SECRET/NOFORN

OPNAV 00215P72

57 055948.00

04-28-94 001

COMBAT SAR STUDY

157108

OFFICE OF THE CHIEF OF NAVAL OPERATIONS

NOTICE: This material contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

SECRET/NOFORN

Appendix A
OPERATIONS AND TACTICS

INTRODUCTION

Combat search and rescue (SAR) missions in SEAsia, like the combat strike operations they support, depend more on the resoluteness, courage, and resourcefulness of the pilots and crews involved than on any other single factor. Improved communications, better personal survival equipment for aircrews, better rescue vehicles, and other material advancements will contribute to the capability of naval forces to effectively back up combat air operations, but in the final analysis it will be the determination of the airborne rescue airmen and the attitude of the downed personnel that will be the governing factors on the success or failure of each combat SAR mission.

That combat SAR operations are the most important missions undertaken in support of combat air operations in Southeast Asia is unquestioned. However, to quantify the cost effectiveness of rescuing combat air crews is not practical since the most important factor, the effect on the morale of pilots and crewmen of having a reliable aggressive SAR capability in the Seventh Fleet, cannot be quantified. The potential saving of valuable military resources (i.e., combat-experienced aircrews) and the deprivation of intelligence sources falling into the hands of the enemy are important reasons for maintaining a strong SAR posture, but beyond these there is the effect that

SAR operations have on the broader issue of our involvement in North Vietnam.

The cost, in lives and material, of U.S. strikes in North Vietnam is important to the American people. The military services must ensure that all practical means are undertaken to protect personnel, including the rescue of downed aircrews, to contribute to the acceptability of U.S. operations in North Vietnam. In all likelihood, as the air strikes in the Hanoi-Haiphong area are intensified, aircraft losses will continue to increase (perhaps dramatically). The effect of these losses can be mitigated in a measure by continuing to improve the Navy's SAR capabilities in the Gulf of Tonkin.

EVOLUTION OF THE SEA-BASED SAR MISSION

The Air Force Aerospace Rescue and Recovery Force was initially and completely responsible for SAR operations in SEAsia. The Navy contribution at the outset of the retaliatory air strikes against North Vietnam was a two-plane A-1 aircraft Rescue Combat Air Patrol (RESCAP) that provided escort for the Air Force HU-16 (then SA-16) amphibian aircraft on station in the Gulf of Tonkin (vicinity of 19°N, 107°E) from sunrise to sunset. (In addition, one destroyer on "roving" SAR station and one destroyer on TOMCAT station provided a communications link with the HU-16/RESCAP aircraft and the Yankee Team Commander.)

In 1965, the HU-16 generally made a water landing to recover aircrews down in the Gulf, with the A-1 aircraft providing cover as required. For land SAR missions, Air Force helicopters from Danang, Nakhom Phenom, or other Thailand bases would be escorted to the SAR scene by the RESCAP while the HU-16 remained over water near the coastline (the HU-16 retained the command function as SAR commander even when at or beyond communications range).

In September 1965, TF-77 established a surface SAR station in the vicinity of 19N, 106-30E that had a capability to support the UH-2 helicopter. The HU-16 with its A-1 RESCAP maintained station on the SAR DD that directed Navy SAR operations. During this period, plane-guard helicopters were occasionally vectored to the SAR scene from their CVA when they could respond more quickly than the strip-alert helicopters at Danang or in Thailand.

In late 1965, a Navy UH-2 helicopter was based on the SAR DD to improve the response time principally in water rescues in the Northern Gulf of Tonkin. In the Spring of 1966, two SAR DD stations (19N, 106-05E and 19-50N, 107E) were established, and in May 1966, armored SH-3 helicopters stripped of ASW equipment and armed with M-60 machine guns were placed on airborne station in the vicinity of the northern SAR DD's. (Previous to this, SH-3A helicopters without combat modification had operated with the DD's, commencing in November 1965 when the first destroyer with JP-5 and the HI-DRINK refueling capability assumed DD SAR duty.*) Rotating SH-3 SAR detachments,

*USS HENRY W. TUCKER (DD-875)

drawn from the HS squadron deployed aboard a CVS in SEAsia, became Yankee Team assets.

Throughout the evolution of this sea-based SAR capability, A-1 aircraft were the principal RESCAP aircraft (the INDEPENDENCE, the first CVA to operate in SEAsia without an A-1 squadron, used A-4 aircraft on RESCAP in 1965). In general, it required six to eight A-4 aircraft to cover the RESCAP cycle normally handled by two A-1's.

In December 1966, the Air Force replaced the HU-16's with C-130E aircraft. One notable improvement in this change was the improved capability of the C-130 to monitor the personal pilot emergency survival radio (PRC or URT) beeper signal at ranges out to 450 n.mi (the normal reception range for these radios is 5 to 25 n.mi, terrain and altitude conditions permitting, with 50-n.mi reception on occasion).

COMBAT SAR OPERATIONS - GENERAL

Combat SAR operations in the Gulf of Tonkin are characterized by:

1. Relatively slow reaction time - The initial response of the RESCAP to a report of a pilot/crew being down is immediate, but the decision to proceed to the SAR area and conduct a search is effected by:

a. The antiaircraft artillery (AAA) environment enroute to and in the SAR area.

b. The likelihood of being able to escort a rescue helicopter to the SAR scene and effect the rescue (this is a judgement factor, strongly influenced by the experience of the RESCAP leader and takes into account such factors as the amount of daylight remaining).

c. The report of the aircraft on the scene. Generally, the wingman notifies the RESCAP of the downed crew's location, condition, and their circumstances (i.e., amount of ground fire being directed at and strike aircraft orbiting the scene, the presence of ground forces, and the weather).

d. The availability of rescue forces (i.e., helicopters, RESCAP, etc.). More than one SAR incident at one time invariably delays the response to the second and subsequent incidents.

e. Reported presence of enemy aircraft and the availability of MIG Combat Air Patrol (MIGCAP) to cover the RESCAP.

2. Limited range - Navy combat SAR in North Vietnam is limited to the route packages bordering the Gulf of Tonkin. Reports of downed Air Force crews in the upper inland route packages in North Vietnam (V and VIA), though occasionally closer to the Navy rescue forces than to the Air Force rescue forces in Thailand or South Vietnam, are beyond the limits of Navy forces. The radius of action of SAR forces is largely governed by the unrefueled range of the SH-3, operating at virtually maximum power during most of the rescue attempt.

3. Limitations on flak suppression capabilities of rescue escort - SAR escorts are capable of suppressing small-

arms fire, automatic weapons fire (12.7mm and 14.5mm machine guns), and single 37mm guns. Multiple 37mm batteries, and such triple-A weapons as the 57, 85, and 100mm guns, are superior to the escort firepower. Moreover, the larger AAA are generally radar-directed and take the escort under fire well beyond the range of the escort's weapons (i.e., 20mm aircraft cannon, LAU-3A, and LAU-10 rocket pods). The helicopter is capable of suppressing only light small-arms and automatic weapons fire for short periods.

4. Communications interference - Initial SAR incident alerts are made on GUARD channel, which is also continuously in use as the primary MIG and surface-to-air missile (SAM) alert frequency. SAR operations are generally conducted on SAR primary or secondary provided that all of the forces involved in the rescue effort are successfully switched to the SAR common. Frequently, substantial delays in determining the location of the downed crew, rendezvousing with on-scene forces, and coordinating the RESCAP and SAR helicopter operations occur because of channel interference or the use of more than one channel by forces requiring close coordination. Additionally, multiple SAR incidents such as those that occurred on 13 August 1965 and 8 August 1966 not only delay the response of SAR forces but seriously interfere with other strike operations.

5. Limitations due to lack of night/low-visibility capabilities - Normally, SAR incidents over land require sufficient ceilings to overfly enemy automatic weapons and effective

37mm fire ([illegible] to [illegible] feet AGL, with less than 0.2 scattered low cloud coverage enroute and good ground visibility at the SAR scene), sufficient in-flight visibility for rescue forces to pick each other up visually and maneuver in the SAR area relatively safely, and general weather conditions that permit terrain navigation. The principal constraint on night SAR operations is the inherent difficulties involved in visually navigating over land and at the same time maneuvering numerous aircraft in a coordinated operation without navigation lights.

CRITERIA FOR SAR EFFORTS

In general, the RESCAP must have the pilot/crew in sight or have communications with the downed crew and be able to maintain some contact before the helicopter is committed to the effort. The vulnerability of the helicopter to ground fire/SAM is also weighed by the senior on-scene RESCAP pilot in his decision to recommend bringing the helicopter into the SAR area. The normal procedure is to leave the wingman orbiting the SAR area while only one escort RESCAP aircraft returns to pick up the helicopter and escort it in.

LOCATION OF THE DOWNED CREW. Specific rules for deciding whether or not to attempt a rescue are extremely difficult to establish. The environment varies according to the route package, and every SAR incident is unique in several respects. However, some generalizations on the constraints imposed by the triple-A environment, and on the geographical position, can be made.

Case examples are used to illustrate several of the most important circumstances, as well as a number of seemingly paradoxical situations (see Addendum in this appendix).

Over Water. The SAR incident involving a crew downed at sea is essentially governed by the distance from enemy territory. Nevertheless, a review of SAR incidents in SEAsia in 1965 and 1966 indicates that there were no instances where a crew was down at sea and no SAR effort made. This becomes even more significant when one considers that approximately 55 percent of all SAR incidents involve pilots and crews down at sea.

The environment is characterized by fishing boats and junks as the main threat to the downed crew in the vicinity of river estuaries and at sea beyond 3 to 5 n.mi. Within the islands along the northern seacoast from Haiphong to Hon Gai, shore batteries, dual-purpose gun positions, and SAM installations pose the major threats to rescue attempts. Along the remainder of the North Vietnam coast, hostile fire directed at water rescue efforts generally comes from populated areas, coastal fortifications, and mobile units. In most cases, the enemy fire can be suppressed by the RESCAP aircraft; however, the RESCAP must retain the capability to discourage enemy surface vessels from approaching the downed crew, so suppression of enemy shore fire is generally held until the actual pickup attempt is to be made. Here, speed of the rescue vehicles becomes a factor for two reasons:

1. The higher the speed, the less the probability of being hit by shore-battery fire.

2. The rescue can be accomplished more quickly, reducing the exposure time of both the downed crew and rescue vehicle. Perhaps equally important is the fact that there is generally a finite time available to accomplish the rescue. The longer the time, the less chance the rescue escort has of suppressing enemy fire successfully (ordnance limitations), and the more opportunity the enemy has to organize the resistance to the effort as well as to effect a capture of the downed crew.

Over Land. The number of areas that the enemy is able to deny to U.S. rescue efforts continues to increase.* The Red River Valley, densely populated areas, the environs of towns and villages, and areas adjacent to well-defended targets are generally "No-Go" areas for SAR efforts (See Addendum, Case A). The SAM envelopes covering much of route packages III, IV, and VIB are being extended into the entire littoral region east of the mountains along the Laotian border and from the DMZ northward to the extreme eastern portion of North Vietnam. In addition, the MIG threat has increased threefold in 6 months, and future

*Navy strike operations (concentrated in the Red River Region) during the first 21 days of May 1967 illustrate the increasing seriousness of the problem: 12 Navy aircraft with 18 crewmen have been downed in that period without a single rescue.

SAR efforts in packages IV and VIB probably will require MIGCAP forces. (A rescue effort on 9 October 1966 was terminated as a result of continuous presence of MIGs, after having been initially frustrated by a MIG attack on the RESCAP.)

SAR FORCES BASING

Current Yankee Team Operation Order directs that when the CVS deployed to SEAsia is not operating in the Gulf of Tonkin, the SH-3 rescue helicopter detachment will be assigned to the larger CVA on Yankee Station. In practice, the small CVA's (BON HOMME RICHARD, ORISKANY, INTREPID, HANCOCK, and TICONDEROGA) have been used as the base for this Yankee Station asset because of the critical loading on the large CVA's. Ready-room facilities, berthing and maintenance spaces, and general support capabilities on the large CVA's are marginal for currently deployed air wings.

Replacement of A-1 squadrons with A-6 squadrons and augmentation of air wings with A-7 squadrons (due in November 1967) will compound this already-critical CVA loading condition. Accommodations for Yankee Team assets will be more difficult to provide, particularly if A-6 squadrons are increased to 15 aircraft per squadron on those carriers deployed during the poor weather months of the year.

There are numerous alternatives for alleviating this situation. With respect to rescue helicopter detachments, the smaller CVA's can be used as SH-3 detachment bases with no degradation in operational capabilities (a possible exception is that since the planning and direction of major multicarrier strikes is normally accomplished on the large CVA, the rescue helicopter crews would be operating without knowledge of many of the details of the overall strike plan due to being based on and operating from other than the large CVA).

Beyond relying on smaller CVA's for SAR-helicopter detachment support, several possibilities offer distinct advantages over current procedures:

1. The most suitable SAR helicopter base in the Gulf of Tonkin is the CVS, since it is best equipped to support SH-3 helicopter flight operations. In addition, a CVS permanently assigned to TF-77 could be used as the base for RESCAP forces if only A-1 or A-4 aircraft are assigned such missions. At least a portion of the normally embarked S-2 ASW aircraft would have to be based ashore (e.g., at NAS, Cubi Point or NAS, Atsugi Japan) within range to return to the CVS for ASW operations, if required. The logistics support capability of the CVS for SH-3 helicopters is obviously without parallel among carriers.

The use of a CVS as a SAR force base offers two advantages: (1) the ability to concentrate, coordinate, and support <u>all</u> Navy SAR operations from a single ship, and (2) the flexibility to take a station that would provide optimum coverage of Navy SAR responsibilities without conflict with other commitments (i.e., strike reconnaissance, etc.), as must be the case on occasion for CVA's.

It should be noted that three CVS support carriers would be required to provide one full-time SAR rescue force base. It is understood that current ASW commitments preclude assigning three CVS's to a special-mission role. But the fact remains that the CVS is a workable alternative.

Several other ships are capable of supporting helicopter operations (e.g., DLG, CLG, CG, etc.), but only the LPH, CVS, and LPD could serve as a base for SAR detachments. Moreover, only the CVS has the capability to support fixed-wing aircraft as well as helicopter operations. Therefore, it is concluded that Yankee Team SAR helicopter detachments will continue to require CVA space unless:

1. A CVS, LPH, or LPD is assigned specifically as SAR detachment base.

2. SAR forces are based ashore at Danang, Dong Ha, or some other site in Corps Area I.

In any event, the long times spent by SAR helicopters (SH-3's) going to and from their SAR alert stations (up to 3 hours of their "normal" 7- to 8-hour cycle times) will not be alleviated until the base is moved closer to the SAR alert station (or faster helicopters are provided).

In this regard, the possibility of employing DLG's as round-the-clock SAR vehicle bases depends on the vehicle size. Currently, SH-3's land on DLG's only under the most urgent circumstances. It is recognized that the UH-2 Sea Sprite is based aboard DLG's, but it is not normally sent on SAR missions when an SH-3 can be vectored because the Sea Sprite lacks twin-engine reliability, armament, and sufficient armor and fuel for most over-land missions.

The optimum posture for SAR helicopters is to have them based sufficiently close to their airborne alert station so that they:

1. Are not required to fly long distances (70 to 100 n.mi) to and from the SAR station:

2. Can respond 24 hours a day to SAR incidents in the water approaches of route packages III, IV, and VIB (weather permitting) without having the long flight from the CVA to their station; and

3. Can effectively provide backup forces more rapidly (e.g., when the helicopter on station has an emergency).

One additional possibility must be weighed in the next 1 to 3 years: The recommissioning of a battleship for duty as an inshore bombardment ship offers the possibility of basing the SAR helicopter forces on the battleship. The battleship, if it patrols the North Vietnam coastline, may be 30 to 70 miles closer to the coast than current SAR helicopter bases and should be capable of maintaining a minimum of two helicopters aboard without interfering with its assigned gunnery missions.

SAR NETWORK - COMMAND AND CONTROL

BACKGROUND. The Interagency National SAR plan contained in NWP37A designates the overseas unified command in the overseas unified command areas as the Regional SAR Coordinators. The Regional SAR Coordinators will organize existing agencies and their facilities through suitable agreements in a basic network for rendering assistance to military and nonmilitary persons and property in distress. For the Pacific Overseas Region, the Regional SAR coordinator is CINCPAC. In addition, the Joint Chiefs of Staff have assigned CINCPAC primary authority and responsibility for military SAR in the Pacific.

• In the Pacific Overseas Region, CINCPAC in his CINCPACINST 3130.OC has delegated to CINCPACAF the responsibility as SAR commander for military SAR and the coordination for civil SAR. These responsibilities for the SEAsia subregion have been delegated by CINCPACAF to the Commander, 7th Air Force. The SEAsia subregion consists of the Saigon, Bangkok, and Rangoon Flight Information Regions.

COMSEVENTHFLT (OPORD 201-yr) has established the following coordination responsibility:

1. SAR Military Regional Commanders will establish standard operating procedures for the conduct of joint SAR operations.

2. COMNAVFORV is to provide Navy representation to the Tan Son Nhut Joint Search and Rescue Center (JSARC) when it is formally established.

3. SAR events incidental to operation of the 7th Fleet are at all times the responsibility of COMSEVENTHFLT.

4. The OTC is responsible for search and rescue incidental to the operations of forces under his command. For ship-based aircraft operating from bases afloat, the primary responsibility for SAR rests with the OTC of the force, regardless of the area of operations.

5. All 7th Fleet Commanders will maintain close coordination with SAR area commanders.

6. Requests for precautionary SAR will be directed to the JSARC.

7. Commanders requiring action in SAR operations as a result of distress are authorized to submit requests directly to the JSARC.

Commander Task Force 77 in CTF 77 Operations Order 201-yr directs the following:

1. All CTF 77 OTC's shall maintain close liaison with the SAR military commanders. These are listed in the Operations Order.

2. Ensure that all pilots are briefed on current SAR information, including SAR responsibilities of on-scene commanders.

Commander, Task Force 77, in his YANKEE STATION Operations Order No. 320-66, cites the following SAR facilities:

1. Two HH-43's and two UH-34's at Quang Tri.

2. One HU-16 airborne at 10,000 feet in vicinity 19-00N, 106-10E.

3. Four SAR destroyers, three capable of helicopter support (TU 77.0.1) composed of two elements of two ships each. The northern element at 20°N, 107°E, the other at 19°N, 106°05E.

4. One UH-2 SAR helicopter on one of the destroyers.

5. Two RESCAP furnished by YT Commander in vicinity 19°N, 106°10E, or in Condition I aboard ship.

6. Other HH-43E and HH-43F A/C in immediate alert at various locations, depending on operations.

In his OPORD 320-66, CTF 77 establishes the following procedures:

1. SAR will be conducted with efforts in all cases where the probability exists that the crew survival and general locations are known. When crew survival and/or location are unknown, SAR will be conducted, provided that there is no serious threat to survival of the search A/C.

2. The Air Rescue Center will provide the on-scene commander with authenticator information.

3. Units in distress and others involved will use SAR Primary (364.2 mc); SAR Secondary is available.

4. In general, the pilot of aircraft accompanying the aircraft in distress will be the initial On-Scene Commander (OSC). Upon arrival of the USAF HU-16 Command aircraft, the OSC's responsibility is shifted to the HU-16. During over-land recoveries, the Air America C-123 or the USAF HC-130 becomes OSC upon arrival in the area. Other aircraft will render assistance as required and to the maximum extent possible.

5. Requests for CTF 77 RESCAP assistance by other services will be made through the Navy Liaison Officer at Tan Son Nhut (CTE 70.2.1.1).

6. If a SAR incident involving Navy aircraft develops, the Yankee Team Commander will ensure that all available forces are alerted. Assistance from USAF will be requested via CTE 70.2.1.1.

7. The SAR DD closest to an incident will proceed at maximum speed to scene.

8. The Air Force has primary SAR responsibility. SAR helicopter missions will be executed as requested by the OSC within the capabilities as determined by CTU 77.0.1 (SAR DD Force Commander).

9. The following operational limitations are made.

a. Helicopters will not be used as search vehicles. A downed aircrewman must be located visually or electronically by fixed-wing A/C prior to over-land exposure of a helicopter. In addition, the OSC must determine that a reasonable chance of rescue exists. Until these conditions are met, the helicopter must remain over water or in a safe area.

b. SAR helicopters must be escorted by fixed-wing A/C on all over-land missions.

c. The UH-2 mission radius must not exceed 125 n.mi.

<u>ACTUAL SAR NETWORK OPERATIONS</u>. Central control of SAR in SEAsia is located in the SAR Center, Saigon (Tan Son Nhut). A second SAR coordination center at Udon Thani (Udorn), Thailand, controls the rescue forces in northern Thailand and coordinates with Air America, the contract civil air transport organization operating in that part of the country. The Air Force Aerospace Rescue Service (Military Airlift Command) provides airborne command posts (C-130 or HU-16) over the Gulf of Tonkin (Northern SAR station) and over land (covering the Air Force route packages in North Vietnam).

The Navy SAR commander is normally the senior officer present in the Northern SAR destroyer (generally a Destroyer Division (DesDiv) Commander embarked in the DLG). The Flight Leader of the RESCAP generally is the OSC at the SAR scene and directs the search for downed crews. The RESCAP flight leader and rescue helicopters are under the direct command of the SAR commander. When a SAR effort is terminated, the RESCAP is directed to terminate the search by the SAR Commander. However, the SAR Commander normally acts on the recommendations of the OSC.

The SAR communications link is SAR Primary or Secondary. However, since most SAR incidents are initiated over UHF guard channel, and since any radio communications with the downed crew must use guard frequency, most on-scene SAR efforts are actually controlled over 243.0 mc.

● <u>CURRENT RESOURCES</u>. HS squadron helicopter detachment, which is a Yankee Team asset, provides an airborne rescue helicopter (normally an armor-plated SH-3A armed with two .30 cal machine guns). The SH-3 maintains airborne alert from sunrise to sundown at the Northern SAR DD Station (vicinity of 19-50N, 107E). Normal cycle times for the SH-3A are 8 to 9 hours.

In addition, the Southern SAR Station destroyer (106-05E, 19-10N) has a "strip" alert UH-2 Sea Sprite helicopter for over-water rescues. The UH-2 is range-limited, lightly armored and armed, and is therefore not <u>normally</u> committed to over-land rescue attempts. Once again, the governing factors are the triple-A environment, the distance inland to the SAR scene (basically, a range factor), and the availability of other SAR forces that govern the use of UH-2.

<u>RESCUE COMBAT AIR PATROL</u>. The initial RESCAP is normally provided by aircraft in the strike/reconnaissance flight. When the pilot/crew are reported down, the initial communications are generally with the wingman. Therefore, the initial RESCAP aircraft will normally be F-4, F-8, A-4, or A-6 aircraft. In virtually all cases, the initial RESCAP aircraft cannot remain over the SAR scene until relieved by the regular RESCAP flight (A-1's currently). The enroute time to most SAR scenes for the A-1 is generally 20 to 40 minutes. Therefore, most SAR incidents involve a localization problem.

The regular RESCAP aircraft is the A-1. Yankee Team CVA's without A-1 assets either rely on other carriers from the RESCAP commitment or employ A-4 aircraft (six to eight A-4 aircraft are required to cover the same RESCAP on-station time (3 to 5 hours) covered by two A-1 aircraft).

Recce/Strike operations in route packages III and IV have not required fighter escort for the RESCAP (MIGCAP). However, SAR operations in upper package IV and VIB have required fighter escort on occasion. (Rescue attempts have been aborted/terminated in route package VIB due to airborne MIGs and no MIGCAP available.)

To date, there have been no instances where IRON HAND (SAM suppression) missions have been flown specifically in support of SAR operations.

TIME FACTORS IN SAR OPERATIONS

AIRBORNE ALERT VS. CONDITION I/II. For the A-1 aircraft, on-station alert minimizes the initial response time. Backup RESCAP forces in "condition" alert aboard a YT carrier are a minimum of 1 hour away from any SAR scene in the coastal regions of North Vietnam.

In general, a rescue attempt in North Vietnam is a contact, loss of contact, search, and location problem, and since helicopter forces are not committed until there is a reasonable assurance that a pilot/crew can be rescued, the time factor becomes critical under several circumstances:

1. For the pilot down in the water, the threat of enemy pickup is governed by the number and proximity of North Vietnamese fishing boats and junks and the fact that RESCAP aircraft have limited ordnance (generally a maximum of about eight firing runs per aircraft). The problem is compounded substantially when the downed pilot cannot be located immediately. Replacement of A-1's with jet attack aircraft as RESCAP will reduce the initial response time but will generally require air refueling in most cases.

2. In the over-land SAR incident, the jet attack aircraft will vastly improve the response of the RESCAP from the standpoint of time, but fuel limitations may become critical in those instances in which contact cannot be established with the downed crew and prolonged search is necessary. In such cases, the jet RESCAP will have to:

a. Depart the SAR scene in order to refuel, since the tankers normally do not operate over enemy terrain, or

b. Be relieved by additional RESCAP forces if search continuity is a factor (it generally is).

<u>ON-STATION DURATION OF JET AIRCRAFT ON RESCAP</u>. Airborne tankers will be required to back up rescue efforts when jet aircraft are used as RESCAP. As indicated in table A-1, the A-7A appears to be the only VA(J) aircraft capable of remaining on a SAR incident without in-flight refueling (IFR).

<u>Water SAR Incident</u>. Jet aircraft conducting a search for or covering a crewman down in the water within 5 to 10 n.mi of the coast will be constrained to operate below 5,000 feet in order to conduct a visual search (or keep the downed crewman in sight) and still be in position to evade SAMs. Operating at such low altitudes will reduce the jet's unrefueled on-station duration markedly. When it is considered that the transit time of the airborne SAR helicopter from alert station to an over-water SAR scene can be as much as 1 hour, it is apparent that airborne tanker support for jet RESCAP will be necessary.

<u>Over-land SAR Incident</u>. As previously noted, unless the restriction on operating airborne tankers over enemy terrain is lifted, jet RESCAP requiring fuel will have to depart the over-land SAR scene in order to tank. The alternative of relieving low-state jet RESCAP on-station will increase the number of aircraft that have to be committed to the RESCAP mission.

THE EFFECT OF WEATHER AND TERRAIN ON SAR OPERATIONS

When over land, cloud coverage and ceiling are important factors in determining whether or not a SAR mission can be successfully accomplished. Low scattered or broken cloud layers (stratus clouds or fog) at 3,000 feet or below seriously interfere with terrain navigation and force the rescue helicopter and RESCAP aircraft down into the most lethal small-arms and automatic weapons range. In hilly or mountainous terrain, low clouds, particularly as they tend to become a complete overcast, will preclude search missions unless it is possible to descend with visual reference to the ground.

Over water, cloud layers are not generally important, except to the degree that they inhibit the conduct of visual search at the optimum altitude (500 to 1,500 feet). Over-water SAR missions, even in close proximity to the enemy coast, are relatively independent of cloud coverage conditions, provided that:

1. A finite ceiling of at least 50-100 feet exists, and the weather is not deteriorating to zero-zero conditions;

2. Visibility is not obscured in all quadrants; and

3. Prominent landmarks can be identified when operating within 5 n.mi of the coast.

Visibility conditions are also determining factors in many instances. Low visibility (in heavy haze and smoke or in rain showers) interferes with terrain navigation both enroute and from the SAR scene and during the search phase.

In addition, visibility conditions play a part in the tactics of the RESCAP aircraft.

Low-visibility conditions can preclude splitting the RESCAP formation and conducting relatively independent searches. Visual contact with the SAR helicopter is vital, since in most instances the helicopter is relying on the RESCAP for navigation instruction. To illustrate:

> In October 1966, a SAR helicopter (SH-3) being escorted by A-1 aircraft sustained flak damage, requiring the shutdown of one engine. The pilot commenced a climbout and penetrated the 2,300-foot overcast, thereby losing visual contact with both the ground and his escort. Due to his unfamiliarity with the area, he took his helicopter across a high AAA area enroute to the coast and sustained two 37mm weapon hits, resulting in the loss of the helicopter. Had visual contact with the terrain and escort been possible, the RESCAP aircraft could have vectored the helicopter around the dangerous area. Had the SAR effort not been in progress when the weather deteriorated, it is doubtful that an attempt would have been initiated, since it would not have been possible for the RESCAP to lead the helicopter to the SAR scene once the ceiling and visibility decreased.

Broken-to-overcast middle cloud layers (3,000 to 6,000 feet) pose another problem for RESCAP aircraft. While it is frequently possible to fly between or over middle cloud layers enroute to and from the SAR scene, the RESCAP leader is confronted with three debilitating circumstances:

1. The difficulty in navigating over unfamiliar terrain accurately enough to avoid heavy AAA defenses.

2. The inability to determine where enemy fire is coming from in order to most effectively evade it.

3. The uncertainties involved in taking evasive action (diving through undercasts) to avoid a SAM threat without knowledge of the terrain or whether or not a ceiling exists that is sufficient to permit visual recovery from the dive.

NIGHT SAR OPERATIONS

The limitations imposed by poor weather are comparable to those attending night SAR operations. The difficulty in accurately navigating by visual contact with the terrain to a specific location (generally remote, mountainous, and heavily forested) in a "darkened" environment is impossible in the dark-of-the-moon periods. Clouds and low visibility due to rain or haze further compound the problem.

Only a few aircraft have the self-contained navigation equipment to permit flying by DR navigation to an unmarked spot as much as 150 miles from the carrier. Moreover, since the best tactic is to continuously "jink" (alter course) while over enemy terrain, it is virtually impossible to fly a preplanned time-on-leg course to a night SAR scene.

The final difficulty is maintaining visual contact with the rescue vehicle in a "lights-out" condition. Safe separation can be maintained by using differential altitudes, or by having the assistance of either airborne or ship radar vectors from on-station E-1B/E-2A aircraft or the SAR station destroyers. However, the RESCAP cannot even provide navigation and AAA evasion directions to the SAR helicopter if he does not have it in sight.

The night SAR mission does offer several advantages, the principal ones being:

1. The rescue forces know when they are under fire from the ground (including small-arms and automatic weapons fire).

2. The downed crewman's flares, signal light, and survival gun tracer rounds can be spotted infinitely better at night.

3. The rescue forces are relatively secure from enemy AAA fire (non radar-directed) enroute to the SAR scene.

In summary, however, it must be reiterated that until RESCAP and rescue vehicles have better electronic equipment for navigation and terrain clearance, night SAR operations will remain a weak capability. They will be possible only on random occasions when atmospheric conditions (principally, strong moonlight and relatively clear weather) and location of the downed crew are such that an attempt is justified.

SAR VEHICLE ESCORT (RESCAP) PROBLEM

Current Navy SAR operations depend upon the A-1 aircraft, which will be phased out by January 1968. As indicated in table A-1, the A-1 possesses the following:

1. Excellent ordnance-carrying capability.

2. Long on-station time (up to 7 or 8 hours).

3. Good maneuverability and excellent speed compatibility with the currently employed rescue helicopters.

4. Good visual search capability.

At the same time, the A-1 has several limitations:

1. No ECM warning equipment, making the pilot wholly dependent upon external sources for SAM and MIG alert warnings.

2. No active ECM gear to reduce the effectiveness of radar-directed guns.

3. Only one radio (AN/ARC-27 UHF).

4. Relatively poor response times (low dash speed capability, 170 to 180 kt max.) when loaded with ordnance. At these limited speeds, the A-1 is exposed to AAA longer. It is too slow to operate in heavily defended areas (those having multiple 37, 57, and 85mm gun positions). Moreover, when loaded with LAU-3 and/or LAU-10 rocket packs and external fuel, the A-1 has such poor rate-of-climb characteristics (on the order of 500 feet/minute or less) that 4 to 5 minutes are required to return to its normal operating

altitudes (5,000-6000 feet AGL) following a missile evasion maneuver. Prolonged exposure to automatic weapons fire (3,000 feet and below) can and does occur, occasionally requiring jettisoning ordnance in order to improve the aircraft's climb and evasive maneuver performance.

The scheduled phaseout of the A-1 will require jet fighter and/or attack aircraft for the RESCAP mission. An analysis of the aircraft available in the next 2 to 3 years relative to their suitability as RESCAP is indicated qualitatively in table A-1. The aircraft listed in table A-1 were evaluated according to a consensus derived from questionnaires submitted by the naval aviators listed in table A-2.* The comparison is based strictly on SEAsia experience. The rating notation is as follows:

1 - Excellent

2 - Good

3 - Fair

4 - Poor

5 - Unsatisfactory

For analysis purposes, a "standardized" SAR mission that exceeds the average SAR incident parameters in SEAsia was used as follows:

---

*Consideration should be given to the fact that answers on the questionaires reflect, to some degree, personal preferences and judgments concerning the relative merits of the various aircraft.

