curve shows the relationship between trucks destroyed or damaged and trucks struck when the moon was full, while the lower curve depicts the relationship when there was no moon. The distance between the two curves shows that increased lunar illumination from 0 to 100 percent resulted in 10 additional trucks being destroyed or damaged for each level of trucks struck. The triangle attached to the lower curve shows that for each additional truck struck, .38 trucks were destroyed or damaged.

TRUCKS DESTROYED OR DAMAGED AS A FUNCTION OF TRUCKS STRUCK AND MOON PHASE

(NOVEMBER 69 - FEBRUARY 70)

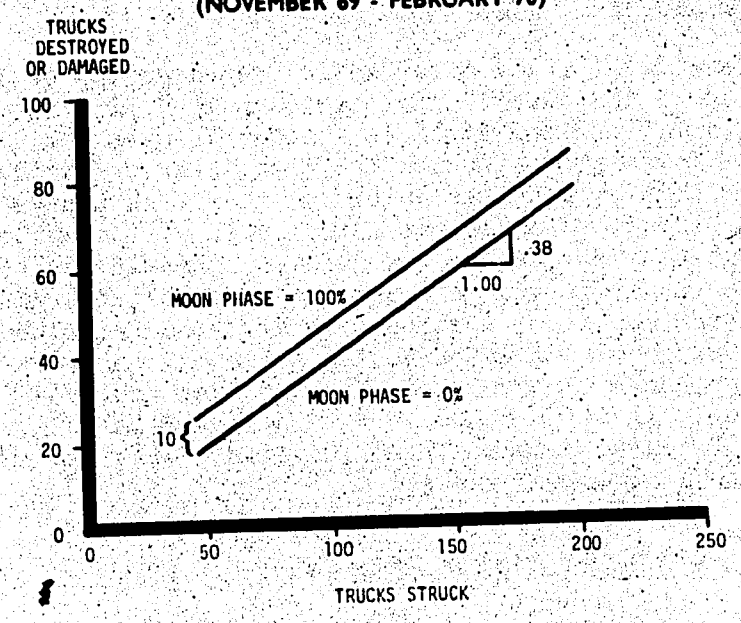


FIGURE III - 11

In summary, the record of enemy truck movements clearly reflects that

- Approximately 98 percent of enemy truck movement occurred at night.
- The enemy moved most of his traffic before midnight.

The analysis of the effects of lunar illumination on enemy truck movements shows that as moon illumination increased,

- Sensor detected truck traffic increased.
- The number of visually observed trucks decreased.
- Trucks destroyed or damaged per truck struck increased.

The analysis of the effect of weather on enemy truck movements shows that when ceilings were 5000 feet or below,

- There was no change in the number of sensor detected truck movements.

o Fewer trucks were visually observed.

o Fewer of the trucks observed were struck.

Attacks Against Trucks

The Commando Hunt III interdiction campaign was as versatile and adaptable as the enemy's logistic campaign. The new weapon systems and munitions described in Chapter II were introduced early in the campaign to counter the enemy's truck build up. The Commando Bolt program was initiated to attack trucks moving through the heavily defended Ban Karai pass. Information from the Igloo White sensor system was used to schedule strike aircraft to the routes during periods of maximum truck traffic. When movements increased, sorties were diverted from other targets. Throughout the campaign the principal emphasis was to attack enemy trucks whenever and wherever they could be found. This philosophy is illustrated in Figure III-12 which compares the number of sensor detected truck movements with the number of sorties that attacked trucks.

SENSOR DETECTED TRUCKS AND
SORTIES ATTACKING TRUCKS
NOVEMBER 69 - APRIL 70

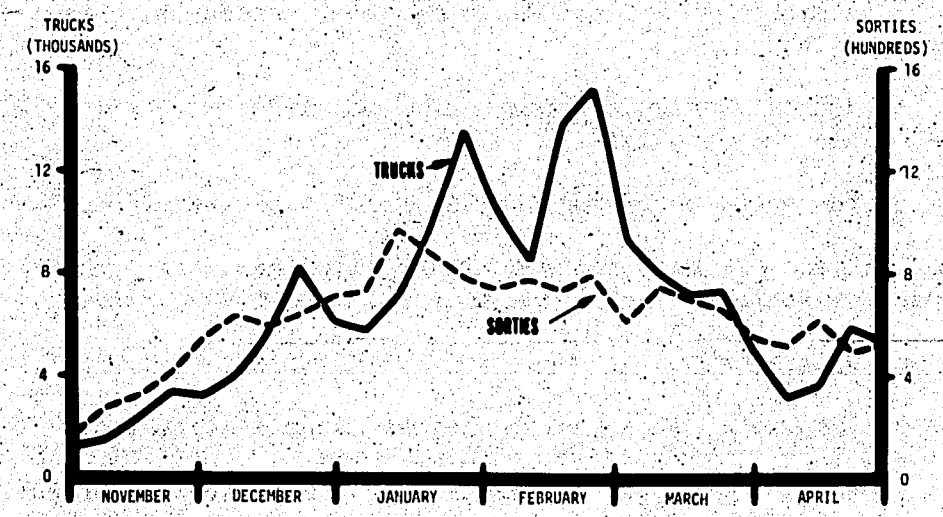


FIGURE III - 12

From the beginning of the campaign until the second week in January, the sorties flown against moving trucks followed the general upward trend of sensor detected truck movements. The decrease in January and February shows the effect of the increased tactical air effort in Barrel Roll and generally poor weather in many of the heavily traveled entrance and exit routes.

Sorties against enemy trucks were flown principally at night, when traffic was at its peak. Figure III-13 shows that the split between night and day was approximately 3 to 1. The day effort was necessary to prevent the enemy from using the road network during daylight hours.

DAY AND NIGHT SORTIES ATTACKING TRUCKS
(NOVEMBER 69 - APRIL 70)

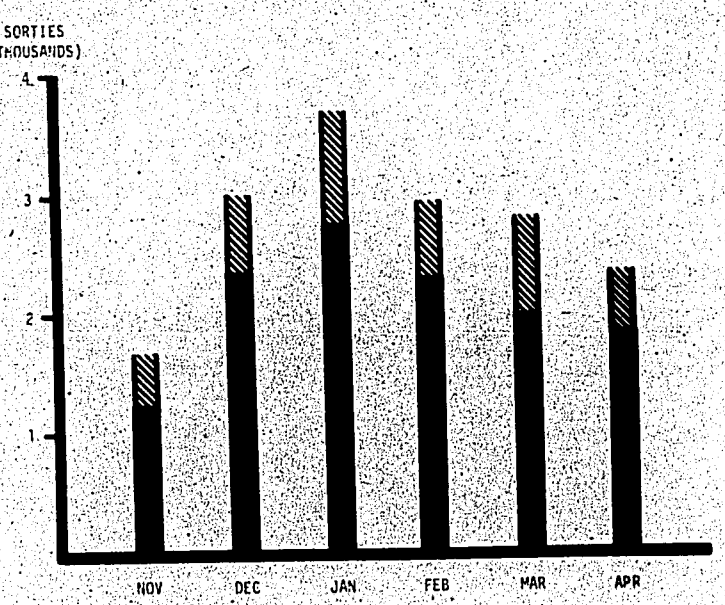


FIGURE III - 13

Trucks Destroyed and Damaged

Table III-7 gives the monthly truck damage assessment data for the campaign. The summary ratios in this table provide an overview of the results of the truck kill operations. The ratio of trucks struck to trucks observed showed a slight downward trend from November to January. This trend, during periods of increasing truck movement, suggests either a force-limited or an operating space-limited situation prevailed (Figure III-14).

RESULTS AGAINST TRUCKS

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
SORTIES	1591	3016	3647	2983	2765	2357	16359
DAILY AVERAGE	53	97	118	107	89	79	90
TRUCKS							
OBSERVED	4220	6836	10708	8313	7045	6353	43475
DAILY AVERAGE	141	221	345	297	227	212	240
MOVING (TRAP)	-	12189	16739	18855	12805	7988	68576
DAILY AVERAGE	-	393	540	673	413	266	454
STRUCK	2920	4460	6268	5031	4260	3932	26871
DAILY AVERAGE	97	144	202	180	137	131	148
DESTROYED OR DAMAGED	869	1295	2231	2119	1779	1739	10032
DAILY AVERAGE	29	42	72	76	57	58	55
RATIOS							
STRUCK/OBSERVED	.69	.65	.59	.61	.60	.62	.62
STRUCK/SORTIE	1.84	1.48	1.72	1.69	1.54	1.67	1.64
DESTROYED OR DAMAGED/SORTIE	.55	.43	.61	.71	.64	.74	.61
DESTROYED OR DAMAGED/STRUCK	.30	.29	.36	.42	.42	.44	.37
DESTROYED OR DAMAGED/MOVING	-	.11	.13	.11	.14	.22	.13
SECONDARIES							
EXPLOSIONS	1666	1165	1532	1961	1906	2232	10462
FIRES	931	1458	2598	2408	2350	1792	11537
TOTAL	2597	2623	4130	4369	4256	4024	21999
DAILY AVERAGE	87	85	133	156	137	134	122

TABLE III - 7

During Commando Hunt III the limitation was actually an operating airspace problem which restricted the number of aircraft which could be flown at any one time over the relatively small area encompassing the enemy LOC structure. This condition was particularly true as the enemy concentrated his efforts in the area from Ban Karai south with emphasis on the short end run around the DMZ via routes 1039 and 92A.

TRUCKS STRUCK vs TRUCKS OBSERVED

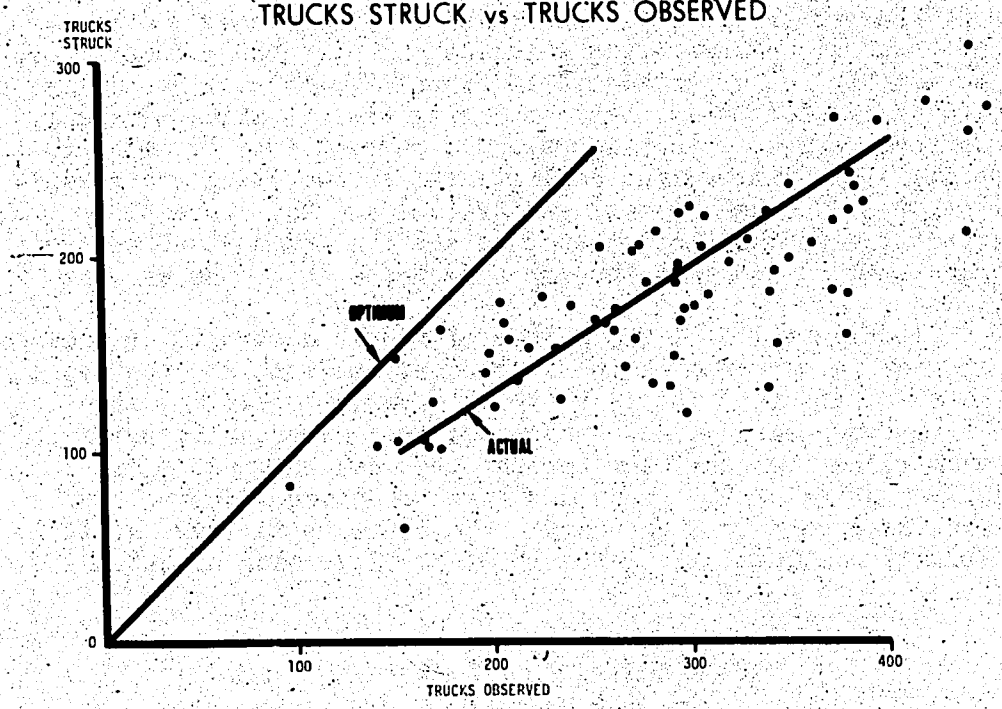


FIGURE III - 14

TRENDS IN STRIKE AIRCRAFT EFFECTIVENESS AGAINST TRUCKS

(NOVEMBER 1969 - APRIL 1970)

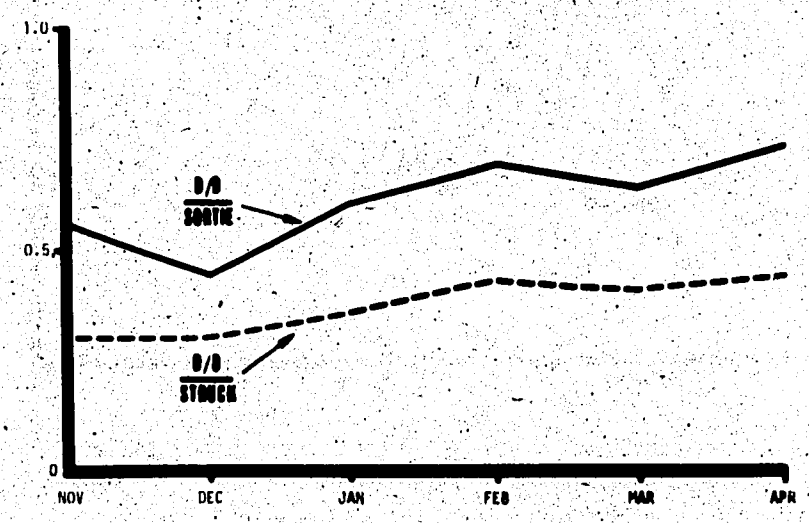


FIGURE III - 15

The number of trucks destroyed or damaged per sortie and per truck struck are primary indicators of force effectiveness. The monthly ratios presented in Figure III-15 show generally upward trends for these measures during the campaign. Overall, the force effectiveness improved 30 percent from November to April. This improvement reflects the introduction and refinement of new weapon systems and tactics and the increasing effectiveness that both the crews and the command and control organizations attained through experience in Southeast Asia.

In Figure III-16 the number of trucks destroyed or damaged per week is compared to the TRAP truck estimate for the week. The combination of increased truck movement, sorties, and strike force effectiveness resulted in an increasing number of truck kills from November through January, culminating in a daily average of 90 trucks destroyed or damaged during the week 28 January to 3 February. The decrease in truck kills in February was primarily a result of the diversion of attack

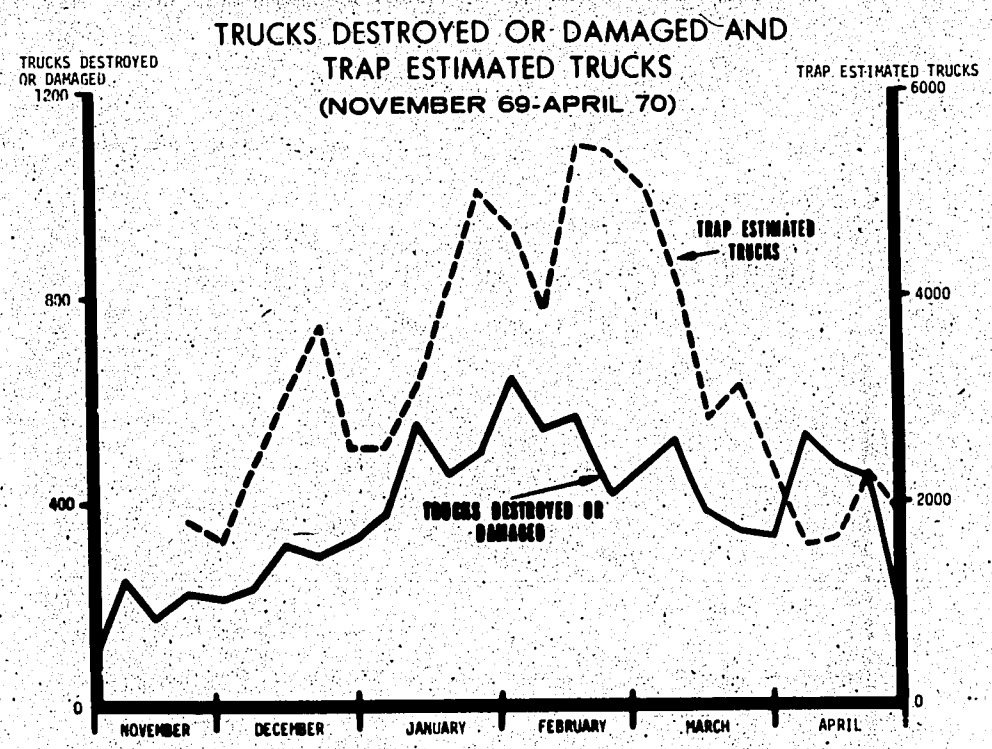


FIGURE III - 16

sorties from Steel Tiger to Barrel Roll during the North Vietnamese Plain of Jars offensive. Continued decreases in trucks destroyed or damaged during March and April reflect the reduction in enemy movements during that period.

The strategy of U.S. operations against trucks was to attack them whenever and wherever they could be found. Significant factors in applying this strategy were that:

- Approximately 76 percent of all sorties against trucks were flown at night when most trucks moved.
- An operating airspace-limited situation existed during periods of maximum truck movement over the enemy's heavily traveled main route structure.
- The overall strike force effectiveness increased 30 percent from November through April.

Individual Aircraft Effectiveness

Two effectiveness measures were established to compare individual aircraft performance and adjust force allocations throughout the campaign. The first was the number of trucks destroyed or damaged per aircraft sortie. This measure of overall system effectiveness accounted for such factors as ordnance load, target acquisition, and time over target. The second measure, trucks destroyed or damaged per truck struck, was a measure of terminal effectiveness, indicating how efficient the aircraft was once a target was acquired. When measuring individual aircraft effectiveness, if the same truck was struck twice, it was included as an additional truck in the denominator. The reasoning was that if the aircraft was required to make a second or subsequent attack, it was not considered as effective as an aircraft that destroyed a truck in one attack. In the previous section, these duplications were eliminated in evaluating the overall force effectiveness.

Both measures rank the aircraft identically except for the F-4 and A-4. The F-4 carried a larger ordnance load and, because it was based closer to the target area, had more time over target than the A-4. Jet fighter and attack aircraft accounted for 3900 trucks destroyed or damaged. The most effective truck killers, the gunships, destroyed or damaged 48 percent of the trucks while flying 8 percent of the sorties that attacked trucks. In making a comparison between gunships and fighter and attack aircraft, however, the fact that the gunships required fighter escorts to perform their mission must be considered. The AC-130s and AC-119s were provided three F-4 escorts and the AC-123s, two A-1 escorts. A team effort was required for the successful performance of the gunship truck killing mission, just as the entire interdiction campaign required a team effort.

AIRCRAFT EFFECTIVENESS
STEEL TIGER

AIRCRAFT	TRUCKS DESTROYED OR DAMAGED	SORTIES ATTACKING TRUCKS	TRUCKS STRUCK	TRUCKS DESTROYED OR DAMAGED PER SORTIE	TRUCKS DESTROYED OR DAMAGED PER TRUCK STRUCK
SURPRISE PACKAGE	822	112	1104	7.34	.74
OTHER AC-130	2562	591	4742	4.34	.54
AC-123	440	141	854	3.12	.52
AC-119	987	435	2005	2.27	.49
A-6	977	1486	2708	.66	.36
A-1	1271	2332	4602	.55	.28
A-7	959	3147	3866	.30	.25
F-4	1576	6310	11178	.25	.14
A-4	245	1223	1446	.20	.17
TOTAL	9839	15777	32505	.62	.30

TABLE III - 8

Early in the campaign, a quality control program based on trucks destroyed or damaged per truck struck was initiated to monitor the effectiveness of the primary aircraft that attacked trucks. Confidence intervals were computed for the weekly effectiveness measures of each type of aircraft, and definite upward or downward trends were identified by the

use of regression analysis. Any significant change in performance of each aircraft type was noted so action could be taken to improve results. In addition, the quality control program provided insight into how the force was being employed and how well it was performing.

An example of the long run trends established both by aircraft type and the overall force is presented in Figure III-17. A majority of the aircraft showed significant upward trends, reflecting the learning phase associated with the rotation policy for U.S. forces. Both day and night effectiveness against trucks increased during the campaign. The large increase at night, over 150 percent, was largely a result of the increased gunship effectiveness.

TRENDS IN AIRCRAFT EFFECTIVENESS
AGAINST TRUCKS
(DECEMBER 1969-APRIL 1970)

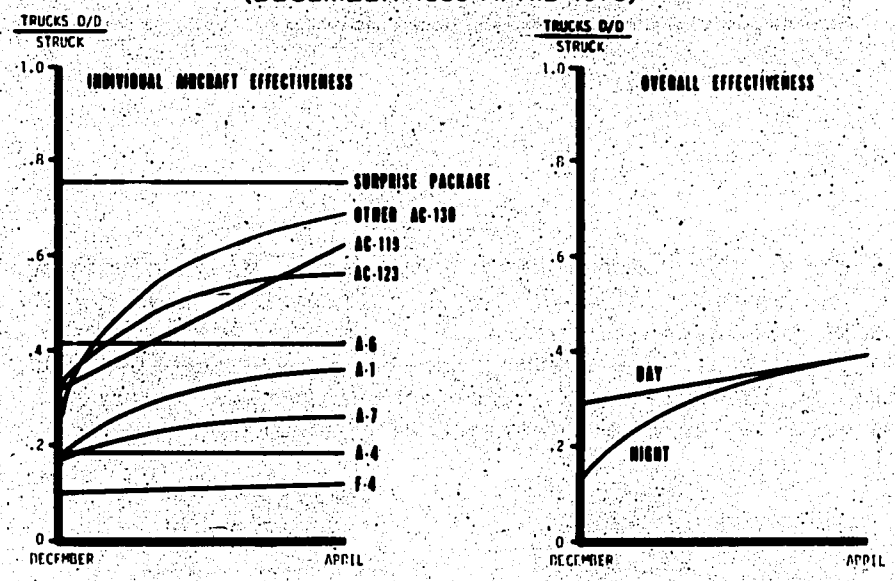


FIGURE III - 17

The AC-130 Surprise Package which entered the inventory in December 1969 destroyed or damaged more trucks than any other aircraft. Although the Surprise Package was clearly the most effective weapon system used in Commando Hunt III for killing trucks, it was subject to the same vagaries of weather, lack of targets, and RNO problems that all other systems experienced. The fluctuations in recorded effectiveness (Figure III-18) indicate there was no consistent bias to the number of trucks reported destroyed or damaged.

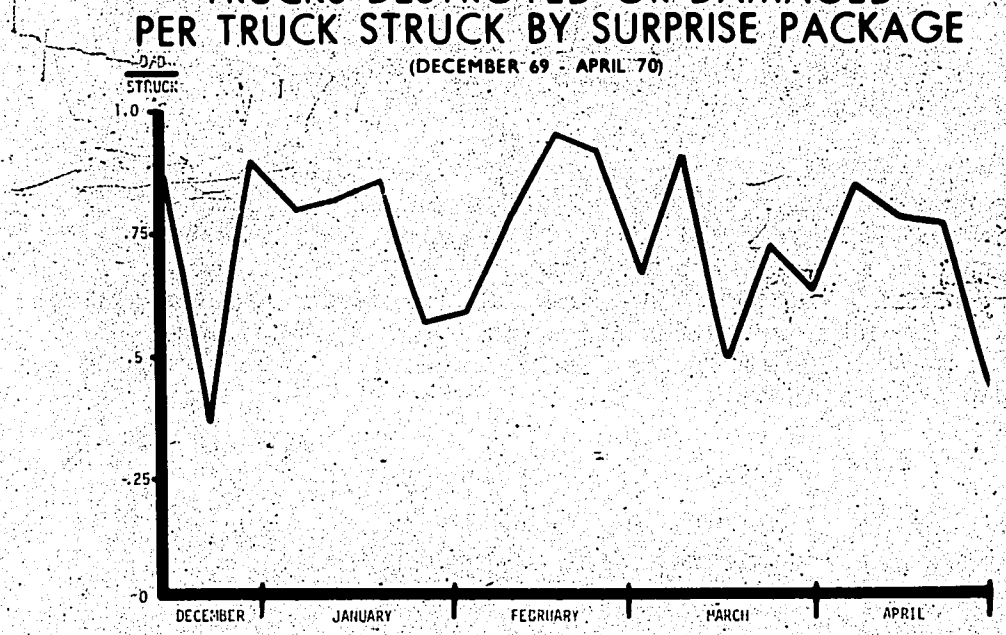


FIGURE III - 18

The M36, 900-pound incendiary cluster, used only by the A-1, was the most effective truck killing bomb used during the campaign. A regression analysis of the contribution of each type of ordnance delivered by the A-1 showed that for each additional M36 used, .29 trucks were destroyed or damaged. These results, on a per sortie basis, were:

Number of M36s per Sortie	Trucks Destroyed or Damaged per Sortie
0	.25
1	.54
2	.83

The analysis of the individual aircraft effectiveness against trucks over the entire campaign shows that

- o A majority of the aircraft showed significant increase in effectiveness in attacks against trucks.
- o Jet fighter and attack aircraft destroyed or damaged 3900 trucks, 39 percent of the campaign total.

- Gunships were the most effective truck killers, obtaining 48 percent of the trucks destroyed or damaged while flying 8 percent of the sorties.
- Gunships required 2 to 3 escort sorties for each attack sortie they flew, reflecting a team effort.
- The AC-130 Surprise Package was the most effective individual aircraft in destroying or damaging trucks.

Effect of Attacks Against Trucks

One measure of the success of the Commando Hunt III truck killing operations was that the cumulative number of trucks destroyed and damaged was over 10,000 for the campaign (Figure III-19).

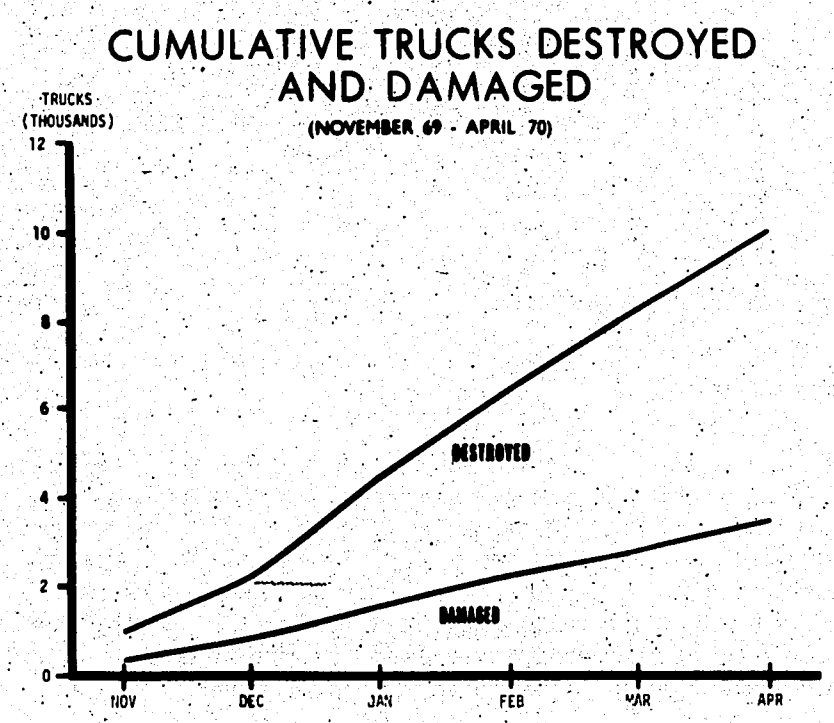


FIGURE III - 19

The attack and destruction of moving trucks had a drastic effect on the enemy's truck resources. The impact on the North Vietnamese truck inventory can be seen in Table III-9. The initial inventory, imports, and evaluated losses were based on Defense Intelligence Agency (DIA) estimates. DIA evaluated reported losses by adding together 75 percent of the trucks reported destroyed and 25 percent of those reported damaged. They added an additional 50 trucks per month to account for noncombat losses and wear and tear. It is not known how DIA arrived at these factors.

IMPACT OF COMMANDO HUNT III ON NORTH VIETNAMESE TRUCK INVENTORY

MONTH	INVENTORY AT BEGINNING OF MONTH	DETECTED IMPORTS TO NORTH VIETNAM	EVALUATED LOSSES	INVENTORY NET CHANGE
NOV 69	8746-10746	440	623	-183
DEC 69	8563-10563	320	824	-504
JAN 70	8059-10059	436	1391	-955
FEB 70	7104-9104	150	1209	-1059
MAR 70	6045-8045	163	1002	-839
APR 70	5206-7206	NOT AVAILABLE		

TABLE III - 9

The decrease in the North Vietnamese truck inventory clearly reflected the accumulated effect of the interdiction campaign. In spite of favorable weather the enemy was forced to reduce his overall logistic effort and all but abandon movement north of the Ban Karai area. As a direct result of the U.S. interdiction campaign in Steel Tiger, North Vietnam was unable to support both its aggression in northern Laos and the high level of NVA resupply activity in southern Laos.

A comparison of the number of northbound and southbound sensor detected truck movements provides insight into the credibility of reported truck kills. If over the entire campaign more trucks moved south than north, the difference probably consisted of those trucks destroyed or damaged. During Commando Hunt III, 12 percent more trucks were detected moving south than north. Table III-10 shows that the ratio of trucks destroyed or

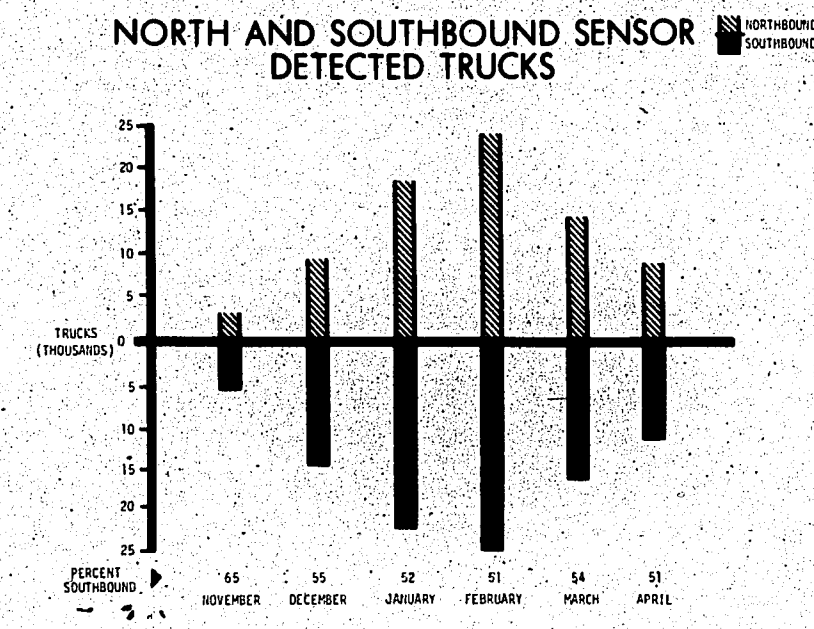


FIGURE III - 20

MEASURES OF EFFECTIVENESS OF OPERATIONS AGAINST TRUCKS

(DECEMBER 1969 - APRIL 1970)

DAILY AVERAGES		RATIOS	
TRAP ESTIMATED TRUCKS	454	STRUCK / TRAP TRUCK	= .35
TRUCKS STRUCK	159	D/D / STRUCK	= .38
TRUCKS DESTROYED OR DAMAGED	61	D/D / TRAP TRUCK	= .13

TABLE III - 10

damaged to the number of trucks estimated by using TRAP was .13. In other words, on the average 13 percent of the trucks operating on a given day were destroyed or damaged. If only destroyed trucks are considered, the ratio is .09. That 12 percent falls within the TRAP range of 9 to 13 lends credence to the reported truck kills and suggests that a number of the trucks reported as damaged were never returned to operation.

Based on the data in Tables II-1 and III-10 and the estimated average daily distance a loaded truck traveled (50 to 60 kilometers), the probability was calculated that a truckload transported from the entry gates to the exit areas was not destroyed or damaged while being moved.

The results shown in Table III-11 illustrate the reason for the enemy's emphasis on the 1039/92A entry gate during the latter part of the campaign. The probability of a truckload successfully reaching all the exit areas was significantly higher from the 1039/92A area than from either Ban Karai or Mu Gia Pass.

PROBABILITY OF A TRUCK SUCCESSFULLY REACHING AN EXIT AREA

EXIT AREA	INPUT GATES		
	MU GIA	BAN KARAI	1039/92A
922/926	.42	.49	.60
966	.28	.33	.41
110	.24	.28	.35

TABLE III - 11

By weighting the individual probabilities by the number of trucks using the various gates, the overall probability of a truckload being destroyed or damaged in transit was calculated to be .59.

In summary:

- Over 10,000 trucks were destroyed or damaged during the campaign.
- The North Vietnamese truck inventory was substantially reduced from November through April.
- The probability that a truckload would be destroyed or damaged in transit was .59.

TRUCK PARKS AND STORAGE AREAS

Truck parks and storage areas were primary targets and, because they were not always time sensitive, served as a buffer for strike planning. Strikes were diverted to or from truck park and storage area targets as required by the tactical situation or weather.

As a result of his experience during Commando Hunt I, the enemy went to considerable expense to disperse his supplies in smaller quantities further from the major road network and to build additional protected storage facilities for his stockpiles. Consequently, there were few instances of spectacular results by individual strikes. The enemy's tactics were countered by improved targeting and operating procedures designed to rapidly exploit the most productive truck park and storage area targets.

The general truck park and storage area target categories included a variety of logistical targets. The spectrum ran from temporary open roadside storage caches and water-to-road transshipment points to storage caves and permanent truck parks and storage areas. Also included were POL storage sites, munitions storage areas, and storage sites near bunkers, military structures, or bivouac areas.

Stockpile Movements

The TRAP computer program provided an indication of the location and extent of the enemy's logistic stockpiles in Laos. The route structure in Steel Tiger was segmented, and the logistic flow into and out of each area was determined from the sensor detected truck movements. Stockpile changes are shown in Figure III-22 for three regions: the entrance area around the Mu Gia and Ban Karai passes and Routes 1039/92A, the exit areas which included Routes 922, 966, and 110, and the central routes between exit and entry areas. The shift in stockpile locations reflected the enemy's changing logistics activity.

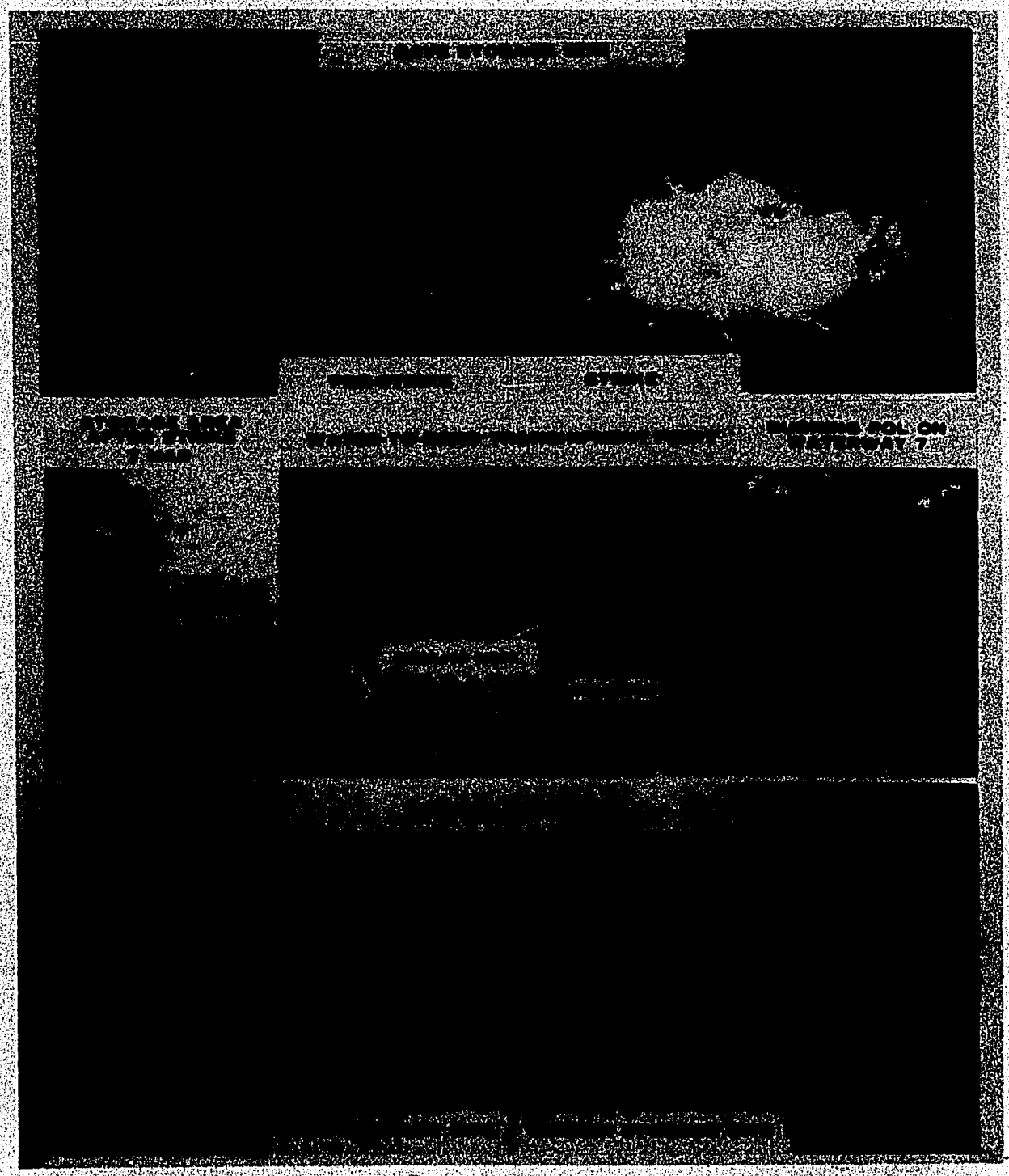


FIGURE III - 21

Operations in November were concentrated in the entry areas, as the enemy put initial supplies into the system and opened the roads. In December supplies were moved into the central routes and in January into the exit areas. During March and April the stockpiles in the entry areas were depleted as the enemy emphasized movement into the exit areas.

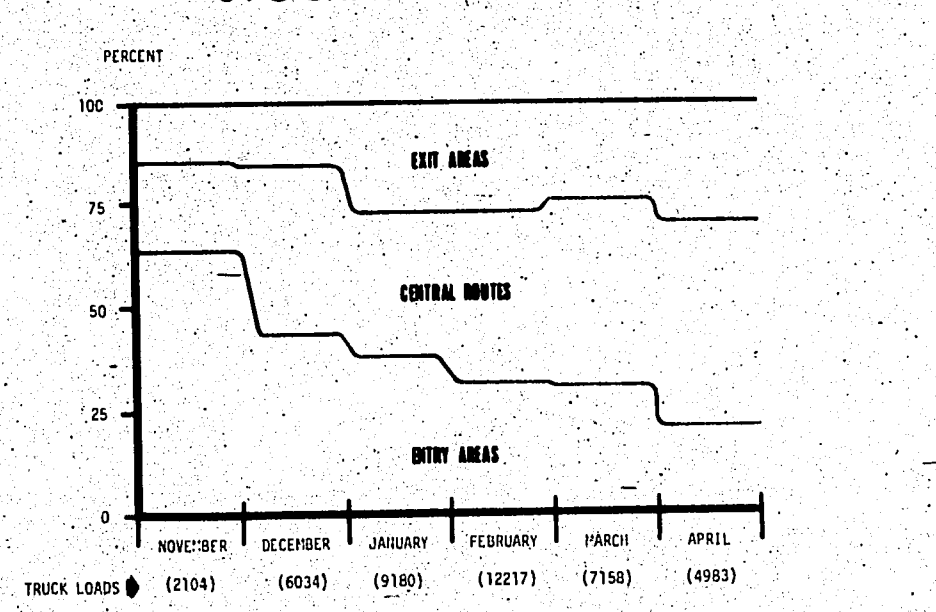


FIGURE III - 22

Tactical Air Attacks Against Truck Parks and Storage Areas

Strikes against truck parks, storage areas, and other logistical targets were 17 percent of the total tactical air allocation in Steel Tiger. The number of sorties attacking such targets per week is presented in Figure III-23. The general upward trend was interrupted by several sharp reductions. One occurred in December during the period of special attacks against enemy defenses. Another in January occurred during the weeks when

sorties against trucks were at their height. In February the dip coincided with increased sortie allocations to Barrel Roll and the return to LOC interdiction after the temporary suspension of attacks against LOCs. The reduction in March also occurred during a period of increased operations in Barrel Roll and poor weather in Steel Tiger.