TABLE A-1. GENERAL COMPARISON OF AIRCRAFT FOR RESCAP MISSION

AIRCRAFT	A-1H	A-4B/C	A-4E	A-6A	A-7A	F-4B	F-8E	OV-10A
1. Status	Phase out Feb'68	Op.	Op.	Op.	Due Late '67	Op.	Op.	Due mid-'68
2. Ordnance Capability for RESCAP Mission	1	3-4	3	3	1	4	3	3
3. Airborne Refueling Required on Proposed SAR Mission	No	Yes	Prob	No	No	Yes	Yes	N.A.
4. Relative Vulnerability to Ground Fire (Small Arms & Auto. Wpns) (armorplate, speed, etc.)	Avg	Avg to Low	Avg (Smoke)	Avg (Smoke)	Low	Avg (Smoke)	Very High	Low
5. Relative Merit as Visual Search Vehicle on SAR Mission (factors such as speed, no. of crews, etc.)	1	3	3	2	3	4	4	1
6. MIG Defensive Capability (air-to-air missiles)	4-5	3	3	2	2	1	1-2	2-3
7. Response Time to SAR Incident (speed capability)	4	2	2	1-2	1-2	1	1	4
8. Ability to Transit Defended Areas (AAA enroute to SAR scene)	4-5	2-3	1-2	2	2	1-2	2-3	3-4
9. Speed Compatibility with 80-100-kt Helicopter	1	4	3-4	4-5	3	4-5	4	1

[redacted]

SECRET

TABLE A-1. GENERAL COMPARISON OF AIRCRAFT FOR RESCAP MISSION (Continued)

AIRCRAFT	A-1H	A-4B/C	A-4E	A-6A	A-7A	F-4B	F-8E	OV-10A
10. Operability in SAM Envelope (ECM capability)	5	2-3	2	1	1-2	2	1	5
11. Unrefueled Duration on RESCAP Station	1	3-4	3	1-2	1-2	4-5	3-4	4-5
12. Aircraft Guns	1	3-4	3-4	5	2	5	1	3
13. Relative Preference (order)	X	3	2	5	1	6	4	X

SECRET

SECRET

TABLE A-2. LIST OF PERSONNEL INTERVIEWED

CAPT R. KIRK, USN	(OPNAV)	Formerly COMDESDIV 32
CDR L. N. HOOVER, USN	(NAVAIR SYSCOM)	Formerly C.O., VF-161
CDR W. L. MCDONALD, USN	(BUPERS)	Formerly C.O., VA-56 and CVW-15
CDR R. MOHRHARDT, USN	(OPNAV)	Formerly C.O., VF-53
CDR R. E. SPRUIT, USN	(OPNAV)	Formerly C.O., VA-66 and CVW-16
CDR F. F. PALMER, USN	(OPNAV)	Formerly C.O., VF-143 and CVW-14
CDR M. PINKEPANK, USN	(OPNAV)	Formerly C.O., VA-115 and VA-122
CDR A. A. SHAUFFELBERGER, USN	(NAVAIR SYSCOM)	Formerly C.O., VA-146
CDR K. T. WEAVER, USN	(BUPERS)	Formerly C.O., VA-192
CDR J. B. MORIN, USN	(BUPERS)	Formerly C.O., VA-155
CDR R. G. THOMSON, USN	(NAVAIR SYSCOM)	Formerly C.O., VA-83
LCDR R. SHEA, USN	(BUPERS)	SEAsia tours in VA-152 and VA-95
CDR B. KEENER, USN	(OPNAV)	Formerly C.O., USS STRAUSS (DDG-16)

SAR PROFILE FOR RESCAP AIRCRAFT

1. Base (CVA) to RESCAP Station.	70 n.mi
2. RESCAP Station to SAR scene (assuming no on-station time prior to initial alert of SAR incident).	75 n.mi at maximum speed at 5,000 ft AGL
3. Localization time (search for downed crews).	15 min at or below 5,000 feet AGL
4. Helicopter Escort:	
a. Return to coast to rendezvous with helicopter.	50 n.mi
b. Escort time to get helicopter to SAR scene.	30 min
5. Rescue time	15 min
6. Escort helicopter from area to vicinity of SAR DD.	40 min
7. Return to CVA.	75 n.mi

TOTAL MISSION: 270 n.mi plus 70 minutes helicopter escort time plus 30 minutes orbiting SAR scene.

A review of aircraft capabilities indicates the following order of preference:

1. A-7A

   Advantages: Excellent ordnance-carrying capability; does not require air refueling on "normal" SAR mission; adequate ECM warning and jamming avionics. Relatively small target to AAA; has aircraft cannon installed; excellent speed capability.

Disadvantages: Not due in quantity until mid-1968, or later; only one crew for visual search; assignment to strike and reconnaissance missions will probably preclude use on RESCAP mission; not the best MIG defense capability.

2. A-4F

Advantages: Good ordnance-carrying capability for RESCAP mission; excellent speed capability; does not require air refueling (with two drop tanks) for normal SAR mission; excellent maneuverability.

Disadvantages: Requires Mk 4 gun pod for substantial aircraft gun capability (only one or two integral aircraft cannons with 40-70 rds/gun now being used due to SHOEHORN installation). Poor MIG defense capability; only one crew for visual search.

3. A-4B or A-4C

Comments: A-4C is superior to A-4B, but neither is as good as A-4E. These versions of A-4 series still have good survivability in the AAA environment, but neither are as well equipped to operate in the SAM envelope as A-4E. Both require air refueling on normal SAR mission and both have ordnance (payload) limitations. Some A-4B's have SIDEWINDER capability, but it can be used only at the expense of carrying other ordnance.

4. F-8E

Advantages: Excellent capability to operate in the environment; excellent speed capability for response; excellent aircraft for strafing (four 20mm guns with 800 rds of ammunition).

Disadvantages: Not good aircraft for visual search (pilot is too busy flying the aircraft to accomplish much in the way of searching). Limited capability for rockets; vulnerable to small-arms fire.

5. A-6A

Advantages: Excellent ordnance-carrying capability and ECM defensive avionics; does not require air refueling on normal SAR mission; excellent speed navigation capability; two crew for visual search, Disadvantages: Does not have integral aircraft guns; no aircraft gun capability (not configured for Mk4 gun pod). MIG defense capability principally dependent upon speed and evasion. Due to normal strike commitment, not likely to be available.

6. F-4

Advantages: Excellent ordnance capability for SAR mission; two crew for visual search. Excellent MIG defense capability; excellent response speed capability and adequate ECM warning equipment for operating in SAM envelope.

Disadvantages: Requires gun pod for aircraft cannon capability; very short on-station time; requires two air refuelings on normal SAR mission; minimum cruise speed not very compatible with helicopter speeds.

7. OV-10A

Comments: The OV-10A is not carrier-configured, but it can operate from a CVA because of its STOL capability. Aircraft has three unique ordnance capabilities (none proven in combat, however): 106mm recoilless rifle (15 rds), 57mm recoilless gun (30 rds), and USAF SUU-11 7.62 minigun pod (5,000 rds of ammunition and two cyclic rates - 2,000 and 6,000 rds/min). OV-10A is an excellent visual search vehicle (two crew) and more maneuverable than any of the preceding aircraft; it has longer on-station time than any jet aircraft. It is speed-limited (170 kt cruise and 220 kt max.), ordnance-limited (about 1,200 lb with one 150 gal. external store). This aircraft could be employed to cover the normal RESCAP if it were based at Danang; however, its on-station time would be about 2 hours maximum. Aircraft has armorplate and twin-engine reliability. Principal advantage of OV-10A would be to alleviate the demand on A-4 aircraft for RESCAP mission (A-4C is the most likely candidate to replace the A-1 on RESCAP). OV-10A is designed to escort helicopters and has more communications capability than any of the previously discussed aircraft.

The preceding order of aircraft does not specifically address the question of speed compatibility with current or future rescue vehicles. Current rescue vehicles normally operate at 70-130 knots ground speed, requiring that the A-1 fly race-track patterns or figure-eights to stay with the helicopter at all times.

Table A-3 indicates the average escort speed. Clearly, the jet escorts will be continuously turning or "yoyo-ing" to keep the helicopter in sight, and even then the escorts will be covering a lot more terrain in their maneuvering. Moreover, the jets will be more exposed to ground fire at the SAR scene because they will be covering more territory while orbiting the area.

RESCAP ORDNANCE

The 20mm aircraft gun is currently the preferred weapon for suppressing small-arms fire or for holding fishing boats and junks at bay. The LAU-10 or ZUNI rocket pod is superior to the LAU-3 or LAU-32 2.75-inch rocket pod for backup to the aircraft guns. With the introduction of the ZAP rocket pod (similar to the ZUNI but with a much better antipersonnel warhead) in late 1968, the ZAP will be the optimum rocket ordnance for the RESCAP mission.

Alternatives to the ZUNI and 2.75-inch rockets are the 106mm and 57mm cannons, which could be available for the OV-10A in the same time frame (2-3 years). These weapons

TABLE A-3. AIRCRAFT CAPABILITIES FOR RESCAP/ESCORT MISSION

AIRCRAFT	F-4			F-8	A-4B/C		A-4E		A-6A		A-7A		OV-10A	
1. No. of External Tanks	0	1	2	0	1	2	1	2	0	2	0	2	0	1
2. Duration on RESCAP Station (hr)	0.5	1.0	NOT USED	1.5	1.0	1.5	1.5	2.0	4.0	4.5	1.5	3.0	1.0	2.5
3. No. of In-Flight Refuelings for RESCAP Mission	2	1		1	2	1	1	0	2	0	1	0	N.A.	
4. No. of Aircraft Guns	0			4	2		2		0		2		4(7.62)	
a. Rounds per Gun	0			200	40-50		40-50		0		250		500	
5. Air-to-Air Missile Capability	Yes			Yes	No		No		Yes		Yes		Yes	
6. RESCAP Ordnance Capability														
a. Mk 4 Gun Pod (no.)	1	2	1	0	2	1	2	1	0	0	-	-	-	-
b. LAU-10 Rkt Pods	-	12	6	2	4	3	6	4	4	2	6	4	2 SUU-11 7.62 Gun Pods	
c. LAU-3 Rkt Pods	-	10	4	-	4	3	6	4	10	6	12	8		
d. LAU-32 Rkt Pods	-	10	4	-	4	3	6	4	10	6	12	8		
e. ZAP Rkt Pods	-	10	-	2	4	3	6	4	10	6	12	8		

TABLE A-3. AIRCRAFT CAPABILITIES FOR RESCAP/ESCORT MISSION (Continued)

AIRCRAFT	F-4	F-8	A-4B/C	A-4E	A-6A	A-7A	AV-10A
7. ECM Capability							
a. APR-27	Yes	Yes	Yes	Yes	Yes	Yes	Yes
b. ALE-29	-	-	-	Yes	Yes	-	-
c. APR-25	Yes	-	-	-	-	-	-
d. ALQ-51	-	Yes	A4B - No A4C - Yes	Yes	-	-	-
e. Other	-	-	-	-	-	Yes	-
8. Requires MIGCAP on RESCAP	No	No	Yes	Yes	Yes	No	Yes
9. Speed When Escorting Helicopter (kt)	300	250+	250	250	250	200	-
10. Normal Speed on Strike Mission	450 up	450+	325-400	400-450	450+	450	210
11. Nominal Strike Radius (n.mi)	200+	250	250 300	250 330	420 1000	480 850	200 350

TABLE A-3. AIRCRAFT CAPABILITIES FOR RESCAP/ESCORT MISSION (Continued)

AIRCRAFT	F-4	F-8	A-4B/C	A-4E	A-6A	A-7A	AV-10A
12. Preferred Ordnance Load for RESCAP							
a. No. Rkt Pods	8	None	None	2 LAU-10	4 LAU-3	6 LAU-10	None
b. No. Gun Pods (Mk 4)	None	None	1	1	None	None	None
c. No. Ext Tanks	1	None	2	2	None	None	1 int
(1) Fuel Capacity/	-	-	-	-	-	-	150 gal.
d. Other Ordnance (Air-to-Air)	2 SW* 2 SPIII**	2 SW	None	None	2 SW	2 SW	1 106mm & 2 57mm

* Sidewinder
**Sparrow

have superior characteristics to the ZUNI and LAU-3A rocket pods on the RESCAP mission.

Table A-3 indicates a preferred ordnance load for RESCAP aircraft. This load is predicated on two conditions:

1. A realistic optimization of the particular aircraft's ordnance capabilities.

2. A mix of ordnance that will give the RESCAP pilot the maximum number of firing runs possible and still have some versatility in his hitting power.

The staying power of the RESCAP is particularly important in the opposed sea rescue. SAR incident reports have occasionally emphasized the fact that the boats in the vicinity of the downed crew knew when the RESCAP no longer had ordnance aboard. On these occasions, the downed crew was picked up by the enemy small craft before additional help could be brought to the SAR scene.

In the over-land rescue situation, the RESCAP attempts to vector the helicopter around enemy AAA enroute to and from the SAR scene. Ordnance must be conserved for suppression of enemy fire during the actual pickup and retirement from the SAR scene.

The F-4 aircraft is limited by a maximum "trap" weight consideration (35,000 or 36,000 lb gross weight, depending upon certain specific considerations) for carrier recovery. Consequently, the Mk4 gun pod is not a suitable RESCAP ordnance load for the F-4 for the following reasons:

1. The employ weight of the Mk4 gun pod (540 lb) reduces the amount of fuel remaining for F-4 recovery to a maximum of 3,000 pounds.

2. If the gun pod malfunctions, the F-4 would have to divert or jettison it in order to have an acceptable fuel load on its initial approach for recovery.

3. With the Mk4 gun pod on center-station, the F-4 would have to have two external fuel tanks or wing stations, further increasing the weight penalties by adding the weight and drag of two empty tanks.

The optimum F-4 configuration is one 600-gallon external tank on the centerline store station. Since this precludes carrying a gun pod, the F-4 would have to operate without guns on the RESCAP mission. In view of the importance of gun capability on RESCAP, the F-4 is unsuitable.

COMBAT STRIKE CAPABILITIES

In considering the projected range capability of future rescue vehicles, a brief analysis of current strike radius capabilities of the aircraft listed in table A-1 was made. Naturally, the in-flight refueling capability can be employed to extend the range of both fighter and attack aircraft. However, considering that Navy strike operations on a day-to-day basis in a conventional limited war environment suggest a need for staying-power, it was not considered likely that strike aircraft would be using IFR over enemy terrain enroute to or from strike missions.

Figure A-1 is illustrative of the range at which strike operations can be conducted. The HI-LO-LO-HI mission profile was considered to be the most representative of the tactics that can be employed. Currently, two factors tend to make the radii indicated in figure A-1 optimistic.

First, there are constraints on the maximum gross weight for catapult launch that are not indicated. As it stands today, the aircraft either has to be launched with partial fuel loads and tanked by airborne tankers during climbout, or the amount of ordnance (bombs) has to be reduced in order to meet catapult weight considerations.

Second, experience has shown that while strike aircraft are in a combat environment that has both AAA and surface-to-air missile defenses, they are operating continuously at or near maximum power. This is considerably different from the power conditions used for figure A-1 (i.e., maximum range power settings).

Nonetheless, figure A-1 does tend to delineate the problem of combat SAR as it relates to operating radius requirements for rescue vehicles (and excorts).

From table A-4, it is clear that the A-6 and A-7 ranges greatly exceed the range capabilities of their F-4 or F-8 escort. Since it is not known whether or not unescorted

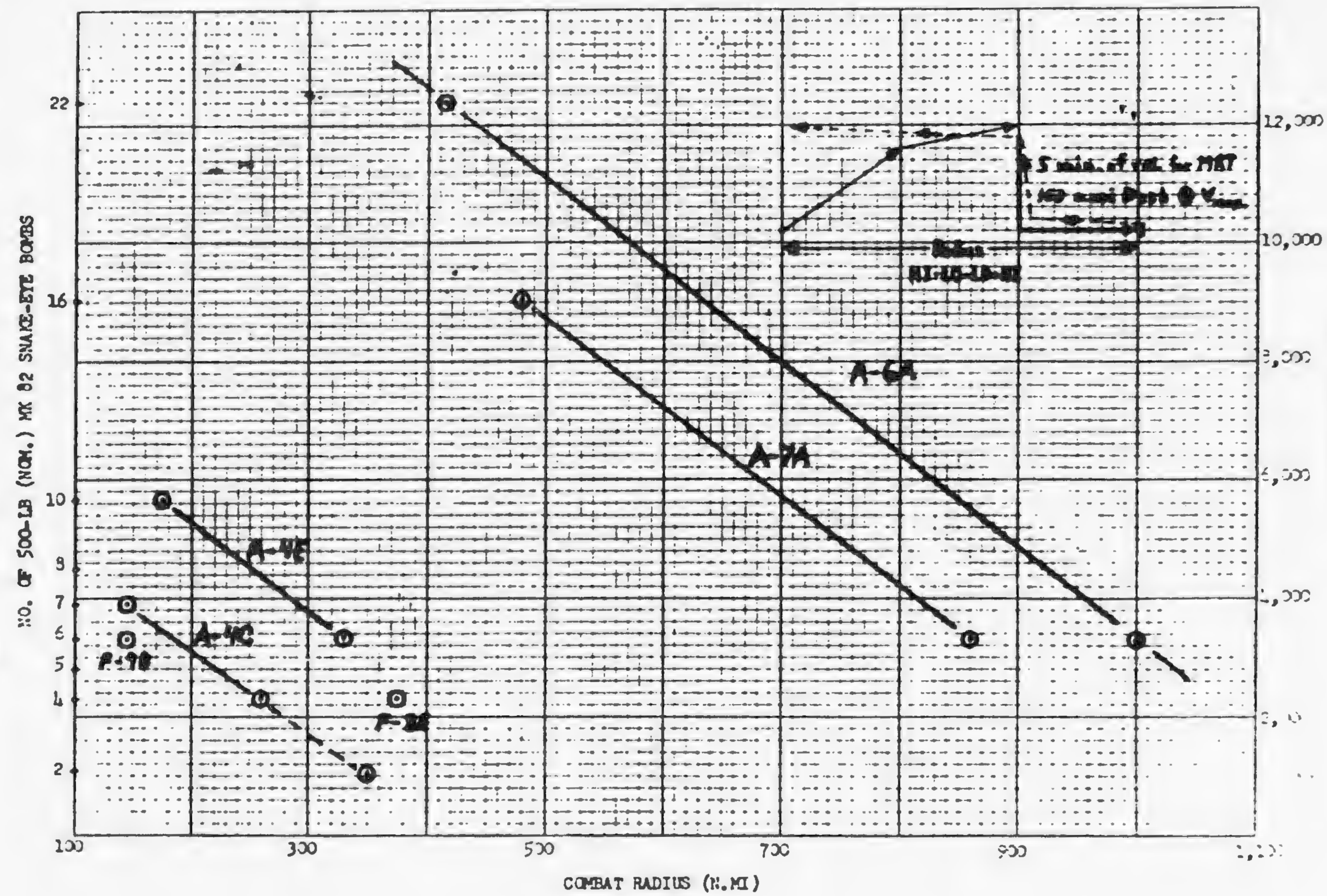


Figure A-1. Stores Load vs Radius.

TABLE A-4. STORES LOAD VS. RADIUS, ATTACK AIRCRAFT AND FIGHTER ESCORT RADIUS

AIRCRAFT	TAKEOFF GROSS WT. (lb)*	FUEL				ORDNANCE LOAD		MISSION RADIUS (n.mi)		
		Internal (lb)	External (lb)	No. Tks	Cap. (gal.)	Weight (lb) (Snake-Eye)	No. Mk 82 Snake-Eye	HI-LO-HI (5-min LO)	HI-LO-HI	Close Support
F-8E	31,300	9,167	None	–	–	2260	4	–	375	–
A-4C	20,300	5,440	1,439	1	300	2260	4	375	260	200
	20,356	5,440	None	–	–	3955	7	225	145	65
	–	5,440	–	2	600	1130	2	–	340	
A-4E	22,116	5,440	2,040	1	300	3390	6	435	330	265
	22,156	5,440	None	–	–	5650	10	265	175	75
	–	5,440	–	2	600	–	–	–	–	–
A-6A	55,152	15,939	8,036	4	300	3390	6	1105	1000	950
	56,011	15,939	None	–	–	12,430	22	540	415	365
A-7A	36,088	10,200	4,080	2	300	3390	6	940	860	785
	37,747	10,200	None	–	–	9040	16	540	480	360
F-4B	48,800	13,560	None	–	–	3390	6	205	145	60
	–	13,560	–	1	400	–	–	–	–	–

*Takeoff gross wt. limited by: 1. 20 kn wind-over-deck, C-7 catapult, and 89.6°F day
2. Structural limits

TABLE A-4. STORES LOAD VS. RADIUS, ATTACK AIRCRAFT AND FIGHTER ESCORT RADIUS (Continued)

Fighter Escort Radius (Unrefueled)

AIRCRAFT	TAKEOFF GROSS WT. (lb)*	FUEL				COMBAT RADIUS (Approx)
		Internal (lb)	External (lb)	No. Tks	Cap. (gal.)	
F-4B	-	13,560	None	-	-	150 n.mi
	-	13,560	4,080	1	600	200 n.mi
F-8	-	9,167	None	-	-	250 n.mi

strike missions would be undertaken in an enemy environment that includes fighter opposition, the range capability of the rescue vehicle is assumed to lie within the envelope of fighter protection.

RECENT EVENTS (MAY 1967)

Recent events are considered indicative of the limitations on combat SAR in the limited war environment as the enemy's defense posture improves. Until recently, Navy strikes in North Vietnam have been conducted without significant air opposition. The greatly increased MIG activity in the Spring of 1967 creates a requirement for anti MIG Combat Air Patrol (MIGCAP) that further increases the number of forces required in order to be able to attempt combat rescue missions.

As indicated previously, Navy forces for combat SAR have grown from two-plane A-1 sections to forces that include DD's on SAR station and SAR helicopters. Now MIGCAP will be required on SAR missions in areas accessible to enemy fighter aircraft.

Few statistics indicate the multiple missions flown when a search is being conducted for a downed crew, particularly when the crew is down in the more remote mountainous regions where capture is not considered imminent. It would appear, in view of recent Navy strike operations in North Vietnam, that long sustained searches by RESCAP aircraft will be increasingly difficult to accomplish because of the tremendous requirements for MIGCAP. For example, in June 1965 search missions totalling 20 sorties (from dawn to dusk for 3 days) were conducted for one downed pilot. Under current conditions in the same area (5 to 30 n.mi south of Thanh Hoa), approximately 72 fighter sorties would be required to provide MIGCAP. Clearly, this would be beyond the capability of TF 77, unless all other operations were virtually suspended.

PRELIMINARY CONSIDERATION OF A SAR TEAM COMBAT RESCUE MISSION

Consideration of an unescorted rescue vehicle (i.e., no fixed-wing attack aircraft, such as those normally used in the RESCAP role, for escort and support) is predicated on:

1. Increased SAR vehicle speeds on the order of 200 to 350 knots.

2. An assumption that the rescue vehicle would have <u>at least</u> the same effective maneuverability and vulnerability as the A-1 aircraft.

3. The fact that:

a. A-7 attack aircraft, which have the optimum capabilities for the RESCAP mission (among all jet attack aircraft), will not be available for assignment to the RESCAP mission.

b. A-6 aircraft will be equally committed to a primary mission of conducting strikes and reconnaissance missions during the next 2 to 3 years and will simply not be made available for RESCAP duties.

c. A-4 aircraft, the most likely candidate as the jet attack replacement for the A-1 aircraft, will be severely handicapped in the RESCAP role. For example, the A-4 will require airborne tankers in order to support the expected mission range/flight time requirements - 270 n.mi range plus 1 hour and 40 minutes of flight time. Moreover, if the A-4C is used, the maximum number of stations available for ordnance is two; for the A-4E, four stations will be available. Here, the problem appears to be not so much the lift capability of the aircraft when using the MER/TER/MBR but the degradation in fuel specs when carrying multiple loads of LAU-3A/LAU-10 and/or Mk4 gun pods.

d. A 200-knot rescue vehicle should present less opportunity to the enemy enroute to and from the target than the current RESCAP aircraft (A-1).

4. The assumption that once in the SAR area, the unescorted rescue vehicle could maneuver better than its support aircraft (e.g., smaller turning radius, and better able to maneuver to exploit any advantages afforded by the SAR scene terrain).

It is envisioned that the unescorted SAR rescue vehicles would be employed in pairs at all times. This would increase the support requirements for the surface vessel force maintaining the vehicles on station. Size of the vehicle, rotor clearance requirements, and gross weight would be factors determining whether or not pairs of rescue vehicles could be maintained on station close to the enemy coastline. These vehicles must be no more vulnerable to small-arms and automatic weapons fire than the current A-1 RESCAP aircraft.

Fighter escort or MIGCAP may be required for the SAR Team to operate in the environment. However, the rescue aircraft (in pairs) would not require assigned RESCAP in order to:

1. Proceed to the SAR scene, and
2. Suppress ground fire.

The rescue vehicle would not require assistance to navigate to the SAR scene. Once in the area, the rescue vehicle would conduct a search for and localization of the downed crew in much the same manner that the normal RESCAP does. Personal pilot survival equipment, which would improve the capability to proceed directly to the downed crew's location, would enhance the survivability of the rescue vehicle in an enemy AAA environment.

Furthermore, the SAR Team concept would:

1. Reduce the response time, since the rescue vehicle would proceed to the scene as soon as a SAR incident develops, and

2. Exploit to the maximum the chance for rescue (take advantage of the first few minutes the downed crew is on the ground, when the enemy has not had the opportunity to

organize its opposition).

It is evident that there is a finite limit on the unescorted rescue capability. However, if the rescue vehicle has superior speed capability to current RESCAP (A-1 aircraft) and helicopters and is no more vulnerable to ground fire, then it has a net advantage over current methods.

In connection with the SAR Team (i.e., no RESCAP in company with the rescue vehicle) mission, two points need amplification:

1. The unescorted rescue vehicle will require MIGCAP whenever it operates in areas accessible to enemy fighter aircraft. However, fighter escort is not envisioned as a backup RESCAP in the event that the rescue helicopter encounters enemy ground opposition to the rescue attempt. The unescorted SAR vehicle must not only be capable of navigating to and from the SAR scene unassisted, but it must have sufficient armament to suppress enemy small-arms and automatic weapons fire at the SAR scene.

2. The unescorted SAR vehicle operation envisions an improvement in the determination of areas in which the SAR vehicle has an acceptable survivability. This also applies to the instance where the SAR vehicle (in the future) accompanies the strike force to the vicinity of the target and takes a preplanned over-land SAR alert station.

In essence, the SAR Team modes of operation require prestrike planning. This, in effect, reduces their utility for supporting reconnaissance and photo/ELINT missions.

The general criteria for earmarking specific areas relatively near the target as over-land SAR stations are:

1. Lack of enemy defenses (37mm weapons or larger).

2. Relatively easily reached by the SAR vehicle (minimum exposure to AAA enroute).

3. Sufficiently closer to the planned target area than the closest over-water SAR stations to justify the inherent risks of penetrating enemy territory in advance of the need to do so (before a SAR incident exists).

The foregoing concept envisions:

1. Close coordination between the strike group and the SAR forces, so that the SAR forces can retire from the area as soon as possible.

2. Optimum applicability for those targets where the distance to the preselected areas is significantly less than that involved in getting back over water, so that the pilot of a damaged aircraft is not confronted with virtually equal alternatives.

3. The SAR vehicle having the support of strike aircraft (for fighter cover and fire supression) during the rescue attempt provided such support is necessary to undertake the rescue attempt.

In general, remote, relatively inaccessible terrain such as mountainous areas will have to be available reasonably near the target if the unescorted, prepositioned, preplanned rescue technique is to have a chance for success. This leads to the recommendation that COMSEVENTHFLT be tasked to determine land areas in North Vietnam that can be used as SAR alert positions and emergency pickup areas. Because the AAA and MIG orders of battle are constantly changing, the designated area for the proposed over-land SAR station, in all likelihood, will be changed for each strike. Nonetheless, if the SAR vehicle could be within 10 to 25 n.mi of the target before the strike, the delay in responding to a SAR incident could be reduced (in the over-land situation) by at least 50 percent.

One last point: The decision as to whether or not to attempt the rescue would still have to be made on the same basis as before (i.e., enemy AAA, ability of the SAR vehicle to reach the scene with acceptable risk, etc.). The advantage would only be in having the rescue capability closer to the area of maximum possible need.

STRIKE GROUP SAR

A rescue vehicle that could accompany the strike group or penetrate the coast in the direction of the target at or near the same time as the strike would offer considerable potential. In this case, the rescue vehicle should have a speed capability of approximately 400 knots and a range capability of at least 250 n.mi, with a loiter time of 15 to

30 minutes at the maximum range point. While the strike group proceeds to the target, the rescue vehicle (which may actually precede the strike group, if required) goes to a preselected location in the vicinity of the target. This station, perhaps 10-25 n.mi from the target, would be not only outside the intense AAA coverage of the target complex, but in an area relatively free of all AAA (e.g., over mountainous or remote terrain) where the rescue vehicle could maintain station without exposure to enemy fire. There are several advantages to this concept:

1. The response time for the rescue attempt is the minimum possible (with the exception of the air snatch method, whereby the rescue vehicle is near enough to the aircraft in trouble to pick the crew out of the air during parachute descent).

2. The rescue vehicle would have the maximum possible support available in terms of ECM jamming and fighter protection during transit to its RESCAP station, since it would be under the same cover provided the strike group.

3. Close coordination between the strike group and rescue force would be automatic, since the rescue vehicle would be an integral element of the strike group. (Current RESCAP/SAR tactics do not have this close coordination today; frequently, the RESCAP/SAR element does not have the details of the strike plan and therefore cannot plan its actions in anticipation of a SAR incident.)

A further extension of the concept would be to have the strike group crews prebriefed on the location of the rescue vehicle so that a damaged aircraft could proceed toward the rescue vehicle (rather than arbitrarily head for the coast). If it were necessary to eject, the crew would be near the rescue vehicle; if it were not necessary to leave the damaged aircraft, the rescue vehicle could provide escort during the retirement.

It is recognized that there is no aircraft in inventory that has the capability to operate as a rescue vehicle (i.e., a hover capability) and at the same time has the performance necessary to stay with current strike aircraft. However, in terms of responsiveness, there is no substitute for being at (or very near) the SAR scene when the SAR incident occurs.

CONCLUSIONS AND RECOMMENDATIONS

To the casual reader, what appears to be needed is a dramatic advance in the combat rescue capability of carrier-based forces. The dogged tactic of having the RESCAP forces proceed to the SAR scene and positively establish contact (visual, radio, etc.) with the downed crew before the rescue vehicle is escorted into the SAR scene guarantees that the rescue attempt will be made hours rather than minutes after the downed crew has reached the ground. However, recent events suggest that a significant improvement in carrier-based SAR capability may become increasingly important, not to enhance the Navy's current capability, but to keep it from being further degraded by the increasing effectiveness of the enemy's defense systems.

In the area of operations and tactics, improvements are generally related to accelerating the response of Navy combat SAR forces. In addition to personal survival equipment, which is discussed in detail in other appendices, improvements should be considered in the following areas.

<u>RESCUE VEHICLE PERFORMANCE</u>. The current primary and secondary Navy rescue vehicles are the SH-3 (armed and armored, to a degree) and the UH-2 (unarmed and unarmored). Current rescue tactics are predicated on these fragile vehicles. Current operation orders prevent using the helicopter for search at the SAR scene. The UH-2 is range-limited to the extent that it cannot adequately cover the North Vietnam coast from the Demilitarized Zone (DMZ) to the Red Chinese border from its SAR station at 19N, 106-10E. With cruise speeds on the order of 70 to 120 knots, these helicopters will be grossly mismatched with their jet fixed-wing escorts, which will be operating at a minimum speed of 250 knots.

A faster rescue vehicle will be less vulnerable to enemy AAA fire. A <u>much</u> faster rescue vehicle may be able to coordinate its tactics with those of the strike mission aircraft without degrading the performance of the strike aircraft if they (the strike aircraft) are used as escort.

COMMAND AND CONTROL. One of the major delays that occur in SAR operations in route packages IV (upper) and VIB results from the unexpected presence of airborne MIGs. The SAR commander generally suspends SAR efforts until the SAR forces have MIGCAP. While this is strictly an operational problem, better coordinated MIGCAP support is indicated so long as intensive combat air operations continue in the Haiphong-Hanoi area.

The need for better radios that will eliminate communications intereference is urgent. The early introduction of multichannel survival radios will reduce this problem significantly.

One of the most difficult tactical decisions to make is whether or not to attempt the rescue. There are areas in North Vietnam in which current SAR forces cannot normally be expected to survive (e.g., Red River Valley). Yet, to date there is not clear declaration on these areas; the SAR commander generally relies on the judgment of the senior RESCAP pilot. As long as the current tactic of sending the RESCAP to the SAR scene remains in effect, it is recommended that the senior RESCAP pilot make the decision as to whether or not to join up with and escort the helicopter to the scene. This would reduce the time spent in waiting for the decision to be made by Staff personnel who are frequently not cognizant of the immediate situation.

Improvements of the combat SAR capability in SEAsia will significantly increase the general rescue capabilities of attack carrier forces as long as the SAR forces are embarked either in the CVA's or in ships normally in company with attack carriers.

The basing of SAR rescue rescue vehicles on ships operating closer to the enemy coast will decrease the response time:

1. During hours of darkness when the SAR helicopter is not on airborne alert;

2. When it is necessary to provide additional backup for the rescue helicopter(s) already airborne (e.g., when multiple SAR incidents occur); and

3. When it is necessary to relieve the on-station rescue helicopter on short notice.

RESCAP AIRCRAFT. As indicated in this appendix, the continuation of the RESCAP mission after the A-1 aircraft is phased out will pose several problems:

1. The F-4, F-8, and A-6 aircraft are not suitable for the RESCAP mission.

2. The A-7A appears to be the optimum jet attack aircraft for the RESCAP mission. However, it is not due in SEAsia for some time, and then only in very limited numbers.

3. The A-4E is considerably superior to the A-4C or A-4P for the RESCAP mission.

4. The A-4C is the most likely candidate for assuming the RESCAP mission when the A-1 is phased out, but there will be two factors that will influence its effectiveness:

a. The A-4C will require airborne tankers on most

RESCAP missions.

b. The A-4C will be ordnance-limited in the two-external-tank configuration and may require other aircraft for backup.

5. Alternatives to employing jet attack aircraft for RESCAP are as follows:

a. Delay the phaseout of the A-1 aircraft, pool all the resources in a single squadron (similar to the A-1D, E-1, and E-2 squadrons, VAW-11, VAW-12, VAW-13, and VAW-33), and provide RESCAP detachments of six to eight A-1 aircraft as Yankee Team assets as long as the supply of A-1's lasts.

b. Establish an OV-10A-equipped RESCAP unit that would provide regular RESCAP either from a CVS or LPH or from a shore air station in South Vietnam near the DMZ (e.g, DANANG).

c. Evaluate the use of rescue vehicles (e.g., AH-56A, CL-84, AH-1G) without RESCAP escort. These aircraft would be less vulnerable at the SAR scene than any jet aircraft provided for their escort since they can maneuver in a much smaller area. Moreover, the optimum search circumstance would be to have the vehicle that must accomplish the rescue actually conduct the search for the downed crew.

d. Develop a SAR capability that employs a vehicle that can operate with the strike group.

LIMITED CONVENTIONAL WAR ENVIRONMENT. The Navy combat SAR capability must be improved in many areas if we use the current experience in SEAsia as a guide. However, in considering SEAsia, it should be noted that the enemy has been improving his AAA and SAM facilities and his defensive tactics for 2½ years. In other places and at other times, it is conceivable that several tactics that have not appeared profitable for SEAsia would be valuable.

The concept of prescheduled rescue attempts wherein the downed crew simply evades initially, knowing that X-hours later (after dark) a rescue attempt will be made. In North Vietnam, the enemy has long since made the capture of a downed crew an immediate all-out undertaking. Consequently, a deliberately delayed rescue attempt in North Vietnam (or Laos) would:

1. Allow the enemy additional time to organize his search and capture attempt;

2. Permit time for the enemy to build up troop strength in the area to oppose rescue; and

3. Allow the enemy time to set up flak traps for the rescue forces. Moreover, the deliberately delayed rescue attempt works to the disadvantage of the wounded/injured downed pilot or crew.

Most targets in SEAsia are sufficiently close to Yankee Station to permit:

1. Air refueling by the strike group before penetrating enemy territory.

2. Fighter escort (F-4 and F-8) to accompany the

mission as MIGCAP.

3. A significant percentage of damaged aircraft to reach the water before the crew has to eject.

It is conceivable that Navy attack carrier strikes could be made where none of the above circumstances prevailed. In this event, the proposed improvements in current SAR capabilities would fall far short of providing adequate SAR for long-range missions (500-1,000 n.mi over enemy terrain). In looking ahead, it is possible that in order to have a truly long-range SAR capability, the SAR vehicle will have to have virtually the same speed and range performance as the strike aircraft. Without elaboration, it would appear that high-speed jet VTOL aircraft may be the SAR vehicles of the future.

ORDNANCE CONSIDERATIONS. The best single aircraft ordnance for the RESCAP mission is the 20mm aircraft cannon. The best ordnance load for RESCAP is the 20mm guns and rocket pods. The order of preference for rocket pods is:

1. ZAP - a four-round, 5-inch folding-fin aircraft rocket pod currently under development. This pod, similar to the ZUNI, appears to have characteristics superior to both the LAU-10 and LAU-3 rocket pods for use in suppressing ground fire or discouraging enemy forces from approaching a downed crew, because of an improved warhead.

2. LAU-10 - four-round, 5-inch folding-fin rocket pack.

3. LAU-3 - nineteen-round, 2.75-inch folding-fin aircraft rocket pack (RADHAZ safe).

4. Other rocket pods such as the LAU-32 and AERO-7D.

Other ordnance, such as CBU and bombs, is not desirable for the RESCAP mission because of its large CEP.

The OV-10A aircraft will have the capability to carry a 15-round 106mm recoilless rifle (currently under development by the Marine Corps). In addition, the OV-10A could carry two 30-round 57mm cannons. These weapons would give the OV-10A tremendous firepower for the RESCAP/escort mission (which it does not currently enjoy with four 7.62mm machine guns).

Many of the A-4 squadrons have removed one 20mm gun to facilitate the SHOEHORN installation, which reduces the integral gun capability of the A-4 to about 50 rounds of 20mm ammunition. This is not adequate to support a SAR incident involving significant numbers of enemy forces or small boats attempting to capture the downed crew, principally because the aircraft is so limited in the number of firing runs.

The Mk4 gun pod carries 1,500 rounds of 20mm ball ammunition. However, the normal loading is about 700 rounds in order to ensure that the A-4 can recover aboard the CVA without jettisoning the pod in the event that the pod malfunctions (weight consideration).

The F-4 is normally not operated with two external tanks in its wing stations because of adverse effects. Therefore, with one centerline external fuel tank, the F-4 cannot be operated with two Mk4 gun pods on its wing stations because of maximum recovery weight-fuel considerations.

The A-6A does not currently have the capability to carry the Mk4 gun pod.

LONG-TERM VIEWS

Looking beyond the improvement of Navy combat SAR capabilities in SEAsia, some thought should be given to the establishment of a permanent combat SAR posture for attack carrier strike forces. The use of HS squadron resources as combat rescue detachments is an expediency predicated solely on the fact that these squadrons have the most suitable vehicle in the SH-3A.

As stated, combat SAR is not a part of the HS squadron mission, and because of this, there is no appropriate training program. Moreover, while HC squadrons do have SAR training and are involved in the development of SAR improvements, the main thrust of HC training relates to the noncombat SAR incident.

One alternative suggests that HC squadrons be assigned the combat SAR mission, and the resources for accomplishing this mission be provided. The expansion of the HC squadron mission to include combat SAR necessarily implies a need to modify helicopter training both in the fleet squadrons and in the helicopter replacement pilot training squadron.

Replacement pilot training for helicopter pilots is oriented to ASW. This training would have to be modified, particularly if the concept of unescorted combat SAR proves operationally feasible and desirable, since this concept envisions tactically operating the helicopters in two-vehicle sections.

Given faster rescue vehicles, improved navigation and communication capabilities, and an improved ability for locating the downed pilot, the proposed combat SAR forces of attack carrier strike forces will significantly improve the Navy's overall SAR posture. In the noncombat role, the rescue vehicle could be operated without armor and armament, thereby increasing its radius of action. If the range, speed, and endurance capabilities of SAR rescue vehicles were increased, the use of fixed-wing aircraft for visual search would not be necessary in many peacetime cases involving missing aircraft or personnel presumed lost several hours before their absence is confirmed.

EPILOGUE

The information presented in this appendix has been drawn in great part from the knowledge and experience of 12 officers (listed in table A-2), all of whom had experience in the SEAsia theater. In discussions with these officers, every effort was made to elicit their views based on realistic circumstances. Undoubtedly, questions will arise concerning the difference between "advertised" performance and what is set forth in the preceding paragraphs, for no attempt was made to specifically correlate these differences. It can only be said that where there was a difference, the view based on actual experience in combat in SEAsia was invariably used.

Addendum
ILLUSTRATIVE SAR INCIDENTS

CASE A 65110690.BAT

In November 1965, an Air Force F-105 was downed in Route Package IV. The area was well protected by AAA, particularly automatic weapons and 37mm guns. As events proved, the rescue helicopter was exposed to terrific AAA fire to the extent that two helicopters (one Navy and one Air Force Jolly Green) and one RESCAP aircraft (A-1E) were shot down during the multiple rescue attempts. In retrospect, the F-105 pilots' chances were virtually nil at the outset, and the decision to attempt the rescue should not have been made. (When one of the RESCAP was downed, it should have been clear that the helicopter would have little chance.)

As the incident progressed, the first helicopter was downed, and the SAR effort shifted to rescuing that crew (four). The net result was that nine additional crewmen were down in enemy territory. Five were rescued.

This incident illustrates the difficulty of using hard and fast criteria as the basis for attempting a rescue. At the time, events governed the decision. A rescue helicopter was down, and additional forces were committed to effect the crew's rescue. When the second helicopter was downed, still more resources were committed. In retrospect, it is easy to decide that the attempt should have been terminated earlier (or not made at all). However, in this case, the SAR scene was not one of the obvious "No Go" areas (heavy AAA defenses and dense population); therefore, the effort continued, and it was not terminated until some of the personnel were rescued.

CASE B

In October 1966, a major effort was made to rescue a downed pilot who had been successfully evading the enemy for 4 days. By the time this maximum effort was made, all contact with the pilot had been lost. In this SAR incident, AAA was very light at the SAR scene; the major factor was the weather. By the time the helicopters were completing their operation, the weather had deteriorated to a 2,000-foot overcast, visibility 3 to 4 miles.

When one of the helicopters was damaged by small-arms fire, the RESCAP was unable to maintain contact during the helicopter's emergency climbout from the SAR scene. As a consequence, the RESCAP was unable to provide navigational vectors to the helicopter, which headed on a line for the Gulf of Tonkin. The helicopter's track took it over a heavy radar-directed AAA area, and it was hit twice by 37mm fire. This additional damage ultimately resulted in its loss. Had the RESCAP been able to visually escort the helicopter, exposure to the heavy AAA would have been avoided, since the RESCAP would have seen to it that the helicopter gave that particular area wide berth on its flight from the SAR scene.

This incident illustrates the importance of the RESCAP being able to keep the helicopter in sight, not only for protection from ground fire but also for navigational assistance. The AAA sites that downed the helicopter were well known to the RESCAP leader, and particular emphasis had been placed on using a route to and from the SAR scene that avoided it. Unfortunately, when the damaged rescue helicopter departed the area and was lost in the clouds, there was no way to vector it clear of any of the known AAA sites located between the SAR scene and the coast.

CASE C

need exact date

In September 1965, a pilot was downed in the immediate vicinity of one of the heaviest AAA concentrations in North Vietnam (Vinh). Because of the proximity to the coast, the RESCAP was able to reach the area at extremely low altitude. By remaining at low altitude, the RESCAP was able to conduct a prolonged search for the missing pilot, since the low hills surrounding the SAR scene effectively masked the enemy 57mm and 85mm AAA batteries.

In this instance, had contact been established with the downed pilot, a rescue would have been attempted despite the heavy AAA, because there was a route for the helicopter from the Gulf of Tonkin to the SAR scene over terrain that had only light automatic weapons fire.

Throughout the search, the helicopter and additional

RESCAP forces were about 10 miles away waiting to come in. A small valley, in close proximity to the coast, provided sufficient isolation from the heavy AAA defenses to afford a reasonable risk factor for attempting the rescue. The point here is that only the RESCAP on the scene could correctly evaluate the situation. If it had been necessary for the commander remote from the scene to decide whether or not to attempt the rescue, in all likelihood he would have terminated the effort if he had only the AAA order of battle plot for that area upon which to base his decision.

This SAR incident also serves to illustrate another phase of SAR operations that vitally affects the decision as to whether or not to continue the search effort. In the first 30 to 45 minutes after the initial alert, the enemy was only able to harass the operation (i.e., 57mm and 85mm fire that could not be delivered effectively as long as the RESCAP remained below the crest of the low hills - 400-500 ft elevation). This constraint forced the RESCAP to operate over a relatively densely populated area at extremely low altitudes. As a consequence, small-arms and automatic weapons fire was most effective (three of the four RESCAP were heavily damaged by this fire). The important point is that for the first 30 minutes or so, this fire was intermittent, but as the SAR effort continued, the enemy was able to move in more and more troops until the area became untenable entirely as a result of small-arms and automatic weapons fire. This buildup of enemy defenses covered some 2 hours, yet the SAR scene was within 5 miles of one of the largest military installations in North Vietnam (Vinh Army Barracks and Supply Base, a divisional and Army headquarters base).

In more remote areas, it would take longer to organize the defense. However, there are few remote areas adjacent to the coast. Therefore, a SAR incident in a remote area generally would entail much greater enroute distances for the rescue helicopter. It would appear, therefore, that regardless of the SAR incident location, only a very finite time will be available before the enemy organizes effective opposition to the rescue attempt.

CASE D

In September 1966, an F-105 pilot successfully ejected in a narrow stretch of water between Ile de De Bao and the North Vietnam mainland. A section of A-1 RESCAP located the downed pilot about 1 mile from the nearest enemy coast. Leaving one A-1 overhead to keep several small craft in the downed pilot's immediate vicinity away from him, the other RESCAP A-1 returned to seaward, rendezvoused with the rescue helicopter, and led it to the SAR scene. The route was exposed to heavy 37mm and 57mm fire at various points, and the SAR scene was literally surrounded by AAA batteries on the adjacent shoreline. The rescue was successful because:

1. The A-1 protecting the downed pilot prevented his capture by the enemy small craft.

2. The RESCAP had sufficient ordnance to suppress enemy fire, particularly during the transit of the helicopter from the SAR scene.

3. The RESCAP were able to operate in a "hole" in the enemy AAA coverage.

4. The rescue helicopter had enough range capability to accept a circuitous route to and from the SAR scene. The direct route to the SAR scene would have exposed the rescue helicopter to tremendous large-caliber AAA fire, and had there not been this range capability, the rescue attempt probably would have resulted in damage or loss to the rescue forces.

In splitting the RESCAP, the section leader recognized the danger, but the fact that the downed pilot would be subject to immediate capture if left unprotected and the fact that it was late afternoon left him no alternative. Had the RESCAP operated continuously as a section for self-protection, there is little doubt that the rescue would have been unsuccessful.

The RESCAP leader's decisions were all predicated on a need to accelerate the rescue attempt. The RESCAP even left the rescue helicopter it was escorting when the SAR alert was received and proceeded as quickly as possible to the SAR scene.

In retrospect, it is clear that speed was of first importance in this rescue. Also, it highlights the particular circumstances whereby jet RESCAP, had they been involved rather than A-1's, would have been in considerably greater danger due to their larger turning radii. Even with their superior maneuverability, the A-1's were barely able to orbit the scene in tight low-speed turns and still remain just beyond effective AAA gunfire range.

Appendix B
SEASIA SAR DATA ANALYSIS

1. INTRODUCTION

The SEAsia SAR Data Analysis considers data from SAR incidents as they relate to five factors:

(1) Those which affect the ability of the pilot to egress from the aircraft.

(2) Those which alert the SAR forces.

(3) Those which affect the search for the downed pilot.

(4) Those which affect the actual pickup.

(5) Those which cause the rescue to be abandoned.

These factors are analyzed in paragraphs 4 through 22 of this appendix. In most sections, the tables and figures refer to incidents rather than personnel, since, for most of the factors evaluated, the circumstances pertaining to the loss of an aircraft containing six crewmen should not carry the same weight as those pertaining to the loss of six single-seat aircraft. In only 5 of 433 Navy incidents the status of the pilot and the remainder of the crew differed. In these incidents the pilot's status determined the status of the incident.

In many paragraphs of the following analysis, the fraction of the incidents that exceed a given time or distance was of interest. Therefore, most figures have been plotted in this fashion; i.e., they are very similar to the survival curves in reliability analysis. For clarity of presentation, and to make changes which occur in time or distance intervals more obvious, the data have frequently been grouped in periods of

5 minutes or 5 miles before plotting.

2. THE DATA BASE

The major portion of the Navy and Marine data used in the Mission Analysis was compiled by the Operations Evaluation Group (OEG) Representatives at CINCPACFLT, with assistance from the Washington office of OEG. In addition, some valuable analysis of data was done by the OEG staff at CINCPACFLT. This analysis is included, generally without separate acknowledgement, in the various succeeding paragraphs of this appendix. The compilation of data at CINCPACFLT was made with the cooperation of the data gathering team from the U.S. Air Force Military Airlift Command, Operations Analysis Section (MACOA). The data on Air Force losses came almost entirely from this source.

The data base consists of detailed accounts of the following incidents:

a. All Southeast Asia losses of Navy carrier-based aircraft, both combat and operational, from 1 April 1966 through 31 March 1967.

b. Marine combat losses of tactical aircraft outside of South Vietnam from 1 April 1966 through 31 March 1967.

Specifically excluded from the Air Force losses are helicopters, and such nontactical aircraft as the C-47, C-123, C-130, U-2, and U-6.

Primary data sources used to compile these detailed accounts of aircraft losses were:

a. OPREP -3, -4, -5 messages

b. SAR SITREP messages

c. Rescue Reports (OPNAV 3480-13)

d. Mission Debrief Forms (MIDEFOs)

e. Mission Debrief Sheets (MIDS)

f. Air Attack Reports (OPNAV 3480-3, -5)

In addition to the detailed accounts of losses delineated above, less detailed accounts of Navy, Marine, and Air Force losses occurring since February 1962 were examined to compare, where applicable, the conclusions based on the recent loss data with conclusions from earlier studies. Time periods covered by the various studies are indicated in figure B-1.

3. OVERALL LOSS STATISTICS

The data base consists of details on 433 SAR incidents involving 604 personnel. Of these, 352 incidents involving 486 personnel were due to combat or combat-associated[1] aircraft losses, and 81 incidents involving 118 personnel were due to operational losses.

The status and recovery rates of USN and USAF personnel involved in combat and combat-associated incidents are indicated in tables B-1, B-2, B-3, and B-4. It should be noted that the locations are where the personnel went down, not where the aircraft was hit. Since the water adjacent to the coast is generally a hostile area, personnel downed within 5 miles of the coast are included in the data for the adjacent land area. Thus, the "water" column of the tables lists only those personnel downed more than 5 miles from the coast. Table B-5 shows the status of the USN and USAF personnel involved in operational losses.

---

[1] Combat-associated losses are those due to premature explosion of own bomb or rocket or where the cause was probably enemy action but may not have been.

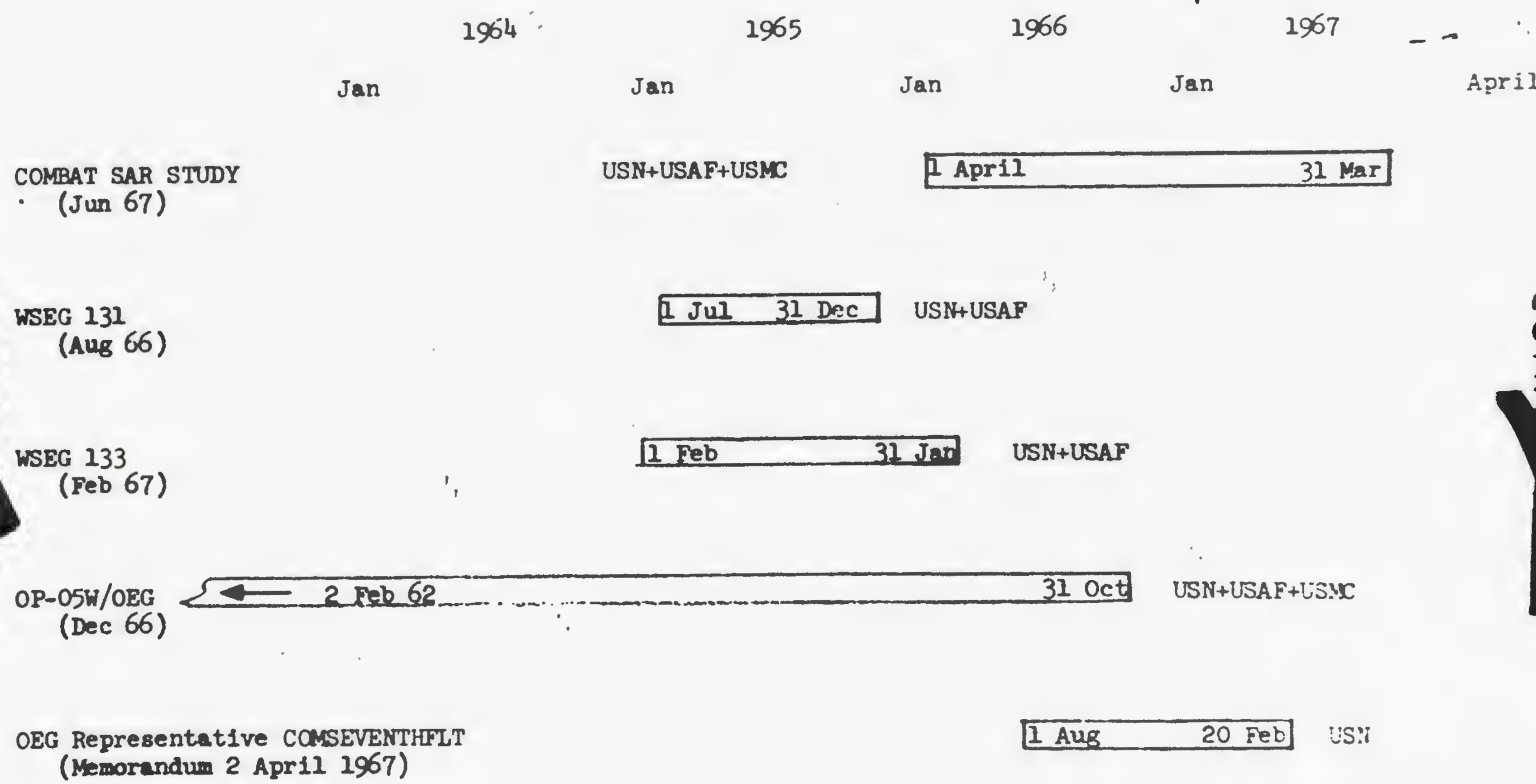


Figure B-1. Time Period of Various SAR Studies.

[redacted]

In addition to data depicted in the five tables, details of six Marine aircraft losses involving seven personnel[2] were contained in the data base.

The recovery rates listed in tables B-1, B-2, B-3, and B-4 indicate the ratio of recovered to recoverable[3] personnel. It should be noted that although the number of persons recovered is known, the number of persons killed, missing, or taken prisoner is uncertain. Occasionally, personnel listed as killed are later determined to be prisoners,[4] but circumstances surrounding the loss of personnel listed as missing indicate that in most instances they are killed.

TABLE B-1. ALL SEAsia COMBAT LOSS PERSONNEL STATUS - USN
1 APRIL 1966 - 31 MARCH 1967

COUNTRY DOWN	NVN	SVN	Laos	Thailand	WATER*	TOTAL
TOTAL DOWN	86	2	3	0	68	159
KIL	17	-	1	-	7	25
POW	25	-	-	-	-	25
MIS	27	-	-	-	8	35
REC	17	2	2	-	53	74
RATE**	25	100	100	-	87	56

* Personnel down in the water but less than 5 miles from the coast are included in the adjacent land totals.

** $\text{Rate} = \frac{\text{Recovered}}{\text{Total down - Killed}} \times 100$

[2] One prisoner in North Vietnam (RP-1), one killed, one missing, two recoverable in Laos, and two recovered from water.

[3] "Recoverable" may be defined as total down minus number known killed.

[4] Three since June 1964.

[redacted]

TABLE B-2. NORTH VIETNAM COMBAT LOSS PERSONNEL STATUS - USN
1 APRIL 1966 - 31 MARCH 1967

ROUTE PACKAGE DOWN	I	II	III	IV	V	VI-A	VI-B	NVN TOTAL
TOTAL DOWN	3	12	29	23	2	0	17	86
KIL	-	5	4	6	-	-	2	17
POW	-	2	10	6	-	-	7	25
MIS	-	-	12	10	2	-	3	27
REC	3	5	3	1	-	-	5	17
RATE**	100	71	12	6	0	-	33	25

TABLE B-3. ALL SEAsia COMBAT LOSS PERSONNEL STATUS - USAF
1 APRIL 1966 - 31 MARCH 1967

COUNTRY DOWN	NVN	SVN	Laos	Thailand	WATER*	TOTAL
TOTAL DOWN	176	91	42	5	13	327
KIL	4	28	10	1	-	43
POW	42	-	1	-	-	43
MIS	86	15	3	-	3	107
REC	44	48	28	4	10	134
RATE**	26	76	88	100	77	47

* Personnel down in the water but less than 5 miles from the coast are included in the adjacent land totals.

** Rate = $\frac{\text{Recovered}}{\text{Total down - Killed}} \times 100$

TABLE B-4. NORTH VIETNAM COMBAT LOSS PERSONNEL STATUS - USAF
1 APRIL 1966 - 31 MARCH 1967

ROUTE PACKAGE DOWN	I	II	III	IV	V	VI-A	VI-B	TOTAL
TOTAL DOWN	57	4	5	0	22	77	11	176
KIL	3	-	-	-	-	1	-	4
POW	7	2	-	-	7	24	2	42
MIS	19	-	2	-	10	49	6	86
REC	28	2	3	-	5	3	3	44
RATE**	52	50	60	-	23	4	27	26

TABLE B-5. ALL SEAsia OPERATIONAL LOSS PERSONNEL STATUS - USN + USAF
1 APRIL 1966 - 31 MARCH 1967

	USN	USAF	TOTAL
TOTAL DOWN	75	43	118
KILLED	31	15	46
MISSING	4	2	6
RECOVERED	40	26	66
RATE**	91	93	92

** $\text{Rate} = \dfrac{\text{Recovered}}{\text{Total down - Killed}} \times 100$

The sensitivity of the recovery rate, as defined above, to the number of missing personnel is illustrated in table B-6, where the "adjusted recovery rate" was computed by arbitrarily assuming that all of the missing personnel in tables B-2 and B-4 were killed.

TABLE B-6. RECOVERY RATE SENSITIVITY (NORTH VIETNAM)

Route Package	I	II	III	IV	V	VIA	VIB	NVN TOTAL
Recovery Rate - USN (from table B-2)	100	71	12	6	0	-	33	25
Adjusted Recovery Rate - USN	100	71	23	14	100	-	42	40
Recovery Rate - USAF (from table B-4)	52	50	60	-	23	4	27	26
Adjusted Recovery Rate - USAF	80	50	100	-	42	11	60	51

Of course, the "adjusted recovery rate" could have been refined somewhat by determining the most likely status (i.e., killed or prisoner) of each individual, and then calculating the "adjusted recovery rate." On the basis of case studies of 35 Navy personnel listed as missing, only 4 appear to have survived. Thus, for illustrating the sensitivity of the recovery rate to the number of missing personnel, the arbitrary consideration of all missing personnel as being killed does not appear to be too unreasonable.

4. HIT-TO-EGRESS TIME DISTRIBUTION

Reported elapsed times from the hit on the aircraft to the egresss of the pilot are listed in table B-7. The distribution of these times is

TABLE B-7. HIT-TO-EGRESS TIME (MINUTES)
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	H-to-E Time	No. of Cases	H-to-E Time	No. of Cases	H-to-E Time	No. of Cases	H-to-E Time	No. of Cases	H-to-E Time
USN DATA (Combat And Combat Associated)	6	0	4	0*,+	1	0	3	0		
	1	0*	2	< 1*,+	2	0*	4	1	1	10*
	4	1	1	1*			5	2	2	15
	1	2	1	5			1	>2	1	17
	3	3	1	> 5*,+			1	<3	1	23
			1	8			3	3	1	30
			1	10			3	4	1	33
			1	52			1	4*	1	35
							3	5	1	35*
							1	6*	1	<40
							1	<8	1	52
							1	<10	1	60
							1	10	1	~240
USAF DATA (Combat only)	2	0	1	1	3	0	2	0	1	14
	2	1	1	8	1	2	2	<1	1	~12-15
	1	~5			1	~2	3	1	1	~15
	1	6.5			1	28	3	2	1	[illegible]
							3	3	1	[illegible]
							1	3-5	1	20
							2	5	1	25
							1	>5	1	[illegible]
							1	6	1	40
							1	10	1	59
							1	13		

* Ditched.
\+ Did Not Survive Hit.

illustrated in figures B-2 and B-3. The value expressed as the ordinate at any point on the graph represents the fraction of cases in which the hit-to-egress time exceeded the time indicated on the abscissa. In most instances, egress was by ejection. However, there were a few cases in which the pilot bailed out or ditched.

The data in table B-7 indicate that of the 19 Navy pilots who were killed for whom hit-to-egress times are known, 14 were killed before getting out of the aircraft. The remaining 5 were killed when they became tangled in their chutes in the water. Of these five, one is known to have been injured before leaving the aircraft. It is not known whether any of the other four were injured prior to egress. Hit-to-egress times were available for only two Air Force pilots who were killed. Although both of these pilots ejected successfully, their chutes failed to open and they were killed on impact with the ground.

Of the 22 Navy pilots who ejected and were later taken prisoners, hit-to-egress times are known for 15. As the data in table B-7 and figure B-3 show, all pilots ejected within 3 minutes of being hit. Further, all incidents occurred over land in populated areas, generally where there was heavy ground fire.

An examination of 23 Navy incidents resulting in the recovery of the pilot with hit-to-egress times of less than 5 minutes revealed that all except 4 were made over water. The 4 land pickups were in sparsely populated areas where there was little or no ground opposition.

The data available on 73 Navy combat losses in the past year show that 68 percent of ejections occurred within 5 minutes of the time the aircraft

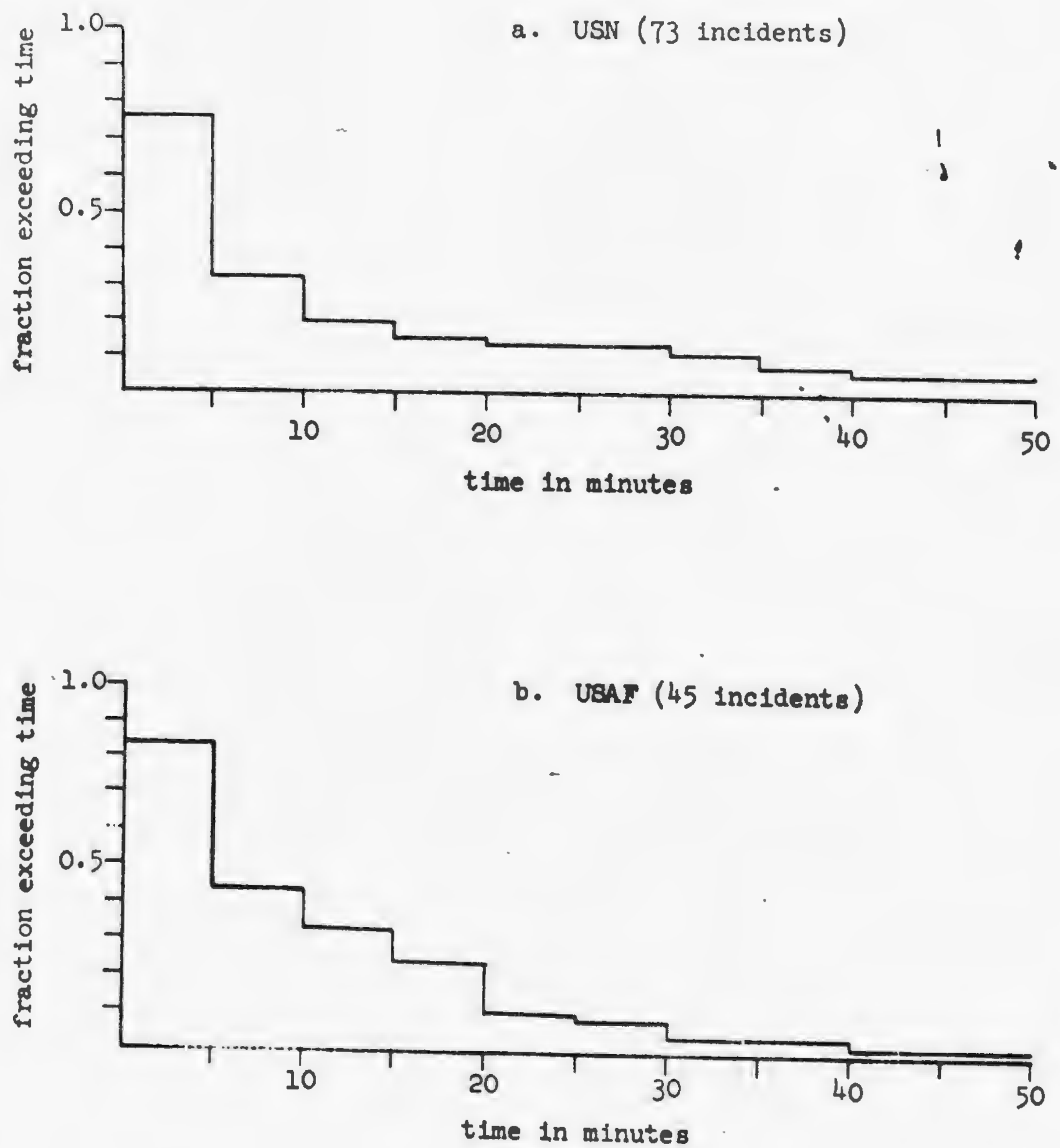


Figure B-2. Overall Distribution of Hit-to-Egress Times, 1 April 1966 - 31 March 1967.