SORTIES ATTACKING TRUCK PARKS & STORAGE AREAS
(NOVEMBER 69 – APRIL 70)

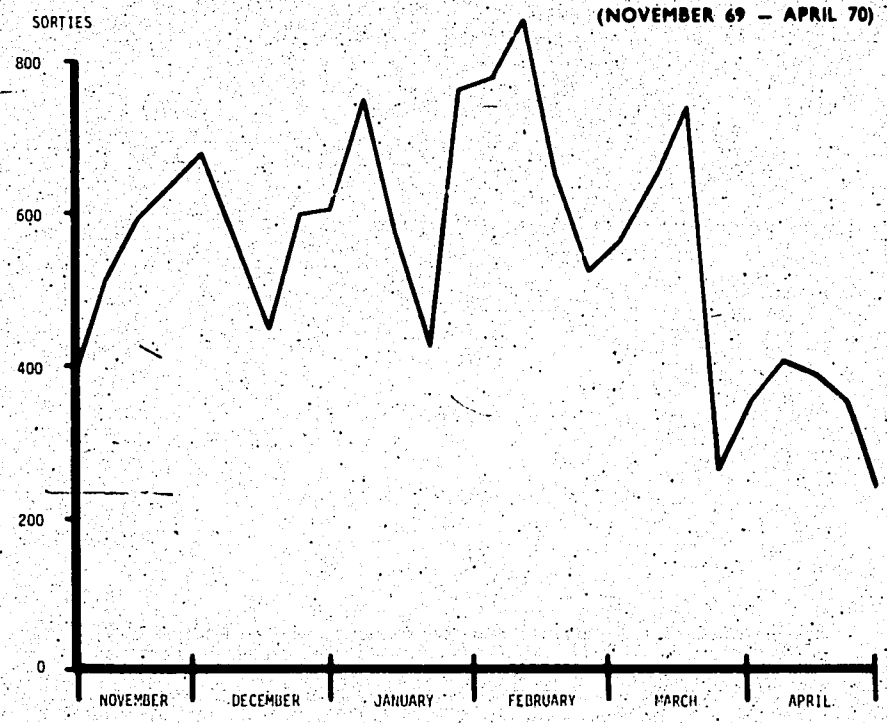


FIGURE III - 23

Sorties against truck parks and storage area targets were flown principally during the day, as illustrated in Figure III-24. Attacks against storage facilities and truck parks therefore occurred when the trucks were off the roads and the targets held a maximum quantity of supplies and equipment.

The sources of information for truck park and storage area targets were varied. The majority were developed from all-source intelligence as described in Chapter II.

A typical example of the targeting process for truck parks

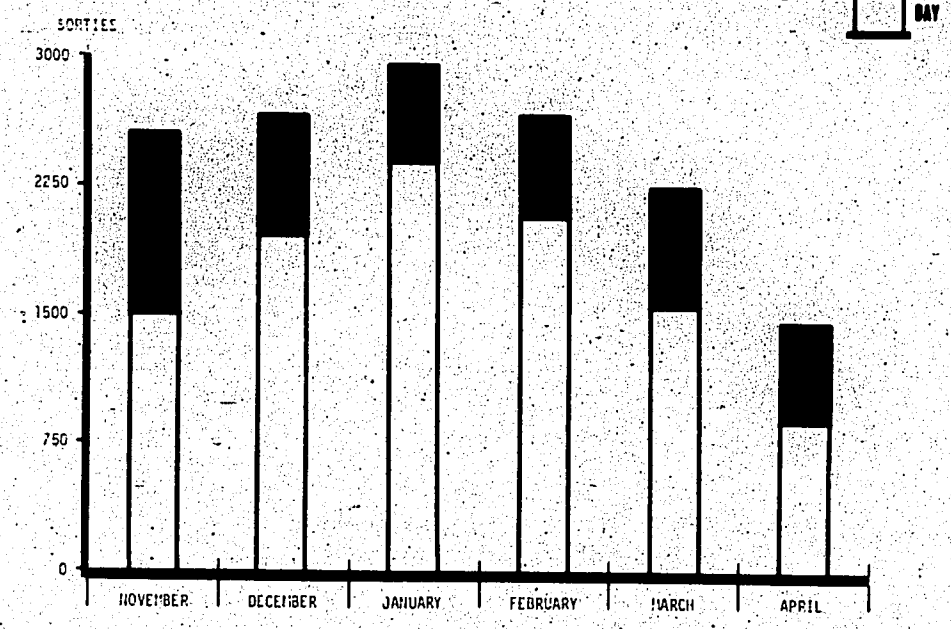


FIGURE III - 24

and storage areas was the extension of SALOA Victor in February 1970 and the resulting strikes by tactical air and Arc Light. In the area west of the DMZ, the enemy had integrated waterway 7 and motor routes 92A, 1032, and 1039 with a POL pipeline. These supply lines led into an LOC complex capable of moving large quantities of supplies from the DMZ area into Laos, an input route that offered the least exposure to air strikes. The area was often covered by clouds. Extensive road building, pipeline construction, and active transshipment points were noted in late August 1969. By December 1969 and January 1970, the river had been channeled and thousands of 55 gallon drums and plastic bag containers were floated down the waterway. Ground scars revealed the presence of a pipeline extending south to waterway route 7, where POL drums were filled. Tactical air and Arc Light strikes against the pipeline during August and September 1969 led the enemy to abandon this fixed segment of pipeline and to run a new flexible line four kilometers to the west. The enemy gave a high priority to construction of this line and attempted to conceal it. Evidence from other intelligence sources indicated that the enemy's completion dates were not being met because of air strikes, even though photographic evidence showed that repairs

and replacements of interdicted line segments were completed in 24 hours or less. By mid-January 1970, most of the enemy's efforts were concentrated southwest of the SALOA-Victor boundaries, where barrels were removed from the river, refilled, stored, and transshipped on new roads.

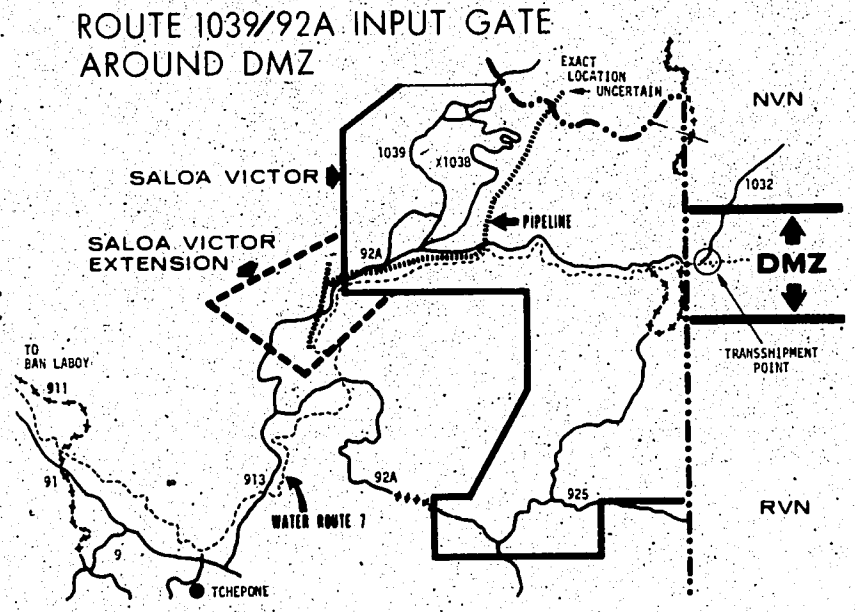


FIGURE III - 25

On 27 January 1970, 7AF requested an extension of SALOA Victor boundaries to encompass the new area of enemy activity. In addition, nine Arc Light target boxes were submitted for validation to permit immediate attack on the area. The American Embassy in Vientiane concurred, and on 6 and 7 February 1970, strikes by forty-one B-52s produced 240 secondary explosions. On 26 February 1970, the requested SALOA extension was granted and the area was struck daily by tactical air and B-52s. From 1 February to 8 March 1970, tactical air flew 222 sorties in the area producing 233 secondary explosions, 237 secondary fires, and 5049 POL drums destroyed. During the same period, Arc Light forces flew an additional 50 sorties producing 464 secondary explosions. Enemy activity in the area began to taper off and photographs taken on 12 March 1970 revealed that the enemy had removed a large amount of the remaining supplies from the area.

Tactical Air Results

As shown in Table III-12 over 44 percent of the strikes

against storage area targets reported results not observed (RNO). In addition to strikes that bombed through cloud cover, which were always RNO, many of the tactical air sorties could not observe bomb damage because of smoke, foliage, or intervening terrain at the time of bomb impact. As the campaign progressed there was a significant decrease in the number of sorties which saw the results of their strikes but reported no damage. This trend reflects both increased enemy stockpiling and improvements in targeting.

TACTICAL AIR BOMB DAMAGE OBSERVATION

MONTH	SORTIES	SORTIES WITH NO DAMAGE	SORTIES RNO	PERCENT RNO
NOVEMBER	2556	432	1110	43
DECEMBER	2651	421	1307	49
JANUARY	2948	316	1394	47
FEBRUARY	2669	399	1168	44
MARCH	2247	291	870	39
APRIL	1474	329	560	38
TOTAL	14,545	2,188	6,409	44

TABLE III - 12

When considering the damage inflicted on the enemy from attacks against truck parks and storage areas, two factors must be kept in mind. First, the damage reported was only that from attacks for which results could be observed. If the sorties which reported RNO inflicted the same damage on a per sortie basis as those which reported results, the bomb damage would be about twice that reported. Second, those sorties which observed results normally reported only secondary fires and explosions. Additional damage certainly occurred, including destroyed or damaged trucks in truck parks, destroyed supplies which did not burn or explode, and personnel killed by air (KBA), but these effects usually could not be observed and therefore went unreported.

The summary of results from attacks against truck parks and storage areas is shown in Figure III-26. The fluctuation in the

results reflects weather, sortie allocation, and target development and selection. The peak in March occurred when a spectacular strike near route 914D resulted in over 1000 secondary fires and explosions.

TRUCK PARK AND STORAGE AREA SECONDARY FIRES AND EXPLOSIONS

(NOVEMBER 69 - APRIL 70)

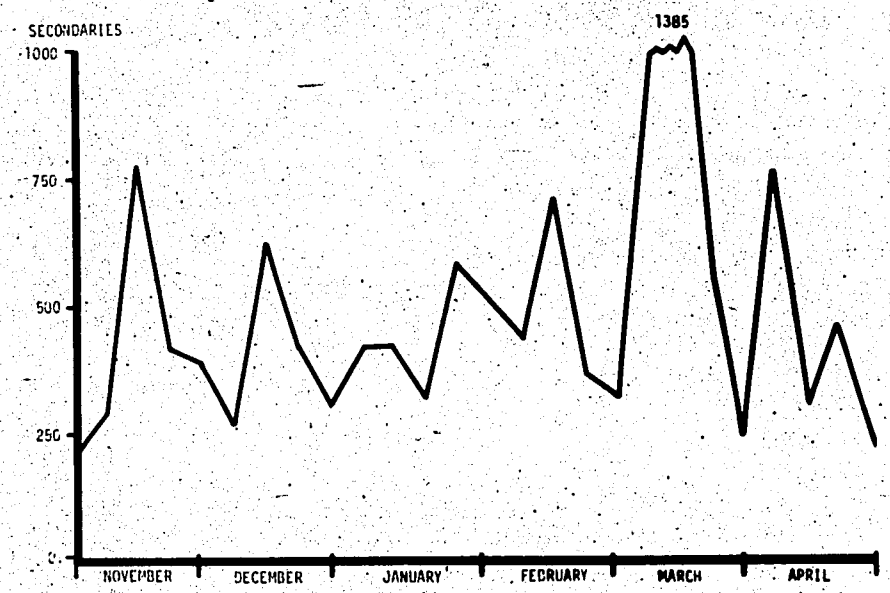


FIGURE III - 26

The monthly results of tactical air strikes against truck park and storage areas are summarized in Table III-13.

Arc Light Operations

The Arc Light strikes allocated to Steel Tiger contributed greatly to the damage inflicted on the truck parks and storage areas. As is illustrated in Figure III-27, there was a generally increasing trend in B-52 sorties flown in Steel Tiger. From an average of 18 per day in November, the allocation to Steel Tiger increased to 33 sorties per day in February and dropped to 19 per day in April as enemy activity in RVN increased.

PRODUCTIVITY OF TACTICAL AIR STRIKES AGAINST TRUCK PARKS AND STORAGE AREAS

MONTH	FIRE & EXPLOSIONS	PER SORTIE	PER SORTIE LESS RNO
NOVEMBER	1973	.77	1.36
DECEMBER	1578	.60	1.17
JANUARY	1917	.65	1.24
FEBRUARY	2076	.78	1.38
MARCH	3349	1.49	2.43
APRIL	1805	1.22	1.97
TOTAL	12,698	.87	1.56

TABLE III - 13

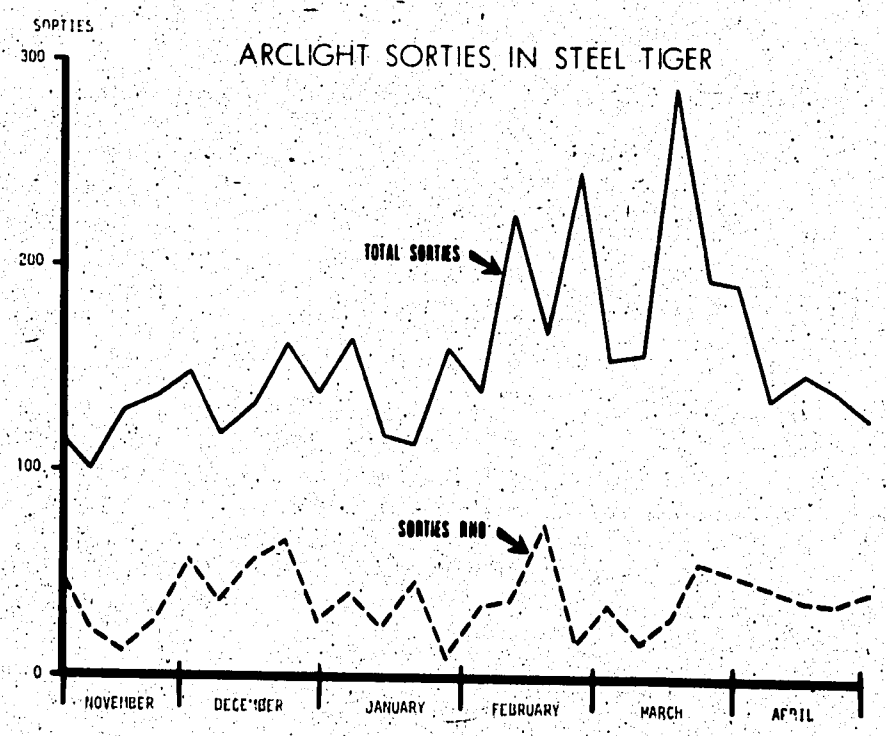


FIGURE III - 27

Over the campaign, 24 percent of the B-52 strikes reported RNO as compared to 44 percent for tactical air strikes against truck parks and storage areas. Secondary fires and explosions obtained from B-52 strikes in Steel Tiger are shown in Figure III-28.

ARCLIGHT SECONDARY FIRES
AND EXPLOSIONS

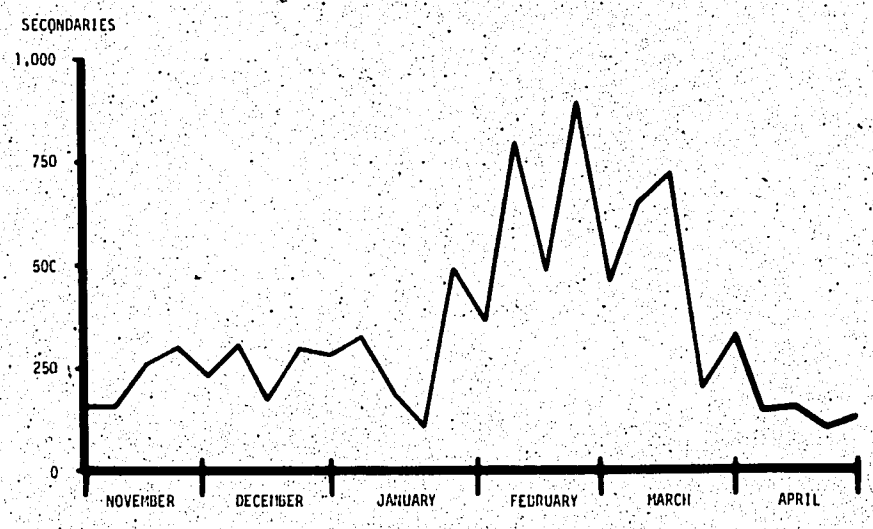


FIGURE III - 28

The general increase in secondaries as the season progressed was an indication not only of the increased number of sorties flown but also the increased productivity of the Arc Light strikes as the enemy stockpiles in Laos grew. Table III-14 shows that the number of secondaries per B-52 sortie rose from 1.81 in November to a high of 2.85 in February. The productivity decreased in March and April, as did the TRAP estimated stockpile level (see Figure III-22).

PRODUCTIVITY OF ARC LIGHT STRIKES

MONTH	SORTIES	SECONDARIES	
		TOTAL	PER SORTIE
NOVEMBER	531	961	1.81
DECEMBER	616	1150	1.87
JANUARY	615	1257	2.04
FEBRUARY	919	2622	2.85
MARCH	893	2110	2.36
APRIL	565	484	0.86
TOTAL	4139	8584	2.07

TABLE III - 14

The tactical air and Arc Light attacks against truck parks and storage areas contributed significantly to the destruction of enemy supplies.

- o The enemy dispersed and protected his stockpiles to reduce their vulnerability to air attacks.
- o Attacks against truck parks and storage areas destroyed over 7900 tons of enemy supplies, approximately 25 percent of the total tonnage destroyed.

LINES OF COMMUNICATION

Strikes against interdiction points (IDPs) illustrate the interdependence of the target categories in the interdiction target system. Although these strikes caused little direct destruction of enemy supplies, their indirect effects were considerable. When an IDP was closed, congestion was created on the roads behind it. Traffic was channeled to alternate routes which were longer and more vulnerable to air attack, or the supplies were placed in temporary storage areas behind the IDP. An indirect result was increased damage to other target categories such as trucks, truck parks, and storage areas.

The appropriate allocation of sorties to attacks against LOCs during Commando Hunt III was a subject of major concern. Given the limited strike force available, a critical evaluation of target priorities and sortie results was continually necessary. These evaluations led to different assessments as to whether sorties attacking LOCs might be more effectively assigned to other target categories.

The delivery of munitions packages on carefully selected IDPs, for example, achieved positive results if the delivery was precisely executed. However, weather and the requirement for low level weapon release against heavily defended IDPs hampered the ability of crews to deliver the package ordnance accurately. In addition, the expansion of the enemy road network with interlinking by-passes maintained by large repair forces reduced the blocking effect on enemy truck traffic to relatively short periods. Because of the redundant road network, it was necessary to use multiple packages and sorties to interdict an area.

Another factor was the difficulty in measuring the results of attacks against LOCs. Ideally an interdiction point was one located on a heavily traveled road, not easily by-passed, hard to repair, and difficult to clear of area denial munitions. To measure the effectiveness of an IDP strike accurately, it was necessary to have sensor strings located immediately above and below the interdiction point with no intervening by-pass. These conditions were difficult to achieve, because the rugged terrain features that made an interdiction point suitable for package emplacement tended to mask sensor signals. The choice was frequently between obtaining measurable results from strikes against other target categories or accepting the uncertainties of LOC strikes. These considerations led to fewer sorties being allocated to LOCs during Commando Hunt III than during Commando Hunt I. In terms of total force allocation, sorties against LOCs ranked third during Commando Hunt III compared to first during the previous dry season.

Munitions Packages

The munitions package concept was area denial--to deny the enemy the use of segments of his road network by closing them for extended periods. A variety of ordnance was used to complicate the enemy's clearing and repair efforts. Packages consisted of both antivehicle and antipersonnel mines as well as cutting ordnance. During Commando Hunt III, combinations of the following munitions were employed.

Cutting ordnance--Paveway laser guided or general purpose bombs fused for cratering of roads and fords.

MK 36 landmines--500-pound general purpose bombs fitted with retarding fins and a magnetic antivehicle fuse.

Delayed-fuse general purpose bombs--500 pound MK 82 general purpose bombs fitted with an FMU-72 or MK 346 delayed fuse, set to go off at specified times over a 12 hour period.

CBU-39 Gravel--canister-dispensed, camouflaged, antipersonnel mines.

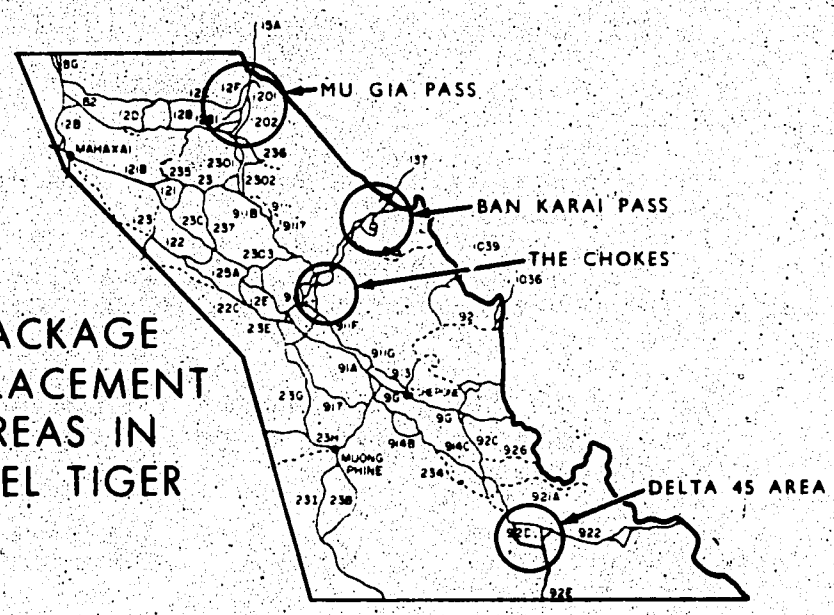
CBU-24/49--antipersonnel bomblets, set to detonate on impact and at random intervals until 30 minutes after impact.

CBU-42--wide area antipersonnel mines (WAAPM), a bomblet which armed after impact, deployed trip wires, and detonated if disturbed.

The sequence and timing of munitions delivery was critical to the effectiveness of munitions packages. Cutting ordnance was delivered first to preclude the possibility of detonating mines or delayed fuse bombs. Land mines and delayed fuse bombs were seeded next and overlayed with antipersonnel mines. The various munitions making up the package were ideally delivered over a short period to prevent the enemy from taking clearing or repair action against a single element of the package. The enemy's clearing operation was further complicated if the package was emplaced late in the day so he was unable to mark mine locations before dark. As the campaign progressed, there was improvement in the execution of package emplacements. In November, 40 percent of the packages took six hours or more to emplace; in early January only 10 percent took over six hours and almost half were emplaced in under one hour. There was a similar improvement in the time of day that sorties delivered package munitions.

It was not feasible to emplace all packages at the same time because of aircraft availability, refueling requirements, and the need to not stereotype delivery times. By December the distribution of emplacement times had shifted toward late afternoon and early evening.

At the beginning of the campaign, munitions packages were concentrated in the vicinity of the Mu Gia and Ban Karai passes, the two major enemy input gates into Laos (Figure III-29). As the enemy's operations moved south in December and January, the emphasis shifted to the "Chokes" area south of Ban Karai pass, where the route structure converged, and to the roads in the vicinity of Delta 45, where the routes to the A Shau Valley and southern Steel Tiger diverged.



PACKAGE EMPLACEMENT AREAS IN STEEL TIGER

FIGURE III - 29

In late January, there was a suspension of package emplacements in an attempt to resolve the question of whether or not new LOC construction had reached a point where package effectiveness was neutralized. The data collected during the suspension failed to conclusively resolve the matter. In view of the continued high level of enemy traffic, it was decided

to reinstate munitions packages. On 8 February, an especially planned munitions package program began in the Mu Gia and Ban Karai area, but poor weather frequently prevented emplacement at the primary points and the packages were diverted to the Chokes and Delta 45 areas. On 14 February, when the increased enemy activity in northern Laos required a shift of tactical air resources to Barrel Roll, the number of sorties devoted to packages was reduced. The suspension of package emplacements and the intensity of operations in Barrel Roll combined to keep attacks against LOCs during the month of February at the lowest level of the campaign.

On 23 February, concentrated LOC interdiction attacks began in the Delta 45 area and other sections of southern Steel Tiger. These attacks marked the beginning of an increased emphasis on the use of FAC reports and visual observations for retargeting interdiction points. The enemy's use of Ban Karai pass as the primary input gate during the beginning of March caused a temporary shift of emphasis to that area, followed by a return to the Delta 45 area which continued through April.

On 21 April, package emplacements were initiated on route 966 south of the Delta 45 area. Although weather hampered emplacement on certain days, a decrease in throughput occurred. The primary purpose of package emplacements on Delta 45 and route 966 was to reduce the quantity of supplies the enemy could move through to South Vietnam before the wet season started.

The shift of emphasis that occurred among the areas is portrayed by the distribution of package sorties shown in Figure III-30. The effects obtained in each of these areas are discussed in the following sections.

Mu Gia. The interdiction points in the Mu Gia area most frequently used are shown in Figure III-31. In terms of potential blocking effect, SE 6061B was geographically an ideal interdiction point. Located less than half a kilometer from the North Vietnam border at the intersection of routes 12F and 1201, the terrain rose sharply to the west and declined to the east of the interdiction point, preventing local by-pass construction. However, a combination of weather, which was generally unfavorable near the North Vietnamese border, and the enemy AAA threat prevented this point from being attacked often. Figure III-31 shows that this IDP was within the range of automatic weapon and 37mm sites in North Vietnam. One package was emplaced on 5 November. A planned attack during February was hampered by weather, causing most of the sorties to be diverted to other

0 5 5 4

SORTIES EMPLACING MUNITIONS PACKAGES BY AREA
(NOVEMBER 69 - APRIL 70)

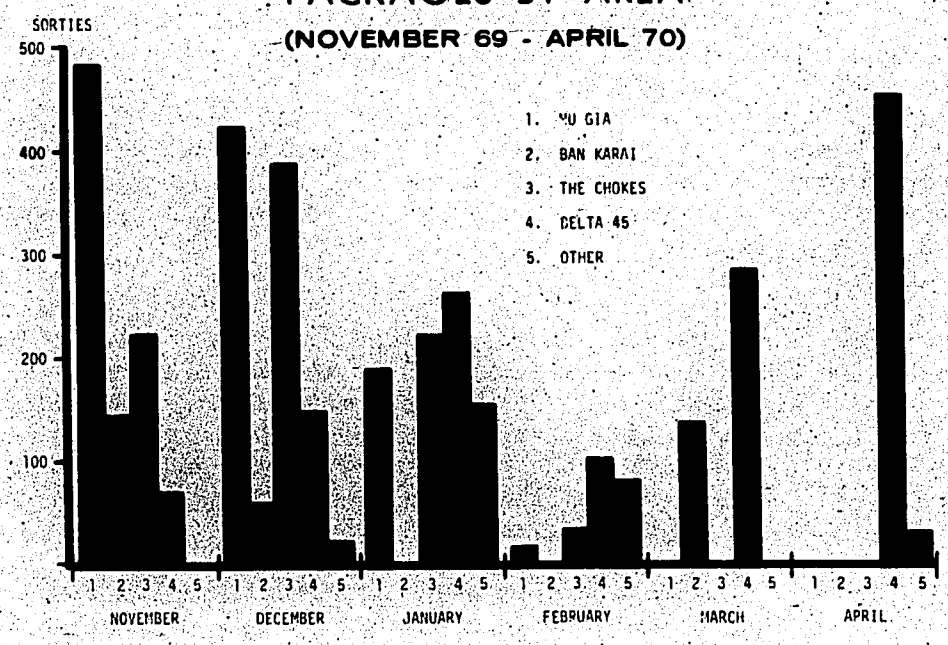


FIGURE III - 30

areas. Because of the vulnerability of SE 6061B, the enemy constructed the alternate route shown on the map with a broken line.

PACKAGE EMPLACEMENT POINTS IN MU GIA AREA

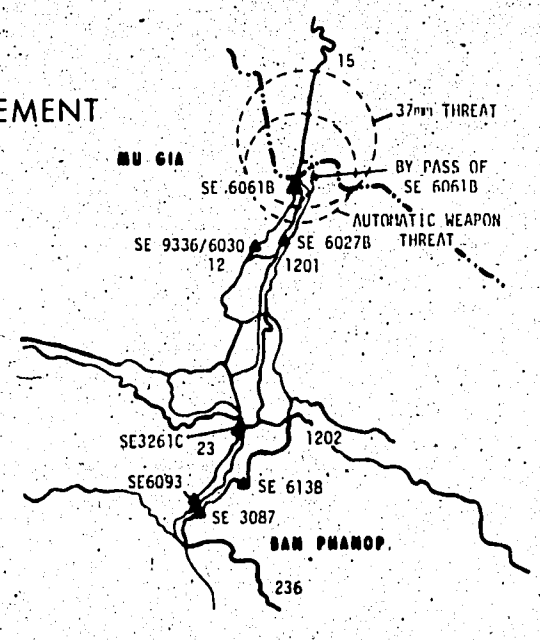


FIGURE III - 31

Moving south from the border, the route structure allowed the enemy to use alternate routes if only one point was interdicted; therefore, the interdiction strategy adopted was to interdict simultaneously two or more points. When the same IDPs were attacked repeatedly, the enemy pre-positioned both his road repair and defense force. It was necessary, therefore, to select several IDPs which could be attacked alternatively. Six primary interdiction points were selected and divided into three package pair points.

The northernmost package sites were SE 9336/6030 and SE 6027B. The photograph below shows the ruggedness of the terrain in the SE 9336/6030 area. SE 9336 was the IDP which the enemy first reached when moving south from the border. It was used as a seeding segment where time delay ordnance, MK 36s, and antipersonnel ordnance were used to deny the area to the enemy and prevent road repair. SE 6030, where the road begins to ascend the ridge, was a cutting point. General purpose bombs, either free fall or laser guided, created slide conditions, making movement up the ridge impossible.

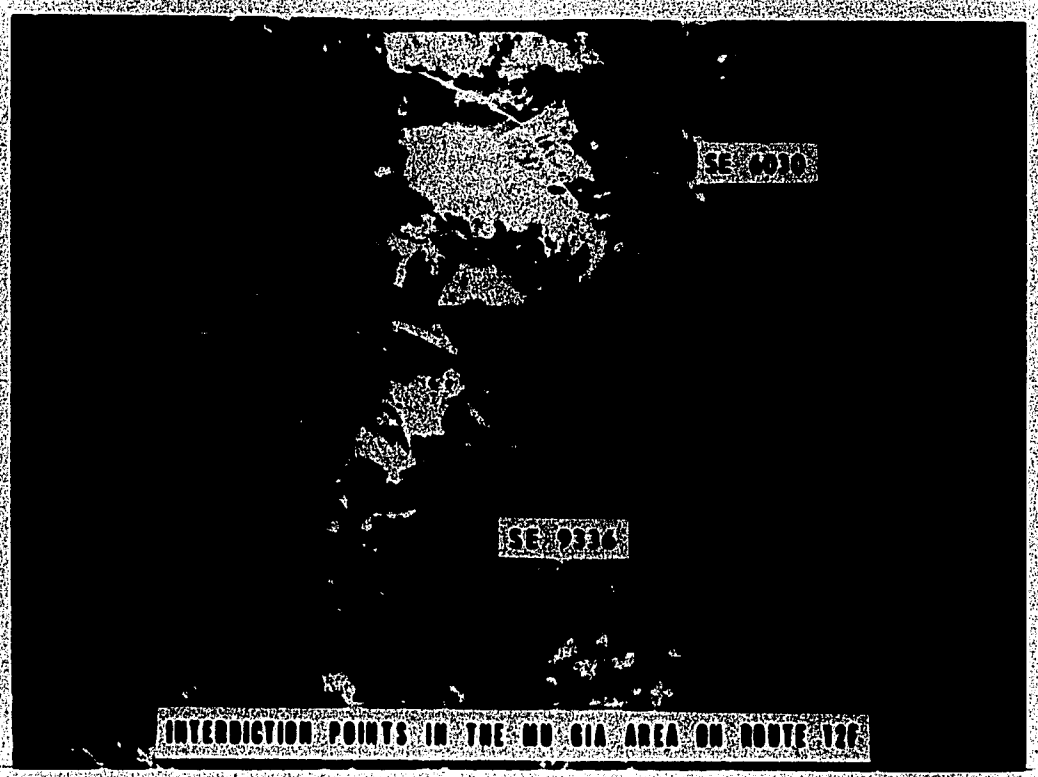


FIGURE III - 32

Further south, SE 6138 and SE 3261 were the next pair of interdiction points. SE 6138 on route 1202 was located between a karst formation and a hill. It could be struck from several angles, making prepared enemy response more difficult. There was direct evidence of the blocking effect of packages at this

point. Sensor string 11-5, one kilometer north of the interdiction point, was used to measure the blocking effect which averaged 35 hours closed per package for the 20 packages emplaced. Closure time was measured from the last time over target of the aircraft delivering package munitions until the first sensor detection through a sensor string above or below the IDP.

The southern pair of IDPs were SE 6093 and SE 3087. Weather was generally more favorable in the area of this pair than those further north. The southern pair was attacked often in November, but when weather improved in December, the northern pairs received greater emphasis.

Although it was difficult to measure the success of package emplacements at specific points in the Mu Gia area, a regression analysis covering the period 1 November to 17 February showed that the number of package emplacements had a significant effect on the input of trucks through Mu Gia. Each additional package emplaced decreased input by approximately 14 truckloads per week. This relationship, shown in Figure III-33, was significant at over the 99 percent confidence level. It was apparent that following package emplacement, the enemy purposely decreased input to prevent truck queuing problems and potential destruction of his supplies as traffic backed up at an interdiction point.

MU GIA
PACKAGE EMPLACEMENT vs INPUT OF TRUCKS

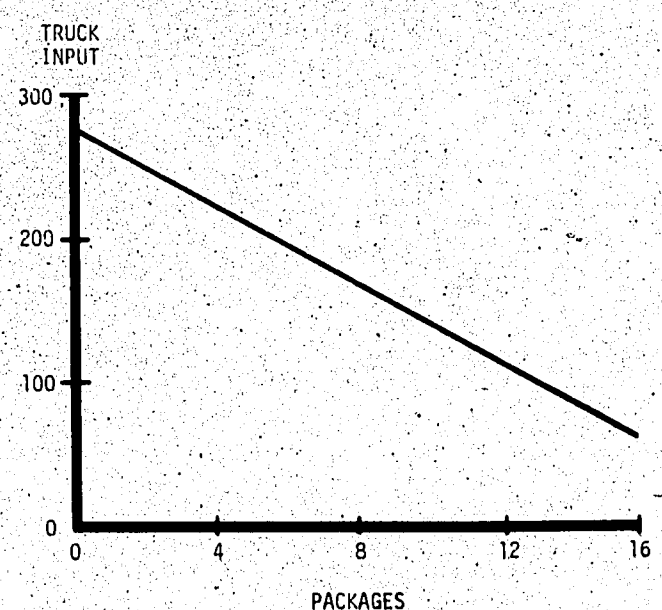


FIGURE III - 33

Ban Karai Area. Figure III-34 shows the interdiction points in the Ban Karai area which were packaged most frequently. Interdiction points SE 6310A and SE 6310B were combined with SE 6085 to form a package pair. These interdiction points were on route 912B. Both SE 6310A and SE 6310B were in a narrow defile where the possibility of bypassing was remote. This feature of the topography also made strikes against these two interdiction points more susceptible to ground fire since the approach path of the attacking aircraft was predictable. Package emplacement at SE 6085, the northern interdiction point of this package pair, was also hampered by bad weather.

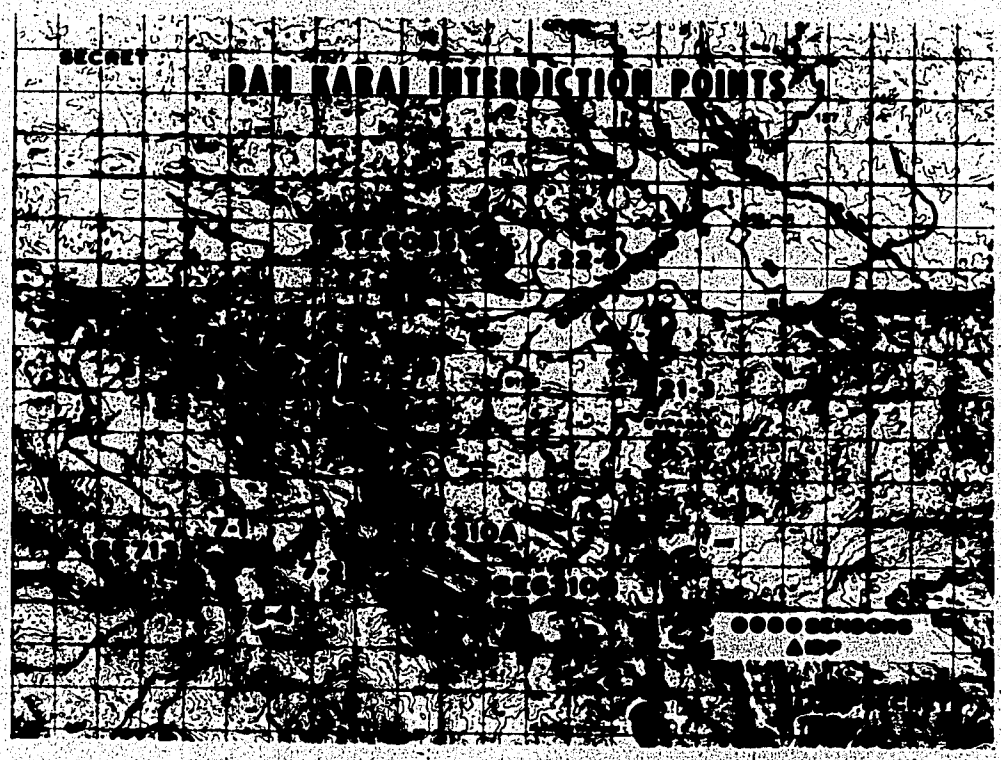


FIGURE III - 34

During the last half of December, packages emplaced at these points showed evidence of causing a channeling effect from Ban Karai to Mu Gia. As package emplacement increased in Ban Karai, input into Ban Karai decreased and sensor detected traffic in the Mu Gia area increased.

From 6 to 16 March 1970, 20 packages were emplaced with 121 sorties in the Ban Karai area. Two points at SE 7135 on segments of route 912B were packaged with an average daily total of 27 MK 36s and 90 MK 82s with time-delay fuses. The traffic in the area was monitored by sensor strings 6-4, 7-1, and 7-2. String

22-9, located approximately 16km north of the package area, provided the primary measurement of input through Ban Karai. Table III-15 shows sensor detected traffic through these sensor strings and total sensor detected traffic in the Mu Gia area. Average daily sensor detected traffic for 1 to 5 March was used as a baseline for comparison with the periods 6 to 17 March, which included the munitions packaging, and 18 and 19 March, shortly after termination.

IDP SE 7135 (ROUTE 912B)
DAILY AVERAGE

MARCH	DIRECTION	STRING 6-4	STRING 7-1	STRING 7-2	STRING 22-9	MU GIA AREA
1-5	NORTH	13	2	9	56	4
	SOUTH	20	14	5	45	4
6-17	NORTH	14	0	14	29	1
	SOUTH	19	2	20	35	1
18-19	NORTH	63	0	62	5	3
	SOUTH	56	0	57	8	4

TABLE III - 15

Sensor string 6-4, which was the best measuring string for SE 7135, did not show a significant change in traffic until 15 to 17 March, the last two days of package emplacement and the day following the last attack. No traffic was detected through the string during this three day period. On 16 March, seven southbound trucks were recorded through string 7-2--additional evidence that the package was holding--since traffic moved south through 7-2 but did not reach string 6-4. On 18 and 19 March there was a surge of traffic through SE 7135, with a daily average of 56 trucks south and 63 north through sensor string 6-4. The same traffic also moved through string 7-2. This was the highest traffic level in March through these two strings, indicating that the package had held for the previous three days and that stockpiling had occurred north of the string, while south of the string northbound trucks awaited the opening of the interdiction points.

There was one factor which distinguished the last two days of package emplacement from the others. The timing of the delayed fuse bombs was changed so that 50 percent were scheduled to go off during the first quarter of the evening. For the first nine days of package emplacement, the bombs were set to go off at intervals throughout the night. This change was made because it was observed that southbound traffic through 6-4 occurred early in the evening.

Southbound traffic through string 22-9 remained constant during the first half of March, but there was a significant decrease in input traffic on March 18. Detections on string 7-1 remained very low, indicating that it was inactive or being bypassed. Traffic in the Mu Gia area remained very low during the package emplacements in the Ban Karai area, and there was no evidence of a channeling effect from Ban Karai to Mu Gia as there was in December. By this time the enemy had ceased using the longer route through Mu Gia.

Overall, the principal effect of packages in the Ban Karai area was to channel traffic to the longer and hence more exposed Mu Gia route during December.