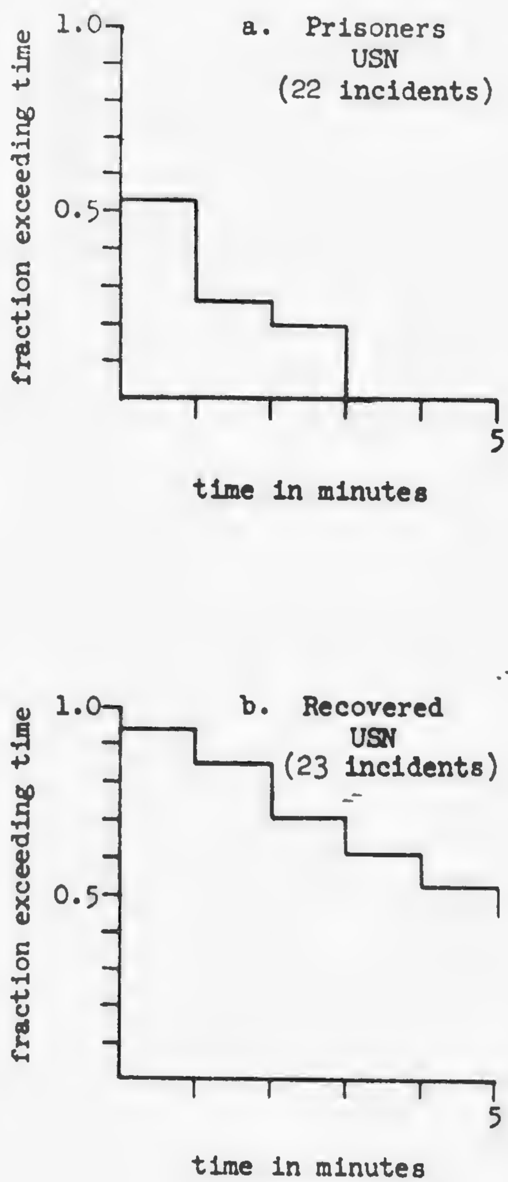


Figure B-3. Distribution of Hit-to-Egress Times, 1 April 1966 - 31 March 1967.

was hit. An earlier study[5] of 168 USAF Combat ejections showed 86 percent of the pilots had ejected within 5 minutes of being hit. However, over the period from 1 April 1966 to 31 March 1967, only 56 percent of the 45 Air Force ejections for which times were known occurred within 5 minutes after hit.

In the cases studied, 86 percent of Navy pilots and 88 percent of Air Force pilots who remained with their aircraft longer than five minutes were recovered.

5. EJECT ALTITUDE DISTRIBUTION

Table B-8 lists known altitudes of Navy and Air Force combat ejections during the study period.

Figure B-4 depicts the distribution of these ejection altitudes. The value expressed as the ordinate at any point on the graph represents the fraction of incidents in which the ejection altitude was above the altitude indicated on the abscissa.

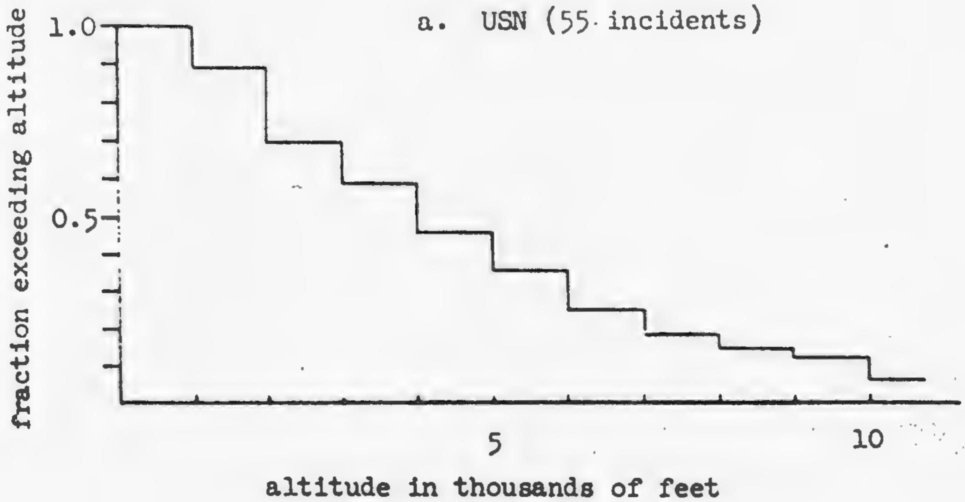
The ejection altitude data were originally tabulated according to the status of the pilot (i.e., prisoner, killed, missing or recovered), and further classified within each status as being from a controlled or uncontrolled ejection, depending upon whether the time from hit to ejection was greater or less than 5 minutes. Due to the small sample size, there was no apparent difference in the ejection altitude distribution for controlled and uncontrolled ejections. Further, the small sample size precluded any strong correlation between ejection altitude and subsequent pilot status; althought it might be expected that pilots who ejected at

---

[5] CINCPACFLT msg 040507Z, May 1967.

TABLE B-8. EJECTION ALTITUDES
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Alt. in 100 ft	No. of Cases	Alt. in 100 ft	No. of Cases	Alt. in 100 ft	No. of Cases	Alt. in 100 ft	No. of Cases	Alt. in 100 ft
USN DATA (combat and combat associated)	1	5	1	10	1	20	1	3	3	40
	1	10	1	15			2	10	1	45
	2	20	1	55			1	12	4	50
	2	25					2	15	1	55
	1	>50					1	18	3	60
	1	70					2	15-20	3	70
							1	20-25	2	80
							2	25	1	90
							1	30	3	100
							1	32	3	120
							3	35		160
USAF DATA (combat only)	1	50	1	60	1	2.5	1	3	2	40-50
	1	60	1	100	1	10	1	5	2	50
	1	80			1	60	1	6	2	60
	1	100			1	100	1	8	1	70
	1	200			1	<160	1	10	1	80
					1	190	2	20	1	85
					1	280	2	30	1	86
							1	35	1	90
							1	40	1	150
							1	45		



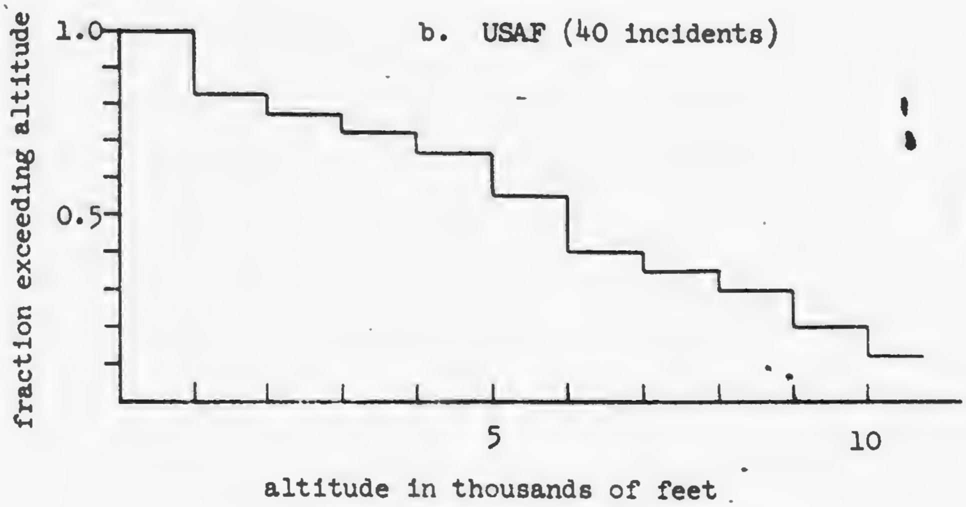


Figure B-4. Distribution of Ejection Altitudes,
1 April 1966 - 31 March 1967.

[redacted]

low altitudes generally did so because it was necessary to eject immediately, and therefore were close to the point where they were hit.

6. DISTRIBUTION OF DISTANCE FLOWN AFTER HIT

Closely associated with hit-to-egress time is the distance flown after hit. Table B-9 lists distances flown after hit for 84 Navy and 19 Air Force incidents.

Figure B-5 illustrates the distribution of the distances flown by Navy pilots after hit. Figure B-5a depicts all USN incidents.[6] Figures B-5b and -c compare the distances flown after hit for pilots who were subsequently taken prisoner and those who were recovered. The value expressed as the ordinate at any point on the graphs represents the fraction of incidents in which the distance flown after hit exceeds the distance shown on the abscissa.

As might be expected from the earlier discussion of the hit-to-egress time distribution (in paragraph 4), the distances flown after hit by those taken prisoner were significantly shorter than distances flown by those who were recovered. The data in table B-9 and figure B-5 indicate that the probability of recovering pilots who survived the initial hit was increased from 55 to 76 percent by flying 5 miles from the point where the hit occurred. Figure B-5b shows that approximately 70 percent of those taken prisoner were down within 5 miles of where hit.

7. ALERT TIME DISTRIBUTION

In this paragraph two alert times are considered. The after-hit alert time is the elapsed time between the time an aircraft is hit and the time

---

[6] The distances illustrated agree closely with the findings expressed in Op-05W/OEG "Analysis of US Navy, Marine Corps and Air Force Fixed-Wing Aircraft Damage and Loss in Southeast Asia", December 1966.

[redacted]

TABLE B-9. DISTANCE FLOWN AFTER HIT (MILES)
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Dist. Flown	No. of Cases	Dist. Flown	No. of Cases	Dist. Flown	No. of Cases	Dist. Flown	No. of Cases	Dist. Flown
USN DATA (Combat And Combat Associated)	1	<1	5	0	6	0	1	1.5	2	25
	1	2	1	<1	1	2	1	~3	1	>25
	1	<3	1	~1	1	3	1	4	1	~30
	1	~3	1	1	1	7	1	<5	1	~35
	1	3	1	4	1	<10	4	~5	1	~37
	1	3.5	1	<5			1	5	2	~40
	1	3-4	1	6			1	~6	1	45
	1	<5	1	~25			1	~3	1	~50
	1	~5	1	30			1	8	1	>50
	1	5	1	~45			1	<10	1	~55
	1	~9					2	10	1	57
	1	9					1	11	2	~90
	1	~20					1	13	1	~100
	1	~25					1	~15	1	~125
	1	~30					1	17	1	~150
							1	~20	2	~170
							1	20	1	~225
							1	>20		
USAF DATA (Combat Only)	1	5	2	0	3	0	1	1	1	[illegible]
	1	177			1	83	1	5	1	[illegible]
	1	196					1	7	1	[illegible]
							1	15	1	[illegible]
							1	~20	1	[illegible]
							1	25	1	[illegible]

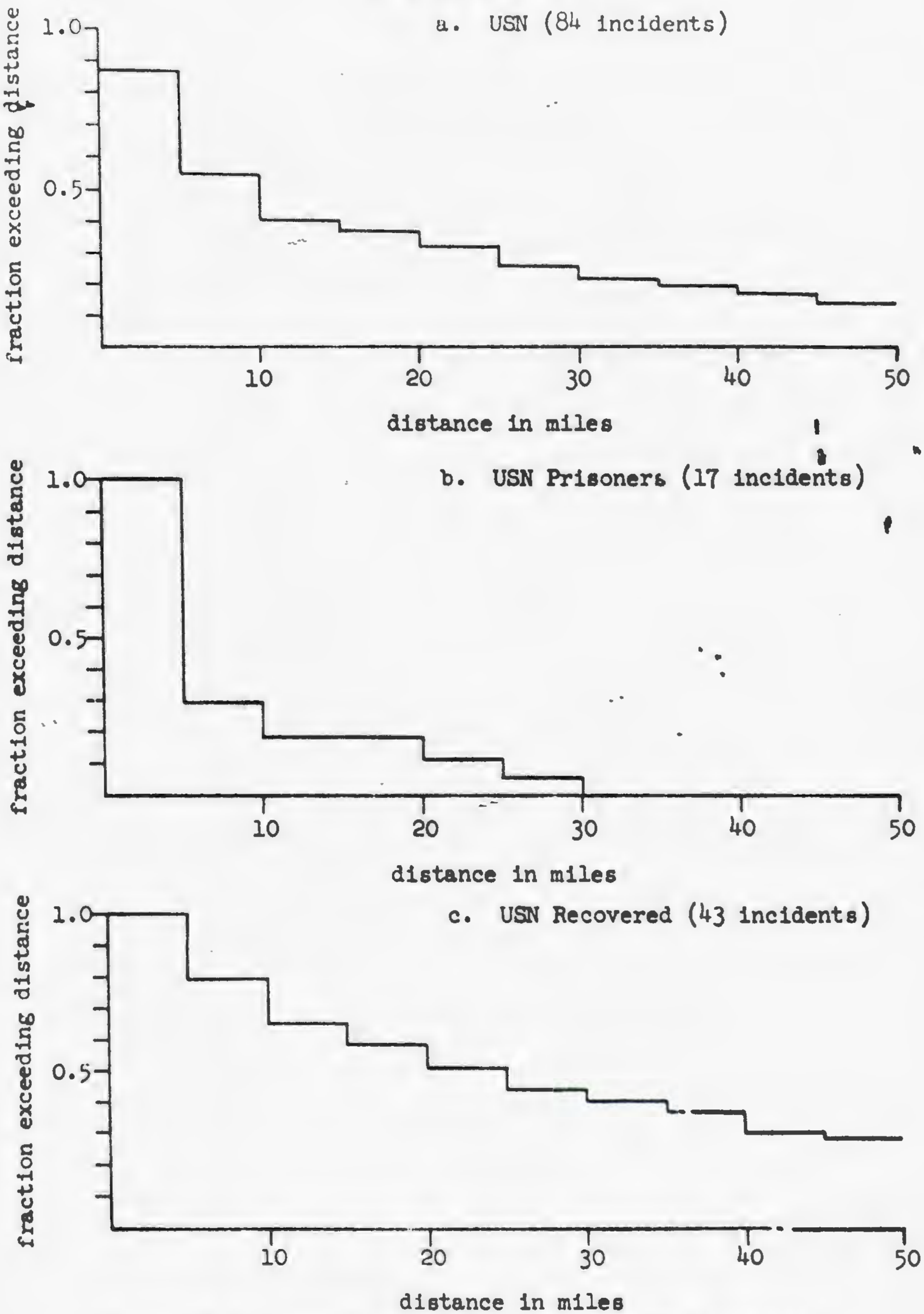


Figure B-5. Distribution of Distance Flown After Hit, 1 April 1966 - 31 March 1967.

information is received by the SAR force that SAR might be required; it gives a measure of the total reaction time of the SAR Command and Control System. The after-down alert time is the elapsed time between the time a pilot reaches the ground (or water) and the time information is received by the SAR force that SAR might be required; it gives a measure of the time actually available to conduct the rescue. Figure B-6 illustrates the time sequence of a typical SAR incident.

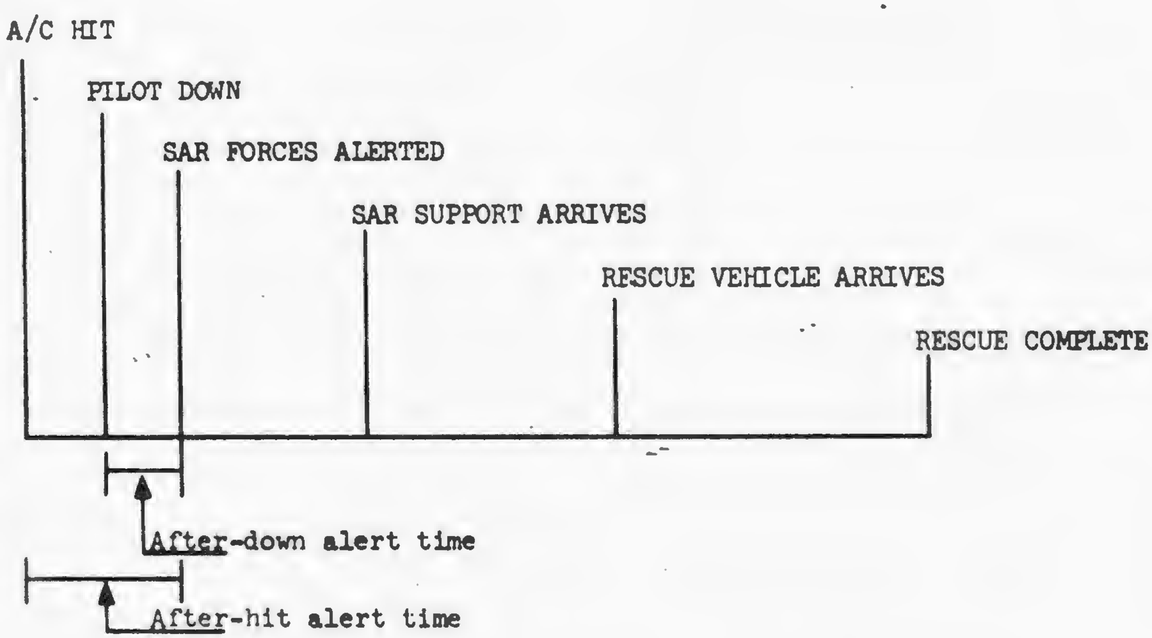


Figure B-6. Time Sequence of a typical SAR Incident.

Table B-10 lists the after-hit alert times, and table B-11 the after-down alert times for SAR incidents occurring between 1 April 1966 and 31 March 1967. The SAR forces that received the alert were sometimes the RESCAP aircraft, but were most often the agency that controlled the rescue vehicle. In table B-11 the negative alert times shown indicate that SAR

TABLE B-10. AFTER-HIT ALERT TIMES (MINUTES)
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time
USN DATA (Combat And Combat Associated)	2	0	2	0	1	0	1	0	1	<13
	2	2	1	4	1	~2	1	1	1	<15
	1	<3	1	>4	1	<5	1	2	1	~15
	1	~3	1	<5	1	>5	1	<3	2	15
	1	~5	1	~5	1	~8	3	3	1	>16
	1	5	3	5	1	~10	1	4	1	18
	1	~10	1	8	1	<25	1	<5	1	24
	1	~15	1	<15	1	28	2	5	1	26
	1	~20	1	<21	1	>35	1	6	1	33
	1	20	1	<145	1	<43	1	7	1	>50
	1	~390			1	<45	1	9	1	>59
					1	~45	1	<10	1	<60
					2	~60	1	<12	1	120
					1	>60	2	12		
USAF DATA (Combat only)	1	0	1	5	1	0	5	0		13
	1	1	1	>8	1	1	2	1	3	[illegible]
	2	2	1	181	1	2	3	2		>15
	1	4	1	312	1	3		>2		>18
	1	>15			1	4	2	3		>27
	1	29			1	5	2	5	2	~30
	1	>178			1	9		>6		72
					1	>115		>7		
					1	128		9		
					1	175		10		
					1	395		>10		

TABLE B-11. AFTER-DOWN ALERT TIMES (MINUTES)
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time
USN DATA (Combat And Combat Associated)	2	-0	2	-3	1	0		-120	1	<7
	2	2	2	0	1	<5		-28	2	7
	2	<5	1	<5	1	>5		-24	1	<12
	1	<7	2	5	1	~8	2	-5	1	15
	1	<7	1	<15	1	9	3	-4	1	<60
	1	~20	1	<20	1	<25	2	-2		
	1	~390			1	>25		*		
					1	35		+		
					1	<40	9	0		
					1	~40	1	1		
					1	>60	1	2		
					2	~60	2	4		
USAF DATA (Combat only)	1	-10	2	0	1	0	1	-16	2	[illegible]
	3	0	2	5	1	1	1	-12	3	[illegible]
	1	1	1	6	1	5	1	-5	2	10
	1	2	1	26	1	6	1	+	1	12
			1	181	1	8	4	0	1	[illegible]
			1	395	1	113	2	1	1	[illegible]
					1	175	4	2	1	~[illegible]
					1	395	2	3	1	[illegible]

* Before egress

\+ Before down

forces were alerted before the aircraft went down.

Figures B-7a and -b compare after-hit alert times for 82 Navy and 53 Air Force combat SAR incidents. The value expressed as the ordinate at any point on the graphs represents the fraction of incidents in which the alert time was greater than the time shown on the abscissa. As the two figures show, after-hit alert time distribution was very nearly the same for both the Air Force and the Navy. It should be noticed that in 50 percent of the incidents, SAR forces were alerted within 5 minutes of the time the aircraft was hit. However, if SAR forces were not alerted in this initial 5 minutes, the time tended to increase considerably.

Figure B-7c is a plot of after-hit alert times for 15 Navy incidents for which times are known, where the pilot is missing. The figure clearly shows that a considerably larger amount of time elapsed between the time the aircraft was hit and the time the SAR forces were alerted for pilots who are missing, than for pilots who were recovered, taken prisoner, or killed.

The after-down alert time distribution is illustrated in figures B-8 and B-9. As may be seen from figure B-8, the alert time distributions were again approximately the same for the Navy and Air Force. Since distribution appears to be approximately the same, the Air Force and Navy data are combined for each of the pilot statuses depicted. As might be expected, the after-down alert times were greater for missing pilots than for pilots taken prisoner. The after-down alert times of both of the previous were greater than those for pilots who were recovered.

The alert time data indicate that the command and control network generally works fairly rapidly. However, the lines of communication between

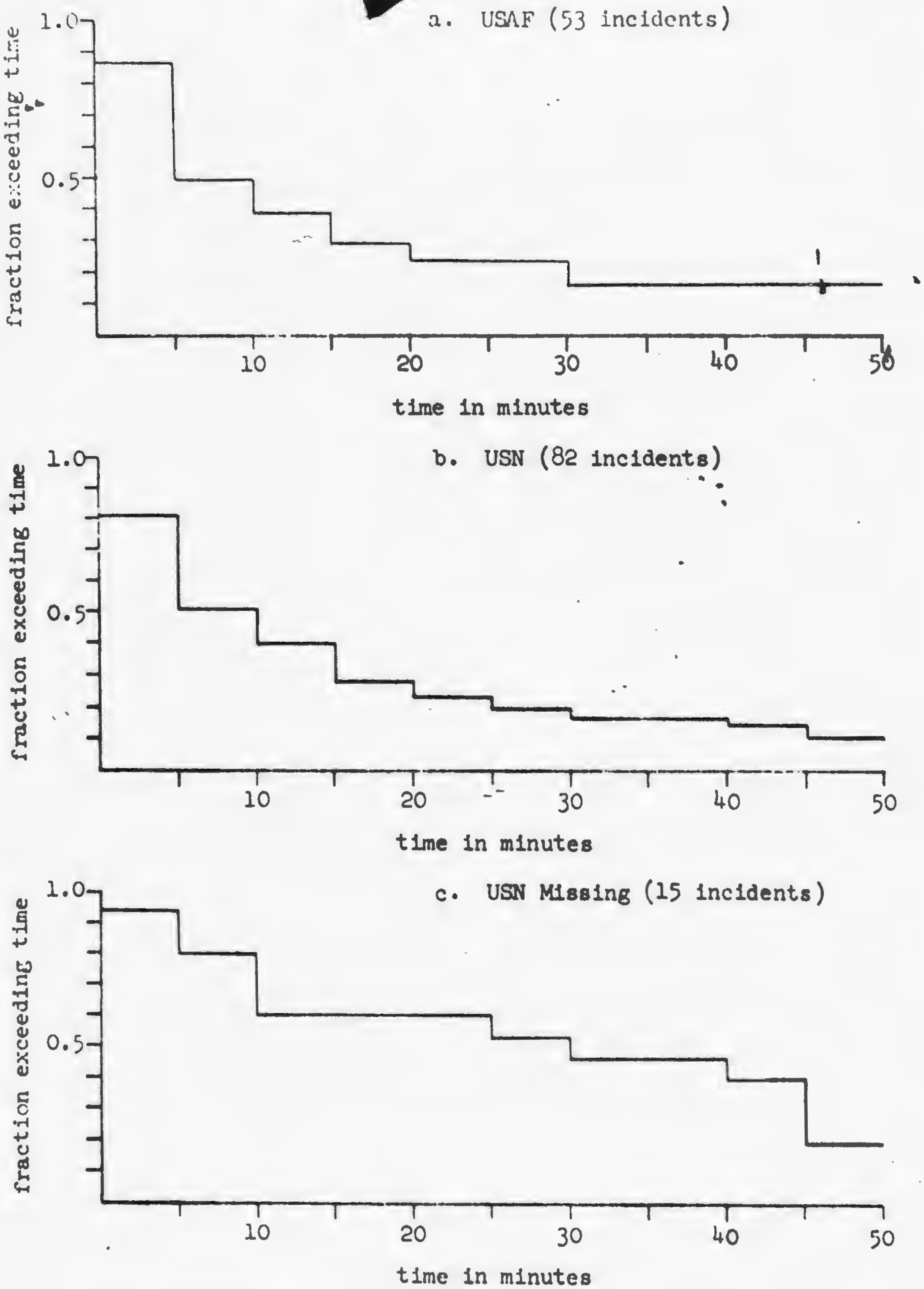
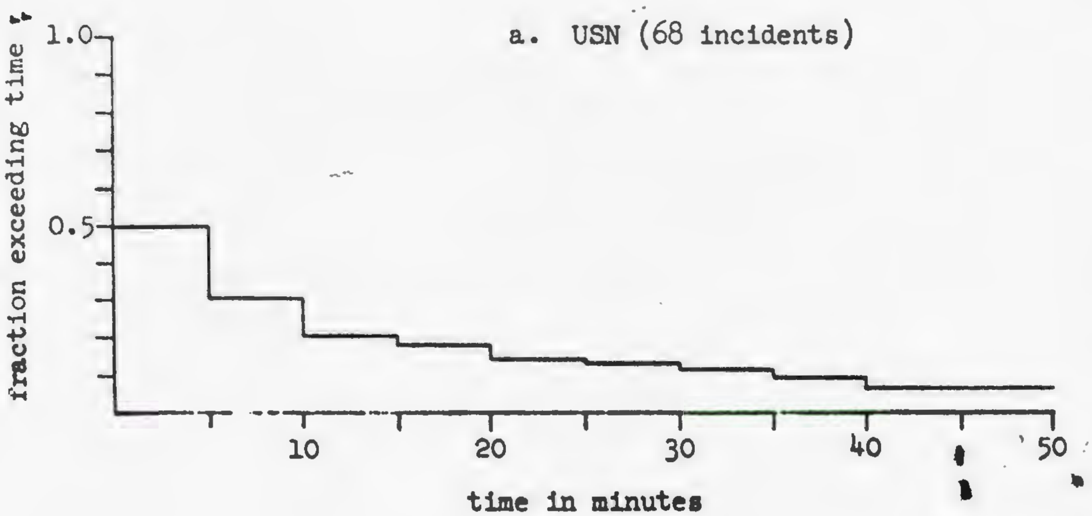


Figure B-7. Distribution of After-Hit Alert Times,
1 April 1966 - 31 March 1967.

[redacted]



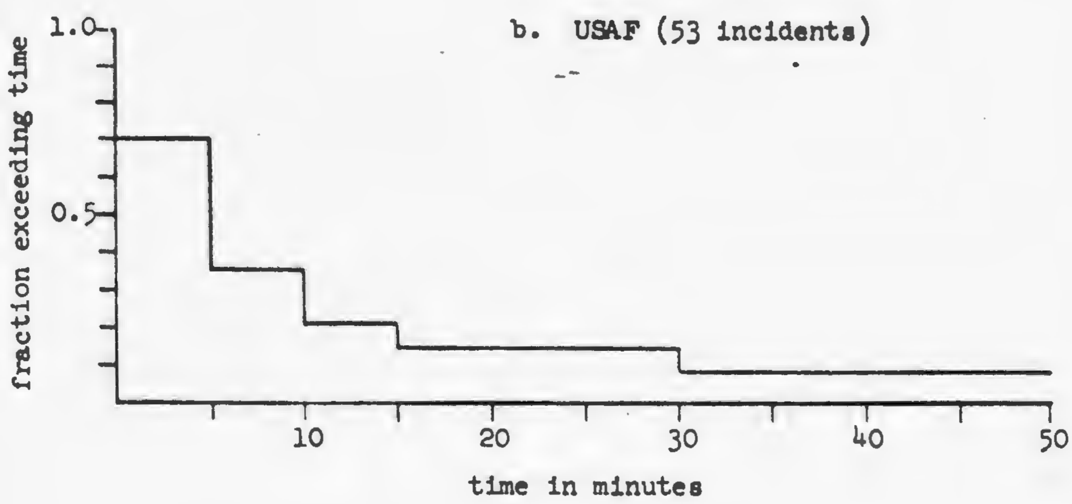


Figure B-8. Distribution of After-Down Alert Times, 1 April 1966 - 31 March 1967.

[redacted]

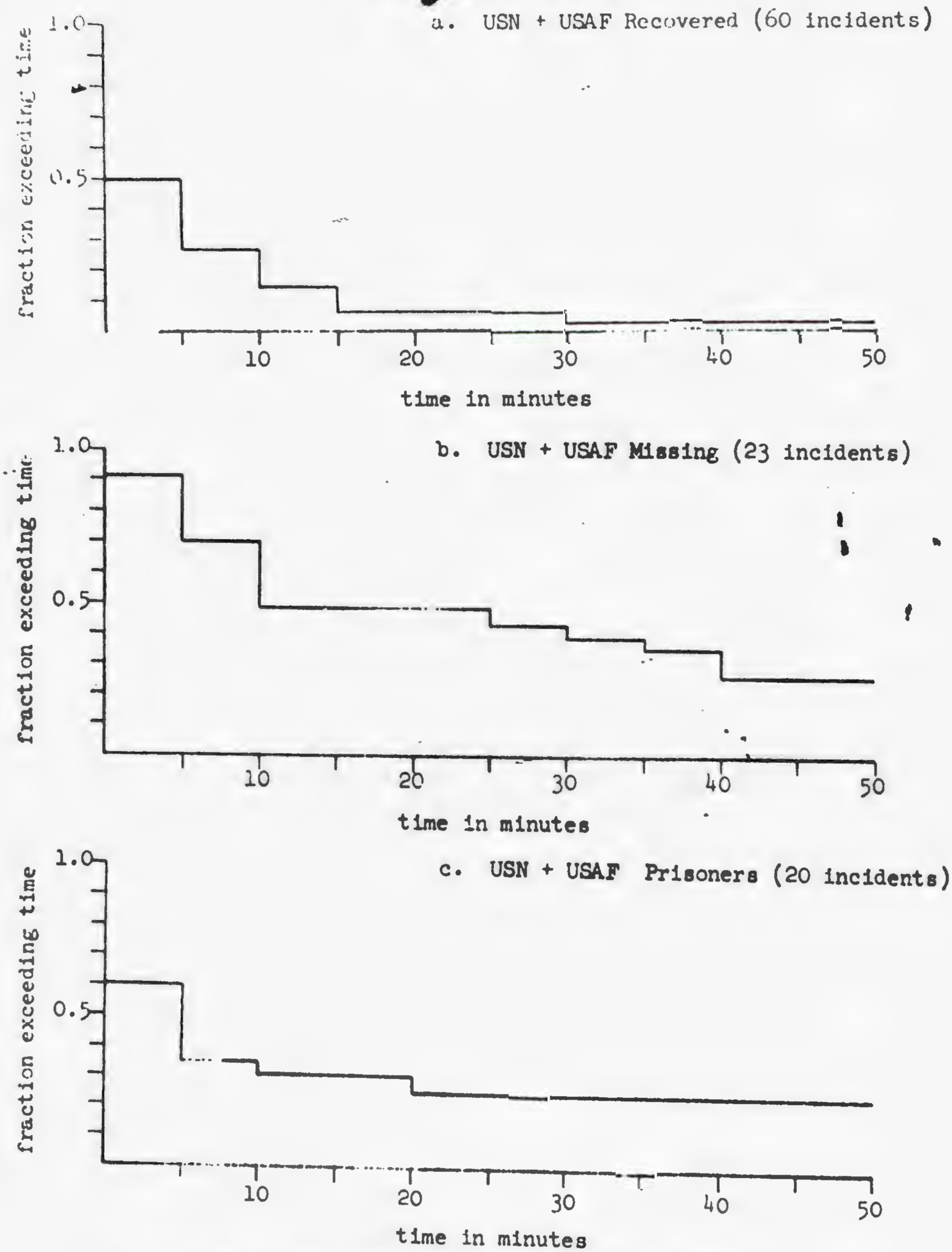


Figure B-9. Distribution of After-Down Alert Times,
1 April 1966 - 31 March 1967.