The Chokes Area. In the Chokes area south of the Ban Karai pass, where the road network converges, one objective of munitions packages was to channel traffic to the western route structure where the gunships operated when moon illumination was high. The complexity of the road network in the Chokes made selection of good package emplacement points difficult. An example was the selection of IDPs to interdict routes 9115, 911D, and 911F. As illustrated in Figure III-35, traffic in this area could be successfully blocked only by interdicting all three points simultaneously.

On 12, 13, 14, and 18 January, packages were emplaced on all three points. On several other days during January, as indicated in Figure III-36, packages were emplaced at individual IDPs. The figure illustrates the effect of packages on northbound traffic above these points. Since there was a possibility of traffic running west through sensor string 6-1 and then going up route 911C toward the western route structure without going through any of these IDPs, northbound traffic through the string was believed to be the most accurate reflection of package effectiveness on these three points. A decrease in sensor activity occurred on each of the evenings following package emplacements when all three IDPs were interdicted. When emplaced at only one IDP, there was no decrease apparent.

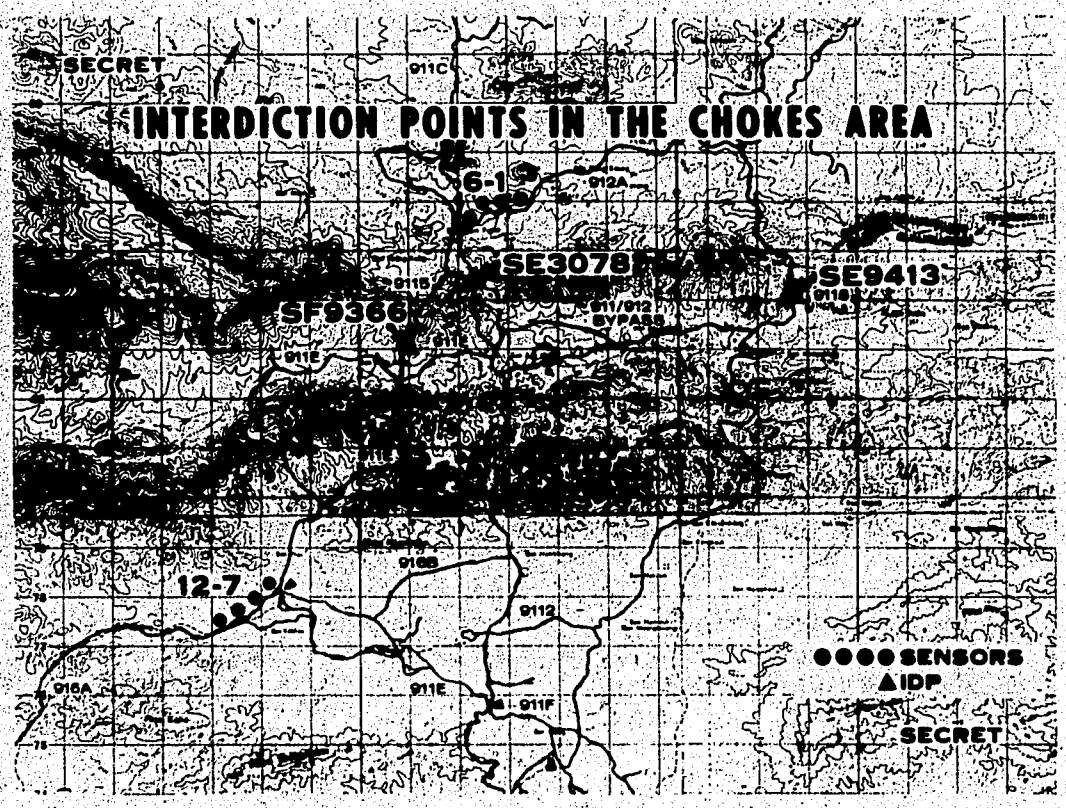


FIGURE III - 35

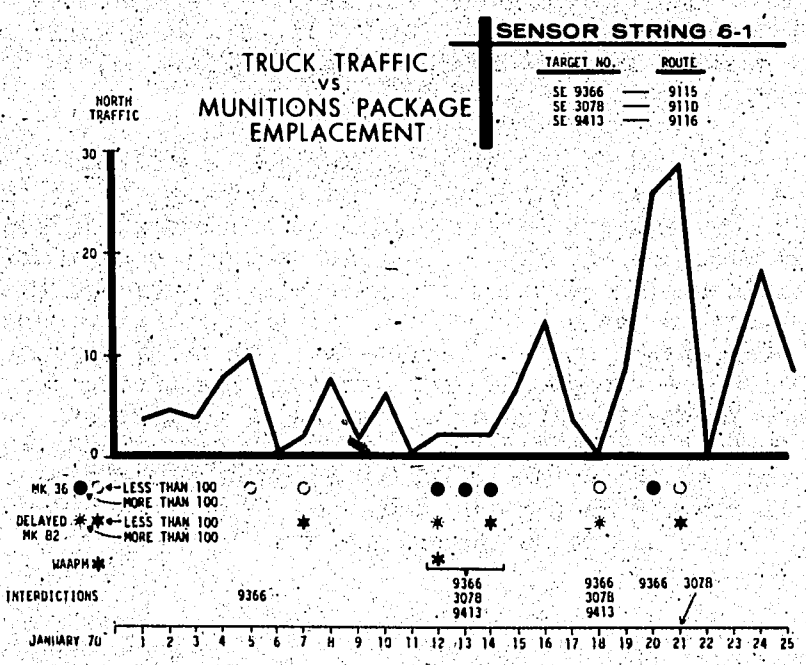


FIGURE III - 36

While the emplacement of the triple packages showed a measurable decrease in traffic, the total number of sorties required to interdict three points successfully involved a relatively large expenditure of resources. And if weather prevented one package from being emplaced, the area could not be successfully blocked. As a result of these considerations, package emplacements in the Chokes were rarely made after January.

Delta 45. In the area around Delta 45, there were three frequently used package emplacement points, two on route 92D and one on route X929 (Figure III-37). The initial IDP used on route 92D was SF 6770, but there was no clear effect of package emplacement on traffic. Based on analysis of sensor detections and as a result of evidence that the IDP was being bypassed, the package emplacement point was moved on 8 January to SF 6822, approximately 400 meters east of the old point. The packages emplaced on this new point were under FAC control. The sensor-detected traffic from 28 December (when sensor string 16-3 was seeded) through 18 January shows that the effect on traffic varied from day to day (Figure III-38).

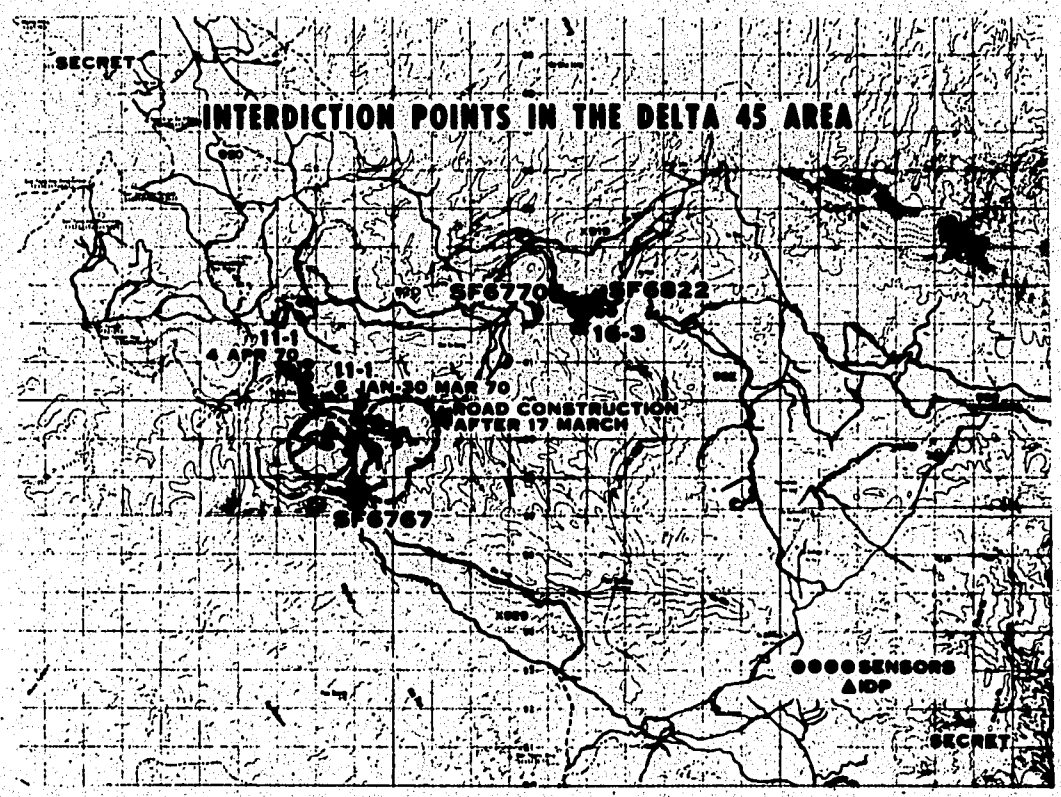


FIGURE III - 37

SECRET

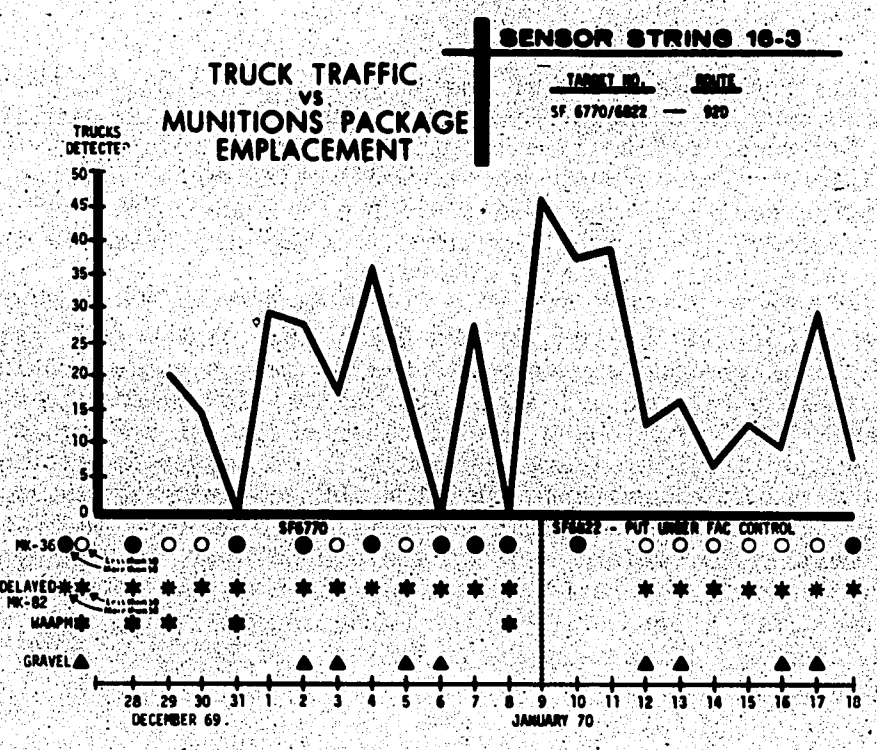


FIGURE III - 38

Beginning on 17 March, packages were emplaced at SF 6767 on route 929 and SF 6822 on route 92D. Through 31 March, 356 sorties delivered the munitions shown below:

DELTA 45
TOTAL ORDNANCE DELIVERED
MARCH 17 - 31

ORDNANCE	SF6822	SF6767
PAVEWAY		5
M117	40	16
MK 82	439	272
MK 82 DELAYED FUZE	308	54D
MK 36	423	382
CBU-42 (WAAPM)	28	21
CBU-33		12
CBU-24/49 (ANTI-PERSONNEL BOMBLETS)	52	30

TABLE III - 16

SECRET

For both interdiction points, cutting ordnance, time delay ordnance, antivehicle, and antipersonnel mines were used. Most of the cutting ordnance was delivered the first few days. The five Paveways at SF 6767 were delivered on 17 March. The photograph below taken at SF 6822 on 25 March shows a road cut and a destroyed bulldozer which had been working in the area.

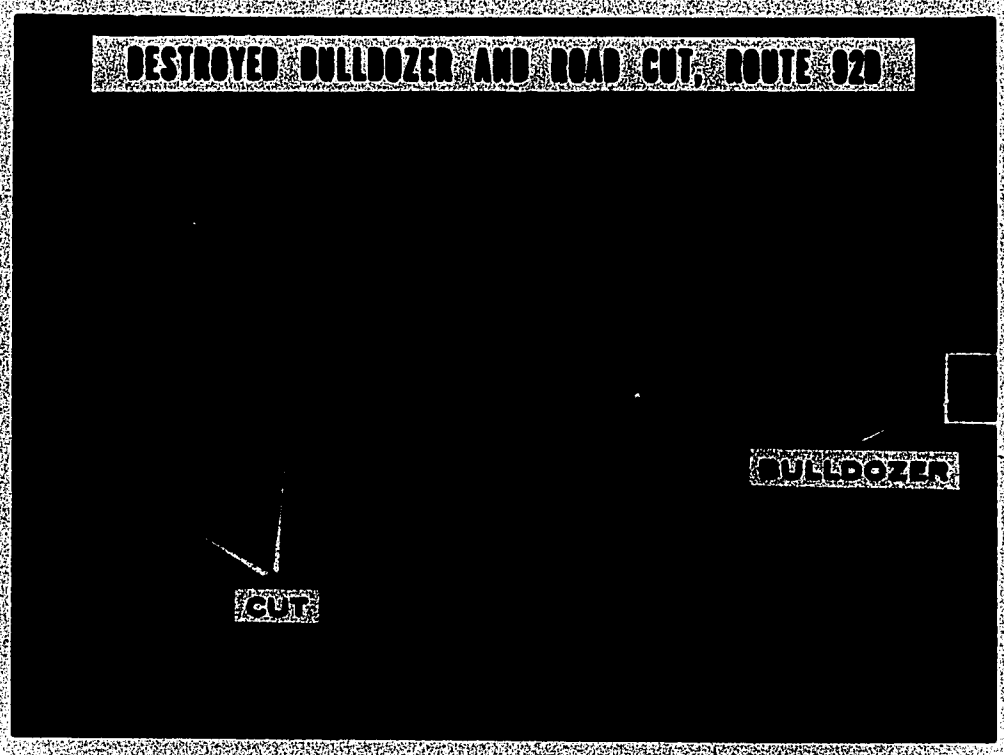


FIGURE III - 39

North and south traffic detected by sensor string 11-1 for the base period 1 to 16 March and during the period of package emplacement, 17 to 29 March, is given below.

ROUTE X929
SF 6767
SENSOR DETECTED TRUCKS
(String 11-1)

	Daily Average Trucks	
March Data	North	South
1 - 16	17	14
17 - 29	1	1

There was a sharp decrease in traffic between the base period and the period of package emplacement. Further, there was no sensor detected traffic between 20 and 27 March.

The enemy, however, was not idle. He constructed roads at a rapid pace directly above interdiction point SF 6767 shortly after 17 March. The road construction is shown encircled with a broken line in Figure III-37. This maze of roads partially compromised the effectiveness of sensor string 11-1, beginning around 20 March. Beginning 5 April, after sensor string 11-1 was reseeded above the new road construction, approximately three kilometers from the interdiction point, an increase in traffic was noted. The increase, however, was only partial evidence that traffic was moving through the interdiction point, as the maze of roads between string 11-1 and the interdiction point indicated a high probability of stockpiling above SF 6767. This was verified when strikes against the area yielded a large number of secondary fires and explosions. There was a significant increase in total truck park and storage area secondary fires and explosions within 60km north of the Delta 45 area after 17 March. Figure III-40 shows that the number of truck park and storage area secondaries was more highly correlated with package strikes against Delta 45 than with truck park and storage area strikes in the area.

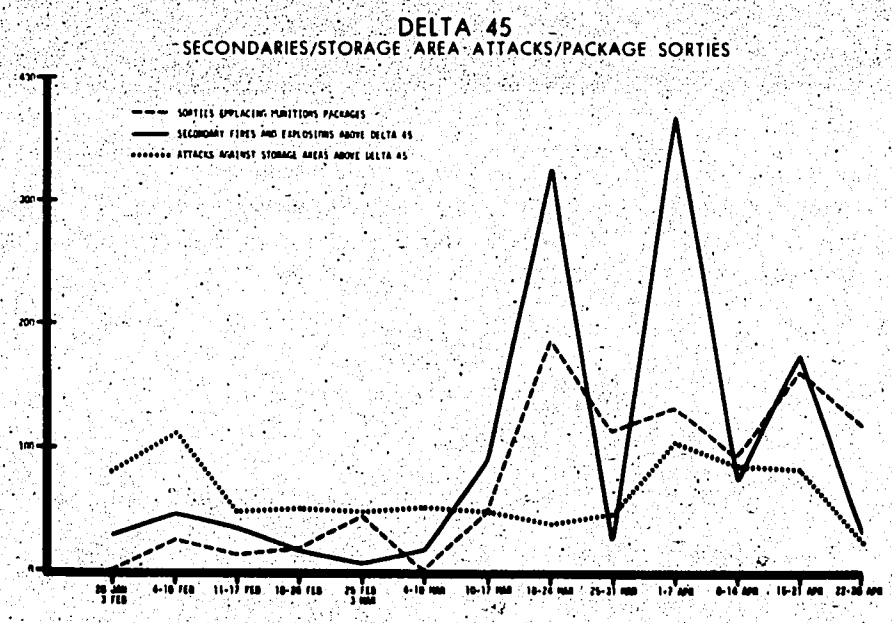


FIGURE III - 40

The package on SF 6822 was emplaced near string 16-3. There was no sensor detected traffic through 22 March when weather prevented emplacement of the package. That evening, there were ten north and two southbound trucks detected by the sensors. When package emplacement was resumed for the following six days, there were no detections. With the exception of one southbound detection on 27 March and one northbound detection on 29 March, there was no additional traffic detected by string 16-3 through 8 April, when the string went inactive.

A measure of the effectiveness of package emplacement at interdiction point 6822 was its effect in decreasing throughput on route 922. The decrease in truckloads of throughput after package emplacements began on 17 March is shown below.

ROUTE 922 THROUGHPUT

	1-16 March	17-31 March
Daily Average Truckloads	15	8

Traffic on route 92E which had to pass through the Delta 45 area is another indication of the effectiveness of package emplacement on routes 92D and X929. Traffic through sensor strings 10-4 and 2-4 is shown below.

ROUTE 92E
SENSOR DETECTED TRUCKS
(Strings 10-4 and 2-4)

March Date	Daily Average Trucks North	South
1 - 16	17	9
17 - 31	9	6

Both north and southbound truck traffic decreased during the period of package emplacement, indicating that traffic was being blocked in Delta 45.

Packaging the Delta 45 area showed mixed results early in the campaign, but the concentrated packaging in March caused a decrease in traffic below the interdiction points. Also, the Delta 45 experience provided direct evidence of enemy expansion of this road net to counter LOC interdiction.

Overall Analysis. A regression analysis based on weekly data from 29 October 69 to 3 March 70 examined the relationship between level of effort devoted to packages, damage assessments, and sensor detected traffic. The three measures of damage were trucks destroyed or damaged, truck related secondary fires and explosions, and truck park and storage area secondary fires and explosions. Level of effort measures were the number of packages emplaced, average sorties per package, and the average number of MK 36s per package. There was a strong relationship between an increase in sorties per package and a decrease in sensor detected traffic. This relationship was significant at the 99 percent confidence level. The indication was that package size, reflected by the number of sorties per package, had a significant effect on sensor detected traffic.

Another method of measuring the effectiveness of various types of packages was closure time, which as stated earlier was measured from the time of delivery of last ordnance until first sensor detections through a string directly above or below the package point. Ideally sensor strings bracketing the interdiction point were required for a precise measurement of closure time; however, because of the unsuitability of certain interdiction points for sensor string emplacement and monitoring, bracketing was difficult to achieve. It was frequently necessary to use a string several kilometers away. If no string was located nearby or if there were intervening by-passes, the closure time could not be computed. During a traffic surge period, packages frequently achieved a general decrease rather than a halt of traffic. Table III-17 provides closure time by package type.

CLOSURE TIME BY PACKAGE COMBINATION

(NOVEMBER 69 - APRIL 70)

PACKAGE ORDNANCE				PACKAGES MEASURED	HOURS CLOSED			
MK-36	DELAYED FUSE	CUTTING	ANTI-PERSONNEL		AVERAGE	MEDIAN	HIGH	LOW
●	●			41	24	17	49	2
●		●	●	23	23	15	47	1
●		●		17	20	15	49	0
●				21	19	11	170	4
●	●	●	●	11	13	8	34	3
●	●		●	19	13	12	48	2

TABLE III - 17

Included in the table are the package types which were emplaced ten or more times on points where closure times could be measured by nearby sensor strings. Closure times varied greatly with no discernible pattern for different ordnance combinations. Factors such as the difference in distances of the measuring sensor strings from the interdiction point and the general level of enemy traffic during package emplacements affect these results. The chart does show, however, that packages could achieve a significant blocking effect.

LOC Road Cutting Attacks

Road cutting attacks were used at selected interdiction points to temporarily block traffic flow. They also diluted the enemy's road repair capability by forcing dispersion of road repair resources throughout Steel Tiger and thus complemented munitions packages.

The general shift in emphasis in attacks against the roads from northern Steel Tiger to southern Steel Tiger as the campaign progressed is shown in Figure III-41. Early in the campaign, before truck traffic increased significantly, road cuts were emphasized in northern Steel Tiger as the enemy activity increased in that area.

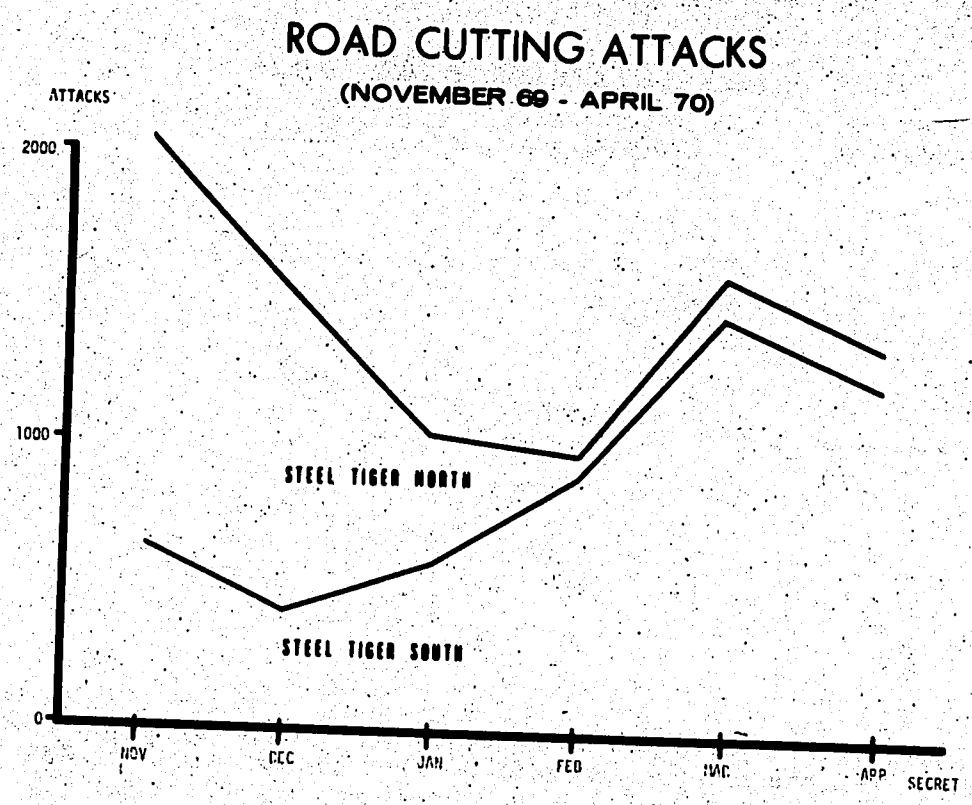


FIGURE III - 41

During December and January, attacks against roads decreased and the force was applied more directly against trucks. In March attacks rose as a result of the increased interdiction effort in southern Steel Tiger. Although LOC interdiction attacks continued during April, there was a decrease in road cutting as package emplacements were made in the Delta 45 area and on route 966.

On 23 February, a plan was initiated to cut the roads in southern Steel Tiger to reduce throughput. The total IDP sorties flown and the road cuts achieved during the first three days are shown below:

	February		
Date	23	24	25
Total IDP Sorties	157	152	153
Road Cuts	47	19	35

Daily average throughput for the base period 18 to 22 February, immediately prior to the special road cutting effort, and the average throughput between 23 and 28 February follow:

AVERAGE DAILY THROUGHPUT IN TRUCK LOADS

ROUTE	18-22 Feb	23-28 Feb
925	0	0
9H	1	0
926	12	4
921B	5	0
922	19	16
966D/165D	19	20
110D	20	4
TOTAL	76	44

There was a significant decrease in throughput on routes 110D and 926. All routes were interdicted with the exception of 925 and 9H. On 27 February, the total throughput was 13 truckloads,

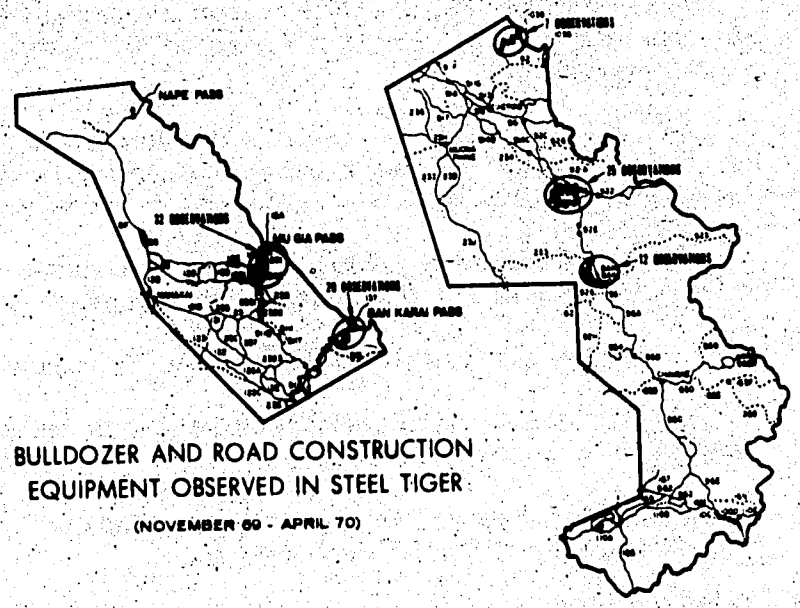
the lowest total since 12 January when the throughput was six truckloads. When package emplacement was initiated on route 966, there was no measurable decrease in throughput related to the road cutting interdiction through 21 April.

On route 110D the LOC interdiction was intensified on 22 April as time delay bombs and MK 36s were used in addition to cutting ordnance at several interdiction points. Although MK 36 anti-vehicle mines were used, the amount emplaced was not sufficient to classify the interdiction as a package emplacement. Associated with the increased interdiction was a decrease in throughput on route 110D.

Although the main LOC interdiction emphasis continued against southern Steel Tiger late in the campaign, attacks were initiated in the 1039/92A area on 13 April to counter the increased input there. Poor weather, however, caused most of the strikes to be diverted to other targets.

Bulldozers and Road Construction Vehicles

One visible result of the effect of the interdiction attack against LOCs was the increased number of bulldozers and road construction vehicles observed in Steel Tiger during Commando Hunt III. These observations are plotted on the map of Figure III-42. Enemy road construction and repair activity occurred primarily in those areas which were frequently packaged and on route 924 near Ban Bak which was attacked during the southern Steel Tiger road cutting operation which began in late February.



BULLDOZER AND ROAD CONSTRUCTION EQUIPMENT OBSERVED IN STEEL TIGER
(NOVEMBER 69 - APRIL 70)

FIGURE III - 42

Table III-18 gives the number of bulldozer and road construction vehicles observed in Steel Tiger by month along with the number destroyed and damaged. Many construction vehicles were observed in November, when the roads were being readied for the coming campaign, and beginning in February, when the enemy increased his repair effort as a result of the concentrated LOC attacks in southern Steel Tiger.

BULLDOZER AND ROAD CONSTRUCTION VEHICLES STEEL TIGER

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
OBSERVED	25	18	11	27	40	22	143
DESTROYED	4	5	2	3	12	5	31
DAMAGED	2	3	3	6	4	8	26

TABLE III - 18

Summary

The expanded route structure and increased repair activities by the enemy made attacks against lines of communication less productive during Commando Hunt III than during Commando Hunt I.

- o LOC interdiction provided interdiction forces a means of taking the initiative, forcing the enemy to react and shift his resources.
- o To be successful, munitions package emplacements had to be carefully planned and precisely executed. In many cases, multiple packages were required to block an area.
- o The results of munitions packaging were not universally accepted as a success. The contributing factors were:
  - Fewer strike sorties available during Commando Hunt III.
  - Inaccurate delivery of munitions packages because of weather and enemy defenses.
  - Ability of the enemy to bypass many interdiction points due to increased road construction.
  - Difficulty in obtaining measurable results.

- Road cutting attacks forced the enemy to expend significant resources on repairs and complemented the use of munitions packages.

ENEMY DEFENSES

The enemy efforts to counteract the interdiction campaign levied costs both on his own resources and on the interdiction forces. This section analyzes the effects of AAA on the interdiction campaign and U.S. operations to suppress enemy defenses.

Analysis of the Effects of AAA

The hit and loss experience of all interdiction aircraft during Commando Hunt III is summarized in Table III-19. The loss rate per 1000 sorties was .74 as compared to .63 during Commando Hunt I. The number of sorties reporting firings during the campaign was nearly double that of Commando Hunt I. As a result, there were twice as many hits experienced. The heavier than usual losses during November 1969 were due to the large number of guns the enemy had in Steel Tiger at the beginning of the campaign (over 3 times as many as at the start of Commando Hunt I) and to the aircrew learning curve, since many of the crews flying during November 1969 had not flown during the previous campaign.

INTERDICTION AIRCRAFT
HIT AND LOSS EXPERIENCE DUE TO AAA

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
SORTIES							
FLOWN	13,332	15,391	15,365	12,309	13,848	11,171	81,416
REPORTING FIRINGS	1,464	2,715	3,284	3,139	2,952	2,710	16,264
AIRCRAFT							
HIT	65	52	51	33	61	48	310
LOST*	15	9	11	2	11	12	60
HIT/1000 SORTIES	4.87	3.38	3.32	2.68	4.40	4.30	3.80
LOST/1000 SORTIES	1.13	0.58	0.72	0.16	0.79	1.07	0.74
LOST/HIT	0.23	0.17	0.22	0.06	0.18	0.25	0.20

*DOES NOT INCLUDE ONE HH-53 RESCUE HELICOPTER SHOT DOWN BY A MIG IN JANUARY.

The vulnerability and survivability of the interdiction aircraft varied according to mission and aircraft characteristics. Vulnerability was computed as the probability that an aircraft was hit, given it was fired upon. Survivability was computed as the probability that an aircraft was not lost, given it was hit. These statistics are dependent on the tactics and force employment used during Commando Hunt III as well as aircraft characteristics and enemy defenses. For example, the gunship record was strongly influenced by the decision to restrict the gunships from higher threat areas. Statistics for November 1969 through April 1970 are presented in Table III-20. Because of their small sample size, vulnerability and survivability probabilities are not included for an RF-101 hit and an EC-47 and OV-1 lost.

AIRCRAFT VULNERABILITY AND SURVIVABILITY

(NOVEMBER 69 - APRIL 70)

AIRCRAFT TYPE	SORTIES FIRED UPON	AIRCRAFT		VULNERABILITY	SURVIVABILITY
		HITS (INCL. LOSSES)	LOST		
A-1	1369	41	9	0.030	0.78
A-4	473	30	4	0.063	0.87
A-6	486	6	4	0.012	0.33
A-7	1234	6	3	0.005	0.50
*F-4	5715	87	19	0.015	0.78
F-100	454	39	7	0.086	0.82
F-105	178	8	2	0.045	0.75
RF-4	211	35	3	0.166	0.91
O-2	702	14	1	0.020	0.93
OV-10	821	30	4	0.037	0.87
C-123	489	1	0	0.002	-
C-130	509	1	1	0.002	1.0
AC-119	740	2	0	0.003	-
AC-123	259	1	0	0.004	-
AC-130	2534	6	1	0.002	0.83

*INCLUDES AIR FORCE, NAVY AND MARINE

TABLE III - 20

Battle damage by type of AAA weapon is shown in Table III-21. Small arms caused most of the hits but 37mm AAA caused a majority of the losses. The operating and bombing altitudes for most of the interdiction aircraft were within the 8200-foot effective range of the 37mm AAA.

AAA HITS AND AIRCRAFT LOSSES IN STEEL TIGER BY AAA WEAPON

(NOVEMBER 69 - APRIL 70)

TYPE WEAPON	HITS (INCLUDES LOSSES)	LOSSES	LOSS TO HIT RATIO
SMALL ARMS AND AWP	109	6	.05
23MM	39	6	.15
37MM	59	21	.36
57MM	1	0	-
UNKNOWN	102	27	.26
TOTAL	310	60	.19

TABLE III - 21

The cumulative hits by aircraft and altitudes is shown in Figure III-43. Aircraft were hit most frequently when flying at 2000 feet or below, within the range of small arms and automatic weapons. Emplacement of CBU-42 (WAAPM), MK 35 landmines, and Igloo White sensors required low altitude delivery. Visual reconnaissance was also flown at low altitude to locate enemy activity under the jungle canopy. Crews were instructed to maintain altitudes commensurate with the threat and mission accomplishment.

AIRCRAFT AAA HITS
BY ALTITUDE IN STEEL TIGER
(NOVEMBER 69 - APRIL 70)

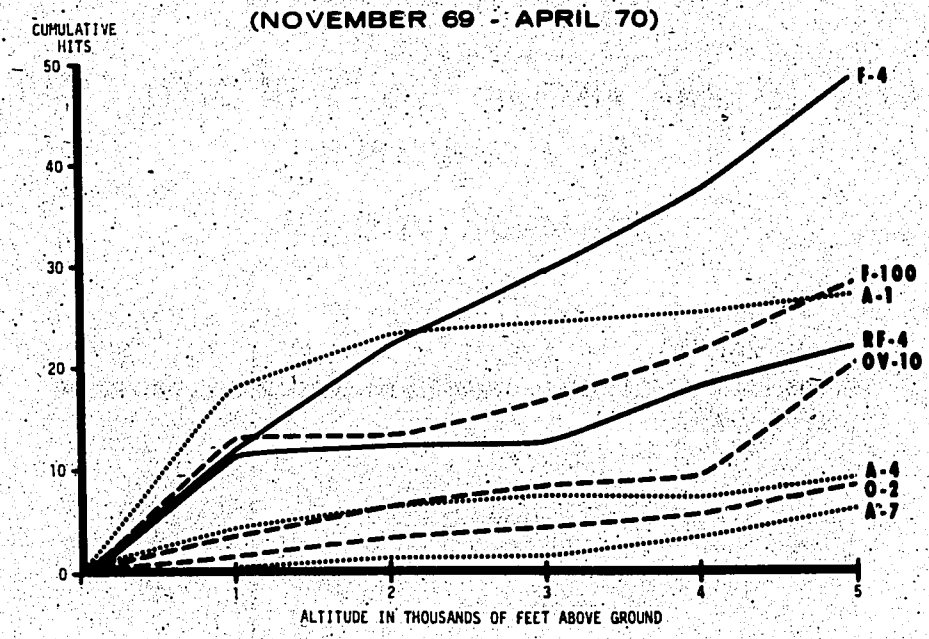
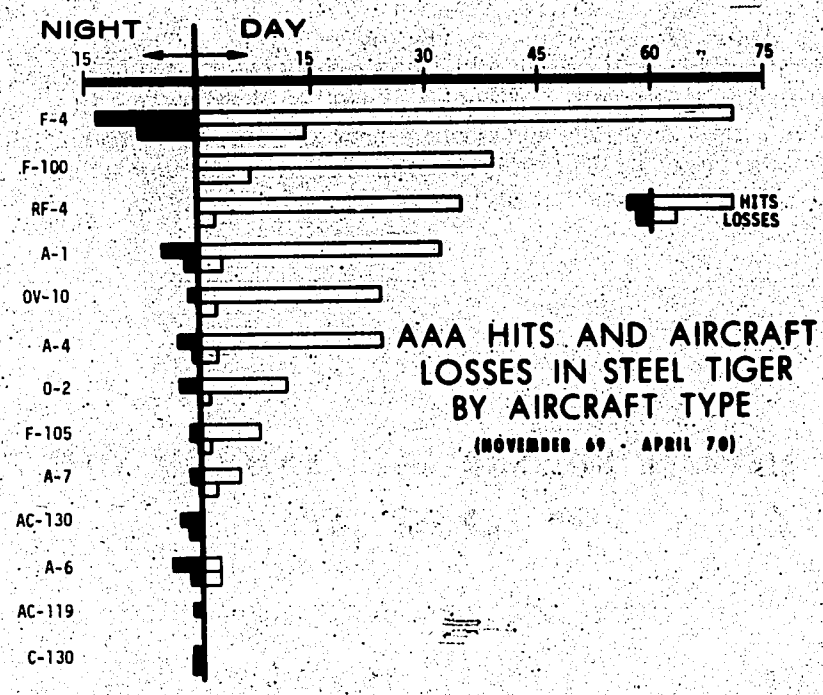


FIGURE III - 43

Although 60 percent of the strike sorties in Steel Tiger were flown at night, 86 percent of the hits and 69 percent of the losses during the campaign occurred during the day when enemy gunners could visually track the aircraft. Daylight operations were necessary to reconnoiter enemy activity and to deny him the use of his LOCs during the day. Figure III-44 presents a breakout of the battle damage incurred during day and night operations.

Aircraft hit and loss rates by mission function are shown in Table III-22. Although strike aircraft had the highest absolute number of hits and losses, they flew the most sorties, and the number of aircraft hit and lost per 1000 sorties were generally lower than that for other missions. Aircraft on visual recce and SAR missions experienced the highest number of hits and losses per 1000 sorties because they operated at low altitude. Their loss-to-hit ratio, however, was low because most hits were taken by small arms.



AAA HITS AND AIRCRAFT LOSSES IN STEEL TIGER BY AIRCRAFT TYPE

(NOVEMBER 69 - APRIL 70)

FIGURE III - 44

AIRCRAFT HIT AND LOSS RATES IN STEEL TIGER BY MISSION

(NOVEMBER 69 - APRIL 70)

		RECCE				
	STRIKE	VISUAL	PHOTO	FAC	SAR	ESCORT	ECM
HITS PER 1000 SORTIES	3.43	50.2	5.19	5.00	32.5	1.75	1.63
LOSSES PER 1000 SORTIES	0.85	6.72	0.52	0.83	6.51	1.05	1.63
LOSSES PER HIT	0.25	0.13	0.10	0.16	0.20	0.60	1.0

TABLE III - 22

Hit and loss rates experienced by aircraft striking the various target categories are given in Table III-23. The heaviest concentrations of AAA were on the major LOCs. Therefore, the aircraft attacking AAA and LOCs sustained the highest number of hits and losses per 1000 sorties. The high loss-to-hit ratio experienced by aircraft attacking trucks reflects the high priority assigned to killing trucks and a tendency of the aircrews to press the attack and make repeated passes.

STRIKE AIRCRAFT HIT AND LOSS RATES IN STEEL TIGER BY TARGET TYPE

(NOVEMBER 69 - APRIL 70)

	TRUCKS	TKP/STO	LOC	AAA
HITS PER 1000 SORTIES	1.28	0.89	4.99	6.48
LOSSES PER 1000 SORTIES	0.55	0.28	0.82	1.85
LOSSES PER HIT	0.43	0.31	0.16	0.29

TABLE III - 23

Enemy defenses also caused the diversion of strike aircraft to search and rescue (SAR) operations required to recover downed crew members. SAR operations required extensive support of strike aircraft. As many as 270 sorties of all types were

required to effect the rescue of one downed crewman. The time required to complete a successful pickup varied from a few minutes to several days. The average time required was 29 hours and the median 19. The average number of sorties was 42 and the median 22. On 5 December and 19 March the two largest SAR operations of the campaign occurred. Both were successful but required a total of 115 and 158 hours and 270 and 156 sorties respectively.

It often took a long time to complete a SAR because there was insufficient time available to effect a pickup before darkness, and it was necessary to suspend the operation until first light the next day. Darkness caused 65 percent of the SARs to be suspended. During the campaign, 47 percent of the 102 downed crew members were recovered.