[redacted]

those at the scene or aware of a downed aircraft, and those who must commit SAR forces do sometimes break down. When this happens, the SAR incident frequently ends with the pilot missing.

8. DISTRIBUTION OF DISTANCE FROM SAR FORCE TO DOWNED AIRCREW

Table B-12 lists known distances from the SAR force to the downed aircrew for 62 Navy and 29 Air Force SAR incidents during the study period.

Figure B-10 illustrates the distribution of these distances, which are greater for the Air Force than for the Navy. This is due to the fact that most Navy targets are close to the coast. Navy SAR forces, since they are able to maintain SAR stations over water close to the coast, can therefore be pre-positioned closer to the scene of a potential SAR incident than can Air Force SAR forces.

Most Navy recoveries have been made at sea. There have been some instances in which Navy pilots were able to eject over the SAR DD or the CVA.[7]

Figures B-11a and -b compare distances from the SAR force to the aircrew for Navy pilots who were recovered with distances from the SAR force to pilots who are prisoners or missing. As expected, the distances to those recovered was less than to those not recovered. However, the distribution of the distances to those recovered is biased by the short distances for those recovered at sea.

9. SAR SUPPORT ARRIVAL TIME DISTRIBUTION

Table B-13 lists known elapsed times between the time a pilot went down and arrival of SAR support (SAR support is the first assistance given, other than by the wingman, in the SAR effort). In some incidents, assistance

---

7 Of 69 Navy personnel recovered, 3 were recovered from land, 16 from water within 5 miles of the coast, and 50 from water more than 5 miles from the coast.

[redacted]

TABLE B-12. DISTANCES FROM SAR FORCE TO DOWNED AIRCREW
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	N. Mi. Away	No. of Cases	N. Mi. Away	No. of Cases	N. Mi. Away	No. of Cases	N. Mi. Away	No. of Cases	N. Mi. Away
USN DATA (combat and combat associated)	1	<1	1	0	1	<3	2	0	2	20
	1	<5	1	<2	1	>10	1	.05*	1	22
	1	>20	1	5	3	20	1	.07+	2	23
	1	21	1	8	1	>20	1	<1	1	2[illegible]
	1	30	1	>15	1	36	1	1	1	27
	1	50	1	25	1	44	1	1.97x	1	3[illegible]
	1	55					1	<2	1	35
							3	2	1	37
							1	4	1	38
							1	8	2	40
							1	9	1	42
							2	10	1	[illegible]
							1	>10	1	53
							1	12	1	62
							1	13	1	73
							2	15	1	1[illegible]
USAF DATA (combat only)	No Data		1	5-10	1	0	1	1	1	[illegible]
			1	25	1	28	1	1.5	1	[illegible]
			1	39	1	42	2	3	1	[illegible]
			1	120	1	71	1	18	1	[illegible]
					1	~90	1	25	1	[illegible]
							2	30	1	[illegible]
							2	43	1	[illegible]
							1	52		

*100 yds
+150 yds
x4000 yds

[redacted]

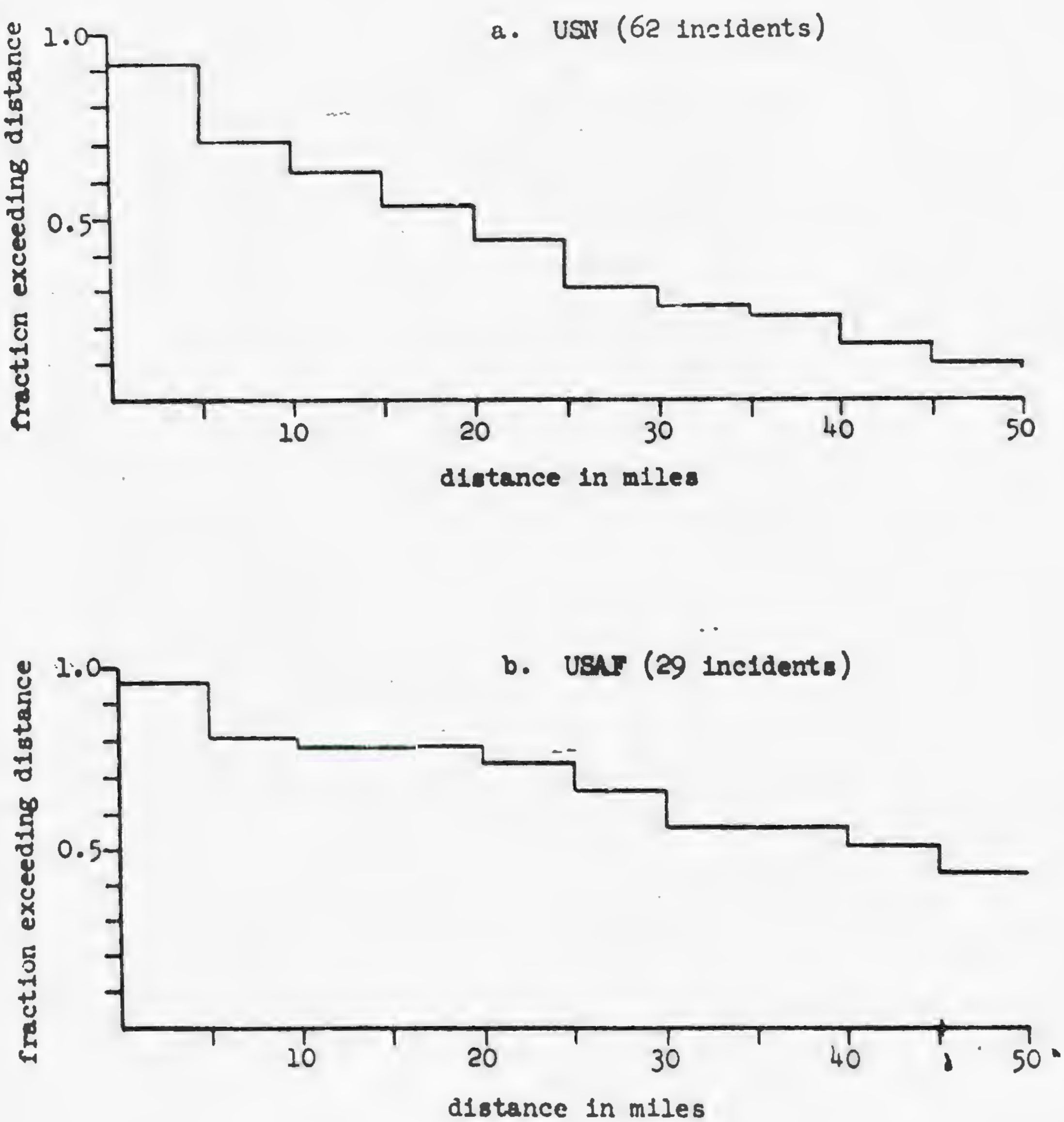


Figure B-10. Distribution of Distance from Sar Force to Aircrew,
1 April 1966 - 31 March 1967.

[redacted]

[redacted]

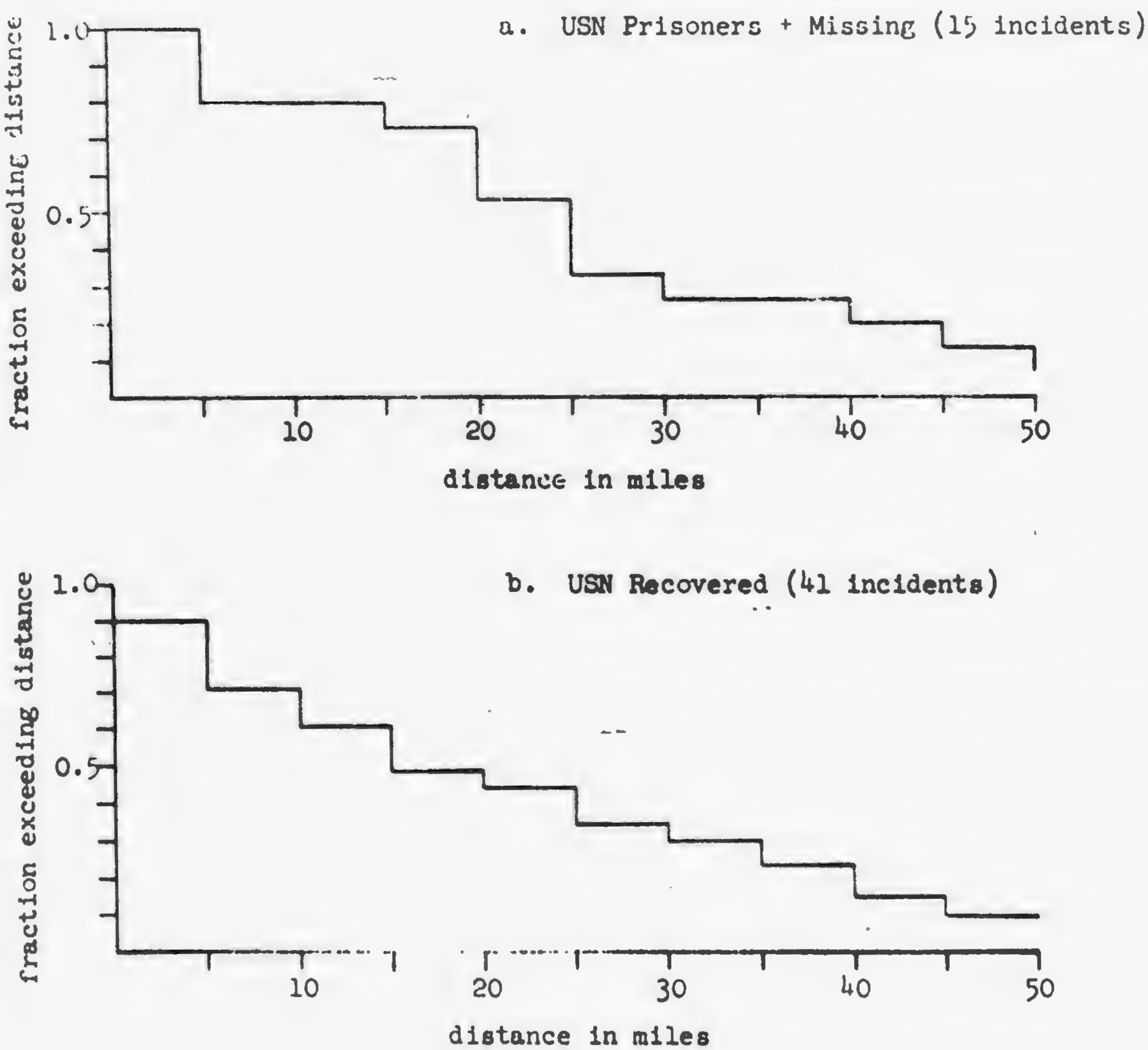


Figure B-11. Distribution of Distances from SAR Force to Air Crew, 1 April 1966 - 31 March 1967.

[redacted]

TABLE B-13. SAR SUPPORT ARRIVAL TIMES (MINUTES)
1 APRIL 1966 - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time
USN DATA (Combat and Combat Associated)	1	0	1	4	2	0	1	-1	3	15
	2	5	1	8	1	20	6	0	1	17
	1	6	1	9	1	<30	1	1	1	[illegible]
	1	19	1	<15	1	<57	2	2	1	[illegible]
	2	20	1	15	2	~60	[illegible]	[illegible]	[illegible]	20
	1	~20	1	21	1	>60	1	[illegible]	2	~20
	1	~40	1	22	1	63	1	6	1	25
	1	~660	1	<25	1	~120	2	7	1	~30
			1	30	2	~690	2	10	1	~40
			1	>120			1	~10	1	43
							1	<12	1	~90
							1	12	1	~240
							1	13	1	270
							1	14		
USAF DATA (Combat only)	1	20	1	10	1	0	2	0	1	[illegible]
	1	40	1	30			1	[illegible]	1	[illegible]
	1	128					1	10	1	[illegible]
							1	15	2	50
							1	20	1	53
							1	22	1	[illegible]
							1	25	1	75
							2	30		

was given by an aircraft assigned a primary mission of RESCAP. In many incidents, an aircraft was diverted from some other mission. In a few incidents, assistance was given by a ship. Frequently, the only SAR support on the scene of water recoveries was the rescue helicopter.

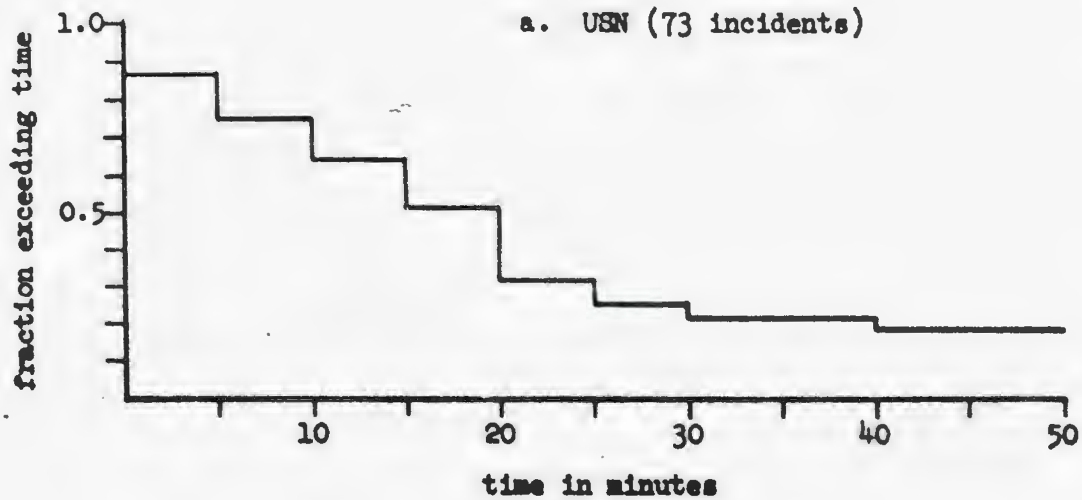
Although the aircraft considered as airborne support was sometimes capable of providing suppressive fire (see paragraph 18), it was frequently used only for communications relay, or to search for the downed pilot.

The 660 minute SAR support time late for one prisoner is worthy of some explanation. In that particular incident (12 Oct 66, A1H, Lt WOODS), the wingman originally reported that there was no chance for survival. Thus, although the SAR effort eventually expended was one of the most extensive of the war, it was not started until a beeper was heard from the area several hours later.

Two other incidents also deserve comment. There was no airborne support in the recovery incident (17 March 1967, A1H, Lt MOORE) with a SAR support arrival time of 270 minutes. The pilot, who had lost his NAVAIDS and radio, and had then ditched at sea, was sighted by a lookout on a U.S. Navy oiler. The other recovery incident (5 July 1966, A4E, Lt HOLBEN) occurred at night, and the airborne support did not arrive until daybreak, 240 minutes later.

Figures B-12a and -b depict the distribution of SAR support arrival times for Navy and Air Force pilots downed during the study period. As the figures show, the arrival times for SAR support for Air Force rescues were approximately double the times for Navy rescues. In fact, the median Air Force SAR support arrival time of 30 minutes was exactly double the Navy

[redacted]



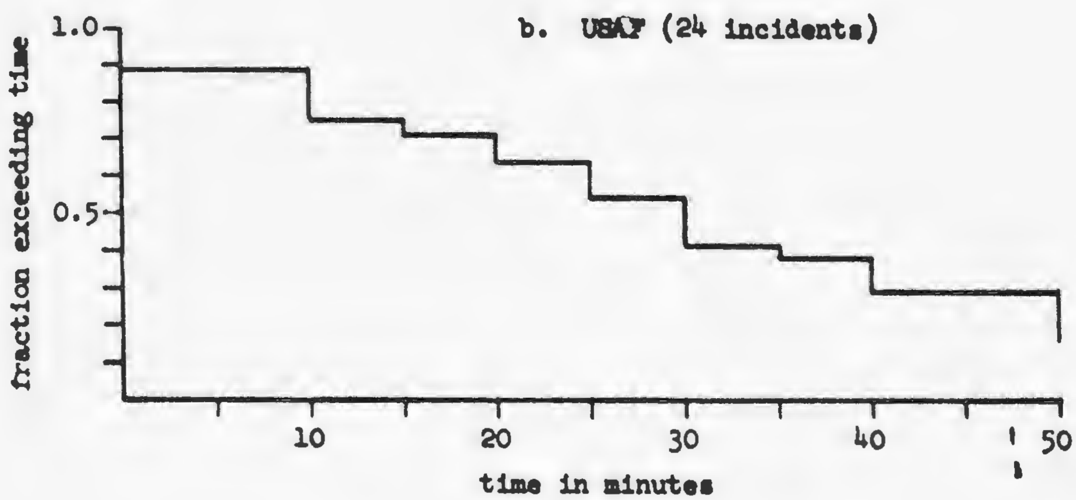


Figure B-12. Distribution of SAR Support Arrival Times.

[redacted]

time of 15 minutes. For any status other than recovered, there was almost no data for Air Force pilots, and very little for Navy pilots. Thus, no strong statements can be made regarding the influence of airborne support force time-late on the success of the mission.

However, from an examination of the time-to-capture in Appendix C, table C-3, it can be seen that approximately 50 percent of those captured were taken within 5 minutes after going down, and approximately 75 percent were taken within 15 minutes.

10. RESCUE VEHICLE ARRIVAL TIME DISTRIBUTION

Known elapsed times between the time a pilot went down and the arrival time of the helicopter or other rescue vehicle (commonly called "time-late"), are listed in Table B-14. The distribution of these times is illustrated in figures B-13a and -b for the Navy and Air Force respectively.

As expected, from a consideration of the greater distances that must be traveled by Air Force helicopters in order to reach the scene of a downed pilot, the Air Force times-late were considerably greater than those of the Navy. The median rescue vehicle arrival time for Navy incidents was 15 minutes. In the small number of Air Force incidents for which data was available, the median rescue vehicle arrival time was 40 minutes.

The Navy incidents include data on 30 rescues that were more than 5 miles at sea, and are therefore heavily biased toward low time-late values. If times are considered only for those 26 Navy incidents which took place over land or within 5 miles of the coast, the median time-late of the rescue vehicle was 25 minutes. A more extensive discussion of the incidents that took place over land, and at sea within five miles of the coast, may be found

TABLE B-14. RESCUE VEHICLE ARRIVAL TIME (MINUTES)
1 APRIL - 31 MARCH 1967

	POW		KIA		MISSING		RECOVERED			
	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time	No. of Cases	Time
USN DATA (Combat and Combat Associated)	1	10	1	8	1	<30	1	-1	1	16
	1	25	1	9	1	<99	7	0	1	17
	1	~560	1	<15			1	1	2	18
			1	21			2	2	1	19
			1	22			1	<3	4	20
			1	>120			1	3	1	~20
							1	5	1	25
							1	6	1	~30
							2	7	1	33
							1	<10	1	~40
							1	10	1	43
							1	~10	1	47
							1	<12	1	~91
							1	14	1	~120
							3	15	1	~240
							1	~15		
USAF DATA (Combat only)	1	40	1	30	1	0	1	9	1	51
							1	<10	1	53
							1	20	1	[illegible]
							1	40	1	75
							1	47		

[redacted]

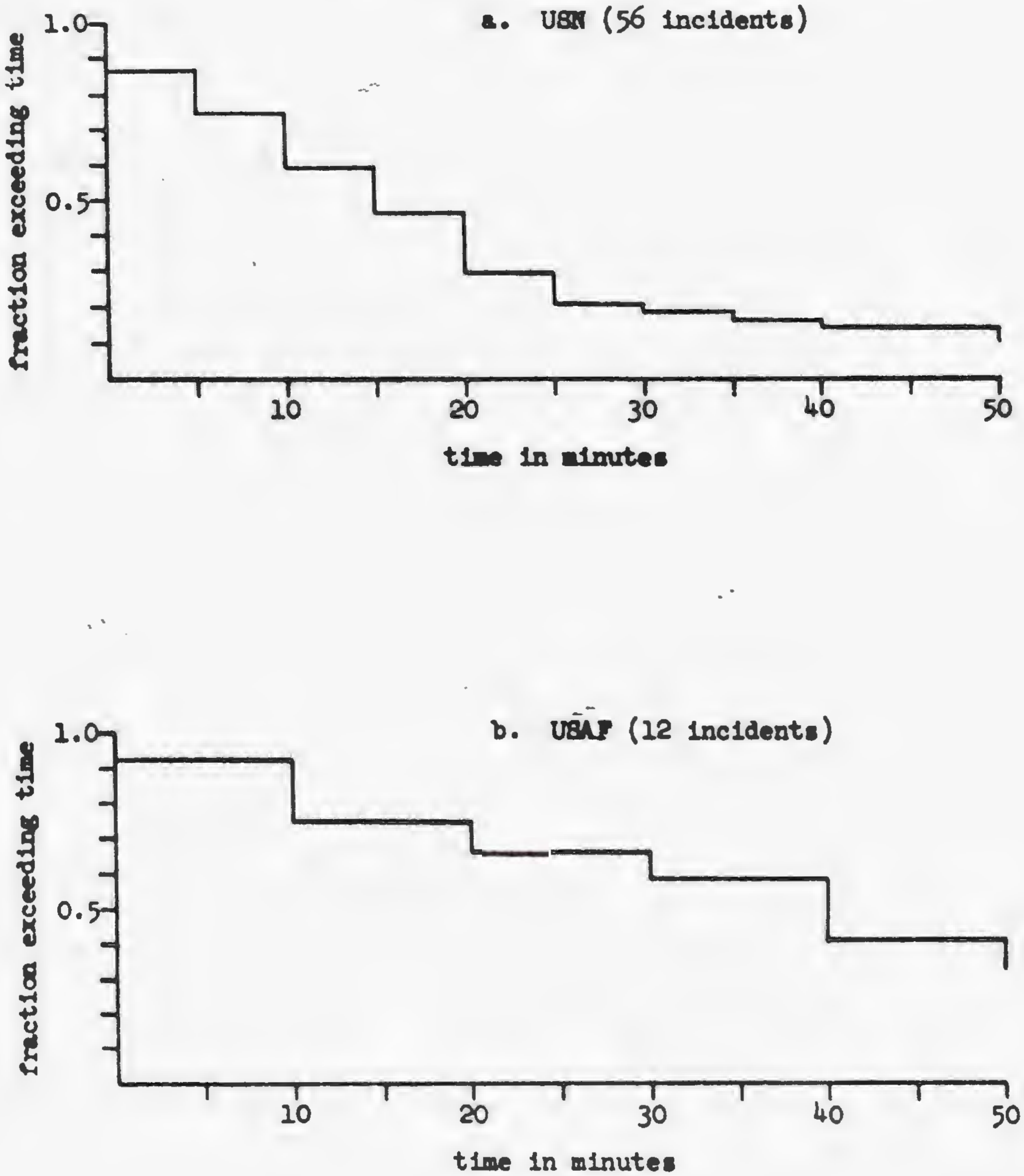


Figure B-13. Distribution of Rescue Vehicle Arrival Times,
1 April 1966 - 31 March 1967.

[redacted]

in paragraph 12.

A few of the rescue vehicle arrival times-late appear to be excessive, and therefore deserve special comment. Two of these are the incidents discussed in paragraph 9. Rain at the pilot's position caused the delay in the incident resulting in recovery in which the helicopter arrived 120 minutes after the pilot went down (17 April 1966, A4E, LCdr HOUGH).

As discussed in paragraph 9, approximately 75 percent of those captured were taken within 15 minutes. It is therefore apparent that an ideal rescue vehicle should be able to accompany the strike force, or at least operate closer to the targets than at present.

As was pointed out in paragraph 7, 5 minutes of the 15 minute rescue vehicle time-late results from delays in the command and control network. Thus, any improvement in this area would also decrease the rescue vehicle time-late.

11. LOCALIZATION TIME AT SAR SCENE

Allowance must be made for the time required to locate the downed crewman after arrival of the rescue vehicle on the scene. In 23 cases where a difference in time is given between rescue vehicle arrival and subsequent sighting of the downed crewman, there was an average time lapse of nine minutes, with a median of six minutes. The cases considered exclude pickup cases that were definitely unopposed.

If the wingman remained on the scene, the reduction in pick-up vehicle search time was not very large. The search time was reduced to an 8 minute average, with a median of 7 minutes (sixteen cases).

12. RESCUE VEHICLE PICKUP TIME DISTRIBUTION

The period that elapses between the time a pilot goes down and actual pickup by the rescue vehicle is of interest, as it reflects the length of time a pilot must remain on the ground or in the water before coming fully under friendly control. If the pilot was injured in the aircraft, or in the subsequent ejection and parachute descent, this is the length of time he must wait for medical assistance.

The data for the 50 Navy cases for which this time is known are given in table B-15. The distribution of these times is shown in figure B-14. The median time spent by a pilot awaiting pickup is indicated in the figure as 15 minutes.

13. EFFECT OF RESCUEE LOCATION

Tables B-1, B-2, B-3, and B-4 showed the wide variation in recovery rate between countries, between different parts of the same country, and between the land and the sea. The sensitivity of the recovery rate was discussed in paragraph 3. It must be recalled that personnel in the water within 5 miles of the coast were included in the data for the adjacent land area.

The high number of downed personnel and low recovery rate in NVN, particularly in the northern route packages, are, of course, the result of the influence of the heavy defenses there. The heavy defenses not only result in more personnel being shot down, but also prevent SAR forces from entering the area.

Figures B-15 through B-22 show the locations of the Navy and Air Force pilots downed in NVN since February 1962 for whom locations are known. Figures B-23 through B-26 illustrate the locations of Navy and Air Force pilots picked up by Navy and Air Force recovery vehicles.

TABLE B-15. RESCUE VEHICLE PICKUP TIME (MINUTES)
1 APRIL 1966 - 31 MARCH 1967

USN DATA (Combat and Combat Associated)

No. of Recoveries	Pickup Time	No. of Recoveries	Pickup time
3	1	4	20
2	2	1	21
5	3	1	22
1	4	2	24
2	5	1	28
2	7	1	29
1	8	1	31
4	9	1	36
2	10	1	38
1	12	1	39
3	13	1	40
1	14	3	45
2	15	1	56
2	19		

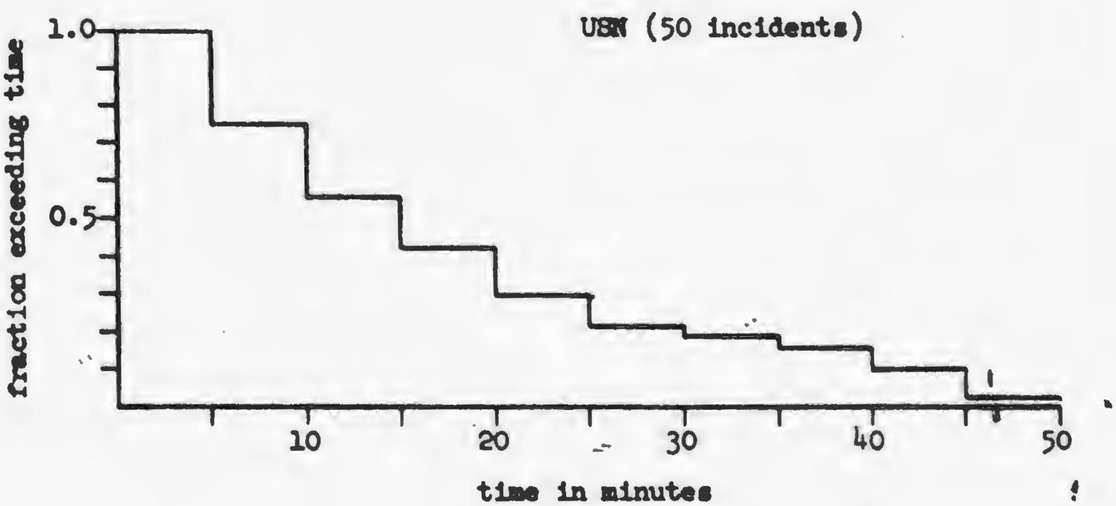


Figure B-14. Distribution of Rescue Vehicle Pickup Times, 1 April - 31 March 1967.

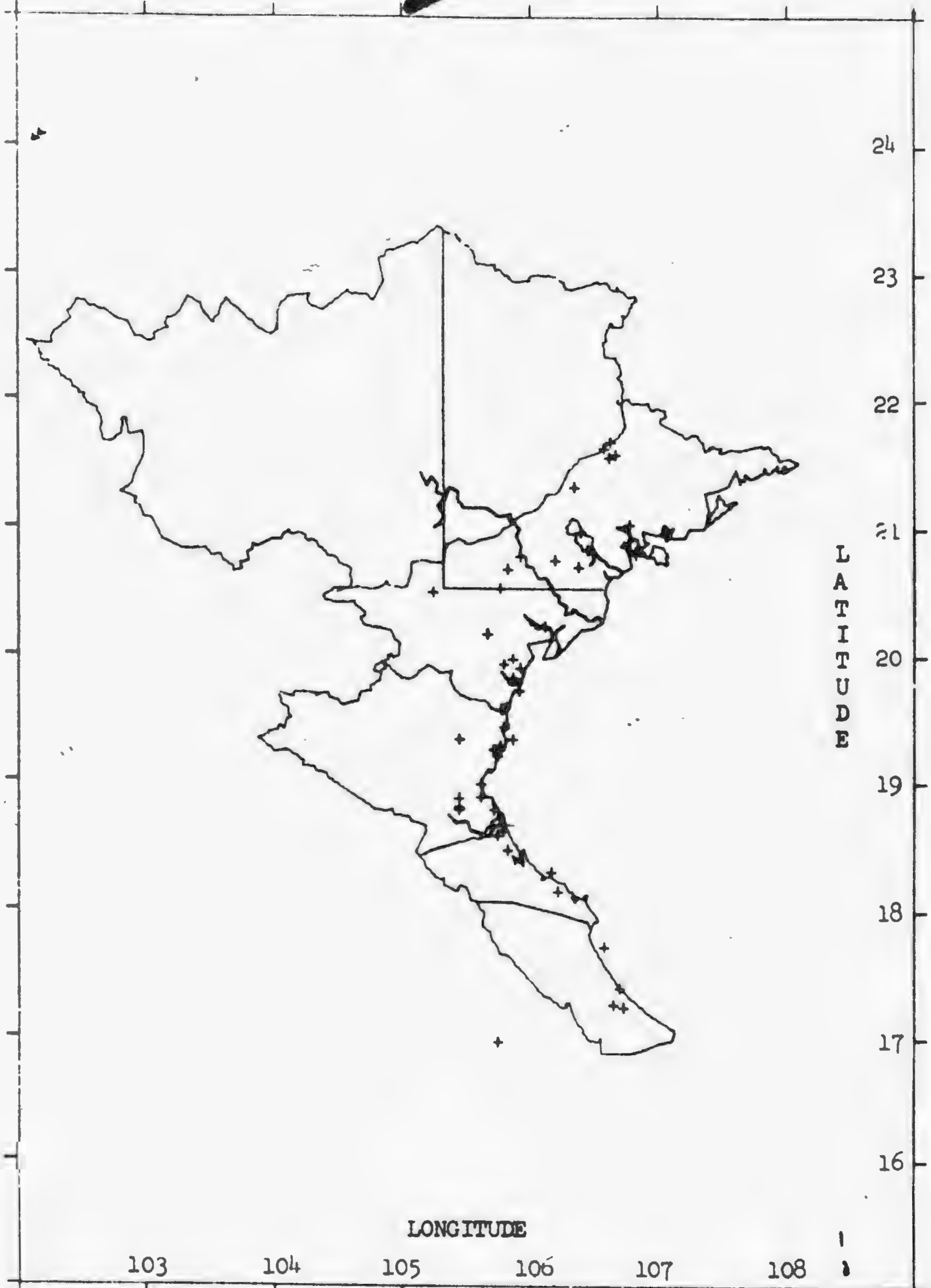


Figure B-15. Navy Prisoners of War.

[redacted]

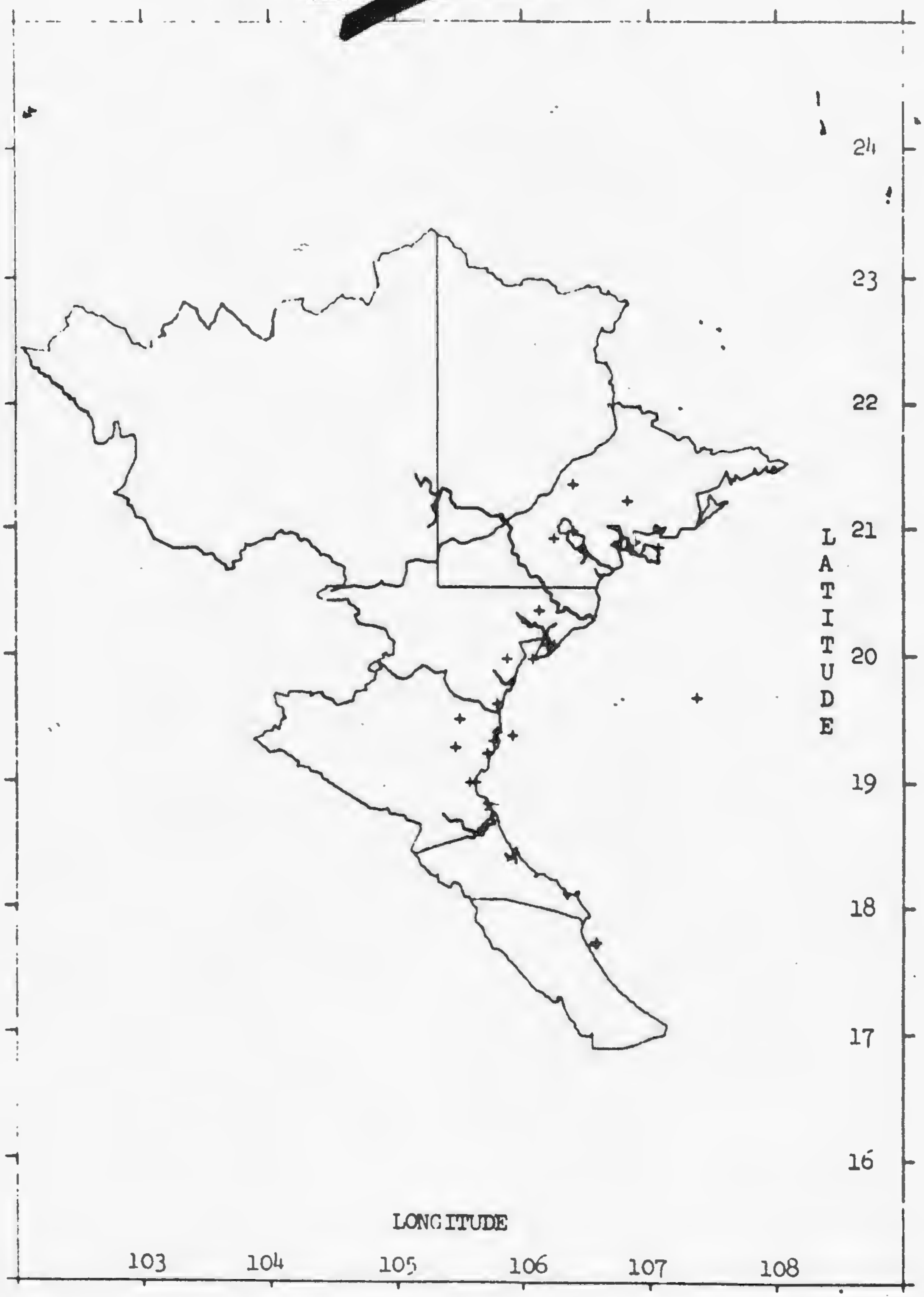


Figure B-16. Navy Killed in Action.

[redacted]

SEC[redacted]

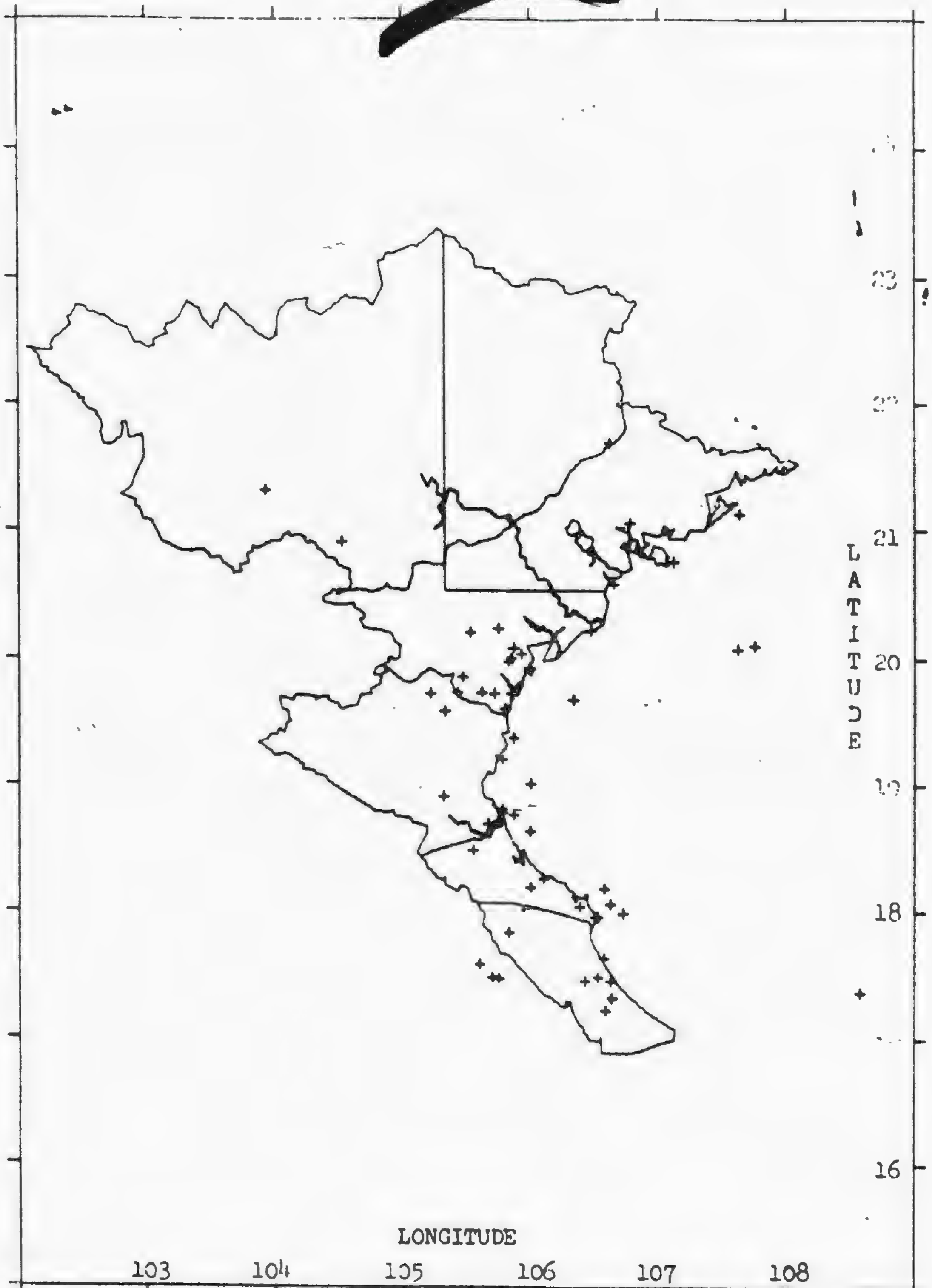


Figure B-17. Navy Missing in Action.

SEC[redacted]

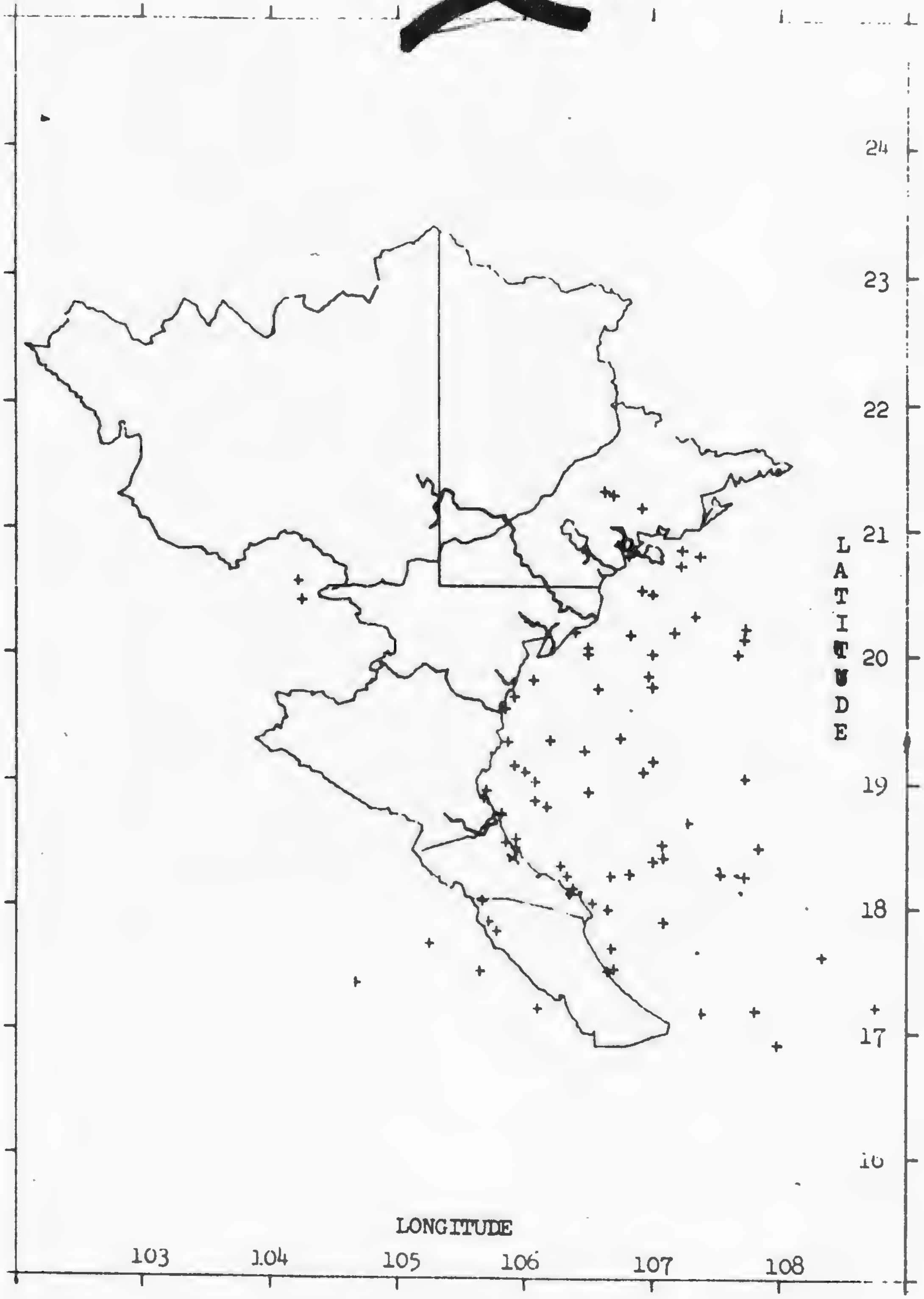


Figure B-18. Navy Recovered.

[redacted]

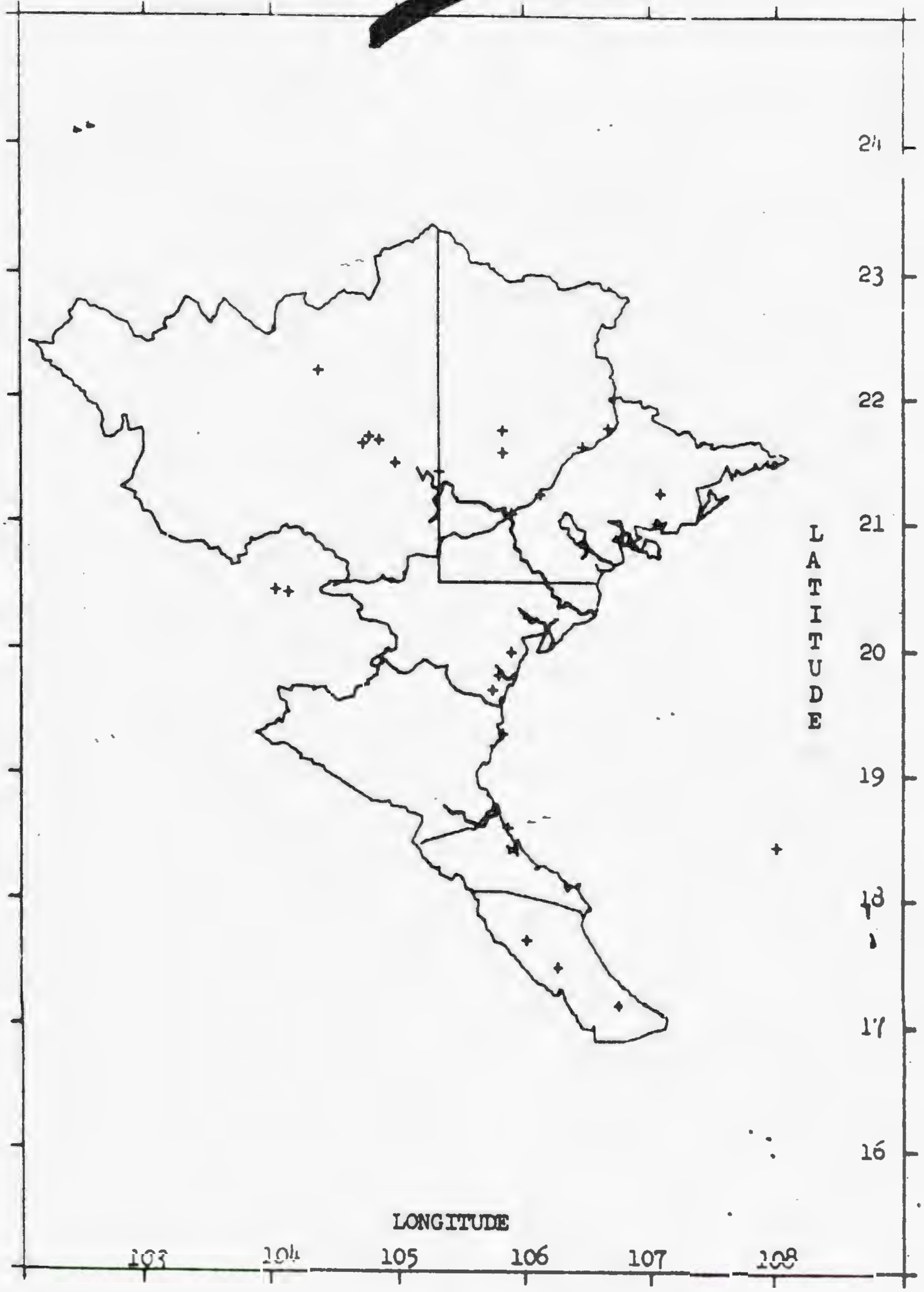


Figure B-19. Air Force Prisoners of War.

[redacted]

[redacted]

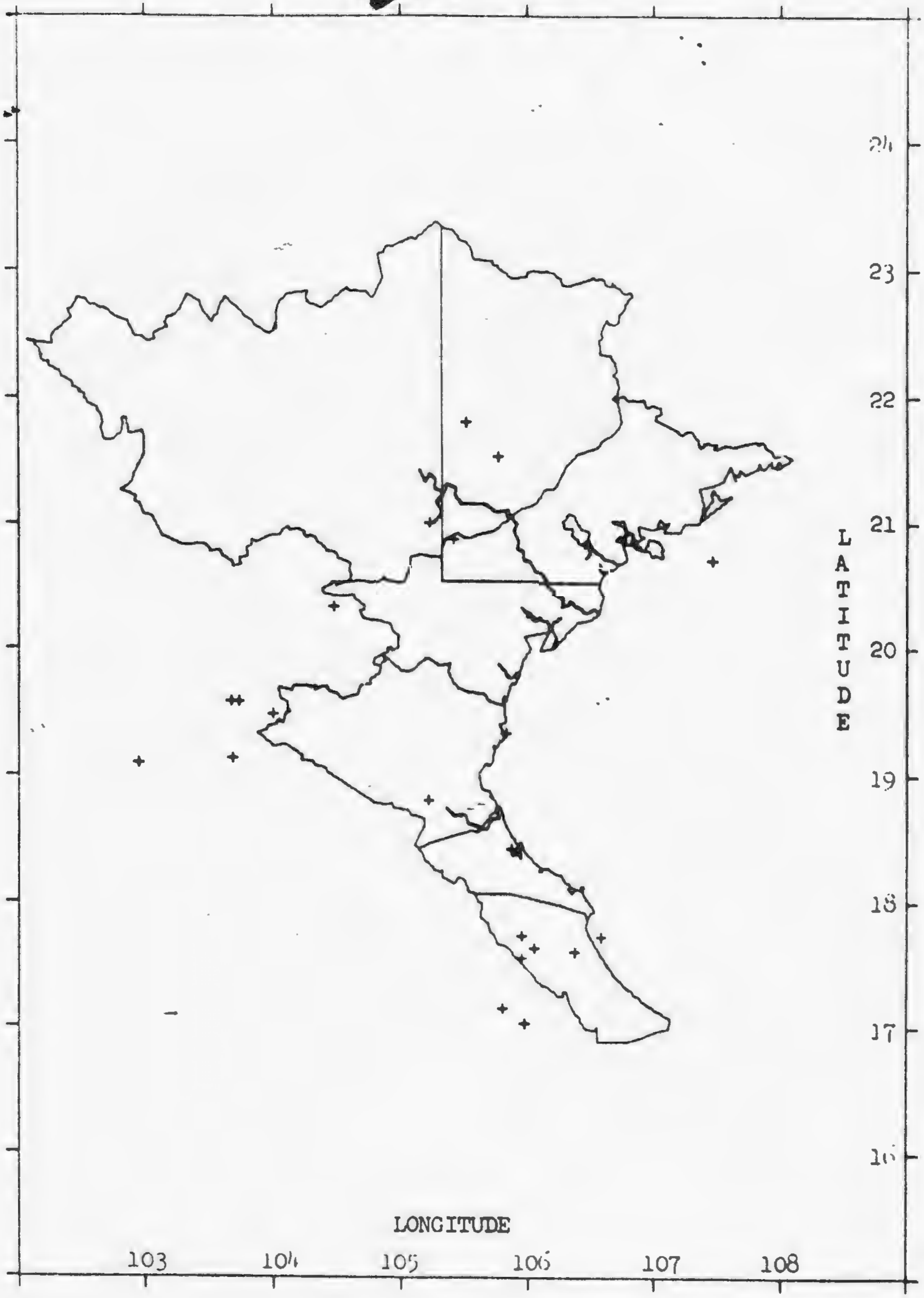


Figure B-20. Air Force Killed in Action.

[redacted]

S[redacted]ET

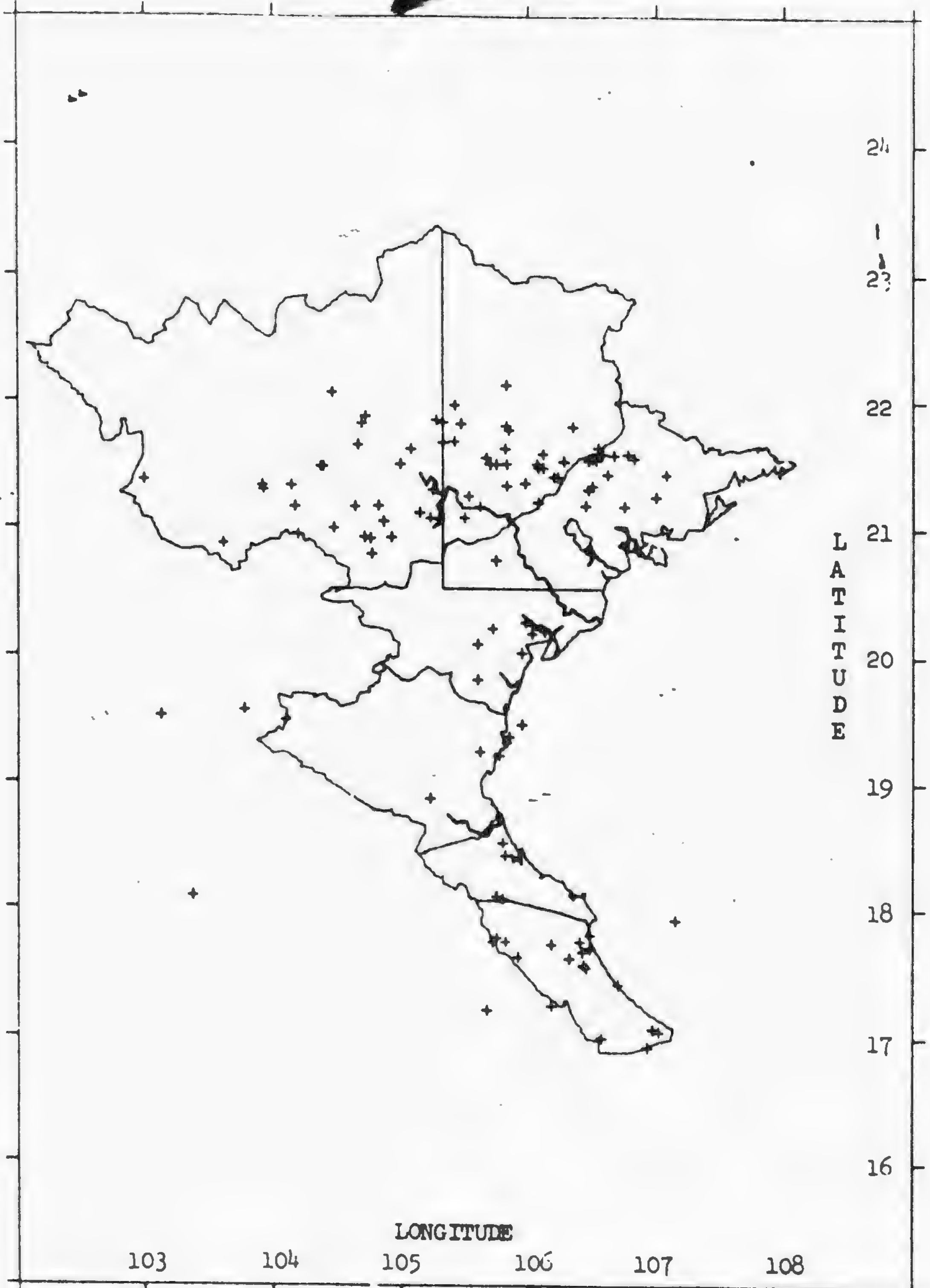


Figure B-21. Air Force Missing in Action.

[redacted]

[redacted]

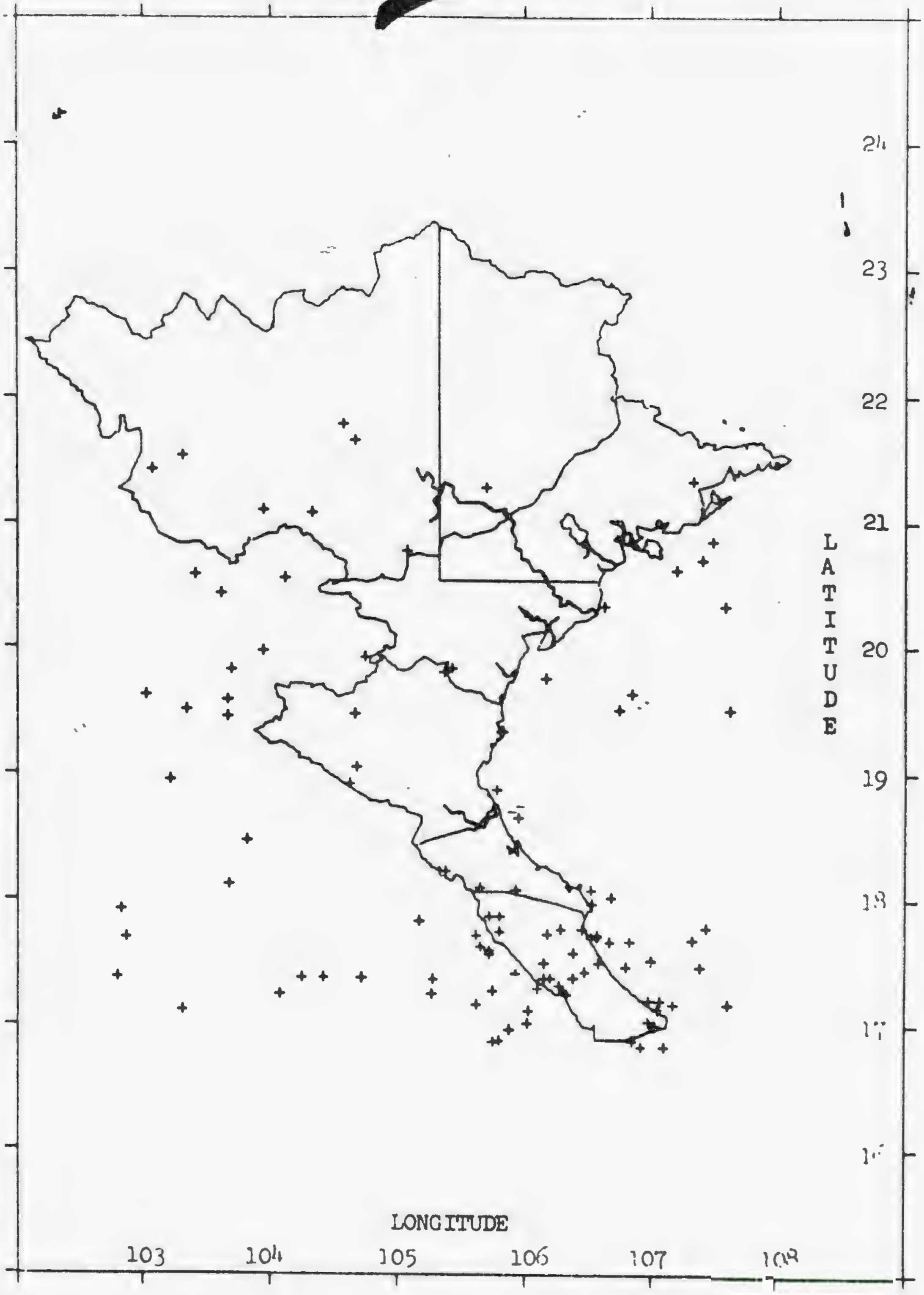


Figure B-22. Air Force Recovered.

[redacted]

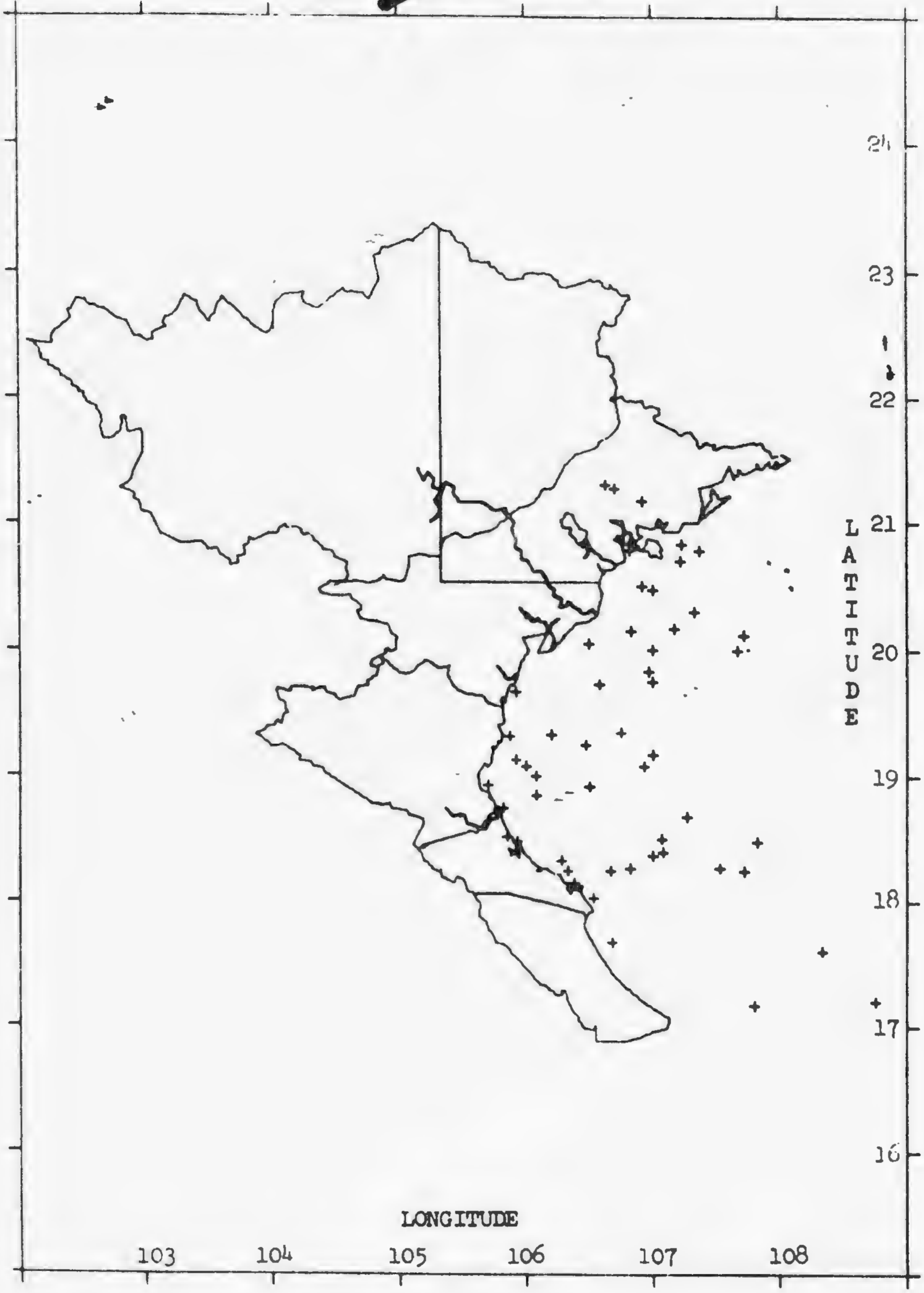


Figure B-23. Navy Pilots Recovered by Navy.

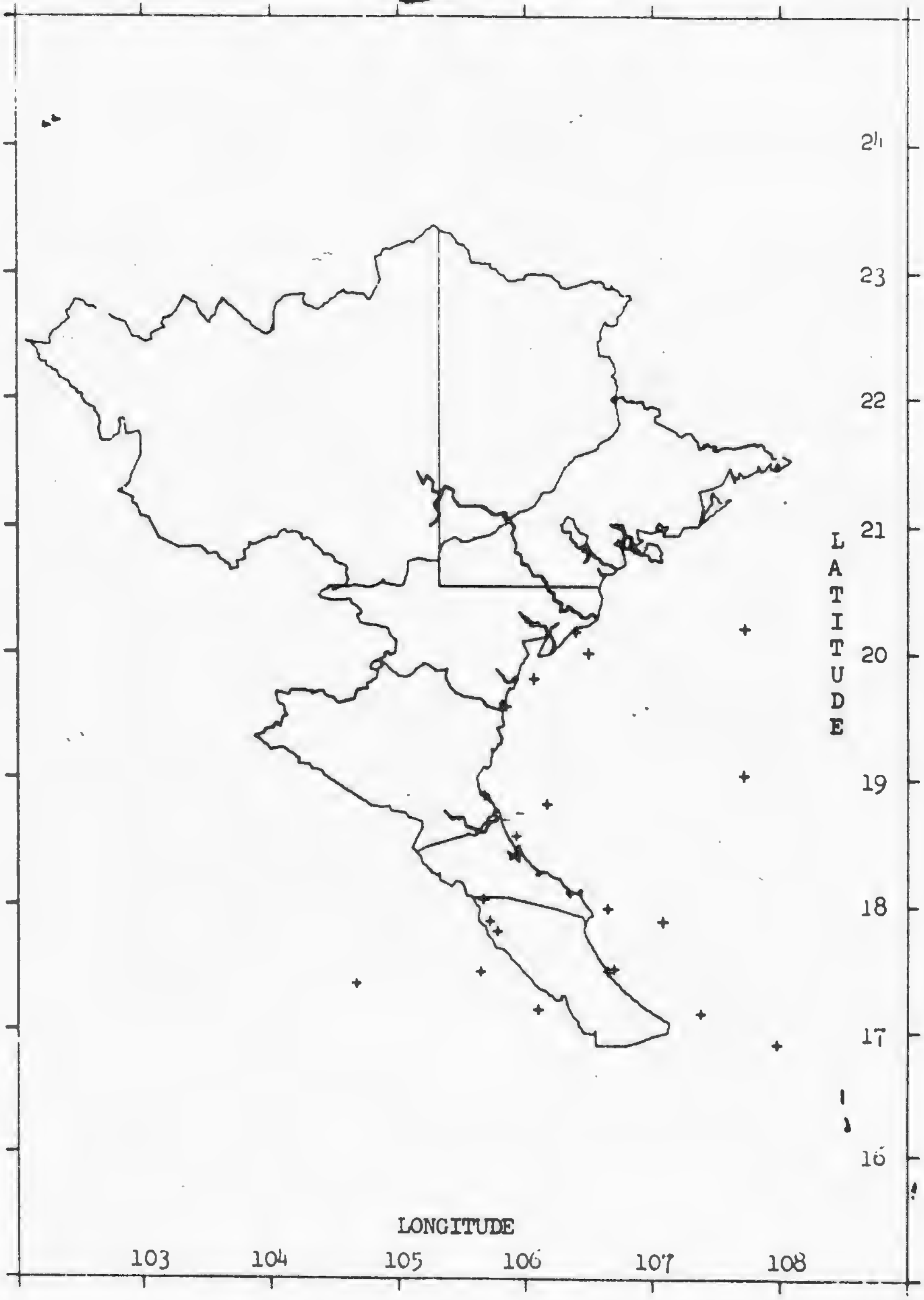


Figure B-24. Navy Pilots Recovered by Air Force.