In summary,

- The enemy used a large amount of resources to defend his LOCs in Laos.
- 37mm AAA was the cause of most of the losses, but small arms and automatic weapons caused most of the hits on interdiction aircraft.
- Enemy defenses degraded bombing accuracy and caused a diversion of strike resources from primary interdiction targets.
- Sixty-one interdiction aircraft and 54 aircrewmen were lost to enemy defenses during the campaign.
- Search and rescue operations recovered 47 percent of the aircrewmen shot down.

Attacks Against Enemy Defenses

The extensive enemy AAA buildup in Steel Tiger during Commando Hunt III required the diversion of strike resources from attacks on interdiction targets. As shown in Table III-24, over 6400 attack sorties, 12 percent of the campaign total, were flown against AAA targets, compared to only six percent of the sorties allocated to these targets during Commando Hunt I.

SORTIES AND BDA AGAINST AAA SITES

(NOVEMBER 69 - APRIL 70)

	SORTIES ATTACKING AAA	GUNS			SECONDARY	
		DESTROYED	DAMAGED	SILENCED	EXPLOSIONS	FIRES
NOV	507	43	17	121	117	85
DEC	1641	153	26	256	385	356
JAN	1269	100	40	313	295	383
FEB	1067	72	33	193	241	375
MAR	1069	103	48	214	537	443
APR	928	77	38	233	270	206
TOTAL	6481	548	202	1330	1845	1848

TABLE III - 24

The month of highest activity against guns was December, when two special operations were conducted. One hundred sixty-one sorties were flown during these operations, destroying or damaging 21 guns. Because of the low productivity of these special operations, they were not repeated after December.

Attacks against AAA destroyed or damaged 750 guns, forcing the enemy to replace essentially his entire Steel Tiger active gun inventory during the campaign. However, he was not limited in the number of guns he could deploy in Laos from his sanctuaries in North Vietnam. As a result it would not have been feasible, with the available interdiction force, to appreciably reduce the AAA threat in Steel Tiger. For this reason the emphasis was on flak suppression to silence the AAA temporarily. The tactic was to attack AAA sites that were a threat to an immediate strike with antipersonnel munitions (CBU-24s and general purpose bombs with fuse extensions) in order to kill crews or discourage them from firing.



FIGURE III - 45



FIGURE III - 46

All strike aircraft carried ordnance for use against AAA. Some aircraft were specifically scheduled as escorts for strike aircraft operating against heavily defended targets. All gunships were escorted. If the escorts did not expend their ordnance in attacks against AAA, they struck other targets. A breakout of the strikes made by gunship escorts is contained in Table III-25.

GUNSHIP ESCORT STRIKES
(NOVEMBER 69 - APRIL 70)

TARGET	F-4	A-1	TOTAL
AAA	1540	89	1629
TRUCKS	768	166	934
TRUCK PARK/ STORAGE AREAS	429	34	463
LOC	66	2	68
OTHER	99	14	113
TOTAL	2902	305	3207

TABLE III - 25

The multi-purpose role of the escort aircraft resulted in increasing their utility and contribution to the interdiction effort. The bomb damage obtained from the escort strikes is listed in Table III-26.

The most effective weapon for destroying AAA was the Paveway laser guided bomb which was used in quantity for the first time during Commando Hunt III. Paveway was a 2000-pound general purpose or a 3000-pound demolition bomb with moveable control surfaces replacing the fins. The bomb was fitted with a laser guidance kit which sought a laser "illuminated" target. One aircraft illuminated the target with a laser designator, while a second dropped the Paveway in a prescribed cone "basket" in relation to the target. The bomb was guided to the target by the seeker kit. Paveways were employed by modified F-4 aircraft

GUNSHIP ESCORT SORTIES BDA

(NOVEMBER 69 - APRIL 70)

	F-4	A-1	TOTAL
TRUCKS			
DESTROYED	65	38	103
DAMAGED	44	10	54
GUNS			
DESTROYED	77	23	100
DAMAGED	2	0	2
SECONDARIES			
TRUCKS	410	145	555
AAA	514	22	536
SUPPLY EXPLOSIONS	157	11	168
SUPPLY FIRES	151	19	170

TABLE III - 26

based at Ubon RTAFB. The 2000-pound Paveway was most frequently used. Four Paveway sorties per day were normally scheduled into Steel Tiger. An average of one gun was destroyed for each Paveway delivered. No Paveway aircraft were hit by ground fire of any kind during the campaign. The number of Paveways delivered and the number of guns destroyed is given in Figure III-47.

The Rockeye 500 pound cluster bomb with shaped charge bomblets was also employed against AAA. Like the timer-fused CBU-24, Rockeye was released from the aircraft as an integral unit. The dispenser fuse functioned after a preselected time interval to separate the clam-shell halves of the dispenser, and the individual bomblets were then released into the air stream. The dispenser contained 247 MK118 bomblets which acted as both shaped-charge and fragmentation munitions. Each bomblet was dual fused for detonation against both hard and soft surfaces, providing flexibility against a variety of targets. During a special evaluation, 100 Rockeye canisters were used to attack 45 AAA positions. Twenty-eight of the positions were hit and twelve guns were silenced. It was not possible to determine either visually or by photography

AAA GUNS DESTROYED BY PAVEWAYS
(NOVEMBER 69 - APRIL 70)

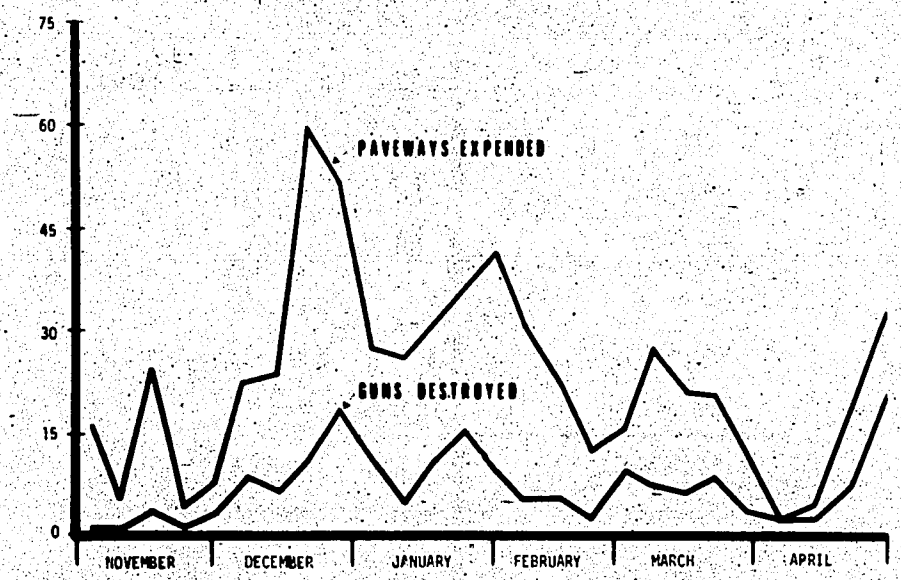


FIGURE III - 47

whether or not a gun was destroyed or damaged by the shaped charge. The shaped charge was designed to go through up to 8½ inches of steel but would not overturn a gun or blow up a portion of the gun. The shaped charge had no blast effect but could destroy the usefulness of a gun without providing evidence visible from the air. It was noted that AAA guns rarely fired after a Rockeye attack.

In summary,

- o 6481 or 12 percent of the total strike sorties attacked AAA.
- o With 750 guns destroyed or damaged, the enemy had to replace essentially his entire AAA inventory in Steel Tiger during the campaign.
- o Emphasis was placed on suppressing AAA in the vicinity of strike operations.
- o Flak suppression required the further diversion of sorties from strike operations.
- o Gunships required 3207 escort sorties during the campaign.

- Gunship escorts destroyed or damaged 102 guns and 157 trucks and caused 1426 secondary fires and explosions.

- Paveway was the most effective gun killing weapon.

Surface to Air Missile Threat

Surface-to-air missiles were not deployed into Steel Tiger but a buildup of sites in Route Pack I of NVN posed a threat to interdiction operations in Laos. The first indication of the buildup came on 12 December when a Fansong radar signal usually associated with SAM equipment was detected in the vicinity of Ban Karai pass. On 19 December two SAMs were fired from NVN at a three-ship B-52 cell near Ban Karai.

On 27 January 1970, at least two SAMs were fired at an RF-4C and its escort, and on 28 January another RF-4C was fired on by at least three SAMs. Escort aircraft attacked the SAM launcher positions, causing secondary explosions. During one strafing run, an F-105 escort aircraft was downed by AAA fire. In the subsequent SAR effort, a MIG-21, probably from Vinh airfield, shot down one of the Jolly Green rescue helicopters over Laos. MIGs had been deployed at Vinh airfield since early January.

On 2 February an attack was made against an AAA site in NVN that had fired at aircraft in Laos. During the attack the SAM site north of Ban Karai pass (VN-374) became active and launched a SAM. The photograph in Figure III-48, taken 29 January, shows a Fansong Radar and a possible launcher at VN-374.

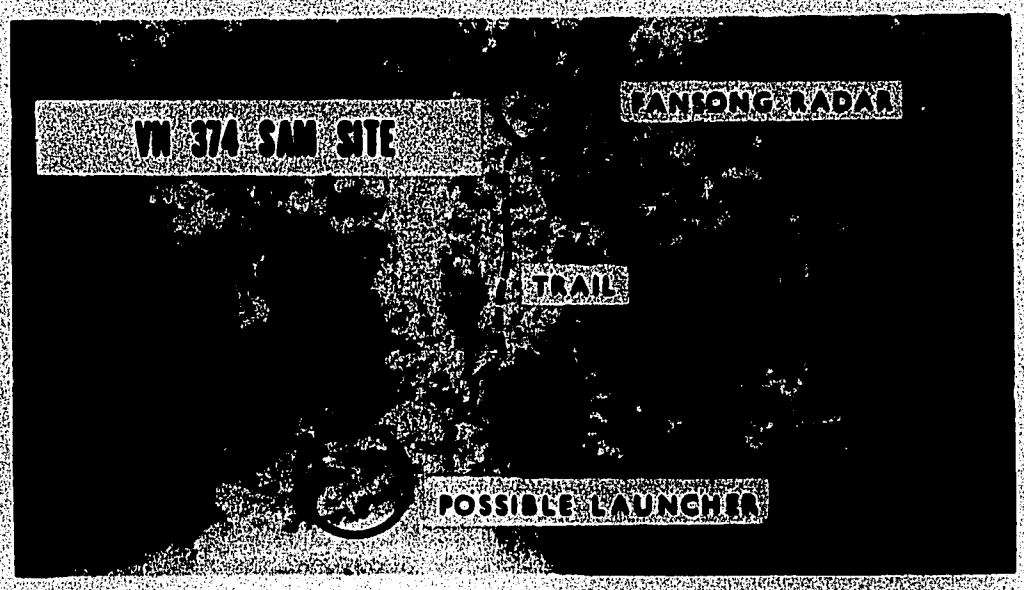


FIGURE III - 48

Sixteen F-4s struck the site on 2 February subsequent to the SAM launch. A strike photo, Figure III-49, showed two secondary fires.



FIGURE III - 49

Post strike reconnaissance produced Figure III-50. The guidance radar and two missile launchers were heavily damaged, 30 secondary fires and explosions were observed, and four 37mm positions were destroyed or damaged. Photography taken on 3 February showed the site completely cleared of debris and SAM associated equipment.



FIGURE III - 50

The enemy occupied only 3 to 4 of his SAM sites simultaneously and then only for brief periods, but the threat was continual. The enemy required only 4 to 6 hours to activate a site. Daily reconnaissance flights with escorts were flown over Route Pack I to monitor the SAM sites, and Arc Light operations were suspended within the SAM threat area.

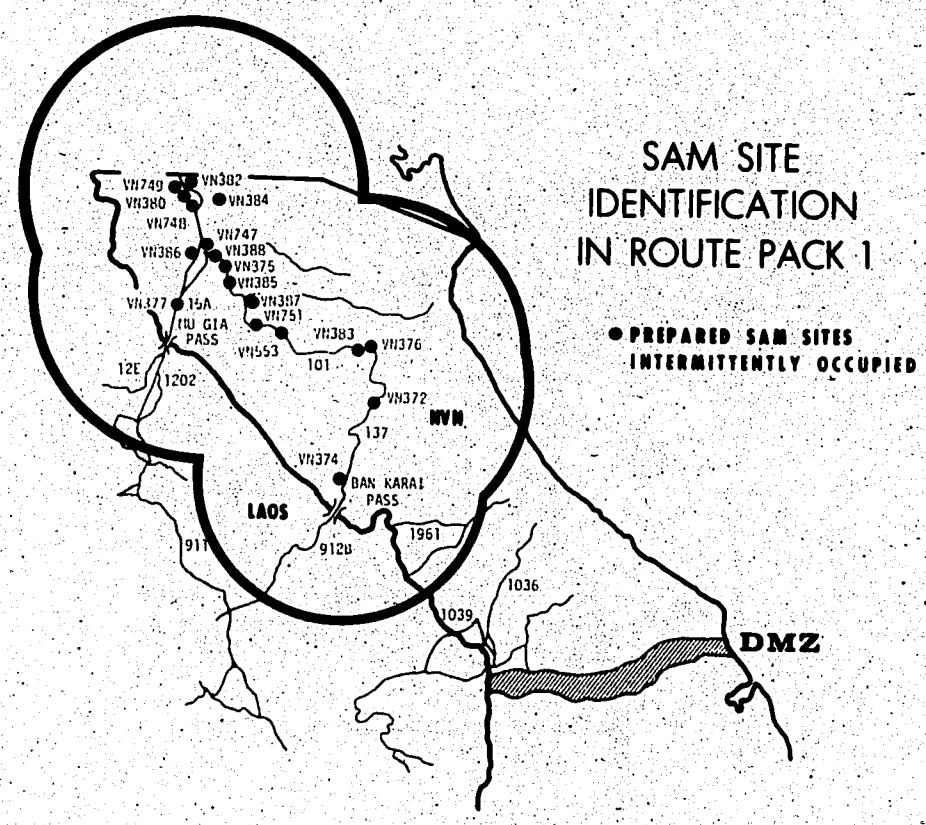


FIGURE III - 51

A total of 18 SAM sites were discovered in Route Pack I during Commando Hunt III. Their locations are shown in Figure III-51. A brief description of each site is given in Appendix G.

ENEMY RESUPPLY ACCOUNT

A primary objective of the interdiction campaign was to reduce to a minimum the quantity of supplies reaching South Vietnam through the LOC network in Laos. This section describes the disposition of those supplies as they entered Laos and were either consumed, destroyed, stored, or transported to South Vietnam. The logistics flow is depicted in the diagram of Figure III-52. A detailed description of the methodology used to calculate the five elements of the account is contained in Appendix H.

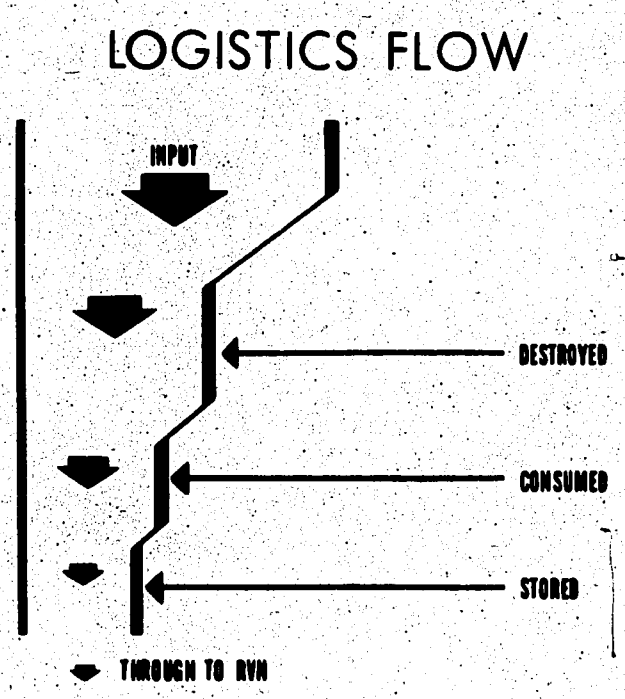
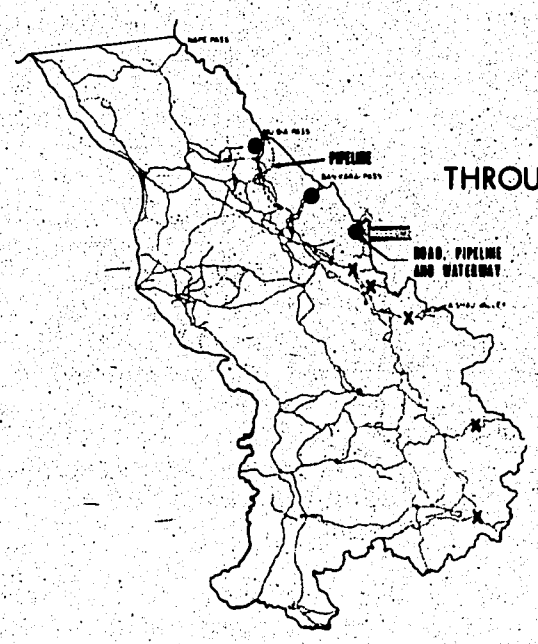


FIGURE III - 52

Explanation of Terms

Input. The basis for the estimate of enemy input tonnages was the total number of southbound trucks initially detected by the most northerly, reliable, Igloo White sensor strings along the routes leading from Mu Gia pass, Ban Karai pass, and the routes around the western end of the DMZ. These input gates are annotated on Figure III-53. After a thorough check to eliminate all possible duplication, the number of southbound trucks visually observed by aircraft and road watch teams was added to the sensor detected truck count. The estimated number of total southbound trucks was then multiplied by the conversion factor of 4 tons per truck to arrive at the tonnage entering the input gates.



INPUT & THROUGHPUT GATES LAOS

FIGURE III - 53

In addition to the truck traffic, it became apparent during Commando Hunt III that a significant quantity of supplies was being introduced into Laos through two pipelines and along waterway 7 west of the DMZ. All-source intelligence estimated that the two pipelines had a practical capacity of 200 tons per day. Based on the number of truck movements, estimated stockpile buildup, and target damage assessment, it was estimated that a POL-input of 60 tons a day was being furnished through the pipelines.

All-source intelligence indicated an additional input, averaging 78 drums and 42 packages a day, was being floated into Laos along waterway 7. The drums were estimated to contain 390 pounds of supplies and the packages, 200 pounds. The floating supplies added 19 tons of input per day to that being carried by trucks and the two pipelines.

Destroyed by Air. Supply tonnage destroyed was computed from the number of trucks destroyed and damaged and the number of secondary fires and explosions observed. Based on a comparison of sensor detected truck movements, 55 percent of all destroyed and damaged trucks were considered to be southbound. Four tons of supplies were considered destroyed in a destroyed southbound truck. One ton of supplies was considered destroyed in a damaged southbound truck. Northbound trucks were assumed to be empty, so no supplies were considered destroyed in them. Thirty percent of the supplies destroyed in truck associated secondaries were considered duplicates of supplies in destroyed or damaged trucks, so the number of secondaries used to calculate the supply tonnages destroyed was reduced by this amount. Through 24 March 1970, the remaining number of secondary fires and explosions was multiplied by 750 pounds to determine the quantity of supplies destroyed. Effective 25 March, the PACOM Enemy Logistics and Lines of Communication Conference changed the factor to 1000 pounds per secondary explosion as a result of new evidence on the size of enemy logistics packages.

Enemy Consumption. Consumption included supplies and equipment used in Laos associated with the movement and defense of supplies enroute to South Vietnam. Food consumption was based on established daily minimum requirements and estimates of the percentage of food that was imported from North Vietnam. Factors for personal and organizational equipment, including POL, replacement parts, and small arms ammunition, were estimated on the basis of interviews with captured enemy personnel and captured documents. AAA ammunition consumption was based on the number of reported rounds fired by each AAA weapon and the packaged weight per round.

These planning factors were combined with estimates of the number of North Vietnamese and Pathet Lao forces to determine the enemy's total consumption in the Lao panhandle. The planning factors and estimates of enemy strength were continually updated as new intelligence was received.

Throughput. Throughput was measured at the exit gates located along the routes into South Vietnam in the same manner as input (Figure III-53), except that the destruction occurring between the exit gates and the border of South Vietnam was subtracted to calculate the estimate. Throughput measurements were totally independent of estimated input, consumption, destruction, or stockpile changes and would have been derived even if no other tonnage measurements had been made.

Change in Stockpile. The stockpile figure was adjusted to bring the total tonnage in the logistics account into balance. The input tonnage reduced by the amount of tonnage destroyed and consumed was compared to the estimated throughput tonnage, and the stockpile change was reduced or increased to balance the two. As such, the stockpile figure was residual and accounted for both changes in internal stockpiles and unexplained elements in the balance question.

Trends and Results

One of the most significant changes in the enemy resupply pattern during Commando Hunt III was the shift to southern input gates as the campaign progressed. This shift is illustrated in Figure III-54. The tonnages entering each gate include those through the pipeline at Mu Gia pass and waterway 7 and the pipeline at the DMZ. The purpose of the shift was to reduce to a minimum the time that supplies were exposed to air attack. By the first of March, the enemy had virtually ceased his effort to bring supplies through Mu Gia pass. At the same time he made a major effort to complete the routes around the western edge of the DMZ and further reduce his exposure to air attack. The most northern input gate, Nape pass, was not used.

There was a similar shift in emphasis in the traffic through the exit areas. From November through January the bulk of the throughput was in the routes leading to northern I Corps and the A Shau Valley, routes 926, 922 (Figure III-55). During the second half of the campaign the majority of the throughput passed over routes 966 and 110. This shift was an indication of increased demand for supplies in II and III Corps, perhaps because of the changing political situation in Cambodia.

TONNAGE BY INPUT AREA

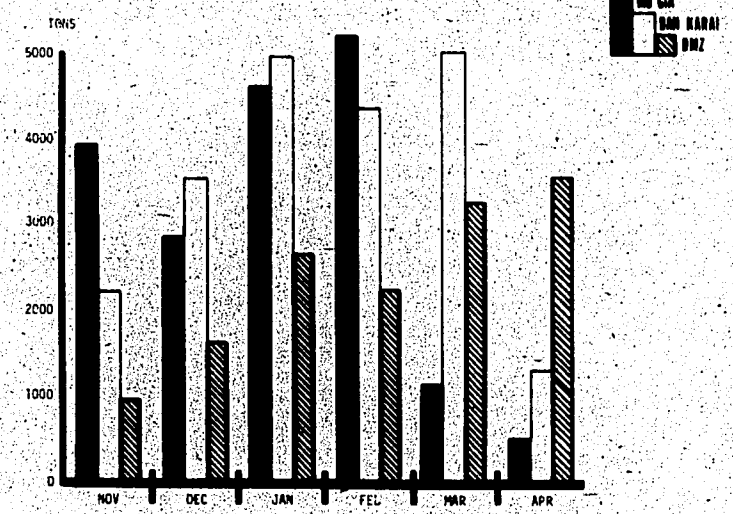


FIGURE III - 54

TONNAGE BY THROUGHPUT AREA

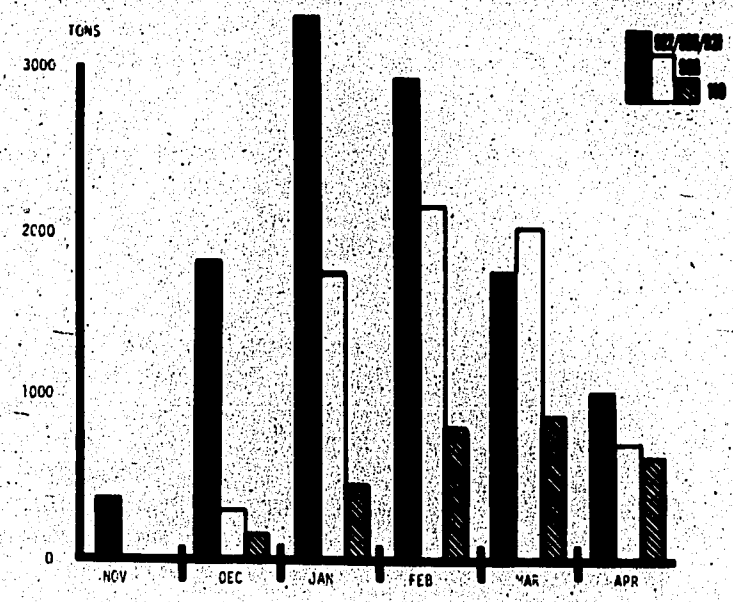


FIGURE III - 55

Figure III-56 presents the supply tonnages recorded at the input and output gates each week. From the high points in February both input and throughput showed a steady decline starting in early March, indicating that the cumulative effect of the interdiction effort had taken its toll of the enemy's logistics resources. The enemy's accelerated logistics effort during the first two months of 1970 was countered by attacks which destroyed or damaged 72 and 76 trucks per day during January and February respectively.

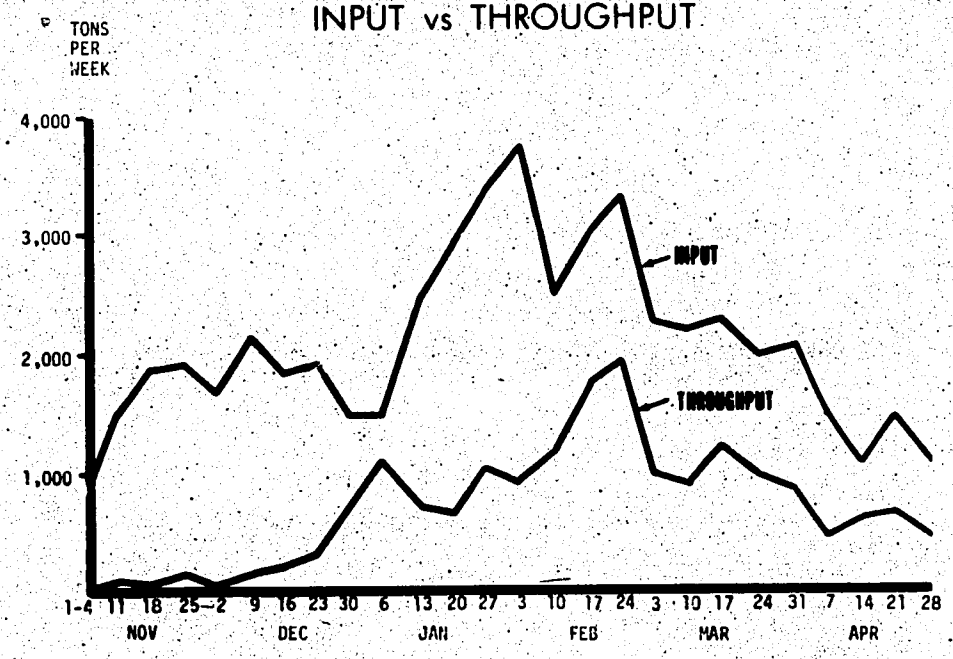


FIGURE III - 56

Cumulative input and throughput tonnages for the campaign are given in Figure III-57. For the campaign the enemy was able to get through only 35 percent of the supplies that entered the Lao panhandle.

The overall effect of air strikes on the enemy's resupply effort is illustrated in Figure III-58. This figure shows the cumulative number of tons destroyed by air by target category. Attacks against trucks, which resulted in trucks destroyed and damaged and truck associated secondaries, accounted for the largest portion of total tonnage destroyed. The emphasis on trucks in the campaign paid off in limiting the enemy's ability to resupply his forces in South Vietnam. In addition to limiting resupply, the emphasis substantially increased the cost to North Vietnam of maintaining an adequate number of vehicles in Laos.

CUMULATIVE INPUT
AND CUMULATIVE THROUGHPUT

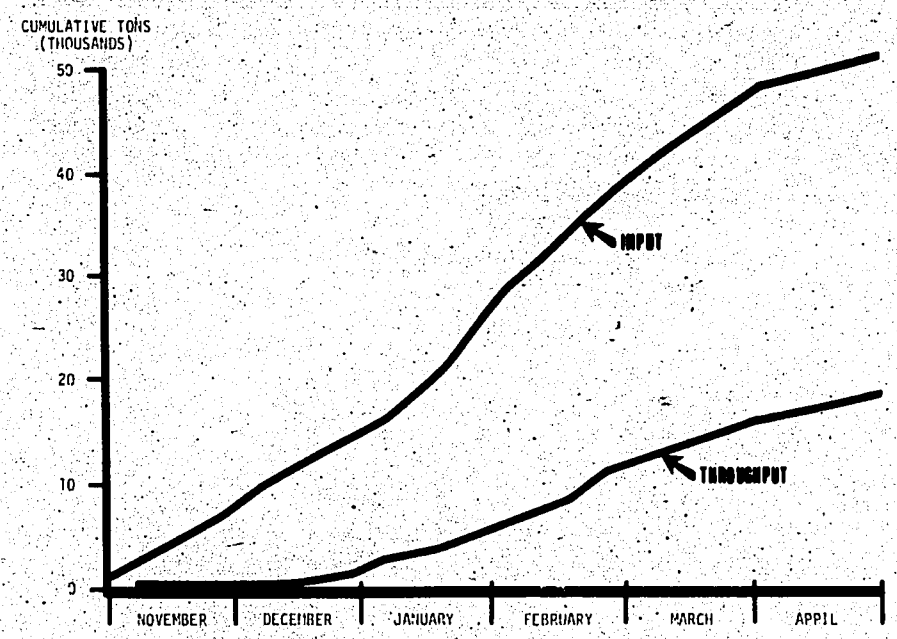


FIGURE III - 57

CUMULATIVE TONS DESTROYED

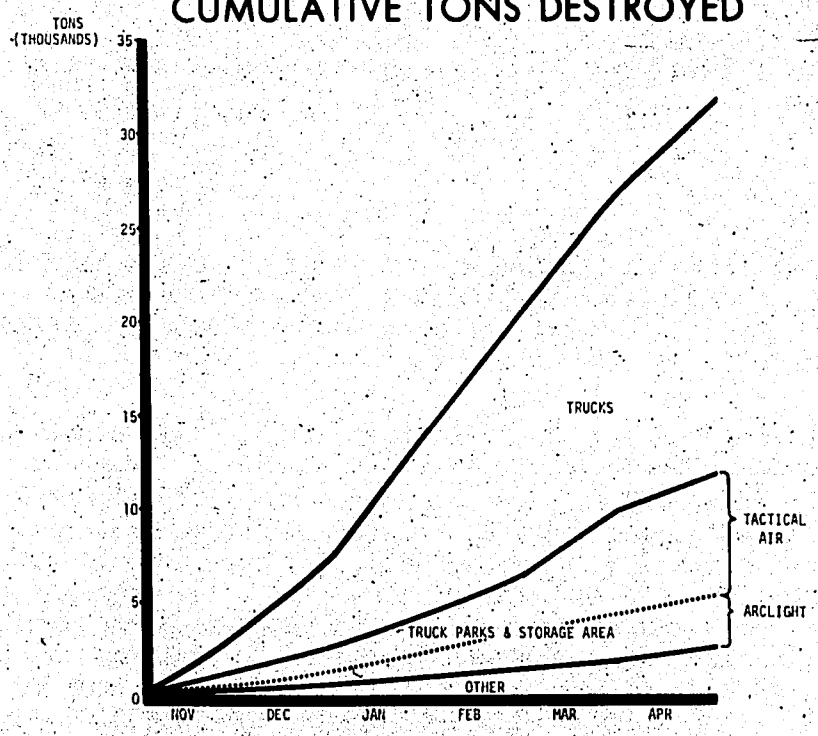


FIGURE III - 58

Added to the truck associated tonnage destroyed were the supplies destroyed by tactical air and Arc Light strikes against truck parks, storage areas, and other target categories. In all, 31,954 tons of supplies were destroyed by U.S. air strikes during the Commando Hunt III campaign.

The five logistics accounts are depicted by month on the bar graph of Figure III-59. The input increased to a peak in January and February and then began to decline. The number of tons destroyed by air showed a continual increase throughout the campaign as steady pressure continued to be applied on the enemy. Consumption rose gradually with increased enemy activity and then remained relatively level after January. Throughput rose to a high in February and then began to fall off. The change in internal stockpiles, the balancing factor, showed a decrease throughout the campaign. Stockpile change, the balancing factor that became negative in January, can be viewed as either a reduction in previous existing stocks stored in Laos or as supplies that were not detected at the input gates. The latter is considered to be more likely in view of the difficulty in measuring input that came through the new routes around the DMZ.

LOGISTICS ACCOUNT

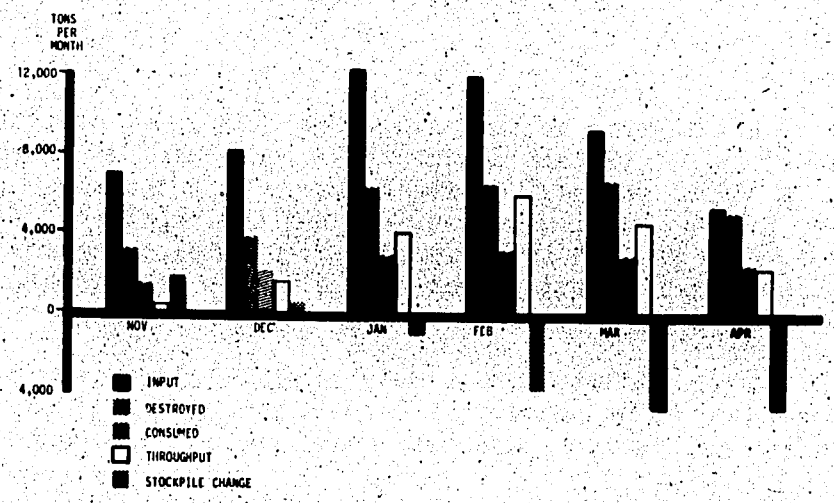


FIGURE III - 59

The enemy's resupply account is summarized in Table III-27. To transport 18,976 tons of supplies to South Vietnam during Commando Hunt III, it cost the enemy 47,220 tons in supplies--31,954 tons destroyed by air and 15,266 tons for enroute consumption.

ENEMY RESUPPLY ACCOUNT IN TONS

(NOVEMBER 1969 - APRIL 1970)

INPUT FROM NVN	54,277
DESTROYED BY AIR	31,954
CONSUMPTION	15,266
CHANGE IN STOCKPILE	-11,919
THROUGHPUT TO RVN	18,976

TABLE III - 27

The logistics account indicates that enemy stockpiles were reduced by 11,919 tons during the 6 month period. A reevaluation of input was made during February to account for supplies being brought in along waterway 7 and the pipelines leading from Mu Gia pass and the DMZ complex. Even after this reevaluation, there was an indication that some elements in the balance equation were being overlooked.

One possibility was an overestimate of the reported target damage. As shown above, the largest proportion of destruction resulted from attacks against enemy trucks. The number of trucks reported destroyed or damaged was up considerably from Commando Hunt I. In Commando Hunt III, a daily average of 55 trucks was reported destroyed or damaged compared to 36 a day the preceding year. The increased truck kills, however, were consistent with the increase in gunships, the larger allocation of sorties to truck attacks, and the heavier enemy traffic.

Input estimates were the weakest element of the enemy's logistic account. Input was difficult to measure and may have been understated even though every effort was made to obtain an accurate count. During Commando Hunt I, the enemy used three restricted mountain passes as input gates and they were well covered with Igloo White sensors. During Commando Hunt III, he used two of the passes and the proliferation of routes around the DMZ, plus two pipelines and at least one waterway which defied the relatively precise monitoring available with Igloo White sensors.

While the input count was approximately the same as during Commando Hunt I, analysis indicated that the enemy had increased his trucks and other resources in Steel Tiger. What apparently occurred was that the enemy used the pipelines, waterways, and sparsely monitored routes around the DMZ for considerably more input than was recorded. Such an interpretation would be consistent with the heavier truck traffic in the central route structure compared with Commando Hunt I.

Additional evidence that a portion of the input was not recorded came when the airborne sensor relay Green orbit (Figure A-1, Appendix A) was shifted southeast in April to provide better sensor coverage of the expanded Commando Bolt area west of the DMZ. After the shift, a 60 percent increase in southbound sensor detections recorded by the primary input-counting string on route 92A was noted. The daily sensor detections for the period 15 April to 9 May are presented in Figure III-60. This example alone indicates that the route 1039/92A input may have been underestimated by some 37 percent.

SOUTHBOUND SENSOR DETECTIONS
THROUGH INPUT STRING ON ROUTE 92A
(15 APR - 9 MAY 70)

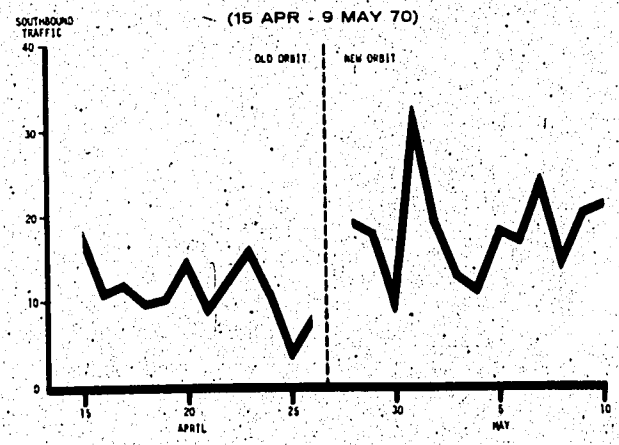


FIGURE III - 60

If the stockpile change was actually missed input, then the enemy supply account would show that he put in more than three tons to get one through to South Vietnam during Commando Hunt III.

In summary, evaluation of the enemy resupply account in Commando Hunt III indicated that:

- The intensive interdiction effort caused the enemy to shift to southern input gates to minimize the time that supplies were exposed to air attack.
- The cumulative effect of the interdiction effort resulted in a marked decline in enemy activity during March and April.
- It cost the enemy 47,220 tons in supplies--31,954 tons destroyed by air and 15,266 tons for enroute consumption--to transport 18,976 tons of supplies to South Vietnam.

MAY EPILOGUE

The enemy continued his resupply activities into the transitional period between the northeast and southwest monsoons. Sensor detected truck movements during the first 15 days of May averaged 675 per day, about the same level as during April, indicating that the enemy had not met his resupply objectives. He made major efforts to keep the roads motorable in spite of the rains. The enemy's area of emphasis remained in southern Steel Tiger. Although input through Ban Karai pass stopped by mid-May, it continued on the LOCs west of the DMZ and on waterway 7. As the weather deterioriated, the number of trucks observed by the interdiction forces decreased.

ENEMY TRUCK ACTIVITY
1 - 15 MAY 1970

	TOTAL	DAILY AVERAGE
SENSOR DETECTIONS	10014	668
TRAP ESTIMATED TRUCKS	3969	265
VISUALLY OBSERVED TRUCKS	2103	140

The total number of AAA firings declined because of poor weather which curtailed air strikes. The number of aircraft hit or lost also declined from April levels.

INTERDICTION AIRCRAFT HIT AND LOSS EXPERIENCE
1 - 15 MAY 1970

SORTIES	
FLOWN	5135
REPORTING FIRINGS	940
AIRCRAFT HIT	10
AIRCRAFT LOST	2

Strike sorties available to maintain interdiction operations decreased due to the increased commitment of tactical airpower to operations in Cambodia. An increasing percentage of strikes was directed against road segments and IDPs in southern Steel Tiger to accentuate the effect of the rains. The emplacement of munitions packages was also continued in the Delta 45 area and on route 966. The input LOCs west of the DMZ were interdicted as often as weather permitted.

TACTICAL AIR STRIKE SORTIES BY TARGET TYPE
1 - 15 MAY 1970

TARGET TYPE	TOTAL SORTIES	DAILY AVERAGE	PERCENT
TRUCKS	827	55	28
TRUCK PARKS AND STORAGE AREAS	697	47	23
LINES OF COMMUNICATION	874	58	29
DEFENSES	316	21	11
OTHER	288	19	9
TOTAL	3002	201	100

Attacks against truck parks and storage areas continued but the observed results decreased considerably due to the weather. Poor weather, the decrease in strike sorties, and the shifting emphasis to LOC strikes combined to reduce the average number of trucks destroyed and damaged per day from 58 in April to 39 during the first half of May. The ratio of trucks destroyed and damaged to those struck continued to increase, as it had during March and April, from .44 to .47. Attacks against AAA were also maintained but at a decreased level.

TACTICAL AIR OBSERVED TARGET DAMAGE
1 - 15 MAY 1970

TARGET	TOTAL	DAILY AVERAGE
TRUCKS		
DESTROYED	299	20
DAMAGED	283	19
SECONDARY FIRES	355	24
SECONDARY EXPLOSIONS	544	36
TRUCK PARKS AND STORAGE AREAS		
SECONDARY FIRES	204	14
SECONDARY EXPLOSIONS	175	12
LINES OF COMMUNICATION		
CUTS, CRATERS AND SLIDES	397	26
DEFENSES		
GUNS DESTROYED	27	2
GUNS DAMAGED	17	1
SECONDARY FIRES	55	4
SECONDARY EXPLOSIONS	82	5
OTHER		
SECONDARY FIRES	58	4
SECONDARY EXPLOSIONS	53	4

Arc Light sorties and secondary fires and explosions also declined from April levels.

ARC LIGHT
1 - 15 MAY 1970

SORTIES	124
SECONDARY FIRES AND EXPLOSIONS	86

Despite the enemy's efforts to maintain the flow of supplies into RVN, his throughput continued to decline as it had in both March and April.

ENEMY RESUPPLY ACCOUNT IN TONS
1 - 15 MAY 1970

INPUT FROM NVN	3093
DESTROYED BY AIR	1379
CONSUMED	1107
CHANGES IN STOCKPILE	-193
THROUGHPUT INTO RVN	800

On 14 May, sensor detected truck movements began a decline to an average of 400 per day through 22 May. Sixty percent of the traffic was headed north.

APPENDICES

APPENDIX A

IGLOO WHITE

The Igloo White anti-infiltration system was an integral part of the interdiction campaign. It used acoustic and seismic sensors emplaced in enemy territory to detect and track vehicles along the LOCs in Laos. The sensor derived data was used to assist in

- The selection of interdiction points,
- The location of by-passes and truck parks or storage areas,
- The direction of FAC and strike aircraft to moving targets on a near real-time basis,
- The preparation of traffic predictions,
- The allocation of forces among target categories,
- The analysis of the efficiency of tactics and specific missions, and
- The calculation of the input and throughput of the enemy resupply system.

The Commando Hunt I report of 20 May 1969 describes the system, its operation, and its contribution to interdiction efforts. This appendix reviews the flow of sensor information, describes refinements to the system incorporated since Commando Hunt I, and reviews Task Force Alpha's employment of the sensor information.

INFORMATION FLOW

Sensors

Strings of acoustic and seismic sensors were used to detect trucks moving along LOCs. Loran-equipped F-4s emplaced the sensor strings under visual flight conditions, usually assisted by FACs who marked desired sensor emplacement points. There were two categories of sensors--noncommandable, or Phase I, and commandable, or Phase II. Command capability was provided by the

Ground Surveillance Monitor (GSM) or the Audio Analysis Technician (AAT) at Task Force Alpha's Infiltration Surveillance Center (ISC). These operators were able to turn on a sensor after implant and verify that it was intact, check its operation during periods when noise or disturbance did not activate it, obtain audio from acoustic sensors upon demand, reduce channel blocking, and turn off unwanted sensors. Sensor sensitivity of the Acousid could also be changed by command, but this feature was rarely used.

The Air Delivered Seismic Intrusion Detector (ADSID), a Phase I sensor, was the workhorse of Igloo White during the campaign. Three types of Phase II sensors were also used extensively: Acoubouy II, an acoustic sensor; Acousid II, a combined acoustic and seismic sensor; and FADSID II, a seismic sensor. Spikebuoy, an acoustic sensor, was also used. A modified spikebuoy—the spikesid—incorporated a seismic detection circuit, a diurnal switch to turn the sensor off during the day, and a field selectable option which made the sensor acoustic or seismic or both. The Spikesid was introduced in Steel Tiger on 5 January 1970 on a test basis. For specifications on sensors employed in the campaign, see Part II, Equipment Annexes, Defense Communications Planning Group (DCPG) System Design Description (Short Title DSDD), 31 July 1969.

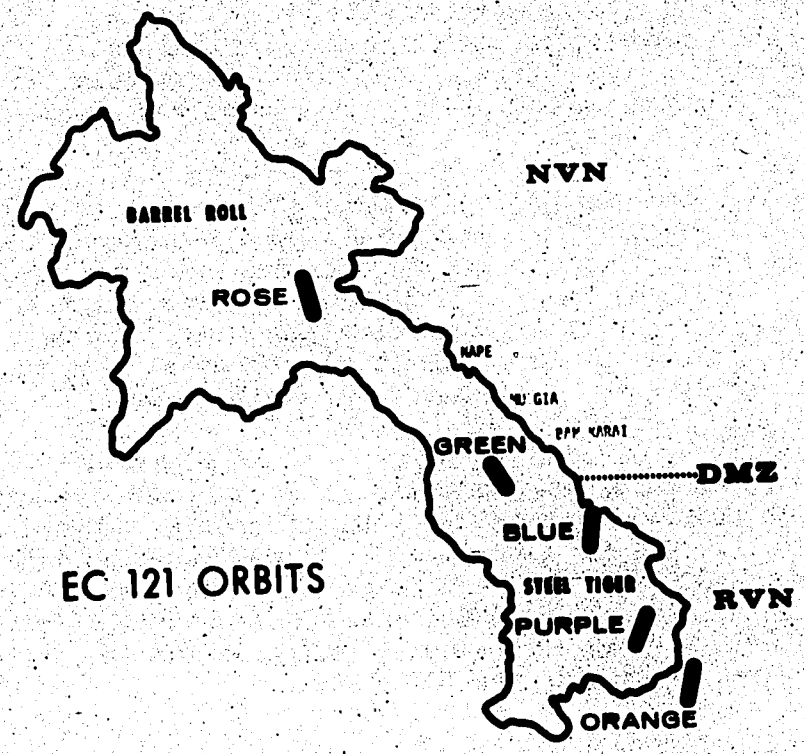
Relay Aircraft

An essential component of the Igloo White system was the EC-121 aircraft, which received sensor signals and automatically relayed them to the ISC. The EC-121 also had the capability to issue commands to sensors and monitor responses. The airborne ISC (AISC) operators monitored sensor activations on manual sensor-display stations referred to as Tell Tale displays or, on automatic displays, X-T plotters. They identified vehicular sequence or personnel targets and passed these targets in near real time to the ABCCC, with follow-on reports to the ISC and 7AF. The airborne monitoring capability was necessary when Automatic Data Relay (ADR) equipment was unusable or when the EC-121 was beyond reception range of the ISC.

The X-T plotters displayed activations of up to 100 sensors on a continuous paper record. The display was accurate and freed AISC personnel from the chore of keeping logs manually from the visual Tell Tale unit display. With manual logging, an operator had difficulty monitoring sensor fields of more than five simultaneously active strings.

The Purple orbit aircraft (Figure A-1) were given first priority for the plotters because this orbit serviced the Ferret

III operation. In Ferret III, the Purple orbit EC-121 was authorized to pass real-time vehicular movements direct to FACs, strike aircraft, and gunships in the Kilo and Lima sectors in the central Steel Tiger area. The Blue orbit aircraft had secondary priority because it provided airborne readout of sensor strings in RVN to artillery fire control posts. Blue orbit also provided Ferret III advisories in the Oscar and Papa sectors in south Steel Tiger. The EC-121 served primarily as an airborne relay platform in Steel Tiger in both Green and Blue orbits, although the Blue orbit aircraft also served as an AISC for the strings in the DMZ. In addition, the Orange orbit provided a limited AISC capability for southern Steel Tiger. Rose orbit operated in Barrel Roll in both manual and automatic modes until 24 January 1970 when it was discontinued.



EC 121 ORBITS

FIGURE A - 1

Information Processing

In the automatic relay mode, sensor information from the

EC-121 went directly to the computer at the ISC with audio signals assessed by an AAT. Display of the audio signature pattern on a spectrum analyzer assisted the AAT in distinguishing between truck targets and overflying aircraft. Sensor information was also fed into the computer through an IBM 2260 Console. Sensor activations were displayed on both the IBM 2250 Display Unit, which presented updated information each minute, and on a computer print-out, the Coincidence Filtering Intelligence Reporting Medium (CONFIRM), which was produced every five minutes.

Phase III A System

For Commando Hunt III, the Phase IIIA information processing system replaced the Initial Commando Link System (ICLS) Phase II program used at the ISC during Commando Hunt I and II. The Phase IIIA program enabled simultaneous Phase I, II, and III reception and processing. Phase IIIA+, installed in November 1969, added two major improvements--the Coordinated Loran Sensor Strike System (COLOSSYS) and Automatic Sequence Routing (ASR).

COLOSSYS was designed to control airborne strikes against moving truck targets using Loran-equipped F-4 aircraft and radar-equipped A-6 aircraft in conjunction with automated displays of sensor activity at the ISC. The system provided a real-time, quick-reaction capability for directing strike aircraft to deliver ordnance on a specific point coincident with the arrival of a moving target. See Appendix B, Commando Bolt, for a description of this operation.

ASR was incorporated into the Phase IIIA data processing system to provide the capability for a computer supported sequence file. The ASR automatically routed sequence data from the GSM to ABCCC and 7AF, and it stored the sequence data for use in generation of the A & B data cards described in Appendix E. Figure A-2 shows the principal elements involved in the transmission of data in the ISC system.

Reporting System

In recording and reporting Igloo White data, A and B cards were used to record sensor information for traffic analysis, and L and N cards were used to record truck sequence nominations transmitted to ABCCC. The Ground Surveillance Monitors and Technicians at TFA assembled information for the A and B cards and entered selected data into the IBM 360/65 computer from the IBM 2260 Console for processing and transmission via Autodin to 7AF.

Truck sequence nomination data was assembled by the Ground Surveillance Monitor. The Operations Report Division at TFA prepared the data for input to the IBM 2260. The computer output was on punched cards from which data was transmitted via Autodin to 7AF and Hq USAF.

SENSOR DATA FLOW

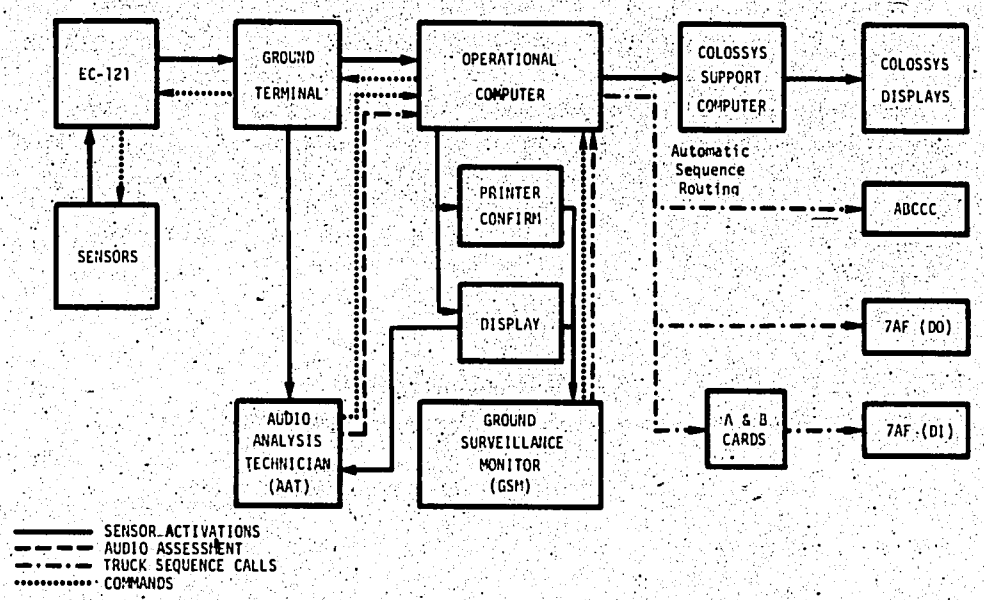


FIGURE A - 2

EMPLOYMENT BY TFA

Planning

The effectiveness of the Igloo White surveillance system depended on proper emplacement of a sufficient number of sensors to monitor continuously areas identified as potential infiltration routes. TFA's sensor emplacement planning centered on the Sensor Emplacement Planning Committee (SEPC) which coordinated all placement programs through final implementation. The SEPC identified problems related to emplacements and reviewed newly

emplaced strings to determine effectiveness and usability. The planning cycle determined the need for a sensor string, located the emplacement to include desired coordinates of first and last sensor, selected the type of sensors desired and arrangement within the string, prepared the photographic materials required for accurate emplacement, determined sensor availability and frequency and tone code availability, requested emplacement, and verified the actual emplacement.

Requests for emplacement of sensor strings came from operational and intelligence agencies. After approval of a request, delivery tactics were determined depending on enemy defenses and terrain. Channels were selected, tone codes assigned, and the sensors were assembled for delivery. The necessary information relating to the sensors was prepositioned in the computer data base to prepare for immediate exploitation after emplacement.

The sensor field for Commando Hunt III covered an area from Barrel Roll through Steel Tiger South. Figure II-19 shows the location of all sensor strings operating the 20th of April. Table A-1 describes the average number of operational sensor strings and seismic and acoustical sensors employed per week during the campaign.

SENSOR STRINGS EMPLOYED

DATE	NUMBER OF STRINGS STEEL TIGER	BARREL ROLL	SEISMIC SENSORS	ACOUSTIC SENSORS
29 OCT - 4 NOV	70	8	384	57
5 NOV - 11 NOV	74	8	428	57
12 NOV - 18 NOV	71	6	495	48
19 NOV - 25 NOV	73	5	485	48
26 NOV - 2 DEC	64	5	447	26
3 DEC - 9 DEC	66	5	471	32
10 DEC - 16 DEC	69	3	483	39
17 DEC - 23 DEC	66	3	481	41
24 DEC - 30 DEC	64	4	461	43
31 DEC - 6 JAN	69	4	432	41
7 JAN - 13 JAN	72	3	462	46
14 JAN - 20 JAN	80	1	492	56
*21 JAN - 27 JAN	88		538	65
28 JAN - 3 FEB	92		609	65
4 FEB - 10 FEB	95		643	57
11 FEB - 17 FEB	92		652	53
18 FEB - 24 FEB	88		641	54
25 FEB - 3 MAR	84		622	50
4 MAR - 10 MAR	86		616	50
11 MAR - 17 MAR	81		625	54
18 MAR - 24 MAR	67		597	51
25 MAR - 31 MAR	62		552	50
1 APR - 7 APR	59		562	38
8 APR - 14 APR	61		583	33
15 APR - 21 APR	62		617	28
22 APR - 28 APR	64		643	23

*ROSE ORBIT WAS CANCELLED. SENSOR STRINGS IN BARREL ROLL WERE ND LONGER MONITORED.

TABLE A 1

Use of Information for Targeting

Task Force Alpha contributed to target selection by 7AF in day visual recce sectors 1 through 5 of Steel Tiger. Targets for both tactical air and Arc Light forces were developed. The sensors provided data on the level, direction, and pattern of enemy traffic. The Keyword File, an automated bank of historical military intelligence, held additional data. TFA also obtained targeting leads from FAC visual/photo reconnaissance, photo interpretation (PI), and the MACV Studies and Observation Group.

Target Exploitation

When TFA received a target lead from sources other than PI, a check of the TFA Automated Tacair Target File and the Tiger Target File determined if the lead was a previously nominated target. If the lead was new, the Exploitation Branch requested photo coverage, coordinate location, and PI readout from the Reconnaissance Division. If photography was not available at TFA, an automated file was searched to see if photography had been requested within 250 meters of the point within the preceding 14 days. If not, TFA requested photo reconnaissance from 7AF. When photography was available, it was examined by TFA photo interpreters, the Keyword File was queried, and the Analysis, Integration, and Current Intelligence offices were queried for later information concerning the target area. Photography by itself seldom clearly delineated a target.

For transmission to 7AF, TFA put targets into one of the following categories:

Category I consisted of the most lucrative truck parks, storage areas, bivouac areas, and transshipment points (in order of priority). Seventh AF included these targets on fragmentary orders for strikes the first "frag day" after receipt of the transmission. Category I targets had to fall within Special Arc Light Operation Areas (SALOAs) or within 200 meters of a motorable road or waterway and more than 500 meters away from an active village. They also needed validation by the U.S. Air Attache in Laos.

Category II consisted of targets requiring special ordnance, such as caves and AAA sites. Geographical criteria and the requirement for validation established for Category I also applied for Category II targets.

Category III consisted of those targets which had not been validated by the U.S. Air Attache in Laos.

At TFA the target information was introduced into the Automated Tacair Target File, a target folder was constructed, and the target was plotted on target boards. The addition of subsequent schedule and strike information made possible periodic reexamination of previously nominated targets for renewed activity.

Arc Light Targeting

Arc Light strikes required larger area targets than those required for tactical air. TFA procedures were essentially similar to those used to nominate targets for tactical air strikes. All known targets were plotted, and strike boxes of one by three kilometers were selected to insure maximum damage. Terrain, target dispersion, defenses, and location of the target entered the assessment. Arc Light bombing was normally confined to SALOAs, although especially lucrative targets were occasionally nominated elsewhere.

FAC Liaison Program

TFA's intensive briefing and debriefing of Thailand-based FACs, both at Nakhon Phanom RTAFB and Ubon RTAFB, and weekly visits to FAC units at Da Nang AB Vietnam played an important part in the targeting program.

A FAC Liaison Officer (FACLO) at TFA met at 0130 each morning with personnel from Traffic Analysis, Photo Interpretation, Target Initiation, and Target Integration to analyze the evening's traffic patterns, identify sensor-derived targets, and determine requirements for visual reconnaissance. Target leads were researched and refined. All available target information, as well as reconnaissance requests and rationale, were immediately sent to the FACLO at Nakhon Phanom Tactical Unit Operations Center (TUOC) for briefing of aircrews taking off at first light. Information concerning visual recce Sectors 4 and 5 was also called to the TFA FACLO at Ubon RTAFB. TFA sent target data and reconnaissance requests which arose later in the day to the FACLOs as soon as the information became available.

During the day, TFA FACLOs in conjunction with analysts reviewed sensor information and analysis of the previous night's traffic to send a projected traffic pattern to the TUOC FACLOs for night FAC briefings. During the night, sensor-detected traffic was passed to the TUOC five minutes prior to each night FAC briefing.

Each morning prior to 0300, TFA sent pertinent sensor information to strike units at Da Nang AB and Tuy Hoa AB to be used in the briefing of crews. In addition, a message was dispatched to all strike and FAC units operating in Thailand which designated certain predetermined area targets as being particularly lucrative for strike during the day. The area targets (generally 3 kilometers square) were those that recent information had shown to be active.

As TFA FACLOs debriefed FACs, they fed information back to TFA for further target development and analysis. Thus the cycle continued around the clock. A weekly average of 60 tacair target nominations was sent to 7AF. Sensor information was used in the derivation of 70 percent of the targeting; 2 percent were directly derived from sensors. An average of 15 Arc Light nominations were sent to 7AF per week and all were sensor related.

SUMMARY

The Igloo White system used sensor derived information to provide intelligence for the conduct and evaluation of the interdiction campaign and for directing strike aircraft to deliver ordnance on a moving target. COLOSSYS, Automatic Sequence Routing, and the X-T Plotter were system advancements not available during Commando Hunt I and II. COLOSSYS provided a real-time quick reaction capability to strike a moving target. The success of the Commando Bolt operation discussed in Appendix A was a direct measure of the utility of COLOSSYS. ASR provided a computer-supported sequence file that was utilized to transmit sequences in near real time to 7AF and ABCCC. The X-T plotters replaced the manual logging of sensor activations in the EC-121.

APPENDIX B

COMMANDO BOLT

Commando Bolt was the name designating the tactical employment of specified FAC and strike aircraft against moving targets based on analysis of real-time sensor derived data. The objectives of Commando Bolt were:

- To exploit the available resources, facilities, and capabilities of Task Force Alpha (TFA) in support of the 1969-1970 northeast monsoon interdiction campaign in Laos.
- To assist visual acquisition of moving trucks during visual weather conditions and to provide a bombing capability against the moving trucks during non-visual conditions.

This Appendix describes and evaluates Commando Bolt as a strike concept which combined the real-time intelligence capability of Igloo White sensors with the visual bombing capabilities of FAC and strike aircraft teams or with the all-weather attack capability of Loran-equipped F-4s and radar-equipped A-6s. The Igloo White sensor system provided the capability to detect and follow the movement of vehicular traffic along route segments monitored by sensor devices. The analysis and interpretation of real-time sensor activations enabled a trained observer to determine the presence, number, direction, and speed of trucks within the detection range of the sensors. By dead reckoning, the estimated times of arrival of a moving target were determined for specified points along the LOC. Strike aircraft were directed to attack the target at a specified point at the corresponding estimated time of arrival (ETA).

A quick-reaction capability was essential for an effective attack on the intercept point at the proper time. The reaction speed required depended upon the number, location, and characteristics of the sensors on the LOC segment; the length and curvature of the LOC segment; and the number and velocity of the trucks constituting the moving target. In general, ten to twelve minutes was the maximum time available from determination of the ETA until ordnance was to strike the specified point. To achieve this reaction time, strike aircraft loitered in the intercept area.

Target acquisition was the primary problem. Visual strikes usually required FAC assistance. Non-visual delivery systems were the Loran-equipped F-4, the Navy and Marine Corps A-6

aircraft, with self-contained radar bomb systems, and the ground-based Skyspot radar.

DEFINITIONS

Strike Nominator. An intelligence officer in the TFA control center who was trained and experienced in the assessment of sensor-derived data and whose duties were to monitor real-time sensor activations, determine the number of target elements and their direction and velocity, compute the estimated times of arrival of targets at specified points on the road segment, and update target composition and movement as required.

Strike Controller (Sparky FAC). A pilot in the TFA control center who was experienced in the operation, characteristics and capabilities of tactical aircraft and trained in the interpretation of sensor-derived data, and whose duties were to direct night FACs to locations of truck movements, direct strike aircraft to attack sensor-derived targets, coordinate aircraft employment with command and control agencies, and direct all activities of the Copperhead control center.

Strike Technician. An enlisted technician trained in ground-to-air radio procedures whose duties were to monitor radio transmissions, relay instructions and information to strike aircraft and ABCCC, maintain data logs, and assist the strike controller.

Copperhead. The call sign of the Task Force Alpha control center for operations.

Panther Team. Initially a night FAC in an OV-10 or an O-2 equipped with a night observation device (NOD) and two A-1 strike aircraft who formed a team which operated directly with Sparky FAC to strike sensor-detected targets visually. The designation was extended to include any strike aircraft operating with a FAC to attack sensor-detected targets.

Flasher Team. Loran or AMTI equipped strike aircraft operating directly with Sparky FAC to strike sensor-detected targets. Also included other high-speed aircraft accompanying Loran or AMTI aircraft.

Sensor Strike String. A designated string of sensors emplaced at approximately 200 meter intervals along an LOC segment which was expected to be heavily traveled and which provided a reasonably straight section a minimum of 3000 meters in length.

DMPI (Desired Mean Point of Impact). A specified point on an LOC in the vicinity of a sensor strike string. It became

the target for Flasher strike aircraft when the ETA of a moving target was computed for that point.

AMTI (Airborne Moving Target Indicator). A mode of operating the radar and weapons delivery system of the A-6 aircraft which provided the capability to detect and deliver ordnance on a moving target without visually acquiring the target.

PROCEDURES

Commando Bolt operations required close teamwork and coordinated activity by all participants. Although the basic concept of operation remained fixed, the mechanics of implementing the concept required constant revision to adapt to the changing tactical environment. The procedures described in the following paragraphs evolved during two months of initial planning and four and one-half months of operations.

The strike nominator monitored the minute by minute updating of sensor activations throughout the designated sensor strike strings. As soon as vehicular movement was detected in a specific area, Sparky FAC was notified that a probable target was developing in that area. As the sensor data was updated, the strike nominator determined the speed of the target and computed the target's ETA at a DMPI near the far end of the sensor string. The time interval from target detection to ETA determination was usually two to three minutes. Sensor data was monitored to revise the target assessment and, if necessary, revise the ETA. The strike nominator kept the Sparky FAC continually advised about the development of targets, the number of targets, their direction of travel, and the ETA on a DMPI. In determining the target ETA at the DMPI, it was assumed that the trucks maintained a constant velocity through the sensor string. The strike nominator monitored the movement of the target through the string, and when changes in velocity were detected, the ETA was revised. The logic diagram for target nomination is shown in Figure B-1.

When a moving target was detected, the Sparky FAC notified the strike pilot to prepare for an attack on a specific strike string. After an ETA was computed for the moving target, the Sparky FAC coordinated with the required control agencies and directed the strike aircraft to initiate an attack with the time on target (TOT) determined by the strike nominator. When Panther and Flasher teams were operating in the same area, the Sparky FAC insured that safe separation was maintained, usually at least two thousand feet of altitude. Lateral separation was provided by establishing the Tacan position of the visual strike flight and routing the Flasher strike flight so as to avoid the other flight by at least 5 nautical miles at the closest point of

COMMANDO BOLT TARGET NOMINATIONS

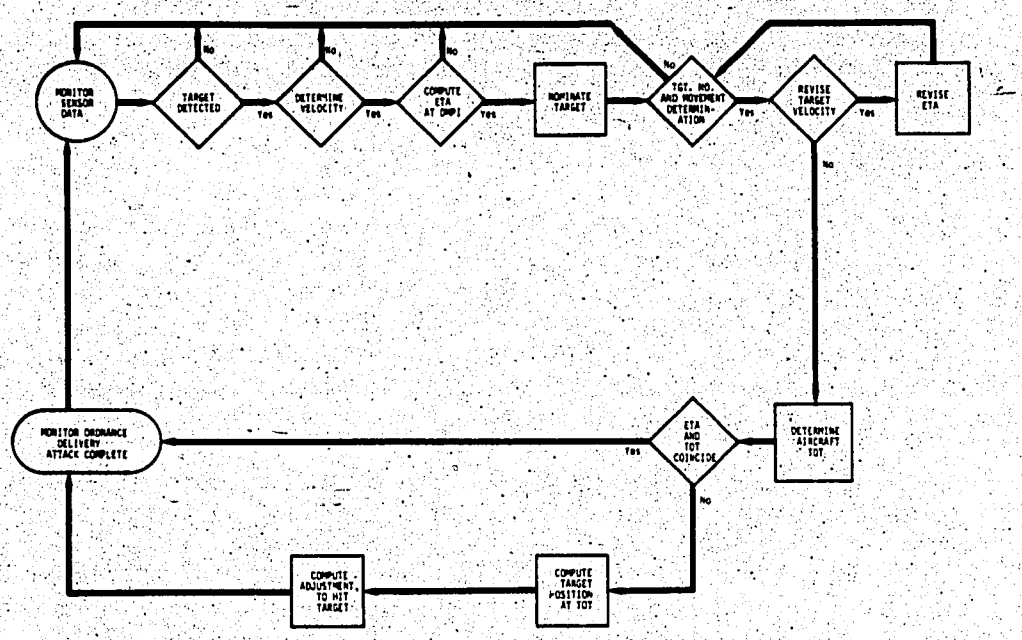


FIGURE B - 1

approach. Descent below 15,000 feet mean sea level (MSL) was not permitted until the aircraft penetrated the sector boundary of the assigned Commando Bolt operating area. Aircraft traffic in adjacent sectors operated to a maximum altitude of 14,000 feet MSL.

Panther Team

A Panther team was made available to Sparky FAC by ABCCC. Panther Points were specified for all sensor strike strings. When traffic was detected by the strike controller, Sparky FAC transmitted its Panther Point ETA to the FAC and strike aircraft team. The FAC then proceeded to the point and, if able to acquire the trucks, continued with standard night strike tactics marking the target for the strike aircraft. If the FAC needed additional ordnance, it was requested from Copperhead who coordinated the request with ABCCC. The Panther team concept exploited the truck killing capability of visual attacks by providing real-time intelligence on truck locations to assist in target acquisition.

Flasher Team

The Flasher aircraft constituted an all-weather threat to enemy truck traffic. Air Force F-4Ds equipped with Loran navigated precisely to the desired bomb release point. The bomb pattern using CBU-24s covered an area 3000 by 1000 feet. Navy and Marine Corps A-6s equipped with AMTI radar acquired and locked onto moving trucks for precise bombing in all weather conditions. If the targets were not acquired on the AMTI, the bombs were dropped using radar offset aim points with the designated DMPI as the target. A-7s, non-Loran equipped F-4s, and other aircraft could bomb designated DMPIs using Skyspot techniques, but the procedure was not used extensively because of its relatively poorer accuracy.

Sparky FAC passed the DMPI and TOT to the Flasher strike aircraft after being notified of the target in the sensor string, DMPI, and ETA. The strike aircraft usually started the attack from a prebriefed initial point (IP) and followed a preselected run-in course, altitude, and airspeed. Changes in target location calculated during the approach to the target were passed to the attacking aircraft in the form of directions to drop so many feet long or short with respect to the designated DMPI. Left and right corrections were provided if necessary. For the F-4, ballistics tables were used to compute the weapon release point so that the bomb pattern bracketed the DMPI.

For the A-6, the pattern was planned to start just before the DMPI and extend beyond to cover the second or following trucks in the convoy. The pilot adjusted speed and flight path to arrive at the IP and weapons release point to achieve the desired TOT. A diagram of the strike aircraft control is shown in Figure B-2.

Commando Bolt Alternate Targets.

TFA continually monitored the status of enemy truck parks, storage areas, and bivouac areas for possible worthwhile targets in the Commando Bolt operating area. A daily list of 10 to 15 targets of this type was prepared and forwarded to 7AF for inclusion in the daily fragmentary operations orders. If there were no moving targets detected in the Commando Bolt area, other targets were struck if they were assessed to be remunerative enough to merit ordnance expenditure. These area targets were designated by number and were listed in order of preference. Aircrews plotted the target on their maps and were prepared to strike the alternate targets when directed by the strike controller.

COMMANDO BOLT STRIKE CONTROL

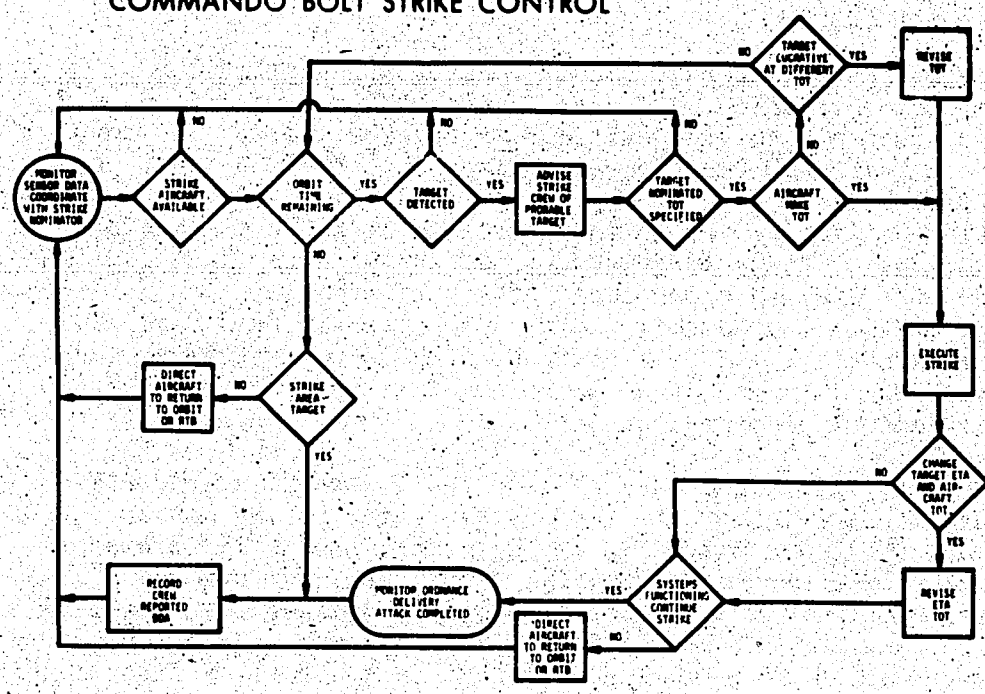


FIGURE B - 2

Combat Skyspot

The Combat Skyspot MSQ-77 installation at Nakhon Phanom, RTAFB, was able to vector aircraft to bomb release points within the area under control of Sparky FAC. This backup capability was less accurate but it made strikes possible in the event of Loran or AMTI radar system malfunctions.

OPERATIONS

Panther Teams

Panther teams initiated Commando Bolt operations on 20 November 1969 in the area of Ban Karai pass, designated CB-1 (Figure B-3). Three FAC aircraft and eight A-1s normally provided continuous strike coverage for a five-hour period beginning at 1815 hours local Lao time. But adverse weather and increasing AAA defenses soon made the CB-1 area unworkable for the Panther teams. Their activity terminated in the CB-1 area on 12 December 1969. On 26 December 1969, Panther teams began operations in CB-2, south

of Ban Phanop (Figure B-3). The employment of gunships in the CB-2 area dictated that Panther operations be shifted out of the area. On 7 February, Panther teams returned to CB-1. The Panther team area of operation was reduced to the southern portion of CB-1 on 13 February because of adverse weather and increased AAA defenses.

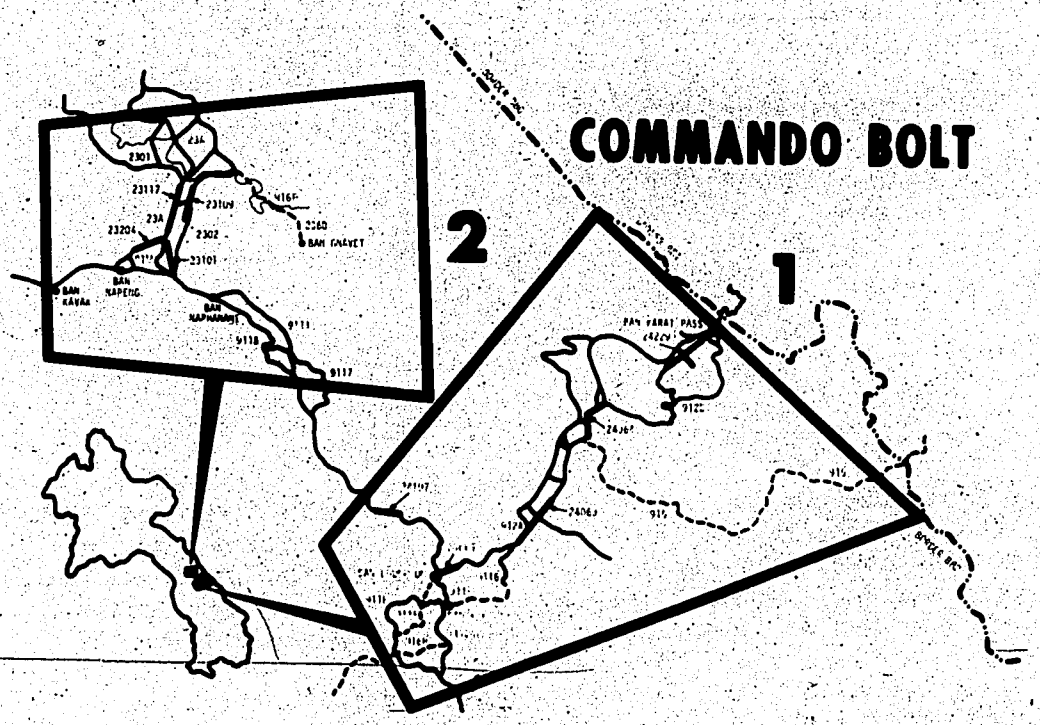


FIGURE B - 3

The number of days that A-1s were employed in Commando Bolt operations was reduced by bad weather, by diversions to search and rescue efforts, and by support of operations in Barrel Roll. During the period from 20 November 1969 through 30 April 1970, the A-1s flew 378 sorties in Commando Bolt operations. The results of these sorties are summarized in Table B-1.

At the beginning of the Commando Bolt operation there were no sensor strings on portions of route 912B or on two routes in the northern portion of CB-2. Sensors were not emplaced because terrain features masked the transmissions. A lightweight portable receiver, the Portatale I, was installed in the Panther team OV-10s for readout of specially emplaced sensors. The Portatale was successful. From 22 through 31 January 1970, 11 of 23 Panther team truck kills were directly attributed to

A-1 RESULTS
COMMANDO BOLT

TYPE TARGET	DESTROYED AND DAMAGED	SECONDARIES
TRUCKS	184	466
TRUCK PARK/ STORAGE AREAS	-	22
AAA	1	20

TABLE B - 1

the Portatale operation. The Panther team concept was not changed by the introduction of the Portatale. The FAC and A-1 strike aircraft continued to receive direction from the Sparky FAC to attack trucks passing through the sensor strike strings. During the intervals when no trucks were detected in the vicinity of the regular strike strings, the navigator in the OV-10 used the Portatale to monitor the specially emplaced sensors. The FAC reported Portatale truck detections to Sparky FAC for correlation with other sensor detections and for clearance to strike Portatale detected traffic if more worthwhile targets were not available.

Flasher Teams

Flasher teams began operations on 24 November 1969 to attack moving targets in nonvisual conditions. Air Force Loran-equipped F-4s led other fighters to strike targets in CB-1. A-6s from Navy and Marine Corps units began Commando Bolt operations on 4 and 6 December respectively. Flasher strikes were also made in the CB-2 area after Commando Bolt operations were started there on 26 December. To counter the enemy's AAA, it became necessary to change Flasher strike procedures.

Flak suppression sorties were scheduled with the A-6s to counter the buildup of enemy defenses. Two Navy A-7s and one Marine F-4 escorted each A-6 from their respective units.

ENEMY AAA ORDER OF BATTLE ALONG ROUTES 912A AND 912B, LAOS

WEAPON	NOV	DEC	JAN	FEB	MAR	APR
AUTOMATIC	8	16	2	2	2	2
23/37MM	24	52	42	48	51	39
57MM	2	2	2	2	2	2
100MM	1	0	0	0	0	0

TABLE B - 2

Marine EA-6s provided electronic countermeasure support for their A-6s. One EA-6 orbited in the area to provide a noticeable reduction in both the accuracy and intensity of AAA fire. However, the reduction was temporary and by mid-January the fire again became intense and accurate due to the predictability of the stereotyped operations. Flasher aircraft continually struck along the same segments of the LOCs where sensor strings were located.

The enemy concentrated his defenses along the LOCs and in areas frequently struck. The strike points (DMPIs) were designated by a code name which was changed daily, but the code name was compromised as soon as a DMPI was struck. There was substantial evidence that the enemy monitored strike frequencies and reacted to the transmission intercepted. One notable example occurred when a wingman reported that the flight was receiving flak at its nine o'clock position and the flak promptly walked through the formation to the three o'clock position.

During the first week in February use of secure-voice cipher was instituted for transmitting target and strike information. The SEATACS mission encoder was used to encode DMPI designators and TOTs for aircraft not equipped with cipher radio equipment. This action coincided with a decrease in AAA accuracy. The AAA threat diminished to the extent that after 20 February, A-7 flak suppression sorties were discontinued by the Navy.

Flasher aircraft began working with the Panther FACs during February 1970. From 24 November 1969 through 30 April 1970, the Flasher aircraft flew a total of 3920 sorties, 361 of which were in support of the Panther teams. The results of all sorties are summarized in Table B-3.

FLASHER AIRCRAFT RESULTS
COMMANDO BOLT

TYPE TARGET	DESTROYED AND DAMAGED	SECONDARIES
TRUCKS	888	2055
TRUCK PARK/ STORAGE AREAS	-	478
AAA	26	131

TABLE B - 3

While Flasher operations were not hindered by weather, damage assessment by strike crews was directly related to target weather. For example, weather was favorable on the night of 8 January 1970, when 15 Air Force F-4s and 36 Navy and Marine aircraft (15 A-6s, 5 F-4s, and 16 A-7s) completed 25 attacks against a total of 54 sensor-detected trucks and five area targets. Results were reported from 12 attacks. By comparison, on the night of 11 January 1970, the targets were obscured by clouds when nine Air Force F-4s and 35 Navy and Marine Corps aircraft (17 A-6s, 6 F-4s, 12 A-7s) completed 23 attacks against a total of 50 sensor-detected trucks and three area targets. Results were reported from only four attacks. Photo reconnaissance the following day revealed that 19 trucks had been destroyed.

Summary of Operations

Commando Bolt provided the capability to detect and attack moving targets in both visual and nonvisual conditions. During the operation, 1072 trucks were destroyed and damaged, representing 11 percent of the total number of trucks destroyed and damaged during Commando Hunt III.

Panther teams operated in CB-1 from 20 to 30 November 1969 and 1 to 21 December 1969. Operations in CB-2 began on 26 December and ceased on 6 February. Panther teams returned to CB-1 on 7 February for the duration of the operation. The results of Panther team operations as compared to other A-1 results are summarized below.

A-1 RESULTS AGAINST TRUCKS IN STEEL TIGER

	NOV	DEC	JAN	FEB	MAR	APR	TOTAL
SORTIES							
PANTHER A-1s	34	54	82	70	54	52	346
OTHER A-1s	249	431	575	320	148	263	1986
TRUCKS DESTROYED/DAMAGED							
PANTHER A-1s	5	14	86	45	14	20	184
OTHER A-1s	112	201	340	189	83	162	1087
DESTROYED/DAMAGED PER SORTIE							
PANTHER A-1s	.15	.26	1.05	.64	.26	.38	.53
OTHER A-1s	.45	.47	.59	.59	.56	.62	.55

TABLE B - 4

The Panther team A-1 aircraft achieved a slightly lower truck kill rate than did A-1s in standard truck attack operations. In January, while operating in CB-2, the Panther A-1 truck kills per sortie were 78 percent higher than other A-1s.