[redacted]

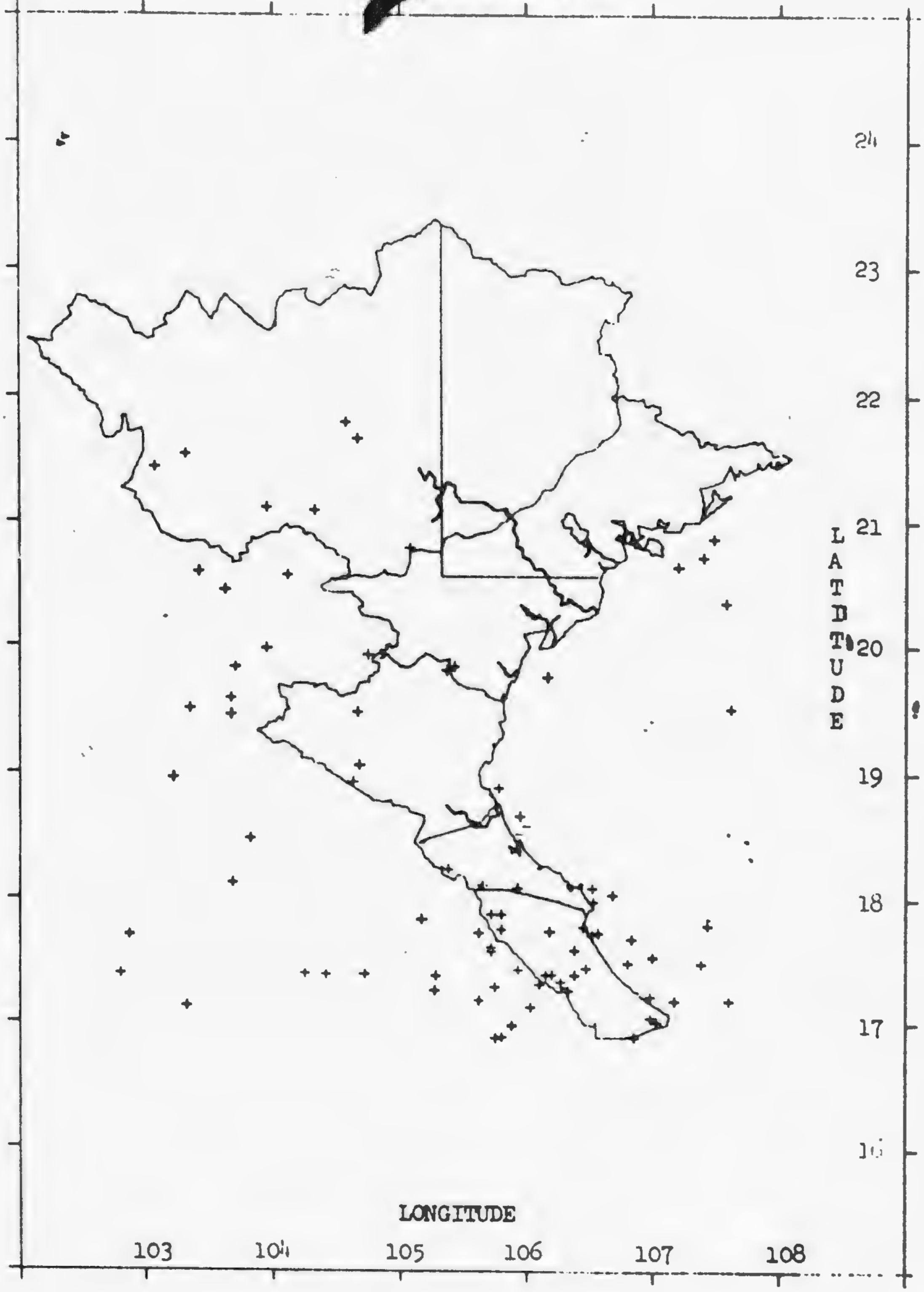


Figure B-25. Air Force Pilots Recovered by Air Force.

[redacted]

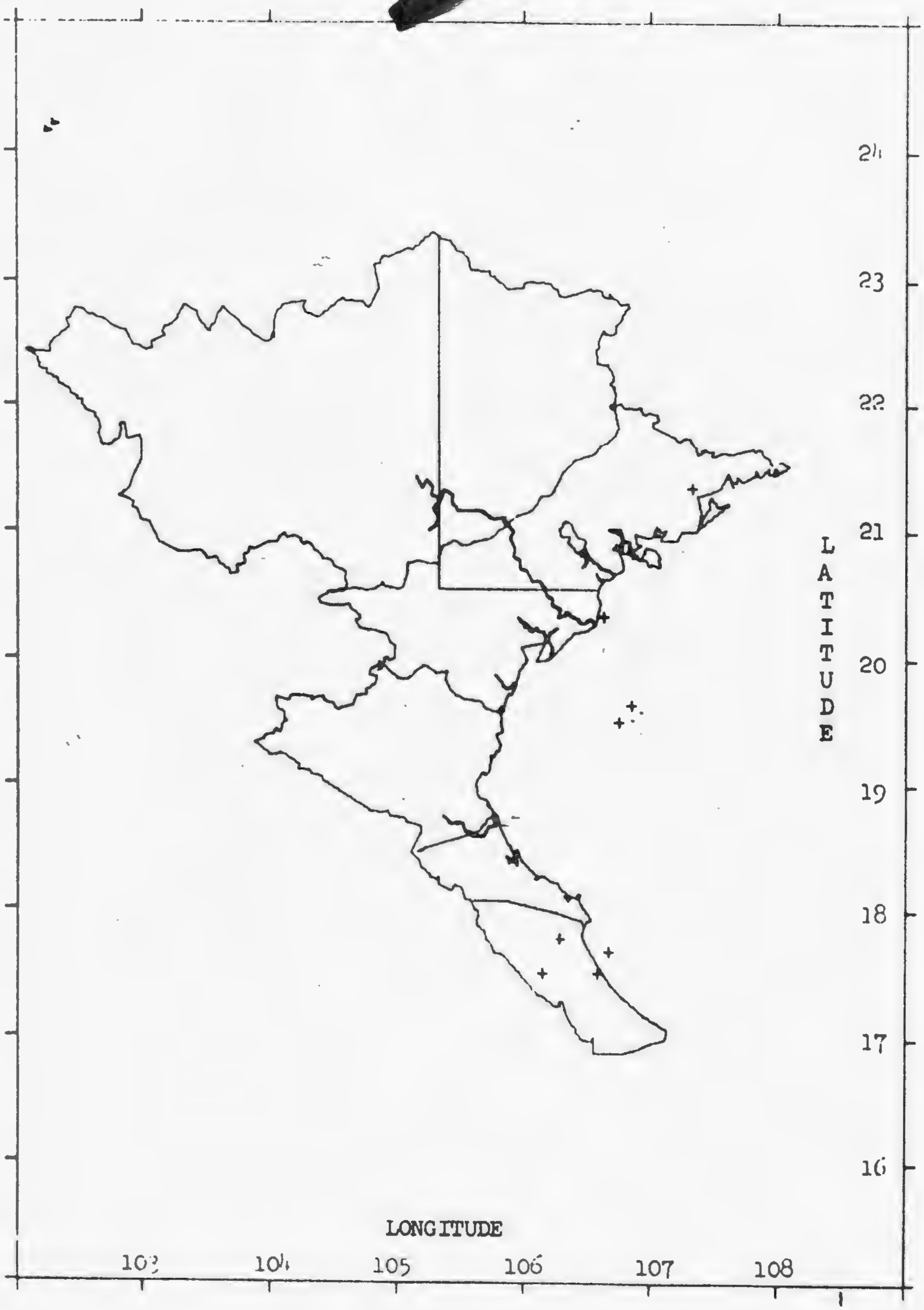


Figure B-26. Air Force Pilots Recovered by Navy.

Since some recoveries have been made by Air America, Army, and Marine helicopters, not all recoveries that appear on figures B-18 and B-22 appear on figures B-23 through B-26. The beneficial effect on recovery of heading out to sea is clearly illustrated in figure B-23. An examination of the Navy and Marine Corps data showed a recovery rate of 7.8 percent for personnel down over land, and 80 percent in the 5 mile strip off the coast. The 87 percent recovery rate in the water beyond 5 miles compares favorably with the operational recovery rate of 91 percent.

Since a large percentage of the Navy recoveries were made over water, those 17 cases which occurred over land or over water, but within 5 miles of the coast were examined separately.

Table B-16 compares the median values of the time or distance indicated for the recovery incidents occurring over land or less than 5 miles at sea with the corresponding median values for all recovery incidents, and for incidents in which the pilot was taken prisoner.

TABLE B-16. DATA COMPARISON OF RECOVERY AND PRISONER INCIDENTS (MEDIAN VALUES)

	Recoveries over land or over water within 5 miles of coast	All Recoveries	Prisoners
Hit to egress time (minutes)	2	5	1
Distance flown after hit (miles)	5	20	4
After-hit alert time (minutes)	4	6	5
After-down alert time (minutes)	0	0	0
SAR force to aircrew distance (miles)	23	15	21
SAR support arrival time (minutes)	19	13	19
Rescue vehicle arrival time (minutes)	33	15	15

The table shows that the median times or distances were almost identical for recoveries made over land, or over water within 5 miles of the coast. and for incidents in which the pilot was taken prisoner. The only apparent difference was in the rescue vehicle arrival time. Since this time was available for pilots taken prisoner in only three incidents, the actual significance of the apparent difference in rescue vehicle arrival time is questionable.

The conclusion to be drawn from the comparison is that times or distances do have an influence, but do not determine by themselves whether a downed pilot is recovered or taken prisoner. Rather, it is these factors plus other factors, such as area defenses, population density, terrain, ability to communicate with the SAR forces, etc., that determine the final outcome of a SAR incident.

An attempt was made to determine the influence of terrain on recovery rate. However, there were too few incidents for which terrain information was available to determine any pattern for correlation. Although some pilots were taken prisoner because they could not be located in the dense jungle cover, there have also been incidents where the thick underbrush enabled the pilot to remain concealed while searchers were close by. The importance of a working two-way radio in the thick jungle cover is obvious, but, even with a working radio, the helicopter was not always able to localize the pilot and make a pickup.

14. EFFECT OF TIME OF DAY

Table B-17 lists recovery statistics for Navy, Air Force, and Marine losses during the study period.

[redacted]

TABLE B-17. DAY/NIGHT RECOVERY DATA

Local Time	0600-1200	1200-1800	1800-0600
No. A/C Down	78	141	67
Recovery Rate (in percent)	64	61	51

As the table indicates, rescue was simplified when sufficient daylight remained after the loss to allow time for search and pickup. This day/night recovery rate difference is statistically significant at the 90 percent level.

Table B-18 lists recovery statistics for USN combat and combat associated losses in North Vietnam, categorized by day/night, and land/sea.

Although the need for an improved night recovery capability is evident from the statistics, it was not necessarily the recovery vehicle that was the limiting factor. More often, it was an inability to determine that there was actually a recoverable pilot on the ground.

Of the 23 "recoverable" pilots from night SAR incidents, 2 are prisoners, 19 are missing, 1 was recovered at night, and 1 was recovered the following day. The night recovery was made in an unopposed area off the coast of South Vietnam on 30 April by an NH-43. Both prisoners were lost due to heavy enemy opposition in the area. The helo was damaged in one night pickup attempt.

In only one incident where the pilot is missing was there any sign of survival. In that one, it was stated that there was only a "possibility" of a flare being seen.

Thus, a major problem in night SAR incidents has been a lack of knowledge of the actual location and the recovery potential of the pilot who is down.

[redacted]

TABLE B-18. COMBAT AND COMBAT-ASSOCIATED LOSSES, USN PERSONNEL ONLY, NVN

153 Total Personnel

NIGHT-LAND (15.0%)		**NIGHT-SEA (3.9%)**	
No. Down	23	No. Down	6
Recoverable	18	Recoverable	5
Recovered	0	Recovered	1
Recovery Rate	0%	Recovery Rate	20%
Fraction Recoverable	79%	Fraction Recoverable	83%
DAY-LAND (26.8%)		**DAY-SEA (54.2%)**	
No. Down	41	No. Down	83
Recoverable	33	Recoverable	73
Recovered	3	Recovered	65
Recovery Rate	9.1%	Recovery Rate	89%
Fraction Recoverable	89.5%	Fraction Recoverable	88%
LAND OVERALL (41.8%)		**SEA OVERALL (58.2%)**	
No. Down	64	No. Down	89
Recoverable	51	Recoverable	78
Recovered	3	Recovered	66
Recovery Rate	5.9%	Recovery Rate	84.6%
Fraction Recoverable	80%	Fraction Recoverable	88%

TABLE B-18. COMBAT AND COMBAT-ASSOCIATED LOSSES, USN PERSONNEL ONLY, NVN (Continued)

153 Total Personnel

NIGHT OVERALL (19.0%)

No. Down	29
Recoverable	23

NIGHT OVERALL (19.0%) (Continued)

Recovered	1
Recovery Rate	4.3%
Fraction Recoverable	79%

DAY OVERALL (81%)

No. Down	124
Recoverable	106

DAY OVERALL (81%) (Continued)

Recovered	68
Recovery Rate	64%
Fraction Recoverable	85.5%

PERSONNEL

TOTAL (100%)

No. Down	153
Recoverable	129
Recovered	69
Recovery Rate	53.5%
Fraction Recoverable	84.3%

NOTES: 1. Land or sea denotes where aircrew was down, regardless of where aircraft was hit.

2. Recoverable is defined as total down minus number killed.

3. Day is considered as from 06:00 to 18:00 local time or 22:00 to 10:00 ZULU.

15. EFFECT OF AIRCRAFT MISSION AND MISSION COMPOSITION

An attempt was made to determine if the long time delay in receiving the SAR alert for many of the missing pilots was related to the aircraft mission and the number of aircraft in the flight. It was thought that some aircraft might have been operating alone, with no wingman to report the loss. This was the case for only two Navy aircraft in the one year period, an A3B on a mining mission, 8 March 1967, and an A3B on a ferry flight, 12 April 1966. No other correlation between aircraft mission and the number of aircraft in the flight could be found that would account for the long SAR alert times.

16. EFFECT OF RESCUEE INJURY

Pilot or crewman injury makes the process of recovery much more difficult. An injury could make it difficult for the rescuee to move on the ground to avoid being captured, or to move into a clearing to signal the vehicle. Often an injury makes it necessary for a vehicle crewman to go down and assist in the rescue operation. In 80 NAVY/USMC water pickup incidents, SAR vehicle crewmen were reported to have entered the water 19 times to aid the downed aircrewmen. In 11 NAVY/USMC land pickup attempts, there were no reports of a SAR vehicle crewman leaving the vehicle to provide assistance.

Some indication as to the cause of injury can be ascertained from the 39 incidents summarized in Table B-19.

The table is based on known incidents only, as evidenced by the small sample of prisoner and missing. However, on the basis of the sampling, it can be seen that most of the injuries occur as a direct consequence of a hit.

TABLE B-19. CAUSE OF INJURY

CAUSE	KIA	POW	MISSING	RECOVERED	TOTAL
Hit	18	1	1	8	28
Egress	4	1		1	6
Ditch	3				3
Landing				2	2

17. REASON FOR LOSS

The reasons for USN aircraft losses in combat and combat associated incidents in NVN, SVN, and Laos were examined over the one year study period (114 incidents). The incidents covered by this examination were divided according to distance flown after hit and the subsequent disposition of the pilot (see Table B-20). As can be seen, fire was the primary cause of aircraft loss; it occurred in 49 percent of all cases, or five times as frequently as any other known case. Fire was also the only known reason for aircraft losses that resulted in the pilot's capture, and accounted for 90 percent (18 or 20) of these cases.

It can also be seen that the three non-recovered categories show higher percentages of incidents in which the distance flown after hit is less than or equal to 5 miles than do the recovered.

18. USE OF SUPPRESSIVE FIRE

The reporting of suppressive fire by friendly aircraft in the vicinity of downed aircrewmen has been sketchy. Few reports indicate suppressive fire having been furnished by the rescue vehicle. There are more reports of suppressive fire being furnished by RESCAP forces; however, usage of

[redacted]

TABLE B-20. PRIMARY REASON FOR AIRCRAFT LOSS
USN COMBAT AND COMBAT ASSOCIATED; NVN, SVN, AND LAOS

INCIDENT CATEGORY	POW			KILLED			MISSING			RECOVERED			OVERALL			TOTAL	% OF TOTAL
Distance Flown After Hit (miles)	<5	5-10	>10	<5	5-10	>10	<5	5-10	>10	<5	5-10	>10	<5	5-10	>10		
Fire	10	2	6[a]	4	1	2	6	0	0	4	5	16	24	8	24	56	(49%)
Engine	0	0	0	0	0	1[a]	0	0	0	1	1	6	1	1	7	9	(8%)
Controls	0	0	0	0	0	1[a]	0	0	0	4	0	6	4	0	7	11	(10%)
Other Structural	0	0	0	0	0	1[a]	0	1	0	0	1	2	0	2	3	5	(4%)
Miscellaneous	0	0	0	0	0	1[b]	0	0	0	1[d]	0	3[b,d,e]	1	0	4	5	(4%)
Unknown	1	0	1[a]	8	0	3	1	1	11[c]	1	0	1	11	1	16	28	(25%)
Total	11	2	7	12	1	9	7	2	11	11	7	34	41	12	61	114	(100%)

Cause of Aircraft Loss

a. Includes 1 unknown distance flown
b. Includes 1 aircrew injury
c. Includes 8 unknown distances flown
d. Includes 1 fuel leak
e. Includes 1 fuel exhaustion

[redacted]

suppressive fire is not frequently reported. The following table indicates the extent of the correlation between the use of suppressive fire and recovery of personnel; the table is limited to cases where the pickup attempt was opposed.

TABLE B-21. EFFECT OF SUPPRESSIVE FIRE ON RECOVERY RATE

	POW	MIA	REC	TOT	% REC.
Suppresive Fire used	5	7	18	30	60%
No Suppressive Fire Reported	18	16	15	49	31%

The table indicates that suppressive fire increases the recovery rate, but the data is insufficient for the evaluation of the relative merit of RESCAP versus the pickup vehicle as suppressors.

19. PERSONAL SURVIVAL EQUIPMENT

Table B-22 illustrates the number of times various equipment types were reported to be instrumental in sighting USN downed personnel.

TABLE B-22. MEANS OF PILOT DETECTION

EQUIPMENT	NO. INCIDENTS REPORTED
Chute	40
Flare	39
Radio	38
Beeper	28
Wreck	26
Dye	12
Others	14

[redacted]

Radio failure was reported occasionally, but usually these reports had little detail. Navy and USMC data indicated 16 attempts to use a personal survival radio when downed on land, with 2 partial failures. Thirty-four attempts to use the personal survival radios at sea resulted in nine total failures and six partial failures. Although two radios per crewman have been available since June 1966, there is no specific data on how many radios are carried by each aircrewman.

20. MEANS BY WHICH SAR FORCE ALERTED.

A comparison was made between the number of personnel rescued and the number of personnel not rescued (and not killed), according to the means by which the SAR force was alerted (Table B-23).

TABLE B-23. EFFECT OF MEANS BY WHICH SAR FORCE ALERTED

Means of Alert	Pilot Mayday	Wingman Mayday	Visual, other than wingman	Ramp check	Comm Lost
Rescued	19	36	12	2	1
Not Rescued	2	24	1	2	9

It can be seen that successful recoveries involve rapid and accurate reports of the position of the downed aircrewman, and that SAR missions initiated because of lost communication have a much lower probability of recovery.

21. PRISONER DETAILS

The cases of twenty-five POW's were examined to determine which, if any, of the configurations of vehicle tactics would have led to a probable recovery.

The use of the Strike Group SAR configuration would probably have led to three recoveries of personnel. In all three cases, armor and supressive fire are the two most important qualities that were needed by the rescue force.

The use of the SAR Team concept would have probably led to the recovery of 4 of the 25 POW's considered. Three of these are cases that would have been capably handled by Strike Group SAR, as they require the ability to penetrate AAA areas.

A fourth case is included in SAR Team capability that could not be effected by other systems because of the heavy local defenses encountered. In this case a light helo was forced to turn back due to a hit by AAA.

In another case considered, a pilot ejected at 8,000 feet and was surrounded by at least four men immediately after his arrival on the ground. Air Snatch is the only system that would probably have prevented his capture.

In yet another case, any system of pickup would probably have been sufficient. A pilot was down in the sea about 2 miles from shore at night. No radio or visual contact was made, but the status of the pilot was changed to POW following a radio Hanoi claim of capture of a pilot in area. This capture could probably have been averted with improved night contact capability.

The POW cases examined revealed that in twelve of the twenty-five incidents, the SAR forces encountered difficulty in their attempts to localize the downed personnel.

22. DATA TREND ANALYSIS

The possible existence of a trend toward a decreasing recovery rate in recent months may be seen in a graph (figure B-27) depicting the cumulative recovered and recoverable personnel for all losses on sorties into NVN during the seven month period from 1 September 1966 to 31 March 1967. Although this graph appears to indicate the recovery rate declined over the period considered, a study of USN, USMC & USAF data over the period from 1 February 1965 to 28 February 1967 concluded: "No statistically significant time trend was noted in South Vietnam, Laos, or route packages 1 through 4. Marginally significant trends were noted in route packages 5 and 6 - but in opposite directions. Thus, there seems to be no evidence that SAR recovery rates are decreasing."[8] The recovery rate of personnel lost on all sorties into NVN over the period from 1 September 1966 to 31 March 1967 was 34.2 percent; for USN personnel it was 36.7 percent.

A further examination of the data was undertaken, in which personnel were separated into categories of killed, missing, prisoners, and recovered. This separation shows that the category of missing is much larger than any other (figure B-28), and includes 46 percent of the personnel considered. The missing category, and its effect upon the data, is more extensively discussed in paragraph 3.

Attack sorties into NVN over the one year period from 1 April 1966 to 31 March 1967 were examined. The sorties and losses[9] were separated according to route packages. In the graphs of figure B-29, the solid line

---

[8] Robert L. Hubbard, OEG Scientific Analyst to Op-5W, Memorandum for Director, Air Weapons System Analysis Staff, (OEG) 00171-67, 3 April 1967, SECRET, Subject: Search and Rescue (U).

[9] Losses in a route package are according to where the aircraft was hit, and not according to the location at which the craft actually went down. Many aircraft flew fairly large distances before the crew ejected.

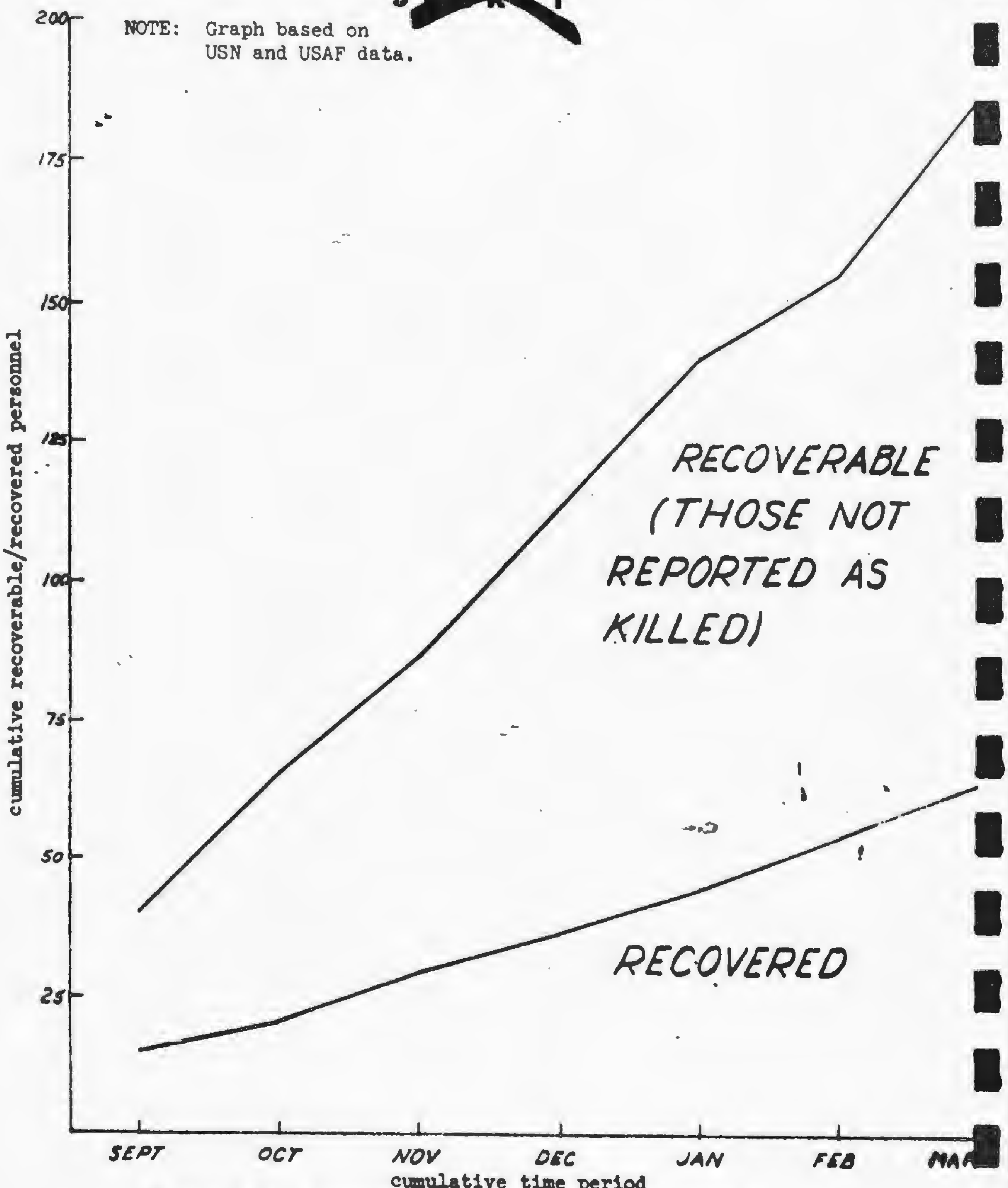


Figure B-27. Cumulative Recoverable and Recovered Personnel for 7 Month Period, 1 September 1966 - 31 March 1967.

[redacted]

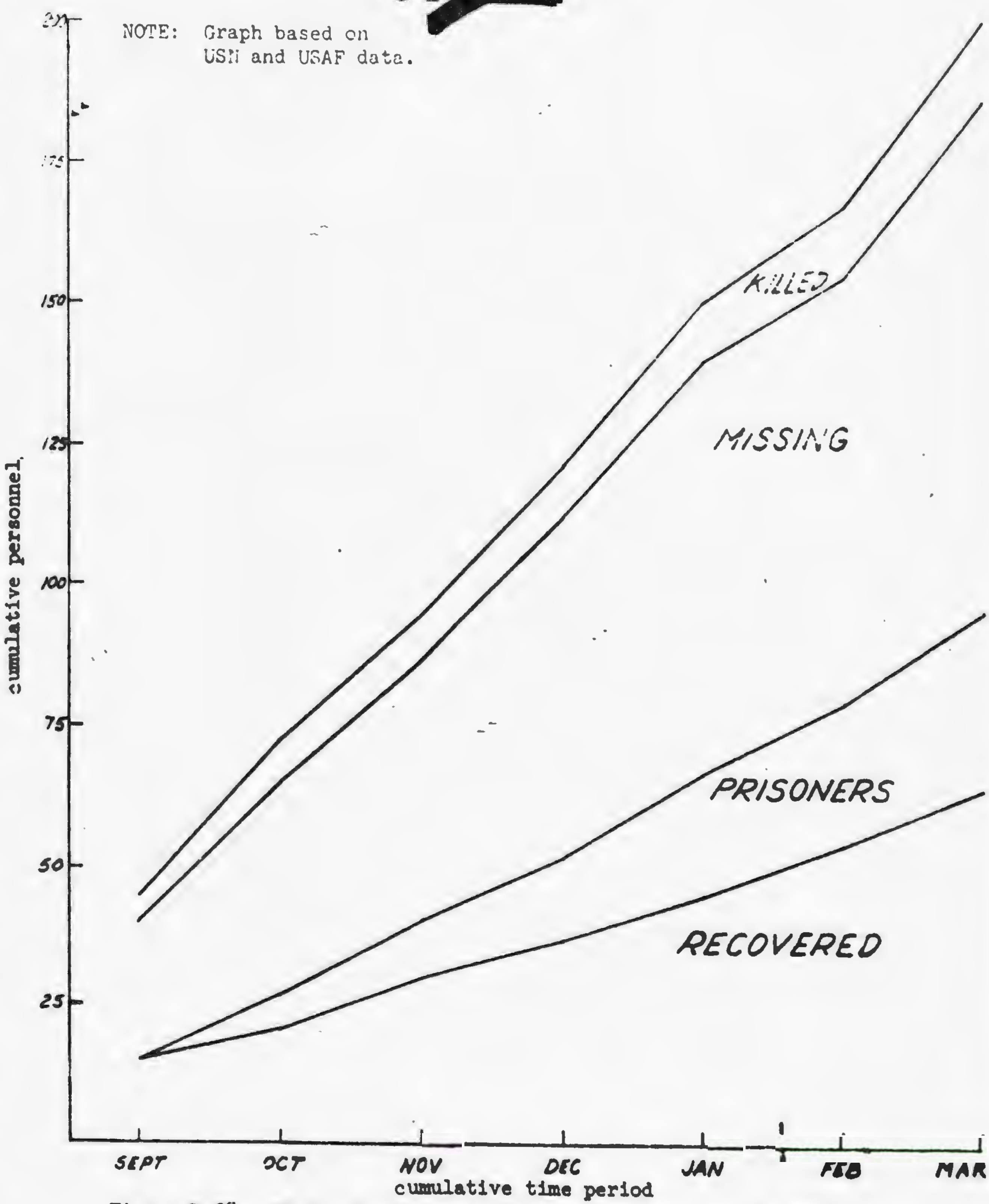
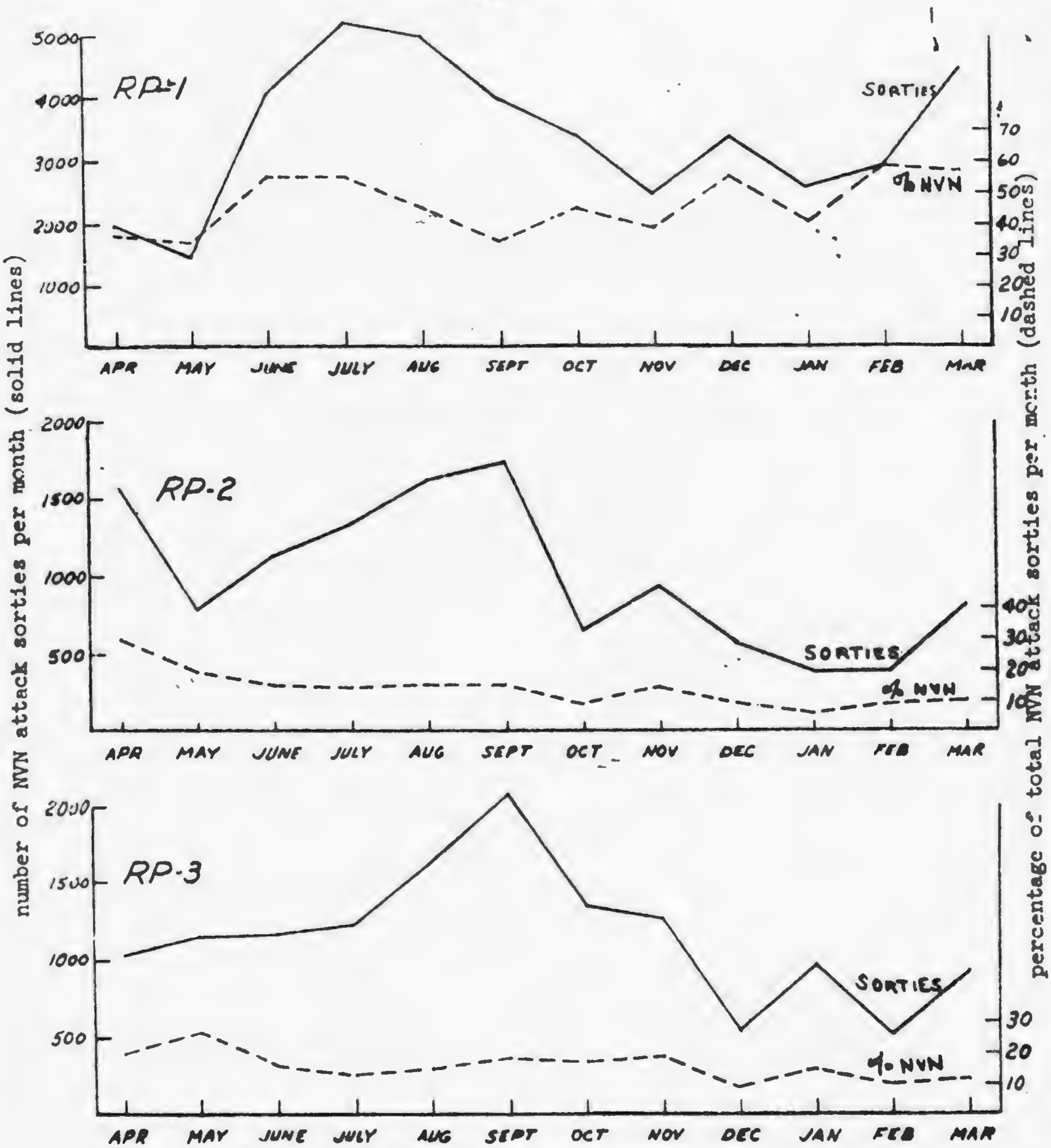


Figure B-28. Status Breakdown of Downed Personnel for 7 Month Period, 1 September 1966 - 31 March 1967.