The Air Force Loran-equipped F-4 began the Flasher team operations on 24 November 1969. A-6 aircraft from Navy and Marine Corps units began Flasher team operations on 4 and 6 December respectively. Flasher aircraft operated with Panther team FACs in February when the A-1s were scheduled to Barrel Roll. The results of the Flasher team operations in Steel Tiger against trucks are summarized in Table B-5.

Flasher aircraft overall truck kill rate was 88 percent of that of all other F-4s, A-6s, and A-7s. During February the Flasher rate was 27 percent higher than that of other F-4s, A-6s, and A-7s.

FLASHER AIRCRAFT RESULTS AGAINST TRUCKS IN STEEL TIGER

	NOV*	DEC	JAN	FEB	MAR	APR	TOTAL
SORTIES							
FLASHER ACFT	83	639	1032	481	462	381	3078
OTHER F-4, A-6, A-7	541	1291	1464	1625	1357	1202	7480
TRUCKS DESTROYED/DAMAGED							
FLASHER ACFT	8	173	287	204	97	119	888
OTHER F-4, A-6, A-7	158	390	486	539	474	407	2454
DESTROYED/DAMAGED PER SORTIE							
FLASHER ACFT	.10	.27	.28	.42	.21	.31	.29
OTHER F-4, A-6, A-7	.29	.30	.33	.33	.35	.34	.33

* F-4 ONLY

TABLE B - 5

ENEMY REACTION

The enemy increased his truck traffic through Mu Gia pass north and around the CB-1 areas during December and January. This extended his supply lines and exposed his vehicles to attack for longer times. In the Ban Karai area during December, the enemy moved trucks mostly on the main road structure. Early in January traffic analysis noted a definite effort by the enemy to by-pass the main route segments where sensor strike strings were located. On 26 January 1970, photo interpreters detected a new road some five kilometers long that paralleled a section of existing road at the end of a valley on route 912B. The existing section of road had consistently been one of the most productive truck target areas. A minimum of two to three weeks was required to complete the by-pass. This represented considerable enemy effort to reduce truck losses due to Commando Bolt operations.

Convoy size reflected short-time reactions. Following successful strikes against convoys of six to ten trucks, the number of trucks in a convoy usually dropped to two or three and remained low for periods of three to five days.

CONCLUSIONS

- Panther team A-1 aircraft were about as effective against trucks as other A-1s working with FACs.
- While operating in high threat areas under visual and non-visual conditions, Flasher teams were 88 percent as effective against trucks as other F-4s, A-6s, and A-7s operating under standard conditions.
- The enemy's attempts to evade Commando Bolt attacks resulted in longer exposure of his trucks to attack and significant expenditures of manpower and supplies.
- The Commando Bolt Operation, using jet fighters to strike moving targets based on real-time sensor derived data, proved to be an effective method of interdiction.
- Commando Bolt provided a specialized capability during periods of adverse weather.

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APPENDIX C

GUNSHIP TECHNOLOGY AND MUNITIONS

GUNSHIP TECHNOLOGY

Technological innovations made important contributions to gunship effectiveness during Commando Hunt III. The equipment involved is listed below, along with brief discussions of the technology.

Laser Ranger Designator (AC-130 Surprise Package, AC-123). The laser ranger supplied accurate range data to any point on the terrain centered in the field of view of the low light level TV. The width of the laser beam was only one and a half inches at a thousand feet, a .7 milliradian beam divergence. This width permitted the grazing angle to approach zero degrees and made possible low-altitude, level attack with accurate range data. The laser ranger provided the system computer with slant range data for solution of the ballistics problem. The ranger was comprised of a receiver-transmitter, range counter, and range display unit.

AN/ARN 92 Loran C-D (AC-130, AC-130 Surprise Package). The Loran Navigation set, AN/ARN-92 C/D (only C-chain Loran capabilities in SEA), was a short/medium range (250 to 500 nautical miles) Loran D navigation system capable of receiving Loran C ground station signals for long-range (1500 nautical miles) navigation. The Loran D system provided highly accurate navigation for reconnaissance, rendesvous control, and interdiction. The system converted time difference data (time differences between reception of signals from the Loran master and slave stations) into geographical position data in either latitude and longitude coordinates, Universal Transverse Mercator (UTM) grid system coordinates, or range and bearing coordinates. It displayed the latitude and longitude coordinates to a 100th of a minute, UTMs to the nearest 10 meters, range to a 100th of a mile, and bearings to a 100th of a minute. The set also used inputs of true airspeed, east-west and north-south velocities, and true heading from other aircraft systems for navigation. It updated output readings at each time delay measurement, every twentieth of a second. A digital computer in the AN/ARN-92 C/D changed Loran TDs into Lat-Long and UTM coordinates, computed ground speed, and gave ETAs, ranges, and bearings to up to four preselected targets simultaneously. ETAs were displayed to a 100th of a minute.

The Loran set was used by the Surprise Package crews to obtain UTMs of petroleum storage areas, truck parks, and other targets for strikes by Loran-equipped F-4Ds. Results obtained from these combined Surprise Package/F-4D operations were impressive.

Air-to-Ground Moving Target Indicator (MTI)(AC-130 Surprise Package, AC-123). This radar submode allowed the detection of moving ground targets. Used in conjunction with any forward-looking radar operating in the X-band or higher frequency range, the MTI detected targets concealed by light to medium foliage and aided target identification. It processed the return video and displayed only moving targets after cancelling all other video. The MTI had a feature that alerted the operator to moving targets while he was looking at normal video.

It also had a background feature which enabled it to paint normal video faintly so one operator could pinpoint the geographical location of the moving targets. The MTI had a variable range of 0-10 miles or 10-20 miles and was designed to detect targets moving at approximately three to four miles per hour and faster. The MTI on Surprise Package operated with the APQ-136 forward-looking radar.

Black Crow (AC-130 Surprise Package, AC-123, AC-130). Although all Black Crow systems used ignition noise to detect trucks, the individual sensing equipment on each system differed. The Black Crow on the Surprise Package was a representative example. The system had two functions--first, to identify and acquire targets by sensing electrical impulses from vehicles or equipment operating with an ignition system, and second, to provide accurate azimuth and elevation information on these targets to the fire control system computer. The receiver amplified and compared the antenna outputs, then fed the sum and difference signals to detectors. The video processor conditioned video signals from the receiver to feed the display systems where target direction in azimuth and elevation was displayed. A complementary audio output from the video processor aided the operator to detect and recognize target signals and provided the capability to discriminate targets. This audio output, combined with the sum pattern on the display screen, enabled the operator to determine course bearings of the target with reference to the aircraft gunline. Target position was determined by positioning the target display, a cluster of dots, in the center of the screen and reading out elevation and azimuth with the fire control computer and operator display as desired. The Black Crow initially

detected about 65 percent of all Surprise Package targets.

Low Light Level TV (LLLTV)(AC-130 Surprise Package, AC-123). Low Light Level Television was used to view discrete objects and terrain under light conditions varying from bright sunlight to the low light levels encountered at night. Its primary function was to detect and track selected targets. On the Surprise Package aircraft two TV cameras were used: one with a wide field of view for area search and aircraft orientation and one with a narrow field for precise target tracking. The system was composed of a camera, camera electronics and ancillary electronics, operator control panel, TV monitor, and camera control unit power supply. The LLLTV camera consisted of the optics, an intensifier, and a secondary electron conduction (SEC) vidicon tube. A remotely controlled, manually switched, four-position iris, working in conjunction with an optical filter, extended the range of input light levels at which the camera operated. The Surprise Package aircraft LLLTV camera tube was protected from accidental burn-out due to inadvertent exposure to high light levels such as bomb explosions, flares, or fires on the ground. The protection against high light levels was provided by a micro channel plate design. The LLLTV camera installed in the Black Spot AC-123 aircraft was not protected by the channel plate design and suffered many vidicon tube failures during Commando Hunt III.

The camera head on the Surprise Package aircraft was mounted on a stabilized aeroflex platform installed in the crew entrance door on the left side of the aircraft just aft of the crew compartment. On the Black Spot AC-123 the camera head was mounted in a ball turret under the nose of the aircraft. When desired, the Night Observation Device (NOD) could be used as a replacement sensor for the LLLTV on the Surprise Package.

Forward-Looking Infrared (FLIR) Detection Device (AC-130, AC-130 Surprise Package, AC-119K, and Black Spot AC-123). The Forward-Looking Infrared System consisted of a mechanical and optical scanner. This instrument provided the aircraft with a viewing capability that was not endangered by intense light as some LLLTV sensing elements were. Hot objects such as truck motors, fires, and vehicle surface heat could be detected, although the detection range varied with humidity and foliage and with the size and temperature differential of the target from its background. The detection ranges of the AN/AAD-4 FLIR on the AC-130 for truck-sized targets varied from 12,000 to 20,000 feet. For the AVCO FLIR on the Black Spot detection ranges varied from 3000 to 8000 feet.

Forward-Looking Radar (AC-130 Surprise Package, AC-123). The Radar Set AN/APQ-135 (V)-1 was a special purpose, airborne radar which provided automatic flight control at low altitude and made possible video mapping capabilities. This allowed the aircraft to follow a profile of the earth's surface safely at selectable terrain clearances which helped in avoiding detection by enemy radar. The AN/APQ-135 (V)-1 had five in-flight modes of operation and test and standby modes. The manual terrain-following override (MTFO) mode provided both pilot and navigator with expanded range and elevation angle displays of terrain along the flight path of the aircraft. A bright line (the template corresponding to the closest that the aircraft could get to the terrain without climbing) was also shown. The terrain avoidance override (TAO) mode provided the pilot with a +45 degree PPI display of obstacles which constituted a threat to the aircraft.

Beacon Tracking Radar (AC-119K, AC-130). This APQ-133 radar was used to detect, acquire, and track a small X-band beacon transponder carried by friendly ground troops. The APQ-133 radome was mounted in the rear troop door. When used with a 5 watt or 400 watt beacon transponder located on the ground, the effective slant range of the radar was approximately six miles. The system was limited by the scope presentation, not the sensitivity of the radar or the output of the ground beacon.

The primary function of this equipment was to provide target offset information from a given ground reference point. The aircraft was guided to the appropriate source on the ground by a radio beacon. When the correct orbit about the source was established, offset target information was fed into the guidance computer. The pilot read out the new approach guidance information and flew a new orbit about the target.

Night Observation Device (NOD) (AC-130, AC-119K). The NOD was an electronically stabilized image light intensifier (40,000 to 1) used for observation of ground targets at night. It was a direct viewing device which amplified reflected ambient night illumination (moonlight, starlight, and sky glow) to produce a magnified, visible image through the eyepiece. When ambient light was insufficient, as on dark overcast nights, covert or overt augmentation could be provided by the electro-optical illuminator described below. The NOD was located at the crew entrance door on the left side of the aircraft. The system on the AC-130 was the AN/AVG-2 NOD. The system on the AC-119K was the lightweight AN/AVG-3 night observation sight (NOS). The Surprise Package aircraft had the capability of using a NOD as a replacement element for the LLLTV.

Illuminator (AC-130, AC-119K). This illuminator provided the gunships with a covert and overt illumination capability. The lamp on the AC-130 was mounted on the cargo ramp and was steerable in azimuth and elevation from a remote position. It had a 40kw output. A selector switch permitted the operators to select either visible light or covert infrared (IR) or ultraviolet (UV) radiation through the use of internal mirrors and filters. With the illumination in the IR mode, output was reduced approximately 50 percent, still providing sufficient illumination. The lamp on the AC-119K aircraft was similar but had a 20kw output. The visible light was not used in high AAA threat areas.

Analog Computer (AC-130, AC-123, AC-119K). The AN/AWG-13 analog computer received inputs from the NOD, FLIR, and beacon tracking radar on the AC-130 and AC-119K. The computer on the Black Spot AC-123 received inputs from the laser ranger, FLIR, and LLLTV. The computer integrated the inputs from the sensors to establish a line of sight to a designated point. It corrected the fire control equations for in-flight wind, true airspeed, and altitude. The computer provided the interface which allowed an attack to be made with a predesignated sensor or combination of sensors. It solved the approach guidance problem, provided computer azimuth steering signals, and facilitated reattack decisions.

Digital Computer (AC-130 Surprise Package). The primary function of this digital computer was to process information from the navigation equipment and from sensors which tracked the sightpoint plus certain manual inputs in order to control fire accurately. The computer accepted azimuth and elevation angle data from up to six sensors. The computer data went to the pilot's sight, the vertical and horizontal indicator on the ILS display, the Fire Control Display, and various flags and lamps which displayed the system's operational status. The computer provided a relay closure which inhibited fire when the firing error exceeded a preset threshold. Following the signals displayed on the ILS indicator caused the aircraft to approach, enter, and remain on a proper attack orbit. The digital computer gave Surprise Package the capability to fire accurately from any airspeed or altitudes rather than just at certain airspeeds and altitudes as with the AN/AWG-13 analog computer.

Inertial Navigation and Targeting System (AC-130 Surprise Package). The inertial targeting system was a compact, lightweight, self-contained system that provided primary navigation information to the navigator for precise positioning of the aircraft and to the fire control system for use in long-offset and direct-fire modes of operation. To provide accurate targeting and navigational data, the system incorporated a precision gyro-stabilized gimbal assembly for reference and a digital computer for data computation and event programming. Its computer provided inertial velocities and an attitude reference to the digital computer through a digital buffer. The Inertial Navigation Unit was located on a pallet securely attached to the aircraft structure.

GUNSHIP WEAPONRY

GAU-2B/A 7.62mm Minigun (AC-130, AC-119K). These guns were extremely effective anti-personnel weapons. They provided two modes of operation, a fast mode expending 6000 rounds per minute and a slow mode expending 3000 rounds per minute. The guns were positioned on the left side of the aircraft, four guns on each aircraft. The AC-119K had the capability of carrying 31,500 rounds of 7.62 ammunition, while the AC-130 carried approximately 15,500 rounds. When used with the fire control system, this gun was accurate to about 7000 feet slant range.

M61 20mm Gatling Gun (AC-130, AC-130 Surprise Package, AC-119K). The 20mm cannon was the primary gunship weapon and was largely responsible for the gunship's success as a truck killer. Mounted on the left side of the aircraft, the weapon could expend 2500 rounds per minute. The AC-119K and the AC-130 Surprise Package were equipped with two guns while the standard AC-130 had four. Munitions stores consisted of 8000 rounds of 20mm for the AC-130 and approximately 4500 rounds for the AC-119K.

M1 40mm Cannon (AC-130 Surprise Package). This was the standard Navy M1 40mm AAA gun, commonly known as the "Bofors." No modifications were made to the gun or its operating mechanisms. A special gun mount built for installation in the AC-130 incorporated an electrical solenoid for triggering the gun remotely. The gun mount could be adjusted in azimuth (0° to -15° from wing tip, aft) and in elevation (0° to -30° from wing tip, down). The guns were loaded manually, using standard four-round clips. Full specifications for the guns are contained in Navy Manual NAVORD OP-3524. The muzzle velocity was 2870 feet per second. The firing rate was single fire or 120 rounds per minute (selectable). The effective

range of the gun was far beyond the sensor detector tracking ranges so that gun range was not a factor. The gun's extreme accuracy (approximately one mil) imposed a strict requirement for precise fire control computations and tracking accuracy.

Modified Hayes Dispensing System (AC-123). The standard Hayes dispenser was modified for use in the AC-123 aircraft. The dispensers were rectangular containers with the inner area divided into 12 cells. Each cell accommodated three cluster bomb adapters (CBU-27) which gave a capacity of 36 canisters per dispenser. The CBU-27 cluster bomb adapter was a cube-shaped, collapsible, aluminum container held together by a stainless steel band and a series of interlocking slots, hinge tabs, and flanges on the top, bottom, and side panels. A mechanical timer released the restraining band at a pre-set time. This allowed the canister to open and the munitions to fall free. The timer could be set for any interval from 1 to 90 seconds. A fail-safe modification was installed on the canister so it could be dropped in a safe condition if desired.

There were two munitions intended for use with the system. The BLU-3/B was a fragmentation bomblet designed for use against materiel. Each bomblet weighed 1.7 pounds and contained 0.35 pounds of explosive. Each canister contained 74 bomblets and weighed 138 pounds. The BLU-26/B, also a fragmentation bomblet, was designed as both an anti-personnel and anti-materiel munition. Each BLU-26/B weighed .96 pounds and contained .18 pounds of explosive. A canister contained 177 bomblets and weighed 182 pounds.

During normal operations the dispenser was loaded with six cells of BLU-26/B bomblets and six cells of BLU-3/B bomblets. A cell of BLU-26/Bs formed a doughnut-shaped pattern upon ground impact; a cell of BLU-3/Bs formed an elliptical pattern. An attack was made by dropping a cell of each munitions type with a timer setting that allowed the BLU-3/B elliptical pattern to fall within the hole left in the doughnut pattern of the BLU-26/B.

APPENDIX D

WEAPONS DELIVERY EVALUATION PROGRAM

The Weapons Delivery Evaluation Program (WDEP) provided data on bombing accuracy and release parameters of fighter and attack aircraft in Southeast Asia. The specific objectives of the WDEP were to (1) improve the delivery capability of tactical units and crews, (2) increase the effectiveness of the tactical force by developing definitive substantiation for refinements in tactical philosophy and procedures and for improvements in weapons and weapon systems, and (3) accumulate a data base for calculating improved planning factors.

METHODOLOGY

Three methods were used to assess bombing accuracy: (1) measurement of bomb miss distances on pre- or post-strike vertical reconnaissance photography in conjunction with strike panoramic photography, (2) measurement of bomb miss distances made directly on strike panoramic photography, and (3) strike crew or FAC estimation of miss distances when bomb impact photography was not available.

Vertical Plus Panoramic Method. The aircrew reviewed the strike film (KB-18 panoramic) up to but not including the frames showing bomb impacts and identified the Desired Mean Point of Impact (DMPI). The photo interpreter (PI) transferred the DMPI and bomb impact points to a pre-strike or post-strike vertical photo of the area. Using the established scale of the vertical photo, the PI then measured the deflection and range distances from impact points to the DMPI.

Panoramic Only Method. The aircrew reviewed the strike film up to but not including the frames showing bomb impacts, identified the DMPI on a reference strike photograph, and assisted the PI in establishing the altitude of the reference photograph. The PI then transferred the impact points to the reference photograph. Using a variable scale based on altitude, he measured the miss distance using a panoramic grid overlay.

Aircrew or FAC Estimate Method. The aircrew or FAC estimated the miss distance by referring to known distances on the ground such as the crater width of an M117 bomb, which was approximately 15 feet.

The Fairchild Model 5-415U (KB-18) panoramic strike camera installed in the A-1, A-37, F-4, F-100, and F-105 aircraft was a key element of the WDEP. It provided 180° horizon-to-horizon coverage (Figure D-1).

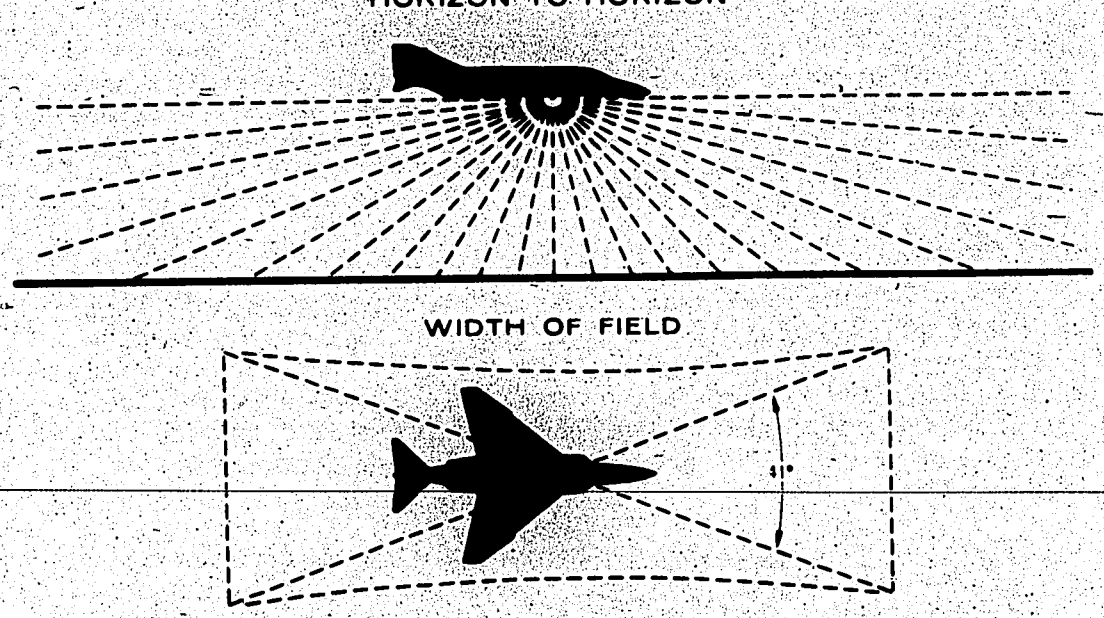


FIGURE D - 1

Photographs gave the most accurate assessments. Both the vertical plus panoramic method and the panoramic only method yielded accurate measurements of miss distances. The panoramic only method yielded a larger sample size, since panoramic strike photos of ordnance impacts were often available when vertical pre- or post-strike photos were not.

Evasive tactics, however, degraded the quality of strike photography in heavily defended areas. In addition, very few impacts of high drag bombs were photographed, because the strike aircraft were usually out of photo range when the bombs hit the ground. Strike photos of impacts on area targets could not be

realistically scored because of the lack of a precisely defined aiming point. The photographic evaluation methods were also limited to day missions. These factors limited photographic scored impacts to a small percentage of the total bomb releases.

Aircrew and FAC estimation was instituted to obtain a larger data sample of delivery parameters. To insure the collection of sufficient information on release parameters, an estimate of miss distance and delivery parameters was required for the first pass of every strike mission whether or not photography was obtained. The estimated data was identified and evaluated separately from the photographically confirmed data.

REPRESENTATIVE WDEP DATA

The data in this appendix was gathered during Commando Hunt III. Bombing accuracy data--circular error average (CEA), circular error probable (CEP), and the numbers of direct hits--are based on photo confirmation. The information on release parameters includes data from attacks for which bomb impacts were not photographed. Correlations of release parameters with bombing accuracy cover only attacks for which photographs of bomb impacts were obtained.

Bombing Accuracy by Ordnance Type.

M117 750-pound bomb. CEAs, CEPs, and direct hits for both in- and out-country strikes with the M117 are shown below.

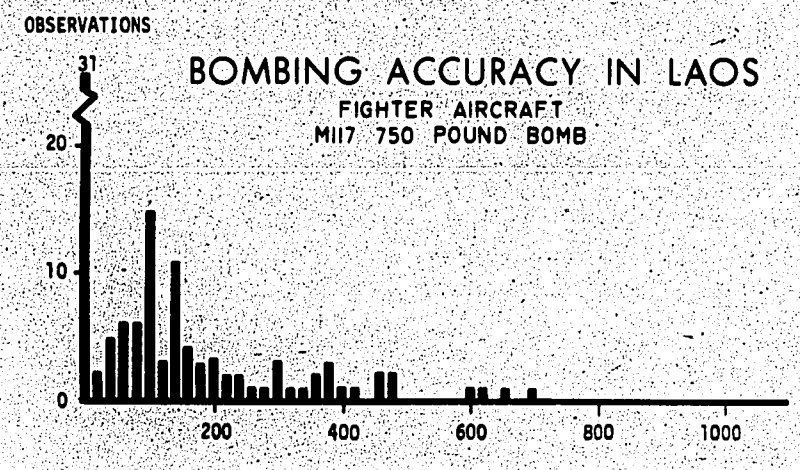
CEA, CEP AND DIRECT HITS FOR M117

	NUMBER OF SCORES	CEA (FEET)	CEP (FEET)	DIRECT HITS NUMBER	DIRECT HITS PERCENT
IN AND OUT-COUNTRY	564	128	50	212	38
OUT-COUNTRY	115	135	90	31	27
IN-COUNTRY	449	120	50	181	40

TABLE D - 1

AAA was an important influence on out-country accuracy. The out-country releases were predominantly at altitudes above 5000 feet, whereas 90 percent of the in-country releases were under 3000 feet. These factors undoubtedly contributed to there being 50 percent more direct hits in-country than out-country and to the 15-foot lower CEA in-country. The distribution of

miss distances is shown in Figure D-2.



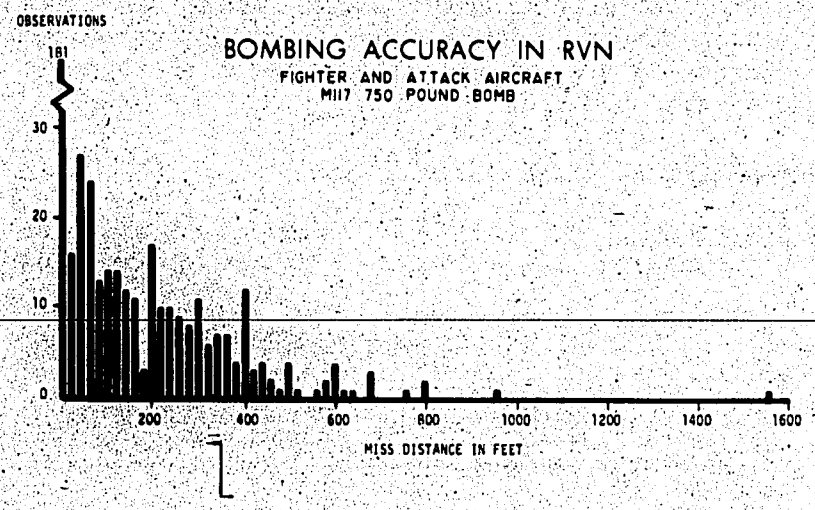


FIGURE D - 2

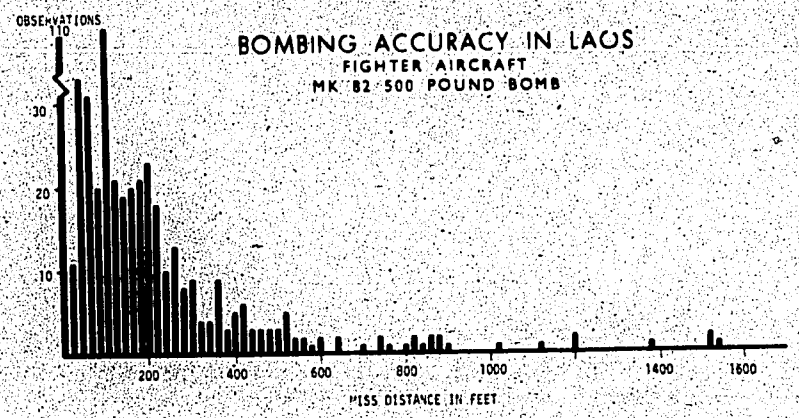
MK-82 500-pound bomb. CEAs, CEPs, and direct hits for strikes with the MK-82 are given below.

CEA, CEP AND DIRECT HITS FOR MK 82

	NUMBER OF SCORES	CEA (FEET)	CEP (FEET)	DIRECT HITS NUMBER	DIRECT HITS PERCENT
IN AND OUT-COUNTRY	647	151	90	148	23
OUT-COUNTRY	489	171	110	110	22
IN-COUNTRY	158	92	70	38	24

TABLE D - 2

The CEA for in-country releases was 79 feet lower than that for out-country releases. Ninety-six percent of the in-country releases were made at release altitudes under 3000 feet; the majority of out-country releases were made at altitudes above 5000 feet. The distributions of miss distances are shown in Figure D-3.



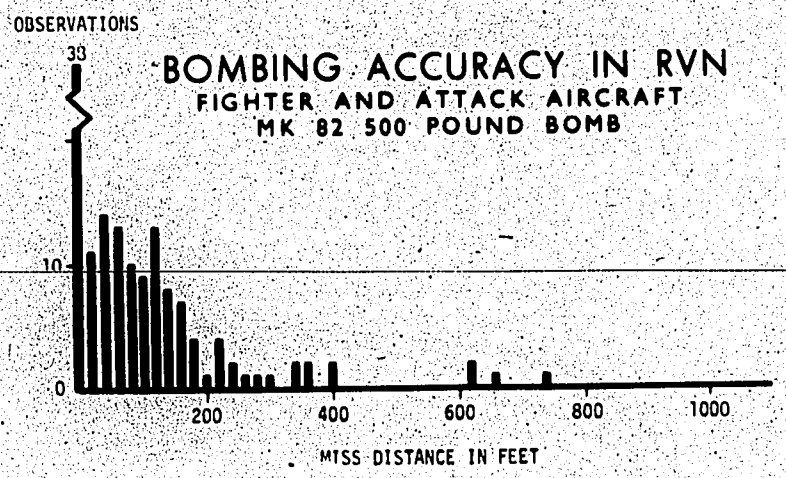


FIGURE D - 3

M117 and MK 82 Comparison. Comparisons of the cumulative missed distances in- and out-country for the M117 and MK 82 are presented in Figures D-4 and D-5. The corresponding percentages of M117 and MK 82 releases by aircraft type are shown below.

PERCENTAGE OF M117 AND MK 82 RELEASES BY AIRCRAFT TYPE

AIRCRAFT TYPE	M117		MK 82	
	IN-COUNTRY	OUT-COUNTRY	IN-COUNTRY	OUT-COUNTRY
F-4	2	4	19	59
F-100	98	65	32	0
F-105	0	31	0	41
A-37B	0	0	49	0

TABLE D - 3

The low CEP for the M117 in Figure D-4 reflects the high number (40 percent) of direct hits. Ninety-eight percent of the M117 releases were made by F-100s, which had lower miss distances than other in-country aircraft (see Figure D-9). The CEA for MK 82 deliveries, however, was lower than for M117 strikes. Fifty percent of the M117s impacted within 50 feet while 50 percent of the MK 82s impacted within 70 feet. The crossover in distributions was caused by several large M117 miss distances.

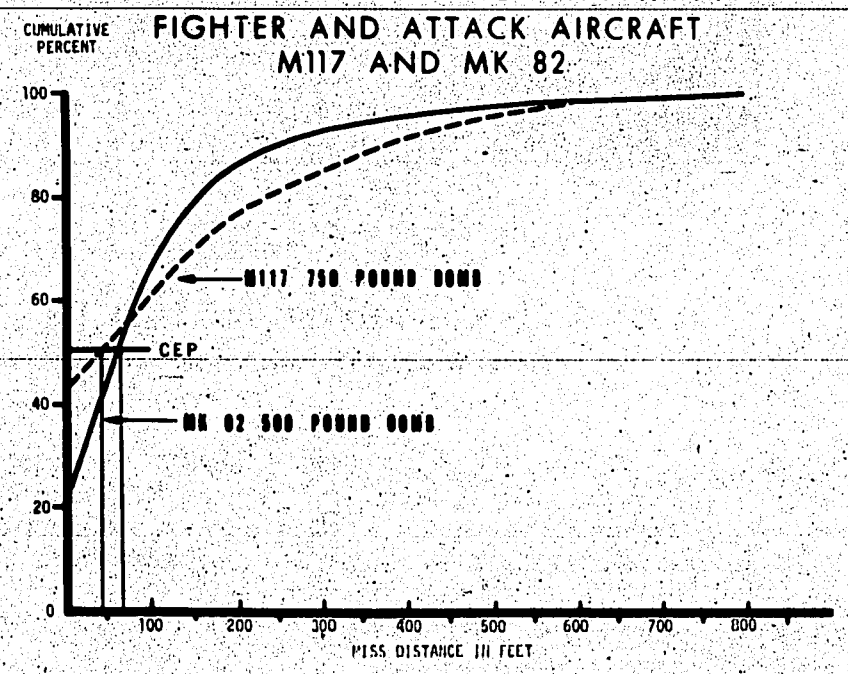


FIGURE D - 4

Figure D-5 shows very little difference in miss distances between the M117 and MK 82 out-country. Fifty percent of the M117 releases were within 90 feet while 50 percent of the MK 82 releases were within 110 feet.

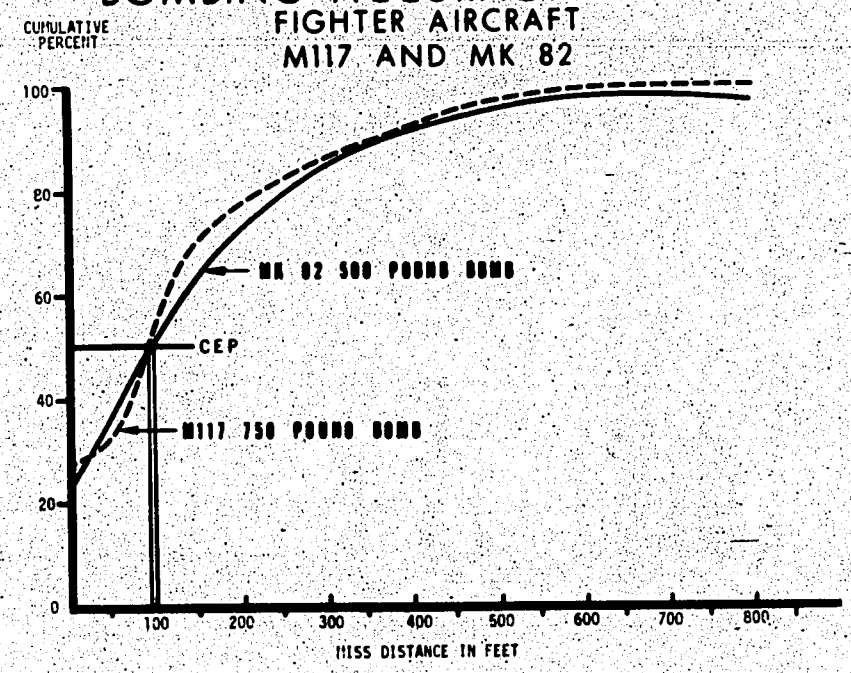


FIGURE D - 5

MK 84 2000-pound bomb. The CEA, CEP, and direct hits for F-4 and F-105 aircraft using the MK 84 out-country are shown below.

CEA, CEP AND DIRECT HITS FOR MK 84

	NUMBER OF SCORES	CEA (FEET)	CEP (FEET)	DIRECT HITS NUMBER	DIRECT HITS PERCENT
OUT-COUNTRY	23	207	190	3	13

TABLE D - 4

The CEA for the MK 84 did not vary significantly from that of the MK 82, although the average release altitude was 1000 feet higher than for MK 82 releases. The large fragmentation pattern of the MK 84 required higher release altitudes. Eighty-three percent of MK 84 releases were at 6000 feet or greater. AAA was reported in only one case. The distribution of miss distances is shown in Figure D-6.

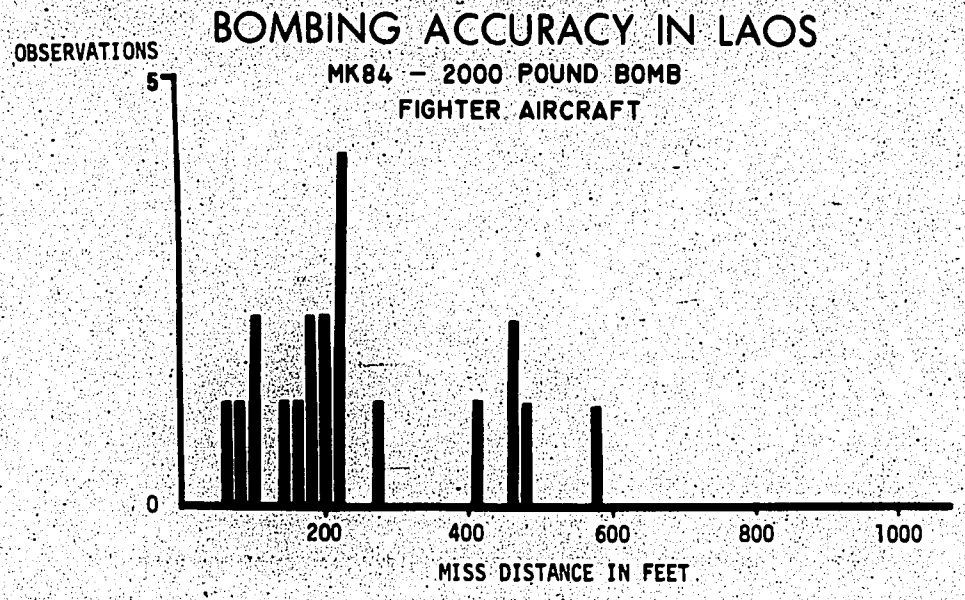


FIGURE D - 6

AGM-12C Bullpup. The CEA, CEP, and direct hits for F-4 and F-105 aircraft using the AGM-12C out-country are given below.

CEA, CEP AND DIRECT HITS FOR AGM-12C

	NUMBER OF SCORES	CEA (FEET)	CEP (FEET)	DIRECT HITS NUMBER	DIRECT HITS PERCENT
OUT-COUNTRY	25	70	0	10	40

TABLE D - 5

One impact was 1000 feet off target. Eliminating this observation reduces the CEA to 29 feet. Seventy-six percent of the miss distances were under 40 feet. Sixty-eight percent of the releases were above 10,000 feet in altitude. AAA was reported in only two cases; one was the 1000-foot miss. The distribution

of miss distances is shown in Figure D-7.

BOMBING ACCURACY IN LAOS
FIGHTER AIRCRAFT
AGM - 12C BULLPUP

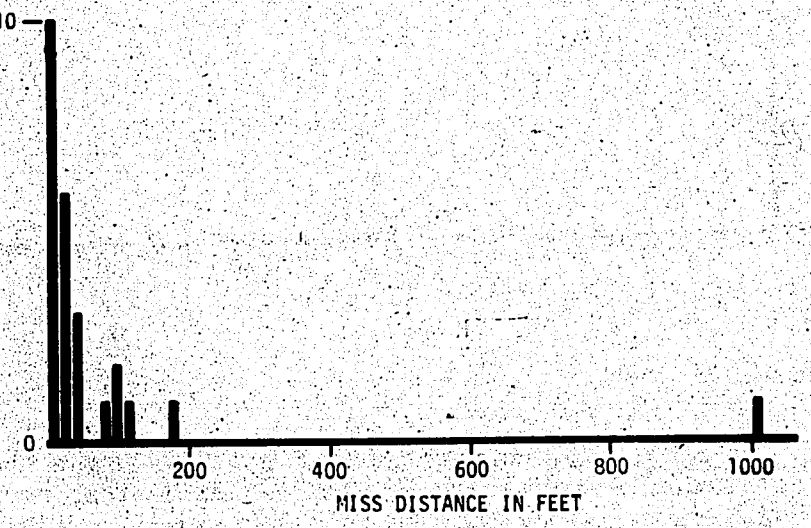


TABLE D - 7

Bombing Accuracy by Aircraft Type.

Out-country. Figure D-8 shows that in Laos the F-105 was generally more accurate with the MK 82 than was the F-4. Fifty percent of the F-4 releases impacted within 140 feet of the target, but 50 percent of the F-105 releases impacted within 80 feet of the target. These results were strongly influenced by the defense environments in which the F-4 and F-105 operated. The F-105 flew predominately in the Barrel Roll where enemy defenses were more sparse than in Steel Tiger, the principal F-4 operating area. Bomb release altitudes for the F-105 were generally lower than those of the F-4 due to the lower threat from enemy defenses (see Tables D-8 and D-12).

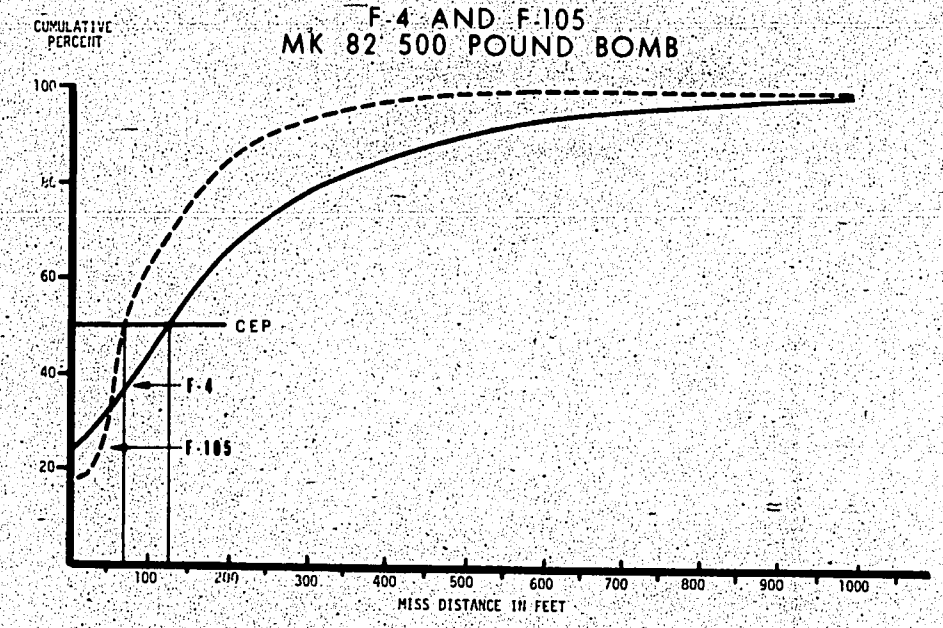


FIGURE D - 8

In-country. The comparison in Figure D-9 shows the F-100 was consistently more accurate with the MK 82 than were the A-37B and F-4. Fifty percent of the releases impacted within 20, 75, and 130 feet respectively for the F-100, A-37B, and F-4.

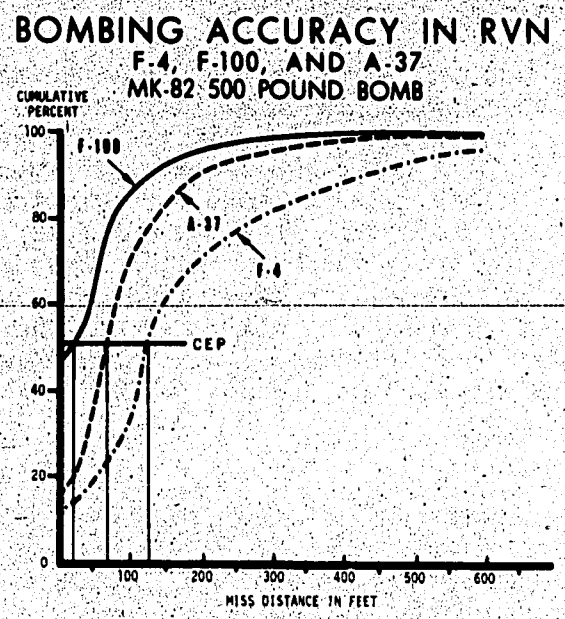


FIGURE D - 9

The prominent release parameters for each aircraft type are shown in Table D-6. Variations in release parameters accounted for no significant differences in miss distances as shown by the cumulative distributions in Figure D-9.

PREDOMINANT RELEASE PARAMETERS BY AIRCRAFT TYPE IN-COUNTRY

AIRCRAFT TYPE	DIVE ANGLE (DEGREES)	AIRSPEED (KIAS)	RELEASE (FEET)
F-4	30	450	3000
F-100	30	450	3000
A-37B	30	320	3000

TABLE D - 6

Release Parameter Data

This section presents release parameter data obtained from both photo confirmed and pilot estimate Tactical Fighter Strike Reports (TFSRs) submitted by the operational wings.

F-4. Tables D-7 through D-9 contain release parameter data for F-4 strikes in Laos. In general, 30 and 45 degrees were the dive angles used most often by F-4 crews.

DIVE ANGLE PERCENTAGES FOR F-4 DELIVERED MUNITIONS IN LAOS

	DIVE ANGLE IN DEGREES								
MUNITION	10	20	30	35	40	45	50	55	60
ROCKEYE	0	4	24	3	3	62	3	0	1
CBU-24	1	1	34	7	13	41	1	2	0
PAVEWAY	0	0	6	19	13	42	17	1	2
MK 82	0	8	25	6	23	34	2	1	1
AGM-12C		0	44	28	28	0	0	0	0

TABLE D - 7

Unguided ordnance (Rockeye, CBU-24, and MK 82) was normally released at 7000 feet AGL. The Paveway was generally released from 10,000 to 12,000 feet and the AGM 12C from 13,000 to 14,000 feet.

RELEASE ALTITUDE PERCENTAGES FOR F-4 DELIVERED MUNITIONS IN LAOS

	RELEASE ALTITUDE ABOVE GROUND IN FEET										
MUNITION	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
ROCKEYE	0	1	25	48	22	1	0	2	1	0	0
CBU-24	1	7	27	46	6	2	4	7	0	0	0
PAVEWAY	0	1	2	2	10	13	23	26	23	0	0
MK 82	8	10	18	45	13	3	2	0	1	0	0
AGM-12C	0	0	0	0	0	10	18	0	18	27	27

TABLE D - 8

The predominant airspeed at release was 450 KIAS for all ordnance types

AIR SPEED PERCENTAGES FOR F-4 DELIVERED MUNITIONS IN LAOS

	INDICATED AIR SPEED IN KNOTS												
MUNITION	350	400	410	420	430	440	450	460	470	480	490	500	550
ROCKEYE	0	1	1	0	1	2	64	8	5	1	1	11	4
CBU-24	0	2	1	2	1	1	68	11	5	2	0	6	1
PAVEWAY	0	4	0	3	2	6	51	7	12	6	1	6	2
MK 82	0	3	0	0	2	0	56	3	3	10	0	23	0
AGM-12C	18	27	0	0	0	0	55	0	0	0	0	0	0

TABLE D - 9

The release parameter data for F-4s delivering MK 82s in-country are given in Table D-10. A majority of the releases were made with a dive angle of 30 degrees at an altitude of 3000 feet and an airspeed of 450 KIAS.

F-4 RELEASE PARAMETERS WITH MK 82 IN RVN

PERCENT OF OBSERVATIONS AT VARIOUS DIVE ANGLES (DEGREES)

20	30	45
4	73	23

PERCENT OF OBSERVATIONS AT VARIOUS RELEASE ALTITUDES (FEET)

2000	3000	4000	5000
8	54	27	11

PERCENT OF OBSERVATIONS AT VARIOUS AIR SPEEDS (KNOTS)

450	470
96	4

TABLE D - 10

F-105. Tables D-11 through D-13 present release parameter data for F-105 strikes in Laos. Thirty degree dive angles were used in a majority of the strikes. The M117 and M82 dive angle distributions were very similar.

DIVE ANGLE PERCENTAGES FOR F-105 BOMBING IN LAOS

	DIVE ANGLE IN DEGREES						
MUNITION	10	20	30	35	40	45	50
M117	1	19	57	13	6	3	1
M118	1	12	59	15	9	3	1
MK 82	1	3	55	13	9	14	3

TABLE D - 11

A majority of the M117 releases were made at 4000 feet. Normal release altitudes for the M118 and MK 82 ranged from 4000 to 7000 feet.

RELEASE ALTITUDE PERCENTAGES FOR F-105 BOMBING IN LAOS

	RELEASE ALTITUDE ABOVE GROUND IN FEET												
MUNITION	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
M117	4	15	66	8	4	2	1	0	0	0	0	0	0
M118	0	7	19	34	21	14	2	0	0	1	0	1	1
MK 82	0	5	15	13	31	27	4	5	0	0	0	0	0

TABLE D - 12

Five hundred KIAS was the predominant airspeed for all releases. The M118 had the widest range of release airspeeds, from 370 to 570 KIAS.

AIR SPEED PERCENTAGES FOR F-105 BOMBING IN LAOS

	INDICATED AIR SPEED IN KNOTS															
MUNITIONS	370	380	420	440	450	460	470	480	490	500	510	520	530	540	550	570
M117	0	0	1	2	20	0	2	16	6	38	7	4	2	2	0	0
M118	1	1	0	0	10	2	4	7	3	55	5	6	1	1	3	1
MK 82	0	0	1	0	6	1	3	11	0	66	6	4	2	0	0	0

TABLE D - 13

A-1. Tables D-14 through D-16 present the release parameter data for A-1 strikes in Laos. Almost all munition releases were made at a 40 degree dive angle. This was especially true for M36 releases in which 351 of 533 releases were made at a 40 degree angle.

DIVE ANGLE PERCENTAGES FOR A-1 DELIVERED MUNITIONS IN LAOS

	DIVE ANGLE IN DEGREES						
MUNITION	10	20	30	35	40	45	50
M36	0	0	0.2	0	99.6	0	0.2
BLU-27	3	7	8	6	73	1	2
MK 82	0	2	2	1	91	2	2

TABLE D - 14

All of the M36 releases and a majority of the BLU-27 and MK 82 releases occurred between 4000 and 5000 feet.

RELEASE ALTITUDE PERCENTAGES FOR A-1 DELIVERED MUNITIONS IN LAOS

	RELEASE ALTITUDE ABOVE GROUND IN FEET								
MUNITION	1000	2000	3000	4000	5000	6000	7000	8000	9000
M36	0	0	0	7	93	0	0	0	0
BLU-27	6	7	8	25	47	3	0	2	2
MK 82	2	2	3	50	38	2	1	2	0

TABLE D - 15

The distributions of airspeeds were bimodal for all the munitions, with the numbers of observation at 280 KIAS approximately twice those at 260 KIAS.

AIR SPEED PERCENTAGES FOR A-1 DELIVERED MUNITIONS IN LAOS

	INDICATED AIR SPEED IN KNOTS								
MUNITION	220	230	240	250	260	270	280	290	300
M36	0	0	0	1	31	3	62	1	2
BLU-27	3	1	2	12	21	9	55	0	1
MK 82	0	3	3	4	22	11	55	2	0

TABLE D - 16

F-100. Release parameter data for the F-100 delivering the M117 in RVN and Laos are given below. A majority of the releases in RVN were made at a dive angle of 30 degrees, an altitude of 3000 feet, and an airspeed of 450 KIAS. In Laos the predominant release parameters were 45 degrees, 6000 feet, and 500 knots.

F-100 RELEASE PARAMETERS WITH M117 IN RVN AND LAOS

	PERCENT OF OBSERVATIONS AT VARIOUS DIVE ANGLES (DEGREES)				
	10	20	30	35	45
RVN	2	4	94	0	0
LAOS	0	0	21	3	76

	PERCENT OF OBSERVATIONS AT VARIOUS RELEASE ALTITUDES (FEET)					
	1000	2000	3000	4000	5000	6000
RVN	2	17	78	3	0	0
LAOS	4	0	19	9	10	58

	PERCENT OF OBSERVATIONS AT VARIOUS AIR SPEEDS (KNOTS)	
	450	500
RVN	100	0
LAOS	32	68

TABLE D - 17

A-37. Release parameter data for 115 observations on the A-37 delivering the MK 82 in RVN are given below. There was little or no variance in these parameters.

A-37 RELEASE PARAMETERS WITH MK 82 IN RVN

PARAMETER	PERCENT
DIVE ANGLE = 30 DEGREES	100
ALTITUDE = 3000 FEET	100
AIR SPEED = 320 KIAS	93
420 KIAS	7

TABLE D - 18

Bombing Accuracy and Release Parameters

The predominant release parameter affecting bombing accuracy was altitude. Regression analyses indicated the F-4 miss distance with the M117 bomb increased an additional 30 feet when the release altitude was raised by 1000 feet. The F-100 CEA with the same bomb increased 19 feet with an increase in altitude of 1000 feet. CEA for the F-105 with the MK 82 increased 43 feet with each additional 1000 feet. An analysis of the data also indicated that aircraft released at higher altitudes, dive angles, and airspeeds whenever (1) ceilings and visibility were higher, (2) stationary targets were attacked, or (3) enemy AAA reactions were observed.

APPENDIX E

DATA BASES

The data bases for air activities in Southeast Asia were maintained to support analysis and reporting requirements. Each data base fulfilled requirements in response to needs of the primary user. In so doing, certain limitations were necessarily a part of each base.

The Combat Activities Report III (COACT III) contained an extensive file of information on air operations in Southeast Asia. However, the file contained only preliminary target damage assessment information from pilot debriefings and was not updated. The Mission Summary File (MISSA), on the other hand, contained an accurate account of target damage assessment. MISSA was limited in that those sorties not reporting damage were not recorded unless they attacked vehicles or equipment.

It was not uncommon to combine data bases for accurate analysis. Caution was necessary, however, to assure that the data used were accurately defined in each data base. For example, the word attack was a general term used in the Southeast Asia Data Base (SEADAB) to represent a family of mission types, such as strike, close air support, air interdiction, flak suppression, and armed reconnaissance, which had a primary mission to deliver air-to-ground ordnance against the enemy. In the Aircraft Control and Target Nomination Data Base (L and N) an attack was defined as one aircraft delivering ordnance against one target. If the same aircraft delivered ordnance against a second target, it would represent a second attack.

This appendix describes each data base. The contents and available output are outlined for those data bases used in preparation of the Commando Hunt III report. The sources of specific data are referenced in the body of the report and in the List of Tables.

IGLOO WHITE FILE

The Igloo White File (IGLOA) contained a history of target sequences (usually moving trucks) as determined by Task Force Alpha (TFA). These target calls were developed from data transmitted by sensors via orbiting EC-121s to the Infiltration Surveillance Center at TFA. IGLOA was implemented in December 1967 at Hq 7AF Directorate of Targets (DIT). TFA recorded Igloo White

sensor information on two types of cards, A and B, and transmitted the cards daily via Autodin to DIT. The A card described the initial appearance of a target in a sensor string. The B card described the final appearance. The A card contained the following data:

Sequence data
Source (ISC or Airborne ISC)
Target type identified
Number of target units
Direction of travel
Operational area
Route segment
Tracking module identifier
Initial string
Initial sensor
Initial sensor identifier
Initial activation time
Initial class
Class of initial sensor activated
Number sensors of initial class
Class of other sensors in string
Time entered into ASR
Collateral source of sequence information
Day/Night indicator
Initial UTM coordinates

The B card contained:

Cross reference information with "A" card
Tactical zone
Special project identifier
Final UTM coordinates
Final string
Final sensor
Final sensor identification
Final activation time
Class of final sensor activated
Number of other sensors in string
Sequence update indicator

The output from the IGLOA file consisted of computer listings distributed to offices within 7AF, the 12th Reconnaissance Intelligence Technical Squadron, MACV J-2, and the 432nd Tactical Reconnaissance Wing. Retrievals available from the IGLOA were:

ID CODE	TITLE
IGL1R	Sensor Detections
IGL2R	Sensor Detections by Area
IGL3R	Total Sensor Detections
IGL4R	Sensor Detections by Week and Area
IGL5R	Traffic by Hour and Route
IGL6R	Traffic by Module and String Totals (a module is a group of strings in the same geographical area)
IGL7R	Listing of Traffic by Module and String
IGL8R	Sensor Detections by Week and Route Segment
IGL9R	Sensor Detections by String

The flow of information is depicted in Figure E-1.

IGLOO WHITE DATA FLOW

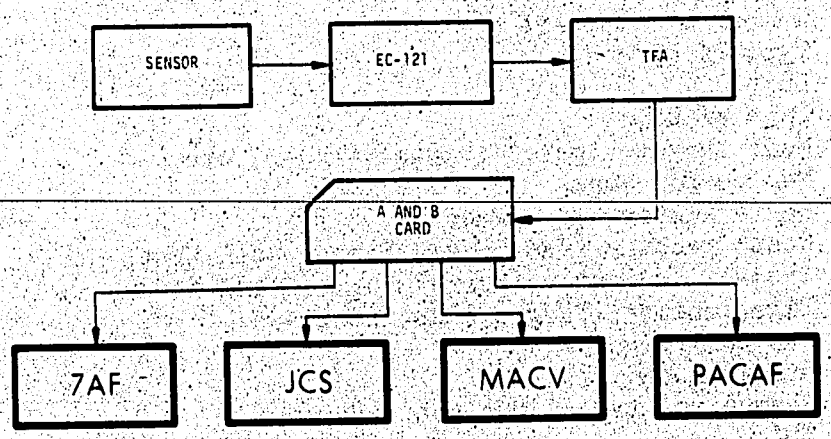


FIGURE E - 1

MISSION SUMMARY FILE

The Mission Summary File (MISSA) contained the bomb damage assessment history for the out-country air war. MISSA was implemented in April 1968 by the Directorate of Targets at 7AF.

Information for MISSA came primarily from strike data submitted by each tactical unit in the Operations Report-4 (OPREP-4) and reports from each FAC unit in the Daily Intelligence Summaries (DISUMs). Beginning in January 1970 additional information was extracted from the Southeast Asia Data Base (SEADAB) record of the OPREP-4. The Directorate of Targets cross-checked damage information from the OPREP-4 and the DISUM to assure an accurate report of damage for each strike. All reports of trucks, bulldozers, tracked vehicles, and watercraft observed or struck were surveyed to eliminate duplicate reports. Damage assessments not previously reported were obtained from interpretation of reconnaissance photos plus other intelligence sources and added to the MISSA file. The MISSA contained the following information:

- Mission date
- Mission number
- Call sign
- Time of ordnance drop
- Day/night
- Number of aircraft
- Type of aircraft
- Unit
- Type mission
- Mode target sighted (visual, radar, etc.)
- Map coordinates
- Route number and segment
- Route package (Laos East, Barrel Roll West, etc.)
- Project indicator (Barrel Roll, Steel Tiger, etc.)
- Tiger number (Target identifier)
- FAC call sign
- Strike mode
- Reason why target was not struck
- BDA
- Characteristic movement (southbound, parked, etc.)

Output from MISSA included computer listings, overlay plots, card decks, and tapes. The products were distributed to MACV, Hq USAF, PACAF, 7AF, AFSC Liaison (DAFSC), 8th TFW, 355th TFW, 388th TFW, 35th TFW, and 12th TFW.

Retrievals available from MISSA included:

ID CODE	TITLE
MIS4R	Truck, Road, Ford, and IDP BDA by Route Segment for Steel Tiger and Barrel Roll
MIS5R	BDA by Route Segment, Route Package for Steel Tiger and Barrel Roll
M444R	Secondary Fires and Explosions
MIS8R	BDA by Area
MMULR	Truck and Watercraft Log
MTSSR	Daily Truck Totals
MIS5R	Trucks, Roads, Fords, and IDP BDA by Aircraft Type
MERRR	Explosions and Fires by Route Package
MIAAR	AWP/AAA Gun Sites Struck
MIABR	Sorties by Route Segment for Steel Tiger and Barrel Roll
MIKKR	BDA by Target Type
MISAR	BDA by Route Segment by Hour
MISBR	Trucks by Direction by Route Segment
MISCR	Trucks by Day by Route Segment
MISLR	BDA by Route Segment
MISOR	Observations by Route Segment
MISXR	Destroyed and Damaged, Secondary Fires and Explosions by Aircraft Type, by Target Type
MIS2R	Mission Summary Listing
MIS6R	Truck, Roads, Fords, and IDP BDA by Date
MIS7R	BDA by Date, Unit, for Barrel Roll and Steel Tiger
MIS8R	Sorties by Date
MIS9R	Sorties by Route Segment
MIXER	Sorties vs BDA by Aircraft
MI02R	Secondary Fires and Explosions by Route Segment
MI04R	Target Size by Target Type
MI88R	Sorties by Coordinates
MI96R	Trucks Observed by Direction and Route Segment
MI99R	Trucks, Personnel, IDP, and Watercraft BDA by Route Segment
MOP1R	Trucks Observed by Direction and BDA
MOP2R	Target Type BDA
MOP3R	Truck Sights by Direction
MPKKR	Laos BDA Overlay Plots by Day and Night and Number of Aircraft

The flow of information is depicted in Figure E-2.

MISSION SUMMARY DATA FLOW

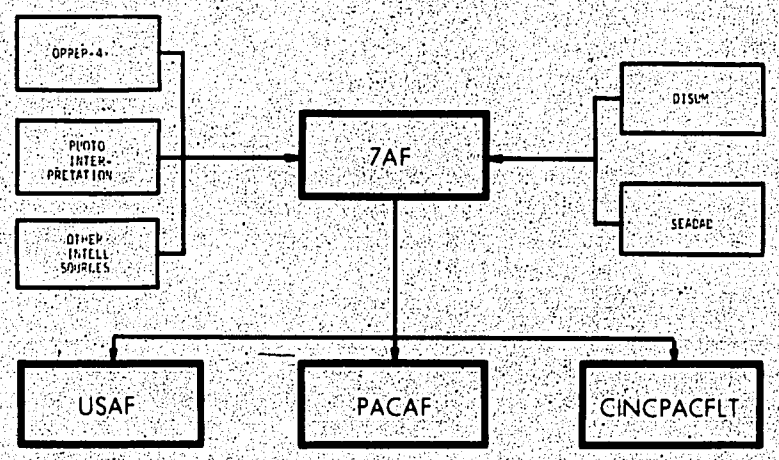


FIGURE E - 2

SOUTHEAST ASIA DATA BASE

The Southeast Asia Data Base (SEADAB) was developed to provide an automated mode for consolidating reported air activity in Southeast Asia. The data maintained in SEADAB was extracted from reports submitted by operational units in response to requirements established by PACAFM 55-3 and supplemented by 7AF directives. Information for the file came from fragmentary orders, OPREP-4s, and OPREP-8s (a telephone report from FAC units to 7AF of sorties flown and flying hours). Damage assessments were updated from MISSA. The data content for SEADAB follows:

Day and year
Unit
Mission call sign
Aircraft type and series

Day/night indicator
Frag data
    In or out-country
    Service
    Number fragged
    Mission function
    Route package
    Time over target
Flown data
    In or out-country
    Service
    Number flown
    Mission function
    Flying Time
    Last time on target
FAC controlling mission
FAC flying time
Primary/alternate target
Special operations
Reason for deviation from frag information
Flying time of aborted mission
Ordnance carried
Ordnance expended
Operation supported
Target type
Target coordinates
Target weather
Province
TDA
Aircraft loss damage data
    Aircraft type and serial number
    Service
    Base
    Unit
    Cause
    Tactic
    Altitude
    Mission function
    Location where hit
    Location where downed
    Crew status

The output from SEADAB file consisted of computer listings distributed to offices within 7AF and 7/13 AF, daily out-country OPREP-5s distributed to JCS, USAF, CINCPAC and PACAF, and daily tapes sent to PACAF and 7AF (DIT).

The list of retrievals available included:

ID CODE	TITLE
001	Summary of Attack Sorties by Route Package
002	Summary of In and Out-Country Attack Sorties by Route Package, Launch Base and Aircraft Type
003	Summary of Weather Aborts, Cancellations and Diversions
004	Summary of Combat Support Sorties by Aircraft Type within a Route Package
005	Summary of Combat Sorties Flown by Aircraft Type within Route Package
006	Weather vs Airops/Rolling Thunder Attack
007	Route Package Summary of Attack Sorties, including FAC and Visual Recce
008	Summary of In-Country Attack Sorties Flown by Corps
009	Summary of Sorties Flown by Unit, Aircraft Type and Mission Function
010	Ordnance Expended vs Route Package
011	Summary of Selected Mission Function Sorties by Service
012	Summary of Sorties by Service, Aircraft, Mission Function and Special Operations Code
013	Summary of Flown Sorties by Mission Function and Service Code
014	Special Route Package Summary of Attack, FAC and Selected Recce Sorties Flown
015	CAS and A-1 Sorties and by Corps Area and Service Code
017	FAC Aircraft Report (Excluding O2B Type Aircraft)
018	Sorties, Fragged, Flown and Air Aborts
019	Summary of Missions for Laos and Thailand
020	Summary of Immediate Requests, Scrambles and Diverts
021	Support of ROK Forces
022	Combat Sorties by Aircraft, Base and Service
023	Mission Summary for North Vietnam and Cambodia
024	Strike Report
025	Summary of Battle Damage Assessment

ID CODE	TITLE
026	Summary of Attack and Other Combat Sorties
027	Special Route Package Summary of Attack, FAC and Selected Recce Sorties Flown
028	In/Out-Country Sorties Fragged/Flown for PSY WAR, Defoliation and Combat Skyspot Missions
029	Aircraft Loss Summary
030	Summary of Commando Hunt Activity Recorded in SEADAB
031	Southeast Asia Monsoon Report
032	Reconnaissance Report
033	Special In-Country VNAF Fixed Wing Airlift/Special Mission Report
034	Special In-country Monthly VNAF Helicopters
035	Special In-Country Monthly OPREP-5 Recap Section VI
036	Flying Time for VNAF Fixed Wing Airlift/Special Mission Aircraft
037	VNAF Sorties by Unit and Selected Mission Functions
039	Sorties Flown vs Sorties Fragged
040	Summary of Ordnance Expended
041	Summary of Sorties Flown
042	Summary of Munitions Expended and Jettisoned
043	Combat Skyspot Sorties
044	In-Country Immediate Sorties Report
045	Immediate Sortie Report
046	OV-10 Aircraft Ordnance Expended Summary
047	Summary of Attack Sorties
048	Weekly Summary of Barrel Roll and Steel Tiger Sorties
049	Preplanned Sortie Report
051	Battle Damage Assessment by Area
052	Deviations for Interdiction and Close Air Support Missions
053	Bomb Damage Assessment for Steel Tiger and Barrel Roll
054	Summary of Barrel Roll and Steel Tiger Sorties
055	Immediate Sortie Report
056	Detailed Fragged Attack Mission Data/Out-Country
057	In-Country Sortie Average

ID CODE	TITLE
058	Summary of Aircraft and Truck BDA
059	Detailed Truck BDA
060	Detailed USAF In-Country Sortie Information
062	Out-Country Strike Summary of Successful and Unsuccessful Sortie
064	Out-Country Weapons - Target - Effectiveness Statistics
065	USAF Sortie Totals
066	Steel Tiger Strike Sorties Against Truck and Defense Type Targets
067	Strike Sorties Against the Four Main Types of Target in the Main O/C Areas
068	Sorties by Delivery Mode
069	Liaison Sorties by Aircraft Type and Corp Area
071	Barrel Roll Strike Sorties Against Truck Type and Defense Type Target

The flow of information is depicted in Figure E-3.

AIRCRAFT CONTROL AND TARGET NOMINATION DATA BASE

The Aircraft Control and Target Nomination Data Base (L and N) established by 7AF OPLAN 544-69 dated August 1968 and succeeding interdiction campaign OPLANs through 512-70 was used primarily by the 7AF Directorate of Tactical Analysis (DOA). The data base correlated target and strike information for all out-country air operations. TFA assembled the data from 7AF fragmentary orders, ABCCC controller's logs, FAC logs and other reports, OPREP-4s, and DISUMs from FAC units and the U.S. Air Attache, Laos. The data was transmitted on L and N cards via Autodin to 7AF.

SOUTHEAST ASIA DATA FLOW

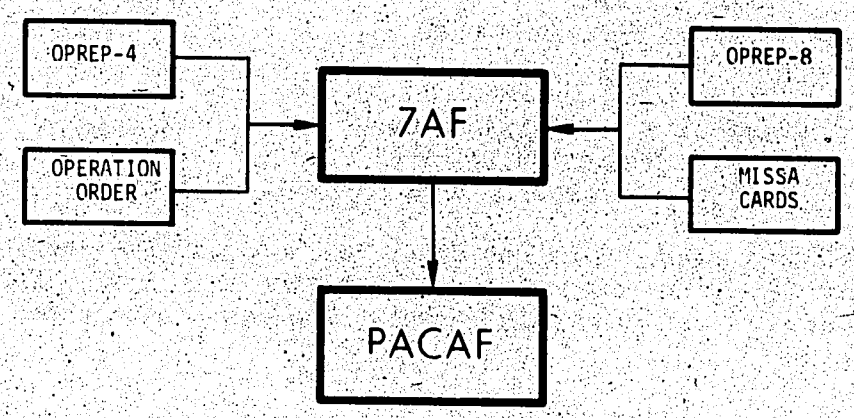


FIGURE E - 3

The L card was a log of the flight mission. A new card was encoded each time a flight of aircraft attacked a different target. The data content for the L card follows:

Controlling ABCCC
Date
Day/night indicator
Mission number
Service
Number of aircraft
Aircraft type
Type mission
Type ordnance
Number of units of ordnance
Dual mission indicator
Frag execution (primary/alternate target)
Geographical area

LOC package indicator
Target location
FAC location
SALOA drop location
Mission check in time
First time on target
Mission check out time
Type FAC controlling strike
FAC mission number
Skyspot or MSG indicator
Loran indicator
Commando Nail indicator
GCI indicator
Action taken by ABCCC
Special mission indicator
Mission variation
Multiple strikes by same aircraft indicator

The N card recorded target data, including strike results and AAA observed. A new card was made each time a different flight of aircraft attacked the same target. The data content for the N-card follows:

Controlling ABCCC
Date
Time target initiated
Target source
Igloo White contribution
Type target nominated
Number of target elements reported
Direction of travel
Target speed
Route/waterway identification
Route segment
UTM coordinates of target
Tiger target number
Action taken by ABCCC
Strike mission number
Type target struck
Number of target elements observed
Reason for no TDA
TDA number of AAA rounds
Type AAA observed

A pair of cards was prepared--one of each type for each strike against each target. For flights that did not strike targets, such as FACs, only an L card was made. For each TFA nominated target that was not struck, only an N card was prepared.

Output from the data base included computer print outs for DOA analysis, sortie data for the weekly Commando Hunt-Igloo White OPREP-5 report to JCS, and a monthly tape file for PACAF. Retrievals available included:

ID CODE	TITLE
ALL	Sortie Allocation by Target Type
OPREP-5	Sortie Allocation by Aircraft Type against Target Types
BRIEF	Sorties by Target Type by Visual or Non-visual Attack Mode with Resultant BDA.
FACAT	FAC Sorties and Hours Flown by Aircraft Type and FAC Area
GEOHIST	Listing of Data by Specified Geographical Area
TRUCKS	Sortie Effectiveness against Trucks by Degree of Igloo White Contribution
SRC	Source of Target Information and Action Taken against Target Categories
RB1	List Sorties, Attacks, BDA, Ordnance Delivered by Aircraft Type and Target Type
YXP1	Calculates Effectiveness of Attacks and Sorties by Aircraft Type
YXP2	Computes Effectiveness of Intelligence Sources in Terms of BDA per Attack

The flow of information is depicted in Figure E-4.

AIRCRAFT CONTROL AND
TARGET NOMINATION DATA FLOW

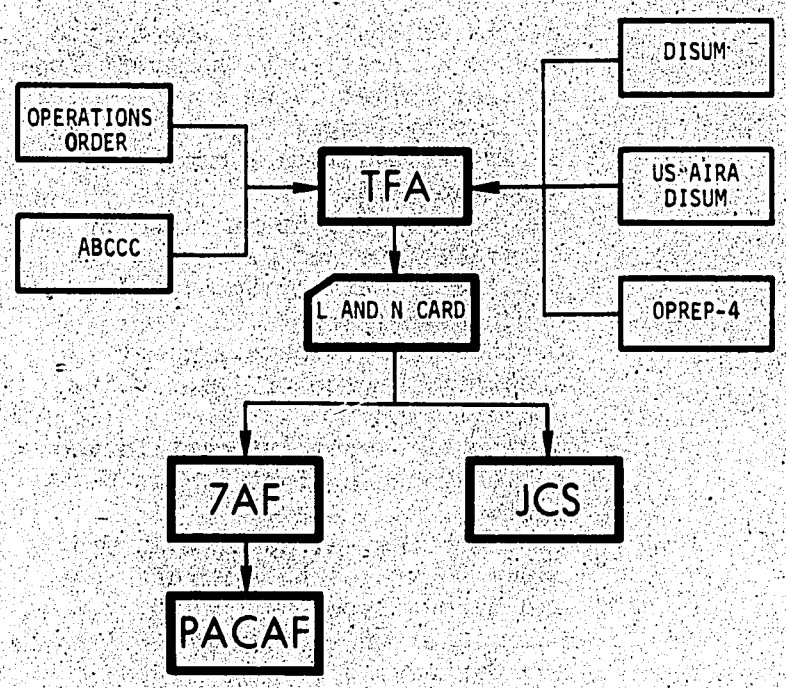


FIGURE E - 4

ANTIAIRCRAFT ARTILLERY INCIDENT HISTORY

The Antiaircraft Artillery Incident History (FLAKA) file contained a history of enemy defensive reactions to U.S. aircraft. FLAKA was implemented in 1969 by the Directorate of Targets at 7AF in support of requirements established by the Directorate of Operational Intelligence (DIO). DIO extracted data from the OPREP-4s and DISUMs for encoding into an automated system. The input to the file included:

Type of aircraft
Target
Location
Time of incident
Type
Accuracy

Intensity
Number of rounds AAA fire
Aircraft Altitude
Burst altitude

The output from the FLAKA file consisted of computer listings and map overlays which were made available to DIO. Retrievals available from the FLAKA were:

ID CODE	TITLE
FLTLR	Large Bore Firings, Cross Border Firings and Aircraft
FLTIR	History File
LSTCT	Rounds by Route Package
FLPTR	Plot Number of Flak by Area
GUNSA	High Threat Area Plot Overlays

COMMANDO BOLT LOG

The Commando Bolt Log was established by TFA to record sorties and BDA for missions under control of Sparky FAC. Operational data was encoded directly from the Sparky FAC log into an automated system at TFA. The input included:

Sorties fragged for Commando Bolt
Sorties available
Sorties executed
Attacks initiated
Attacks completed
Total trucks struck
Results observed
Trucks destroyed
Trucks damaged
Large explosions
Medium explosions
Small explosions
Large fires
Medium fires
Small fires
Total fires
AAA silenced

The output was a listing of the data by Panther operation, Flasher operation, FAC, A-1, and jets.

SECRET

WEAPONS DELIVERY EVALUATION PROGRAM

The Weapons Delivery Evaluation Program (WDEP) contained a history of strike pilot weapon releases. WDEP was established in accordance with PACAFM 55-25, 1 September 1968. Strike units prepared Tactical Fighter Strike Reports (TFSRs). The information from TFSRs was transmitted to the Directorate of Tactical Analysis, 7AF, and PACAF via Autodin for analysis. The following information was contained in the file:

Date of mission
Frag sequence number
Time on target
Squadron identification
Aircraft tail number
Number of ECM pods carried
Whether or not chaff was carried
Target weather
Cloud cover
Cloud base
Visibility
Enemy defense
Target acquisition problem
Material malfunctions affecting accuracy
Munition malfunction
Ordnance impact accuracy

Output from the file consisted of a list of all photo confirmed and pilot estimated bomb and release data. Pilot estimated data was based on the first pass of each sortie during which ordnance was expended and the target visually observed. The list was stratified by unit and date and described release parameters, release conditions, and impact accuracy. See Appendix D for additional details on this program.

AIRCRAFT COMBAT LOSS AND DAMAGE DATA REPORT

The Aircraft Combat Loss and Damage Data Report (DAD) was maintained by the Directorate of Tactical Analysis (DOA), in response to requirements established by 7AF Regulation 55-40, 25 June 68. The report provided detailed information for analysis of aircraft lost or damaged due to hostile causes. Each wing submitted a report to DOA for each incident of battle damage. The information was encoded by DOA and entered into an automated file.

Information contained in the file included:

Date of incident
Type aircraft
Tail number, squadron and base
Sortie function
Type target
Time of day the aircraft was hit
Route package where hit
Airspeed and altitude
Number of passes at same target
Type defense

The output was a list of data which reflected lost and damaged aircraft by type aircraft and area, type defense, mission function, base, type target, airspeed, and altitude.

COMBAT ACTIVITIES REPORT III

The Combat Activities Report III (COACT III) was an automated information file compiled and edited by the Directorate of Automated Systems (DOS) at 7AF. COACT III contained detailed information on air operations in Southeast Asia. All Air Force (including VNAF), Navy, and Marine units flying fixed wing combat and combat support sorties reported data to DOS in accordance with CINCPAC Instruction 3480.2. DOS compiled and edited the data and generated a tape for daily transmission to PACAF. One retrieval, Aircraft Losses (Program ID: COACT 02), was available at 7AF.

ADDITIONAL FILES

Intelligence data files also available to 7AF and other users were:

Side-Looking Airborne Radar File (SLARA). The SLARA file contained counts by route segment of trucks, bulldozers, tracked vehicles, and watercraft detected by side-looking airborne radar.

SEA Installations File (SEAIN). The SEAIN file contained the current status of BE-numbered targets in Cambodia, Laos, and North Vietnam.

Multi-Source Activity File (ACTVA). The ACTVA file contained information on vehicle, water, and personnel traffic; AAA reactions to U.S. aircraft; logistic and construction activity; road status; and headquarters and base camp positions.

In-Country Reconnaissance Data File (ICRDA). The ICRDA contained the in-country targets requiring reconnaissance coverage and a history of the recce flights over these targets.

Photo Reconnaissance (RECNA). The RECNA file contained the current status of vehicular movements in Route Package I.

Out-Country Reconnaissance Mission Summary File (REMSA). The REMSA file contained a history of scheduled out-country reconnaissance missions.

Tiger Targets File (TIGRA). The TIGRA file was the tactical target data base for North Vietnam and Laos and was designed to support combat air operations.

Emplacement Nomination/Validation File (EMNOA). The EMNOA file contained a history of areas in Laos that had been nominated and/or validated for emplacement of Mark-36 munitions and Igloo White sensors.

Sensors - Munitions (SENMA). The SENMA file contained a history of all sensor and munition fields emplaced in Laos.

AAA Order of Battle (AMODA). The AMODA file contained information pertaining to the status of all active out-country anti-aircraft artillery sites.

Aircraft Combat Instances (ACOMIN). The ACOMIN file contained a historical record of enemy defensive reactions to friendly aircraft.

Surface to Air Missile Order of Battle (SAMOA). The SAMOA file contained a history of all surface to air missile sites and SAM support facilities in North Vietnam.

SEA Imagery Reconnaissance File (SIRFA). The SIRFA file contained photo reconnaissance requirements for North Vietnam and Laos.

Trucks (TRCKA). The TRCKA file was a history of truck and watercraft traffic in North Vietnam, Laos, and China as reported by CAS roadwatch teams.

In-Country Combat Incidents (INCOA). The INCOA contained a history of friendly aircraft hits and losses in the Republic of South Vietnam.

APPENDIX F

REGRESSION ANALYSIS

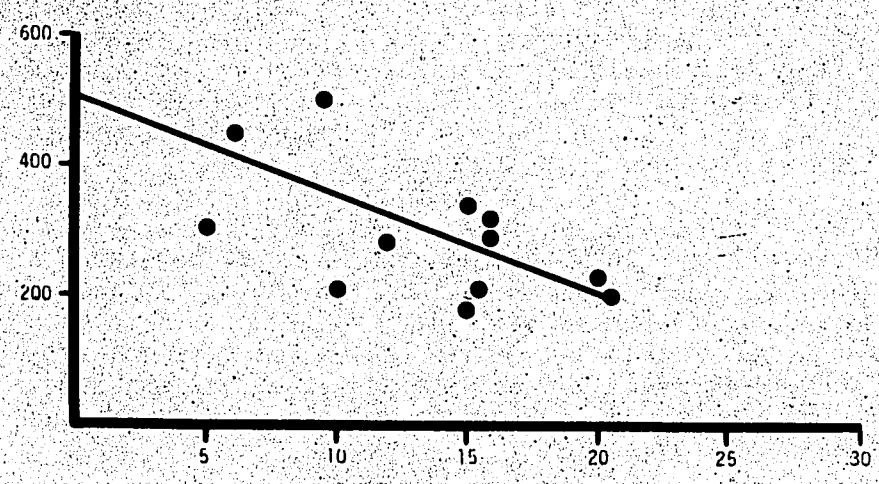
A statistical technique known as regression analysis has been employed in a number of the analyses appearing in this report. This technique assists the analyst in identifying cause and effect relationships and in specifying the nature of such relationships. Further, regression analysis aids in identifying the individual influences of separate variables. It is the purpose of this appendix to explain this technique and its applications within the context of the Commando Hunt III campaign.

The term "regression analysis" is derived from an early study by Sir Francis Galton in which the heights of fathers were plotted against the heights of their sons. Galton noted that tall fathers tended to have sons shorter than they, while short fathers tended to have sons taller than the father-that a "regression" to an average value occurred. The name "regression" was applied to the technique used by Galton to demonstrate this relationship and the term has been used ever since.

The initial step in regression analysis lies in defining some variable, such as target damage, sensor detected trucks, stockpile tonnage, etc., which can be explained by other variables. This first variable is called a "dependent variable" since it is dependent on, or a function of, other variables called "independent" variables. For example, a dependent variable such as trucks destroyed is a function of the independent variables weather, moonlight, total trucks moving, type of strike aircraft and perhaps others. Thus once the dependent variable has been identified, it is necessary for the analyst to specify the major factors, or independent variables, which cause fluctuations in the dependent variable. The identification of these independent variables is a crucial step in the analysis, and experience plays a large role in their selection. For example, FACs may report much heavier truck traffic on moonlit nights, and they may believe that the moon has an effect on the enemy decision to run trucks.

Similarly, 7AF analysts theorized that input through Ban Karai and Mu Gia passes is related to the number of interdiction packages placed in these areas. Regression analysis enables the analyst to test these observations, to determine the direction and strength of the relationships.

The mathematics involved in solving such problems are somewhat complicated, but the principles involved are simple. Suppose, for example, that the amount of input through the passes in truckloads is plotted on the vertical axis of a graph and the number of packages emplaced in the pass areas is plotted on the horizontal axis. The graph below illustrates this example.



It is apparent that total input fell as the number of packages emplaced rose in number. If a line is drawn through this scatter of points, the slope of that line will indicate the relationship between total input through the passes and package emplacements in the pass areas. The equation of the line in the graph above, for example, is

Input = 514.8 - 15.48 (packages)

This equation states that as the number of package emplacements increases by one, the number of truckloads of input can be expected to decrease by 15.48. Conversely, as the number of package emplacements decreases by one, an additional 15.48 truckloads of input can be expected to move through the passes. The first term in the equation, called the intercept, shows the point at which the regression line intersects the vertical axis. The relationship in this example is explained quite well by a

straight line, but as additional packages (beyond 20) are emplaced the return to each additional package in terms of decreased input could be expected to diminish, and the line would flatten out. It is usually unwise to project a regression line too far beyond the limits of the available data.

The problem in this case involves the selection of the regression line. A number of lines could be drawn which would describe the data, each with a separate equation, and each depending upon the criteria used in construction of the line. An obvious approach involves minimizing the sum of the vertical distances from the observed points to the line, but if the line is passed through the mean value of the two variables, then the sum of these distances is always zero, no matter where the line goes. It is therefore necessary to minimize the sum of the absolute differences, or the sum of the squared differences. Because of computational and theoretical difficulties with minimizing absolute differences, minimizing the sum of the squared differences is by far the most commonly used technique. This method is called "Least Squares."

Most problems actually encountered involve more than one independent variable. In other words, truckloads of input may be a function of weather, enemy intentions, tactics and so on. It is not possible to graph all of these variables, but the principle involved does not change. It is still postulated that:

$$y = a + b_1 x_1 + b_2 x_2 \ldots + b_n x_n + e$$

where:

y is the dependent variable.

a is the intercept term, the value of which is determined by the regression analysis.

$x_1 \ldots x_n$ are the variables (number of packages, weather, tactics, etc.) thought to explain changes in the dependent variable.

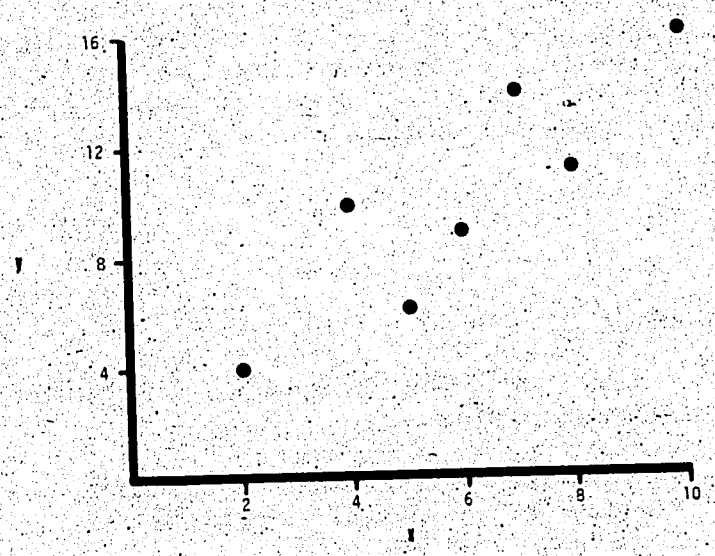
$b_1 \ldots b_n$ are the coefficients which determine the influence of each independent variable. When x_1 changes by one unit the y changes by b_1 units. These b values are determined by the regression analysis.

e is the error term. This value, along with the intercept, represents the influence of all independent variables <u>not</u> included in the model. If the model is correctly specified, the error term will be small.

The values for a and b can only be determined if a large number of observations on y and x are available for analysis. The actual computation of these values is illustrated by the following example. Suppose that observations on two variables (x and y) are as follows:

y	x
11	8
4	2
10	4
9	6
6	5
14	7
16	10

These points are plotted on the graph below.



Obviously it is not possible to draw a straight line that will pass through all plotted points, but it is possible to construct a line such that the sum of the squared distances from the points to the line will be minimized. The equation of that line will have the following form:

$$y^1 = a + bx$$

where a and b are to be determined and y^1 is the estimated value of y. Note that $y - y^1 = e$, or the distance from the actual y value to the line. The mathematics involved in the determination of a and b are beyond the scope of this discussion, but the values resulting are as follows:

$$a = 1.714 \qquad b = 1.381$$

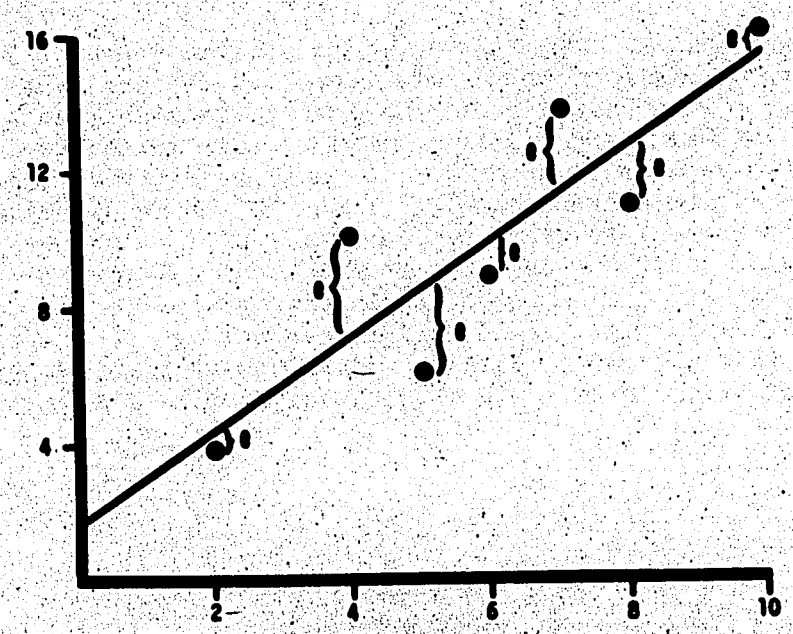
The equation of the regression line is therefore

$$y^1 = 1.714 + 1.381\ x$$

Inserting the values for x in this equation gives the following values for y^1. Subtracting y^1 from y yields the e values.

x	Y	Y^1	e
8	11	12.762	-1.762
2	4	4.476	- .476
4	10	7.238	2.762
6	9	10.000	-1.000
5	6	8.619	-2.619
7	14	11.381	2.619
10	16	15.524	.476

The values for x, y and y^1 are plotted below. The values of y^1 lie directly on the line. Note the e values.



This example deals with a single independent variable, since such an example can be graphed. The principles involved in solving problems dealing with several independent variables are identical to those described above, with the concept of minimizing the sum of the squared error terms governing the formulation of the regression equation.

Examination of the figure shows that a strong relationship exists between x and y. The equation resulting from the regression analysis "explains" a large percentage of that relationship.

As the points become more widely scattered, the relationship may be more difficult to explain and consequently the regression equation will explain a smaller percentage of the fluctuations in the dependent variable. Two separate but related tests are performed on the analysis. The first computes the percentage of the variation in the dependent variable which is explained by the independent variables. The second tests whether or not each independent variable has a statistically significant influence on the dependent variable. The analyst may reason that a cause and effect relationship exists between two variables, such as enemy truck movement and moon phase and the regression may support his hypothesis. Thus the statement that a certain variable is entered into the equation at the 95 percent confidence level simply means that there is a probability of at least .95 that a relationship does exist between the dependent variable and the independent variable under investigation. It is not necessary that the regression analysis explain a large percentage of the variation in the dependent variable in order to have significant relationships exist between variables, and it is possible to specify the influence of an independent variable even when that influence is relatively minor.

For example, a study involving the effectiveness of Commando Bolt operations and package emplacements in the Ban Karai area revealed a highly significant relationship between such operations in Ban Karai and sensor detected trucks in the Mu Gia pass area. This regression accounted for approximately 65 percent of the variation in sensor detected trucks in the Mu Gia pass area, leaving 35 percent unexplained. In spite of this rather large unexplained variation, the number of A-6 and A-7 sorties flown in Ban Karai and the number of packages emplaced in Ban Karai were both highly significant variables. A large percentage of the variation in sensor detected trucks can be attributed to enemy intentions, a variable which is difficult to measure accurately.

The examples discussed on the previous pages deal with linear relationships, but straight lines may not adequately explain the data in all cases. It is possible to estimate nonlinear relationships using regression analysis, although this requires a transformation of the data. For example, a cubic equation may be fit to observations on a dependent variable by adding the square and the cube of the independent variable as additional independent variables. There are a number of such transformations which can be used in fitting various curves.

Regression analysis was frequently used to examine air operations in Southeast Asia during Commando Hunt III. Studies concerning aircraft effectiveness, truck movements, input, throughput, package effectiveness, and related operations were conducted using this statistical technique, and the results are contained within the body of the report.

APPENDIX G

SAM SITES IN ROUTE PACK I

This appendix provides a brief description of the SAM sites discovered in Route Pack I (RP-1) during the Commando Hunt III campaign. SAM sites were designated by the letters VN followed by a three digit number. The 7XX series were assigned by the 7AF, the 5XX series by PACAF, and the 3XX series by DIA. Assignments were based on detailed analysis of reconnaissance photography, ELINT, and all-source intelligence. For the location of these sites see Figure III-51.

VN 372, the first site discovered in RP-1, was identified as VN 743 by 7AF on 21 December 1969 and confirmed by DIA as VN 372 on 13 January 1970. This site probably fired at the B-52s on 19 December 1969. Photos of the site showed three launch positions with missiles and an unmodified Fansong Radar. On 22 January and subsequent photography, this site was unoccupied.

VN 383 was identified on 2 January 1970 based on analysis of all-source data. Photo reconnaissance on 29 January 1970 confirmed three launch positions, four missiles on launchers, and an unmodified Fansong radar. Also collected in the same area were five missile transporters, four tracked prime movers, a jib crane, and seven trucks. This site was unoccupied on 21 February photography.

VN 373 was identified on 7 January 1970 based on analysis of 3 January photography. When first observed, it was occupied with three launch positions, five missiles and launchers, and an unmodified Fansong radar; however, the launchers were not in firing position. 22 January photography revealed it to be unoccupied, yet it was confirmed occupied again on 4 February photography. On 8 April the site was deleted as an active SAM site and identified as a staging area.

VN 374 was the southernmost site in RP-1, 4.5nm north of the Ban Karai Pass. Photography of 26 January and 1 February indicated two occupied launchers. The site was struck on 2 February and subsequent photography showed it unoccupied.

VN 747 was discovered 27 January 1970 on photography. There were three launchers but no electronics equipment was discernible. The site was unoccupied on 3 February and in subsequent photography.

VN748 was identified 27 January 1970 as occupied using all-source information. It possibly was involved in the 27 and 28 January firings. 3 February and subsequent photography showed this site unoccupied. On 20 February, an area similar to a SAM site was found nearby and contained a dummy Fansong, three dummy missiles, four 57mm positions (totaling 20 guns), and three Firecan radars.

VN 749 was identified on 29 January using all-source information. Photography of 2 February showed three launch positions with missiles and a possible Fansong radar. DIA analysis of photography indicated possible dummy/decoy equipment had been used and 3 February photography showed the site unoccupied.

VN 375 was identified on 29 January 1970 by the National Photographic Interpretation Center (NPIC) based on analysis of 3 January photography. The site contained three unrevetted launch positions. No actual SAM equipment was noted. Subsequent photography indicated the site was still unoccupied.

VN 376, about one nm from VN 744, was identified on 4 February 1970 by NPIC using 29 January photography and was not confirmed as occupied.

VN 384 was detected on 3 February based on 1 February photography. Equipment at the site included one launcher with missile and a Fansong radar. Subsequent photography indicated that it was unoccupied.

VN 377, the southernmost site in the Mu Gia pass area, was identified on 6 February 1970 by NPIC based on analysis of 1 January photography. The site consisted of three unrevetted launch positions. No missiles or missile associated equipment were noted on photography.

VN 380 was identified on 10 February 1970 by NPIC analysis of 3 February Giant Scale (SR-71) photography. This and subsequent photography showed four unrevetted launch positions with a revetted guidance area. No missile or missile associated equipment were observed at this site.

VN 382 was identified by NPIC on 11 February 1970 based on analysis of 3 February Giant Scale photography. The site consisted of four unrevetted, unoccupied positions and an unoccupied, revetted guidance area.

SECRET

VN 751 on Route 101 was determined from 18 February photography and a SAM support facility was located within one nm of this site. The only pieces of equipment identified at the SAM site were four missiles on transporters. This site could have been a staging area rather than an actual site.

VN 385, identified on 22 February photography, contained one launcher, one Fansong radar, one Spoonrest radar, three support vans, and a possible Mercury Grass van. This site was within one nm of VN 373, one of the first sites in RP-1 actually identified on photography.

VN 386 was identified by NPIC on 20 March 1970 using 20 February photography. The site was unusual in that it consisted of two launch positions on each side of route 15. The site was noted occupied on 28 March but was unoccupied after 30 March.

VN 387 was identified on 3 February by detailed analysis of ELINT and confirmed as occupied on 26 February photography. It contained four launchers, three missiles, one Fansong radar, one Spoonrest radar, two tracked prime movers, and four vans. The site was active until 17 April and no activity was noted beyond that date.

VN 388 was identified on 30 March by 7AF based on 29 March photography. It was occupied by four missiles on launchers and one Fansong radar until 5 April 1970. No activity was noted past that date.

VN 553 was established by PACAF on 17 April using 11 April reconnaissance photography. The site consisted of three unrevetted launch positions and was located 11nm east of VN 751.

SECRET

APPENDIX H

THE ENEMY'S RESUPPLY ACCOUNT

For analytical purposes the enemy's logistics account was considered to consist of five elements. Four of the elements--throughput, input, destruction by air, and enroute consumption--were each computed independently. The fifth element, stockpile change, was derived by comparing the input with the total of throughput, tonnage destroyed by air, and enroute consumption in the following manner:

$$\text{Input} - \left| \begin{array}{l} \text{Throughput} \\ + \text{ Destruction} \\ + \text{ Consumption} \end{array} \right| = \text{Stockpile Change}$$

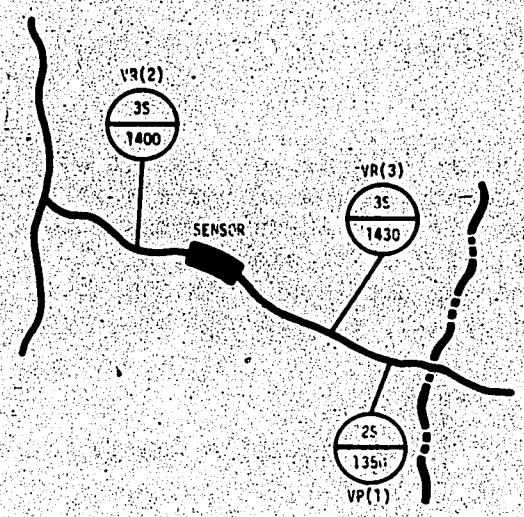
If the stockpile change was positive, it was assumed that the enemy had increased his stockpiles in southern Laos. If it was negative, the indication was that the enemy had reduced his stockpile.

THROUGHPUT

The basic measure of throughput was the total number of southbound trucks detected by the sensor strings located near the Laos/South Vietnam border on routes 926, 921B, 922, 966D, 110D. After a thorough check was made to eliminate all possible duplication, southbound trucks visually observed by aircraft and road watch teams were added to the measurement. Based on a comparison of sensor detected truck movements, 55 percent of all trucks coded as parked or direction unknown were also considered to be southbound. Figure H-1 gives an example of the check for duplication that was conducted.

The number of southbound and northbound trucks detected by the sensor string near the border on a given day is presented on the figure. In addition, visual sightings of trucks occurred at 1350, 1400, and 1430. A comparison of the number of trucks detected and the time of detection indicated a high probability that the three visually observed trucks sighted at 1400 and 1430 were the same three trucks detected by the sensor string at 1415. Therefore, only the two trucks observed at 1350 but not detected

EXAMPLE OF THROUGHPUT TRUCK COUNT



	TIME	SOUTH	NORTH
VISUAL RECCE	(1)1350	2	
	(2)1400	3*	
	(3)1430	3*	
		8(-6)*	
SENSOR DETECTION	1400	4	
	1415	3*	
	1533		2
	1550		2
	1727	5	
	1800	2	
		14	4
	TOTAL	16	4

* DUPLICATIONS, INVOLVING TOTAL OF 6 TRUCKS, VR(1) IS THROUGHPUT

FIGURE H - 1

by the sensor string were added to the number of sensor detected trucks to give a total throughput of 16 truckloads.

When Commando Hunt III began, a factor of 3.5 tons per truck was used to convert truckloads into tons of throughput. Additional evidence indicated that as the roads dried out the enemy was able to use larger trucks, so the factor was changed to four tons per truck and all earlier throughput was reestimated on this factor.

The policy was to implant throughput sensor strings immediately adjacent to the RVN border. As sensor strings died out and were replaced by others; however, the exact location of the throughput strings varied. Destruction of trucks and supplies reported between the string and the border was deducted to calculate the throughput estimate.

INPUT

The number of truckloads of supplies entering the three input gates at Mu Gia pass, Ban Karai pass, and the DMZ complex were computed in the same manner described in the throughput section above. In addition to the truck traffic, it became apparent in February that a significant amount of supplies

was being introduced into Laos through a pipeline at Mu Gia pass, and a pipeline and waterway 7J west of the DMZ.

The two pipelines entering Laos were estimated to have a practical capacity of 200 tons per day. Based on the number of trucks operating, estimated stockpile buildup, and destruction, the enemy's POL requirements were calculated to be 60 tons per day. With an estimated practical capacity of 200 tons, it was reasonable to estimate the 60 ton per day requirement was met by the pipelines.

Waterway 7J was also used for some POL shipment but not primarily for gasoline. Strike photographs showed dense black smoke which indicated a slower burning POL product such as diesel oil. Usually reliable sources reported that some diesel fuel was being floated down waterway 7J.

Intelligence estimates of waterway 7J inputs ranged from 30 drums a day, as reported by DIA, to 3000 drums or packages reported by FACs. The estimate used by 7AF was a daily average of 350 drums or packages—this figure is supported by all-source intelligence. The transit time from the border of North Vietnam west of the DMZ to the farthest transshipment point was approximately three days. To maintain the 350 average, it would have been necessary to add about 120 drums and packages to the flow each day. Since all-source intelligence and photography indicated a 65 to 35 ratio between drums and packages, 78 drums and 42 packages were taken as the daily input to waterway 7J.

All-source intelligence indicated that the drums contained 390 pounds of supplies while the packages varied between 100 and 700 pounds. If a package weighed 700 pounds, however, it would have to be about twice the size of a drum. Since all available photography indicated that the packages were smaller than drums, a factor of 200 pounds was used for the packages. This factor was based on the relative sizes of the drums and packages and how low in the water they floated.

The 78 drums and 42 packages added a total of 19 tons of supplies to input per day. On any one day, the tonnage could have been considerably more, but for the entire campaign, the estimate was considered the most accurate available given the combat environment.

DESTROYED BY AIR

Supply tonnage destroyed by air was computed from the number of trucks destroyed and damaged and the number of secondary fires

and explosions reported during the week. Table H-1 gives the calculation for the week of 22 to 28 April 1970. This data was extracted from the Mission Summary File (Appendix E) which separates Steel Tiger into two areas, north and south. The number of trucks destroyed and the number damaged were added for the two areas of Steel Tiger. Then any trucks destroyed or damaged on route 8 leading to Barrel Roll were subtracted from this total.

The same procedure was used to compute the number of truck associated secondaries. It was determined by analysis that 30 percent of these secondaries were supplies destroyed in the trucks reported destroyed or damaged, so this 30 percent was subtracted from the total of all secondary fires and explosions computed in the next step.

A comparison of south and northbound sensor detected trucks indicated approximately 55 percent were southbound. The estimated capacity of the average truck was 4 tons, so a factor of 2.20 (.55 x 4) was used to estimate the tonnage destroyed. Only 25 percent of the tonnage in damaged trucks was assumed to be destroyed so the factor used to compute tonnage for damaged trucks was .55 (.25 x .55 x 4).

A distribution of large, medium, and small secondary fires and explosions reported by FAC aircraft indicated that on the average 750 pounds, or .375 tons, was a valid conversion factor for secondary fires and explosions, and this factor was used through 24 March 1970. On 25 March the factor for secondary explosions was changed to 1000 pounds, or .500 tons, by the PACOM Logistics and Lines of Communication Conference as a result of new information on the size of logistics packages.

The total tonnage destroyed by air attacks using these factors is given at the bottom of the Table H-1.

CONSUMPTION

Enemy consumption in Steel Tiger of supplies from NVN was based on all-source estimates of the total enemy strength in Steel Tiger, the minimum daily requirements per man, the percent of these requirements that were imported from North Vietnam, and the number of trucks operated daily. Since personnel consumption requirements differed, enemy units were separated into five basic categories: North Vietnamese engineering and AAA units assigned to the 559th Transportation Group (NVA), 559th Transportation Group personnel primarily engaged in the transport of supplies (559TG), Pathet Lao regular units (PL), Pathet Lao-North Vietnamese mixed units (PL/NVA), and North Vietnamese infiltrators. Estimates of enemy strengths were updated continually

DESTRUCTION BY AIR

22 - 28 APRIL 1970

	DESTROYED TRUCKS	DAMAGED TRUCKS
STEEL TIGER NORTH	17	13
STEEL TIGER SOUTH	+124	+73
SUBTOTAL	141	86
MINUS THOSE OUTSIDE AREA	-0	-1
NUMBER USED	141	85

	TRUCK ASSOCIATED SECONDARY FIRES	TRUCK ASSOCIATED SECONDARY EXPLOSIONS
STEEL TIGER NORTH	40	13
STEEL TIGER SOUTH	+161	+268
SUBTOTAL	201	281
MINUS THOSE OUTSIDE AREA	-0	-0
TOTAL	201	281
TIMES .3	x.3	x.3
30% TRUCK SECONDARIES	60.3	84.3

	ALL SECONDARY FIRES	ALL SECONDARY EXPLOSIONS
STEEL TIGER NORTH	68	44
STEEL TIGER SOUTH	+262	+404
SUBTOTAL	330	448
MINUS THOSE OUTSIDE AREA	-0	-0
SUBTOTAL	330	448
ARC LIGHT	+0	+126
SUBTOTAL	330	574
MINUS 30% TRUCK SECONDARIES	-60	-84
NUMBER USED	270	490

TONS DESTROYED

2.200 x 141 TRUCKS DESTROYED	=	310.20
.550 x 85 TRUCKS DAMAGED	=	46.75
.375 x 270 SECONDARY FIRES	=	101.25
.500 x 490 SECONDARY EXPLOSIONS	=	245.00
TOTAL	=	703.20

TABLE H - 1

from MACV special order of battle summaries. Table H-2 gives the enemy personnel strengths used during Commando Hunt III.

ENEMY PERSONNEL STRENGTH BY STEEL TIGER

UNIT	1 NOV-11 NOV	12 NOV-2 DEC	3 DEC-13 JAN	14 JAN-24 FEB	25 FEB-30 APR
559 TRANSPORTATION GROUP	39,500	36,400	36,400	43,600	43,600
TRANSPORTATION UNITS (559TG)	(18,000)	(18,000)	(18,000)	(18,000)	(18,000)
SUPPORT UNITS (NVA)	(21,500)	(18,400)	(18,400)	(25,600)	(25,600)
PATHET LAO (PL)	8,400	4,500	4,500	2,545	2,545
PATHET LAO - NORTH VIETNAMESE (PL/NVA)	3,300	10,800	10,800	5,695	3,120
INFILTRATORS	1,000	1,000	5,000	15,000	20,000
TOTAL	52,200	52,700	56,700	66,840	69,265

TABLE H - 2

The factors used to compute daily consumption were updated whenever intelligence sources indicated a change in the enemy's consumption pattern. The following paragraphs outline the consumption factors that were in effect at the end of the campaign.

Class I (Food)

Minimum ration per man per day (pounds):

Rice	1.5
Food supplement (meat, etc.)	.5

Required from North Vietnam (percent):

NVA, 559TG, Infiltrators	100
PL, PL/NVA	10

Factors (tons per 1000 men per day):

NVA, 559TG, Infiltrators	1.00
PL, PL/NVA	.10

Class II (Individual Equipment)

Equipment required in pounds per man per day:

NVA, 559TG, Infiltrators	.045
PL, PL/NVA	.021

Required from North Vietnam (percent):

NVA, 559TG, Infiltrators	75
PL, PL/NVA	25

Factors (tons per 1000 men per day):

NVA, 559TG, Infiltrators	.0169
PL, PL/NVA	.0026

Class III (POL and Truck Park)

All-source intelligence estimates:

Distance traveled in miles per day	30
Fuel consumption in miles per gallon	5
Gasoline weight in pounds per gallon	6.1
Spare parts replacement in pounds per truck per day	10

Factors (tons per moving truck per day):

POL	.0183
Spare parts	.0050
Total	.0233

The number of trucks operated per day was estimated by the Traffic Analysis and Prediction Program (TRAP).

Class IV (Organization Equipment)

Estimated replacement rate in tons per 1000 men per day .0175

Class V (Ammunition)

Ammunition expenditures were separated into two categories, small arms and AAA:

Small Arms. NVA, PL, and PL/NVA were estimated to expend .015 tons per 1000 men per day. The 559TG and Infiltrators were not assumed to use ammunition.

AAA Estimates. Table H-3 provides an example of how the enemy's AAA expenditure was calculated for the week of 22 to 28 April. The number of reactions (firing instances) was adjusted by day and night factors. Since the probability of observing a firing was less during the day than during the night, the day figure was weighted more heavily. Next the sum of day and night adjusted firings was multiplied by the estimated average reaction time for each type of antiaircraft weapon. This product was multiplied by the average number of rounds the weapon was capable of firing a minute to arrive at the total number of rounds fired. The packaged weight of each of the rounds was then used to obtain the total tonnage of AAA ammunition expended during the week.

WEEKLY AAA AMMUNITION EXPENDITURE
22-28 APRIL 1970

TYPE WEAPON	D N	OBSERVED REACTIONS	TIME FACTOR	ESTIMATED REACTIONS	TOTAL REACTIONS	DURATION OF FIRE	TOTAL DURATION	ROUNDS PER MINUTE	ROUNDS FIRED	CRATED WT/ROUND	TOTAL WEIGHT IN POUNDS
12.5MM	D	14	4.00	56.00	66.50	.17	11.31	80	904.8	.7	633
	N	10	1.05	10.50							
14.5	D	14	4.00	56.00	65.45	.17	11.13	300	3339.0	1.3	4343
	N	9	1.05	9.45							
23MM	D	79	4.00	316.00	434.65	.25	108.66	400	43464.0	1.5	65196
	N	113	1.05	118.65							
37MM	D	60	4.00	240.00	586.50	.33	193.55	80	15484.0	4.4	68130
	N	330	1.05	346.50							
57MM	D	1	4.00	4.00	7.15	.50	3.58	70	250.6	21.6	5413
	N	3	1.05	3.15							
85MM	D	0	4.00			.75		15		45.8	
	N	0	1.05								
TOTAL POUNDS PER WEEK											143715.0
TONS PER WEEK											71.9
TONS PER DAY											10.3

TABLE H - 3

The consumption factors that could be attributed to enemy personnel strength are summarized in Table H-4. To the total consumption predicated on these factors was added the Class III POL and spare parts consumption described above. All-source intelligence also revealed that an average of 4 percent of all supplies shipped to Laos from North Vietnam was TNT for use in

road construction and repair. Therefore, 4 percent of the daily tonnage requirements for Classes I through V was added to arrive at total enemy consumption for the period.

COMBINED CONSUMPTION FACTORS

TONS PER 1000 MEN

UNIT	CLASS I	CLASS II	CLASS IV	CLASS V	TOTAL
NVA	1.0000	.0169	.0175	.0150	1.0494
PL	.1000	.0026	.0175	.0150	.1351
PL/NVA	.1000	.0026	.0175	.0150	.1351
559 TG	1.0000	.0169	.0175	-	1.0344
INFILTRATORS	1.0000	.0169	.0175	-	1.0344

TABLE H - 4

SUMMARY CALCULATION

Table H-5 summarizes the logistics calculations described above for the week of 22 to 28 April 1970.

LOGISTICS CALCULATION

22-28 APRIL

CONSUMPTION(Daily)

	1000's OF MEN	FACTOR	TONS
NVA	25.600	1.0494	26.8646
PL	2.545	.1351	.3438
PL/NVA	3.120	.1351	.4215
559 TG	18.000	1.0344	18.6192
INFILTRATORS	20.000	1.0344	20.6880
SUBTOTAL (CLASS I,II,IV,V)			66.9371
POL AND PARTS (CLASS III) 281 TRUCKS x .0233			6.5473
AAA EXPENDITURE			10.2714
SUBTOTAL			83.7558
PLUS 4% TNT			3.3502
TOTAL DAILY CONSUMPTION			87.1060
WEEKLY CONSUMPTION			609.742

INPUT (Weekly)

	TRUCKS	TONS
MU GIA	14	56
BAN KARAI	49	196
1039/92A	91	364
WATERWAY 71	-	133
PIPELINES	-	420
TOTAL	154	1169

THROUGHPUT (Weekly)

	TRUCKS	TONS
9H	3	12
926	14	56
922	39	156
966C/D	16	64
110D/E	16	64
TOTAL	88	352

TONS DESTROYED (Weekly)

	NUMBER	FACTOR	TONS
TRUCKS DESTROYED	141	2.200	310.20
TRUCKS DAMAGED	85	.550	46.75
SECONDARY FIRES	270	.375	101.25
SECONDARY EXPLOSIONS	490	.500	245.00
TOTAL			703.20

LOGISTICS ACCOUNT (22-28 Apr)

INPUT		1169
DESTRUCTION	703	
CONSUMPTION	610	
THROUGHPUT	352	
TOTAL DEDUCTIONS		1665
STOCKPILE CHANGE		-496

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II. MESSAGES, MEMORANDA, AND LETTERS.

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Letter, 7AF DOD to 7AF DPLP, Subj: 7th AF OPLAN AB 145-70, Combined Campaign Quarterly Report, October-December 1969, January-March 1970, undated (Secret).

Memorandum, General Brown to 7AF (VC), Subj: Truck Interdiction, 16 November 1969 (Secret).

Other

Msg, CINCPACAF to RUHHHQA/CINCPAC J-2, Subj: Monthly Air Defense Trend Analysis Report, 060236Z March 70 (Secret NOFORN).

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Msg, 388 TFW Tiger DISUM (Published daily) 1 November 1969-30 April 1970 (Confidential).

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IV. INTERVIEWS

Interview, General Creighton W. Abrams with Mr. Kenneth Sams and Major Philip Caine, Hq MACV, 3 March 1970 (Secret).

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V. DATA BASE

Primary

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Aircraft Control and Target Nomination Data Base (L & N), 7AF.

Antiaircraft Artillery Incident History (FLAKA), 7AF.

Combat Activities Report III (COACT III), 7AF.

Commando Bolt Log, Task Force Alpha.

Igloo White File (IGLOA), 7AF.

Mission Summary File (MISSA), 7AF.

Southeast Asia Data Base (SEADAB), 7AF.

Weapons Delivery Evaluation Program (WDEP), PACAF and 7AF.

Other

AAA Order of Battle (AMODA), 7AF.

Aircraft Combat Instances (ACOMIN), 7AF.

Emplacement Nomination/Validation File (EMNOA), 7AF.

In-Country Combat Incidents (INCOA), 7AF.

Multi-Source Activity File(ACTVA), 7AF.

Out-Country Reconnaissance Mission Summary File (REMSA), 7AF.

Photo Reconnaissance (RECNA), 7AF.

SEA Imagery Reconnaissance File (SIRFA), 7AF.

SEA Installations File (SEAIN), 7AF.

Sensor-Munitions (SENMA), 7AF.

Side-Looking Airborne Radar File (SLARA), 7AF.

Surface to Air Missile Order of Battle (SAMOA), 7AF.

Tiger Targets File (TIGRA), 7AF

Trucks (TRUKA), 7AF.

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3. MAJOR COMMANDS

a. TAC

(1) HEADQUARTERS
- (a) DO..... 4
- (b) DPL..... 1
- (c) DOCC..... 1
- (d) DORQ..... 1
- (e) DIO..... 1

(2) AIR FORCES
- (a) 12AF
  - 1. DO..... 1
  - 2. DORF..... 1
  - 3. DI..... 1
- (b) 19AF (DI)..... 1
  (DO)..... 1
- (c) USAFSOF(DO)..... 1
- (d) 9AF(DO)..... 1

(3) WINGS
- (a) 1SOW(DO)..... 1
- (b) 4TFW(DO)..... 1
- (c) 23TFW(DOI)..... 1
- (d) 27TFW(DOI)..... 1
- (e) 33TFW(DOI)..... 1
- (f) 64TAW(DOI)..... 1
- (g) 67TRW(C)..... 1
- (h) 75TRW(DOI)..... 1
- (i) 316TAW(DOP)..... 1
- (j) 317TAW(EX)..... 1
- (k) 363TRW(DOC)..... 1
- (l) 464TAW(DOIN)..... 1
- (m) 479TFW(DOF)..... 1
- (n) 516TAW(DOPL)..... 1
- (o) 4410CCTW(DOTR).. 1
- (p) 474TFW(TFOX) ... 1
- (q) 4510CCTW(DO16-I). 1
- (r) 4554CCTW(DOI)... 1

(4) TAC CENTERS, SCHOOLS
- (a) USAFTAWC(DA) ... 1
- (b) USAFTARC(DID)... 1
- (c) USAFTALC(DCRL).. 1
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b. SAC

(1) HEADQUARTERS
- (a) DO..... 4
- (b) DOPL..... 1
- (c) DPLF..... 1
- (d) DM..... 1
- (e) DI..... 1
- (f) OA..... 1
- (g) HI..... 1

(2) AIR FORCES
- (a) 2AF(DO)..... 2
- (b) 8AF(DO)..... 1
- (c) 15AF(DO)..... 1

c. MAC

(1) HEADQUARTERS..... 2

(2) AIR FORCES
- (a) 21AF(DO)..... 1
- (b) 22AF(DO)..... 1

d. ADC

(1) HEADQUARTERS..... 2

e. ATC

(1) HEADQUARTERS
- (a) ATXPP-X..... 1
- (b) ATXDC..... 1

f. AFLC

(1) HEADQUARTERS
- (a) MCVSS..... 1
- (b) MCO..... 1

g. AFSC

(1) HEADQUARTERS
- (a) SCLAP..... 3
- (b) SCS-6..... 1

(c) SCGCH..... 1
(d) SCTPL..... 1
(e) ASD(ASJT)WPAFB... 1
(f) ASD(ASBR)WPAFB... 2
(g) ESD(ESO)..... 1
(h) RADC(EMOEL)..... 1
(i) ADTC(ADGT)..... 1
(j) ADTA Eglin AFB... 1
(k) ESWN Hanscom..... 1
(l) FTD(TDFC)WPAFB... 1
(m) FTD(TDPI)WPAFB... 1
(n) AFATL(ATB)Eglin AFB... 1

h. USAFSS

(1) HEADQUARTERS

(a) XR..... 1
(b) CHO..... 1

(2) SUBORDINATE UNITS
(a) Eur Scty Rgn(OPD-P).1
(b) 6940 Scty Wg (OOD)..1

i. AAC

(1) HEADQUARTERS
(a) ALDOC-A.....1

j. USAFSO

(1) HEADQUARTERS
(a) COH..... 1

k. PACAF

(1) HEADQUARTERS
(a) DP..... 1
(b) DI..... 1
(c) DPL..... 2
(d) CSH..... 1
(e) DOTE..... 2
(f) DE..... 1
(g) DM..... 1
(h) DOTECH..... 1

(2) AIR FORCES
(a) 5AF(DO)..... 2
5AF(DOPP)..... 1
(b) Det 8, ASD(DOASD)... 1
(c) 7AF
1. C..... 1
2. VC..... 1
3. CS..... 1
4. DI..... 4
5. DE..... 1
6. DM..... 1
7. IG..... 1
8. DO..... 11
9. DPL..... 2
10. SWO..... 1
11. TACD..... 2
12. AFSSO..... 1
13. DOSACADVON..... 1
14. DONAVLO(CTU 78.1.1)... 1
15. STOCK..... 47
(d) 13AF..... 1
1. CSH..... 1
2. DPL..... 1
3. DXI..... 1
4. DO..... 3
(e) 7/13AF (CHECO)..... 1
Dep Comdr..... 4
(f) 6400 Test Wg..... 1

(3) AIR DIVISIONS
(a) 313AD(DOI)..... 1
(b) 314AD(DOP)..... 1
(c) 327AD
1. DO..... 1
2. DI..... 1
(d) 834AD(DO)..... 1

(4) WINGS
(a) 8TFW..... 2
(b) 12TFW..... 2
(c) 35TFW..... 2
(d) 37TFW..... 2
(e) 56SOW..... 2
(f) 347TFW..... 1
(g) 355TFW..... 2
(h) 366TFW..... 2
(i) 388TFW..... 2
(j) 405TFW..... 1
(k) 432TRW..... 2
(l) 460TRW..... 2

(m) 475TFW 1
(n) 633SOW 1
(o) 1st Test Sq(A) 1
(p) 483TAW 1
(q) 553RW 2

(5) OTHER UNITS
(a) Task Force ALPHA ... 5
(b) 504TASG 1

m. USAFE

(1) HEADQUARTERS
(a) ODC/OA 1
(b) ODC/OTA 1
(c) OOT 1
(d) XDC 1

(2) AIR FORCES
(a) 3AF(DO) 1
(b) 16AF(DO) 1
(c) 17AF(DO) 1

(3) WINGS
(a) 20TFW(DCOI) 1
(b) 36TFW(DCOID) 1
(c) 50TFW(DCO) 1
(d) 66TRW(DCOIN-T) 1
(e) 81TFW(DCOI) 1
(f) 401TFW(DCOI) 1
(g) 513TAW(OID) 1

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d. AU
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c.	CINCPAC	3
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	(2) CINCPACFLT (Code 321)	1
	(3) CINCPAC J-3	1
	(4) CINCPAC J3A1	1
	(5) CINCPAC J-2	1
	(6) USARPAC G-2	1
d.	COMUSKOREA	1
e.	COMUSMACTHAI	2
f.	COMUSMACV	5
	(1) MACEVAL	1
g.	COMUSTDC	1
h.	USCINCEUR	1
i.	USCINCSO	1
j.	CINCLANT	1
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s.	CINCSTRIKE	2
t.	CINCAL	1
u.	MAAG-China/AF Section (MGAF-0)	1
v.	Hq Allied Forces Northern Europe (U.S. Documents Office)	1
w.	DIA	5

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a.	Senior USAF Representative, National War College	1
b.	Senior USAF Representative, Armed Forces Staff College	1
c.	Senior USAF Rep, Industrial College of the Armed Forces	1
d.	Senior USAF Representative, Naval Amphibious School	1
e.	Senior USAF Rep, US Marine Corps Education Center	1
f.	Senior USAF Representative, US Naval War College	1
g.	Senior USAF Representative, US Army War College	1
h.	Senior USAF Rep, US Army C&G Staff College	1
i.	Senior USAF Representative, US Army Infantry School	1
j.	Senior USAF Representative, US Army Field Artillery School	1
k.	Senior USAF Rep, US Army JFK Center for Special Warfare	1

7. OTHER

JUSMAGTHAI 1
AMB-SAIGON 1
AMB-THAILAND 1
AMB-VIENTIANE 1

ICAF 1

III MAF 1
AFAITC 1
DCPG (WASH) 2
DCPG LNO-1 1

SNAFREP (SEC) 1
USCINCEUR (ECT) 1

COMSEVENTHFLT 1

CTF 77 2
CTG 77.0 1
CTG 77.3 1
CTG 77.4 1
CTG 77.5 1
CTG 77.6 1
CTG 77.7 1
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USS CONSTELLATION (CVA-64) 1
USS BON HOMME RICHARD (CVA-31) .. 1
USS ORINSKANY (CVA-34) 1
USS RANGER (CVA-61) 1
USS HANCOCK (CVA-19) 1
USS CORAL SEA (CVA-43) 1
USS TICONDEROGA (CVA-14) 1
USS KITTY HAWK (CVA-14) 1
USS ENTERPRISE (CVAN-65) 1

CGFMPAC 1
CG II MAF 2
CMDR USAFSS 1
USAIRA, Vientiane, Laos 2
376SW, Kadena AB, Okinawa 2
307SW, U-Tapao RTAFB, Thai 2
621TCS, Udorn RTAFB, Thai 1
4220ARS, Ching Chuan Kang AB, Taiwan 1
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620 Tac Con Sq, Son Tra AB, RVN .. 1
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