[redacted]

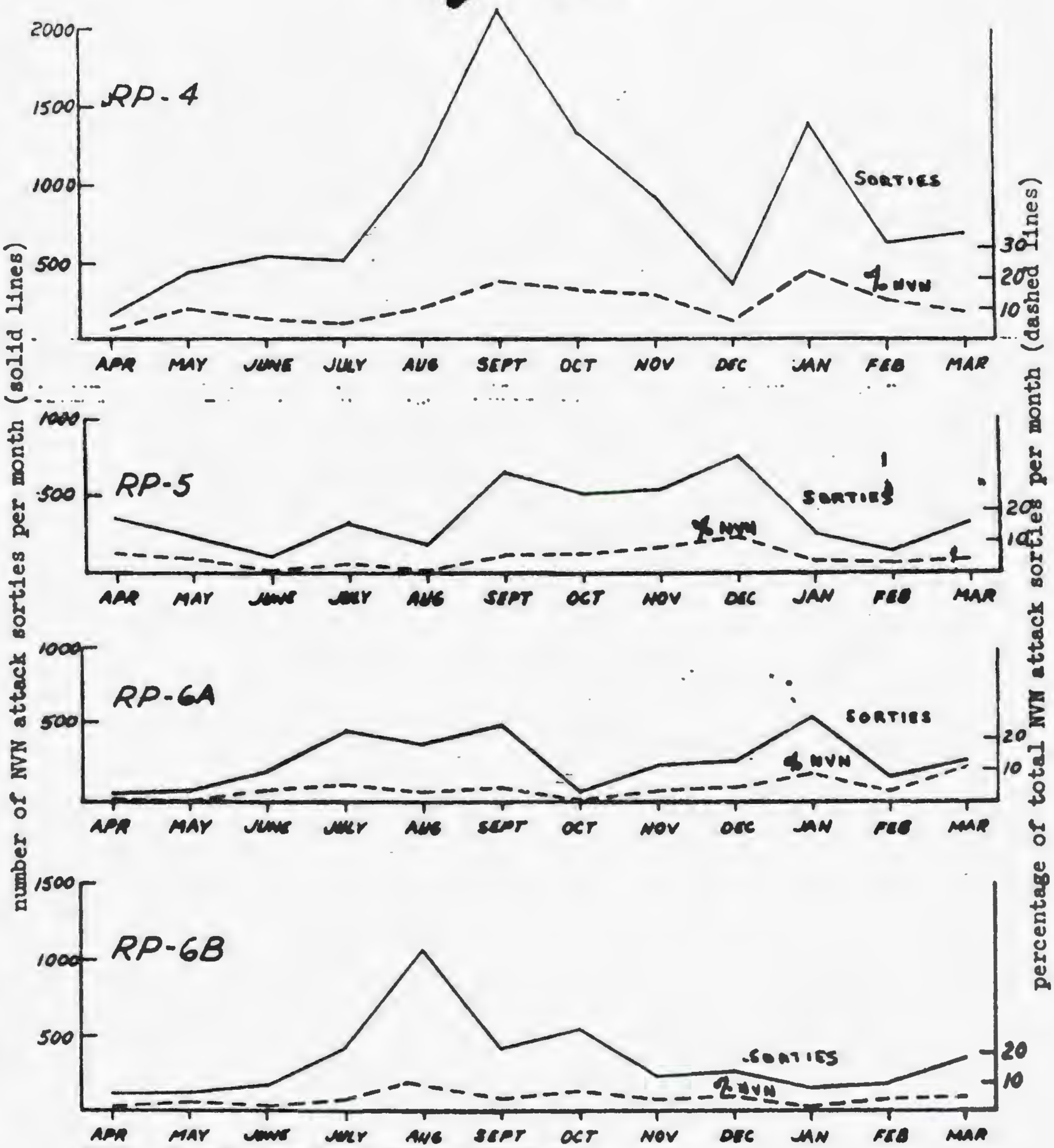
[redacted]



NOTE: Graphs based on USN and USAF data.

Figure B-29. Attack Sorties and Percent of NVN Attack Sorties by Route Package by Month for 1 Year Period, 1 April 1966 - 31 March 1967 (Sheet 1 of 2).

[redacted]



NOTE: Graphs based on USN and USAF data.

Figure B-29. Attack Sorties and Percent of NVN Attack Sorties by Route Package by Month for 1 Year Period, 1 April 1966 - 31 March 1967 (Sheet 2 of 2).

shows the number of attack sorties flown in the indicated route package. The dotted line shows the percent of the total attack sorties flown into NVN that is represented by the solid line.

A similar examination was made of total sorties into NVN over the seven month period from 1 September 1966 to 31 March 1967 (figure B-30).

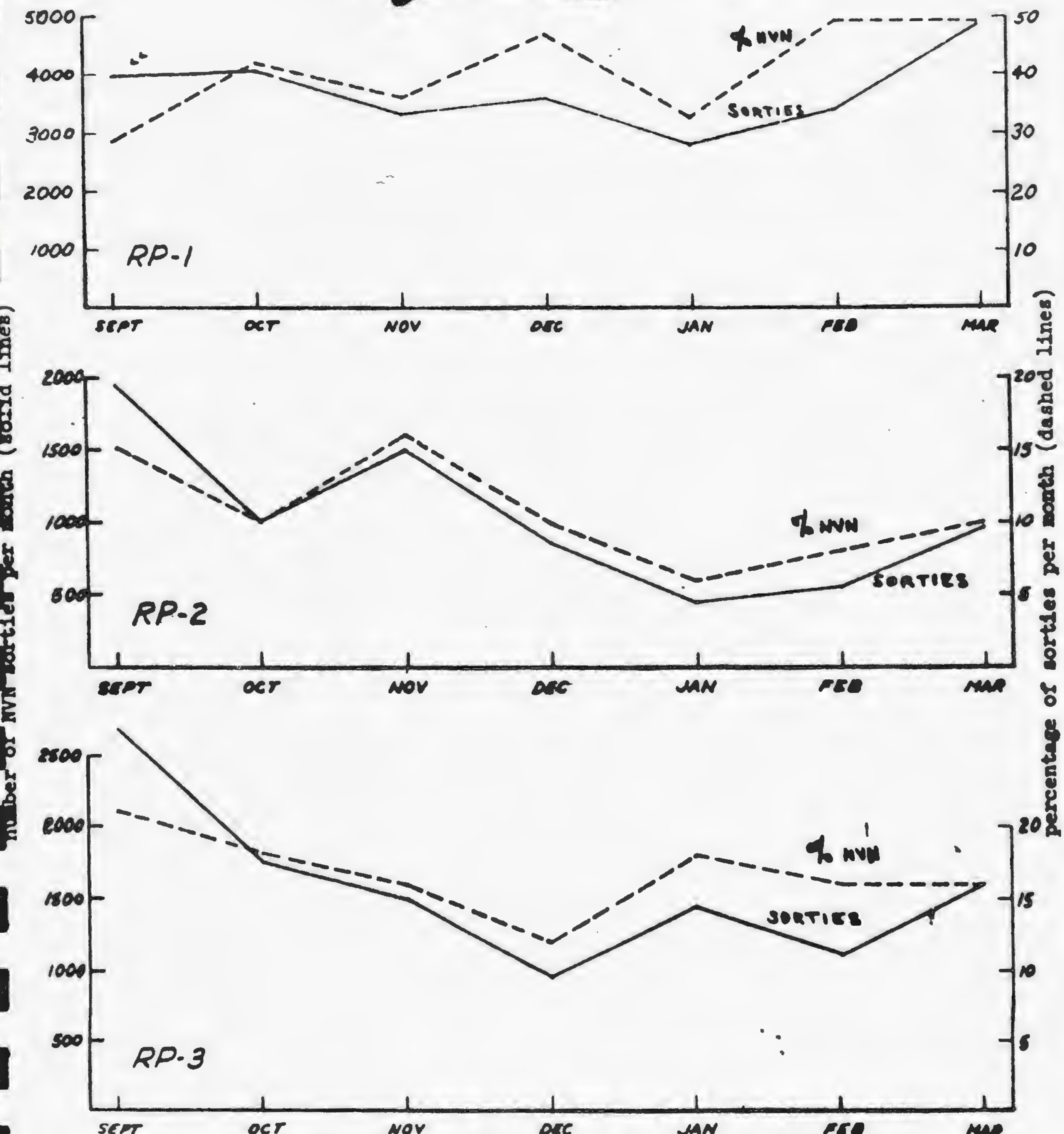
The results were compared to determine if there was a simple correlation between high loss months and a high percentage of NVN sorties over route packages associated with high losses (IV, VI-A, and VI-B). No such correlation was found.

Another test applied to the data was a comparison of aircraft down and personnel down. This comparison was made to determine if the recovery rate might be influenced by a change in the ratio of multi-place aircraft lost to single-place aircraft lost. The change of the ratio of personnel down to aircraft down was found to be negligible over the seven-month period (figure B-31). This was also the case when attack sorties into NVN were considered over the one year period from 1 April 1966 to 31 March 1967 (figure B-32).

Table B-24 shows aircraft losses and personnel losses occurring on sorties into each route package each month over the seven month period (1 September 1966 - 31 March 1967). This table illustrates loss rates for each route package for the seven month period, as well as status of downed personnel.

Table B-25 shows aircraft losses and personnel losses for attack sorties into each route package each month for the aforementioned one year period. This table shows aircraft and personnel losses, as well as loss rates for attack sorties into each route package for the one year period.

[redacted]

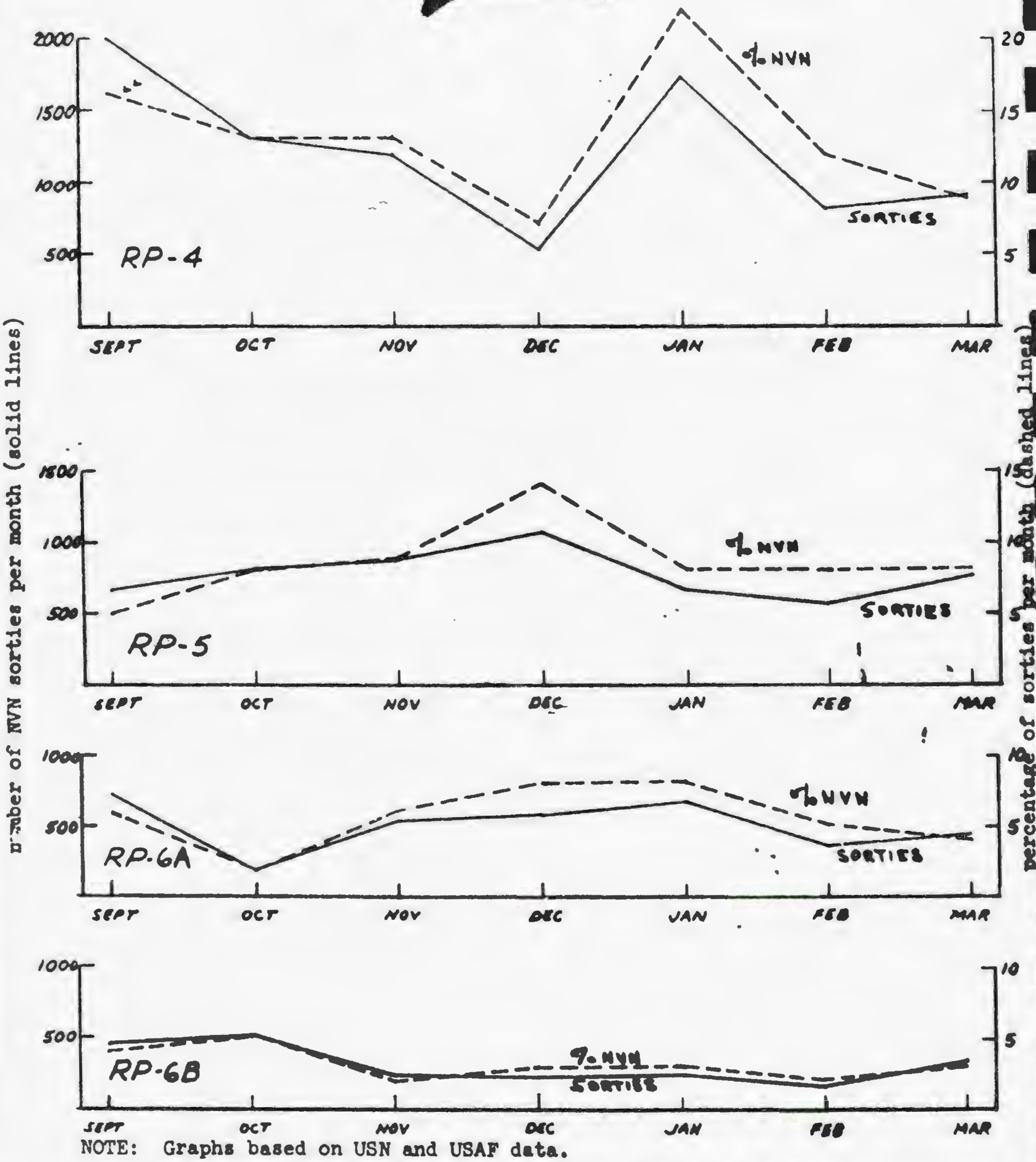


NOTE: Graphs based on USN and USAF data.

Figure B-30. Total Sorties and Percent of Total NVN Sorties by Route Package by Month for 7 Month Period, 1 September 1966 - 31 March 1967 (Sheet 1 of 2).

[redacted]

[redacted]



NOTE: Graphs based on USN and USAF data.

Figure B-30. Total Sorties and Percent of Total NVN Sorties by Route Package by Month for 7 Month Period, 1 September 1966 - 31 March 1967 (Sheet 2 of 2).

[redacted]

[redacted]

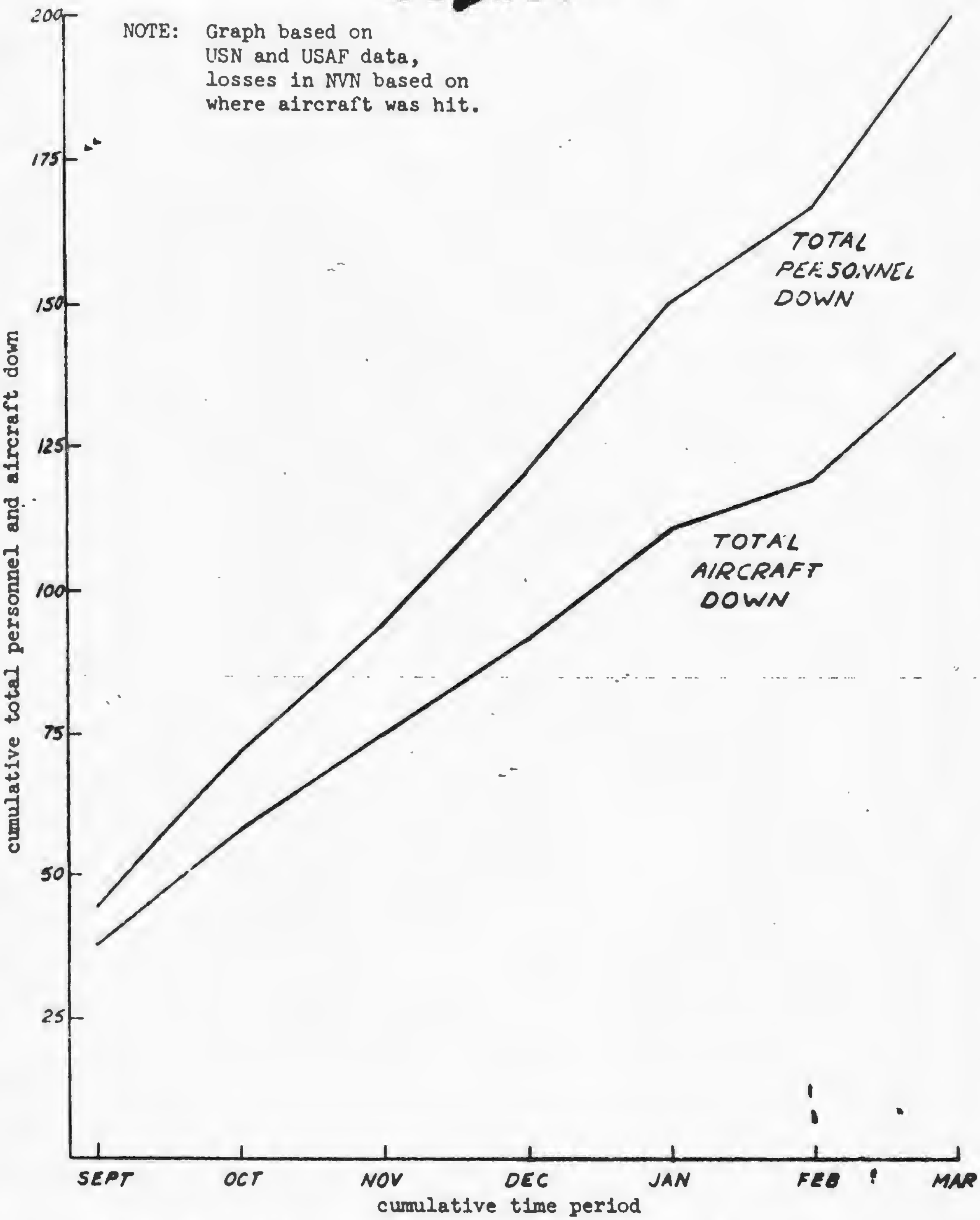


Figure B-31. Cumulative Total Personnel and Aircraft Downed for 7 month period, 1 September 1966 - 31 March 1967.

[redacted]

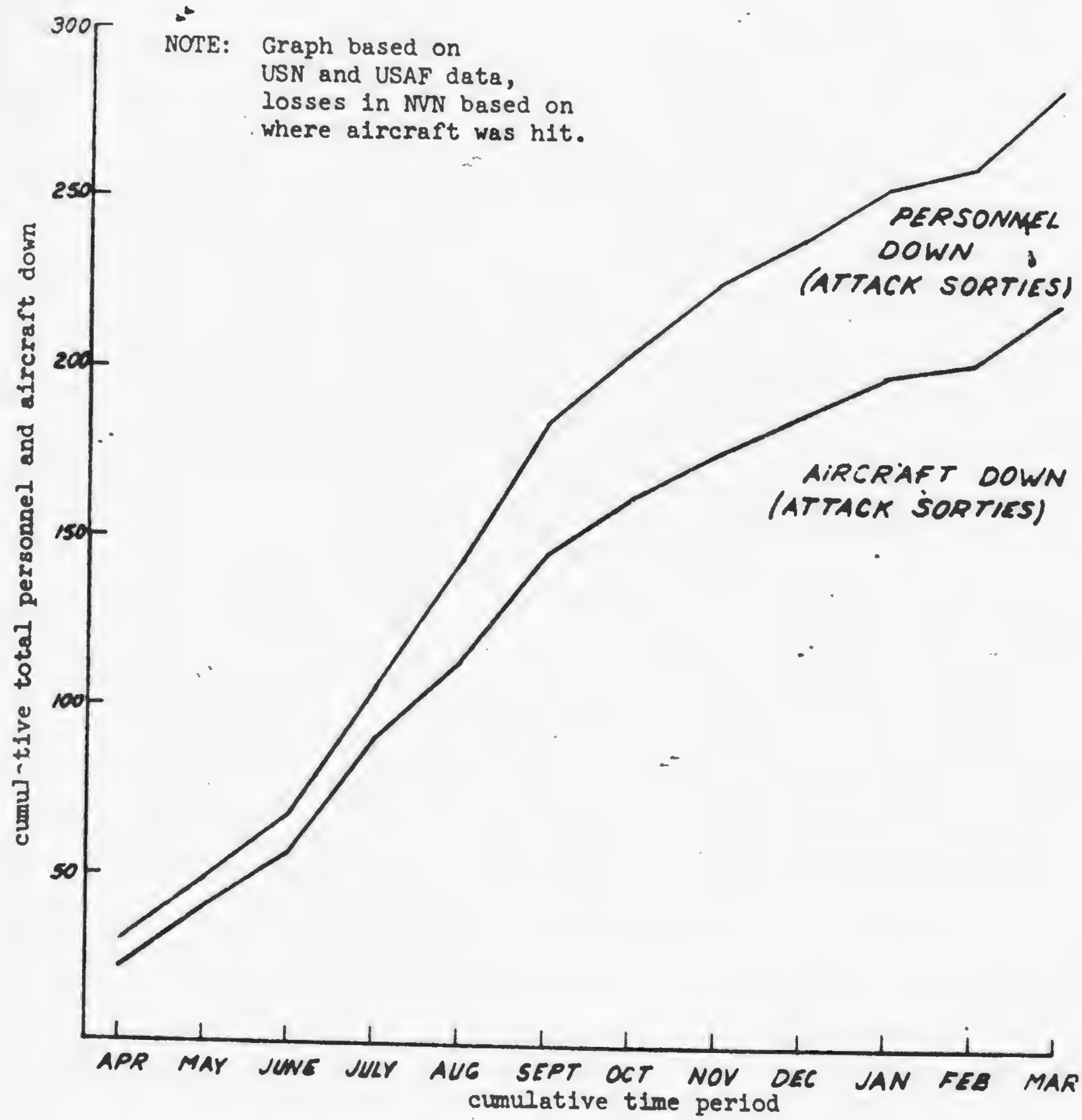


Figure B-32. Cumulative Personnel and Aircraft Downed, Attack Sorties, 1 Year Period, 1 April 1966 - 31 March 1967.

TABLE B-24. USN AND USAF NVN SORTIES - TOTAL LOSSES

MONTH		I	II	III	IV	V	VI-A	VI-B	A&B	TOTAL	STATUS OF PERSONNEL DOWN
		ROUTE PACKAGE									
SEPT 66	A	3,968	1,952	2,702	2,005	642	720	456	1,175	12,[illegible]	P - 0
	B	32	16	22	16	5	6	4	10	100	K - 5
	C	10	3	5	3	1	11	4	15	37	M - 25
	D	13	3	7	3	1	12	6	13	45	R - 15
OCT	A	4,056	1,002	1,758	1,289	811	185	511	696	9,612	P - 6
	B	42	10	18	13	8	2	5	7	100	K - 3
	C	6	0	5	5	1	0	4	4	21	M - 13
	D	9	0	5	6	2	0	6	6	28	R - 6
NOV	A	3,368	1,499	1,504	1,179	873	525	223	748	9,171	P - 5
	B	37	16	16	13	9	6	2	8	100	K - 0
	C	6	2	0	1	2	2	4	6	17	M - 8
	D	8	3	0	1	2	4	4	8	22	R - 9
DEC 1966	A	3,598	858	950	512	1,068	585	217	802	7,758	P - -
	B	47	11	12	7	14	8	3	11	100	K - 1
	C	1	1	0	3	4	8	3	11	20	M - 15
	D	2	1	0	3	5	12	4	16	27	R - 7
JAN 1967	A	2,819	451	1,456	1,728	651	676	235	911	8,016	P - 7
	B	35	6	18	22	8	8	3	11	100	K - 2
	C	1	0	3	5	1	9	0	9	19	M - 12
	D	2	0	3	7	2	15	0	15	29	R - 8
FEB	A	3,414	556	1,114	806	556	351	148	499	6,945	P - 3
	B	49	8	16	12	8	5	2	7	100	K - 2
	C	3	0	1	3	0	1	0	1	8	M - [illegible]
	D	3	0	2	6	0	6	0	6	17	R - [illegible]
MAR 1967	A	4,874	967	1,604	917	754	416	336	752	9,868	P - 5
	B	49	10	16	9	8	4	3	8	100	K - 1
	C	6	0	4	3	2	7	1	8	23	M - 17
	D	9	0	4	4	4	11	1	12	33	R - 10
TOTAL	A	26,097	7,285	11,087	8,436	5,355	3,458	2,126	5,55[illegible]	63,5[illegible]	P - 30
	B	41	11	17	13	8	5	3	9	100	K - 1[illegible]
	C	33	6	18	23	11	38	16	5[illegible]	1[illegible]5	M - [illegible]
	D	46	7	21	30	16	60	21	[illegible]1	201	R - [illegible]
PERSONNEL STATUS		P K M R 1 1 24 20	P K M R 1 2 0 4	P K M R 6 4 9 2	P K M R 4 5 10 11	P K M R 1 0 8 7	P K M R 11 2 33 14	P K M R 6 0 9 6	P K M R [illegible] 2 [illegible] 20	P K M R 30 14 [illegible] [illegible]	
Loss Rate A/C/1,000 Sorties		1.26	.82	1.62	2.73	2.05	10.99	7.53	9.67	2.27	
Pers. Down/ 1,000 Sorties		1.76	.96	1.89	3.56	2.99	17.35	9.88	[illegible].51	3.15	

A - Sorties
B - Percent of Total
C - Aircraft Losses
D - Personnel Down

TABLE B-25. TOTAL USN - USAF A/C LOSSES AND SORTIES - ATTACK, NVN ONLY

MONTH		ROUTE PACKAGE								
		I	II	III	IV	V	V1A	V1B	A&B	TOTAL
APR 66	A	1,928	1,574	1,029*	156	359	41	116*	157*	5,203
	B	37	30	20	3	7	1	2	3	100
	C	5	3	5	2	1	5	1	6	22
	D	7	4	9	3	1	5	1	6	30
MAY	A	1,477	803	1,146	437	239	65	128	193	4,295
	B	34	19	27	10	6	2	3	4	100
	C	4	2	5	0	5	0	2	2	18
	D	5	2	5	0	5	0	2	2	19
JUNE	A	4,087	1,127	1,167	537	102	195	181	376	7,396
	B	55	15	16	7	1	3	2	5	100
	C	8	0	3	1	0	4	1	5	17
	D	9	0	3	1	0	5	1	6	19
JULY	A	5,232	1,341	1,235	514	325	457	414	871	9,518
	B	55	14	13	5	3	5	4	9	100
	C	10	2	4	0	3	10	5	15	34
	D	13	2	4	0	3	12	5	17	39
AUG	A	5,004	1,620	1,622	1,129	190	368	1,065	1,433	10,998
	B	45	15	15	10	2	3	10	13	100
	C	5	0	4	2	4	10	6	16	31
	D	8	0	5	2	4	12	6	18	37
SEPT	A	3,944	1,739	2,093	2,113	644	497	418	915	11,[illegible]8
	B	34	15	18	18	6	4	4	8	100
	C	6	4	5	2	0	11	4	15	32
	D	8	4	7	2	0	14	6	20	41

TABLE B-25. TOTAL USN - USAF A/C LOSSES AND SORTIES - ATTACK, NVN ONLY (Continued)

MONTH		ROUTE PACKAGE								
		I	II	III	IV	V	VIA	VIB	A&B	TOTAL
OCT	A	3,654	646	1,343	1,331	508	66	547	613	8,095
	B	45	8	17	16	6	1	7	8	100
	C	6	0	5	5	0	0	1	1	17
	D	9	0	5	6	0	0	2	2	22
NOV	A	2,522	918	1,277	919	537	217	237	454	6,627
	B	38	14	19	14	8	3	4	7	100
	C	4	2	0	1	2	2	3	5	14
	D	6	3	0	1	2	4	3	7	19
DEC 66	A	3,390	582	549	365	751	250	278	528	6,165
	B	55	9	9	6	12	4	5	9	100
	C	1	1	0	2	2	4	1	5	11
	D	2	1	0	2	2	5	1	6	13
JAN 67	A	2,583	391	971	1,398	253	532	157	689	6,285
	B	41	6	15	22	4	8	2	11	100
	C	1	0	3	5	0	3	0	3	12
	D	2	0	3	7	0	4	0	[illegible]	16
FEB	A	2,996	395	520	636	147	164	199	363	5,057
	B	59	8	10	13	3	3	4	7	100
	C	1	0	1	2	0	0	0	0	[illegible]
	D	1	0	2	4	0	0	0	0	7
MAR	A	4,498	814	923	692	319	270	380	650	7,896
	B	57	10	12	9	4	3	5	8	100
	C	5	0	3	0	1	7	1	8	17
	D	6	0	3	0	2	11	1	12	23

TABLE B-25. TOTAL USN - USAF A/C LOSSES AND SORTIES - ATTACK, NVN ONLY (Continued)

MONTH		ROUTE PACKAGE								
		I	II	III	IV	V	V1A	V1B	A&B	TOTAL
TOTAL	A	41,315	11,950	13,875	10,227	4,374	3,122	4,120	7,242	88,983
	B	46	13	16	11	5	4	5	8	100
	C	56	14	38	22	18	56	25	81	229
	D	76	16	46	28	19	72	28	100	285
A/C Lost/ 1000 Sorties		1.36	1.17	2.74	2.15	4.12	17.94	6.07	11.18	2.57
Personnel Down/ 1000 Sorties		1.84	1.34	3.32	2.74	4.34	23.06	6.80	13.81	3.20

A - Sorties
B - Percent of Total
C - Aircraft Losses
D - Personnel Down

CONCLUSIONS

The conclusions drawn from the foregoing data are subject to the limitations imposed by the size of the samples examined. Some samples are too small to permit accurate statistical treatment with high confidence limits. The majority of the samples, however, are large enough to indicate significant trends.

Those phases of the SAR operation which are relatively independent of the location of the downed aircraft are examined without regard for locational groupings, so as to benefit from the greater reliability of the correspondingly larger sample size.

Conclusions that are apparent as a result of the study are discussed in the paragraphs that follow:

Any means of extending the time between hit and ejection would increase the recovery rate. The mean time from hit to eject for Navy POW's was 1 minute, compared to 4 minutes for recovered personnel.

Thirty percent of Navy and 50 percent of Air Force personnel ejected above 5800 feet - the minimum altitude that would make air snatch with a normal parachute feasible. Seventy percent of Navy and 75 percent of Air Force personnel ejected above 2000 feet - the minimum altitude at which a para-balloon operation is feasible. However, if pilots knew that an air snatch recovery could be made if they increased altitude rather than attempted to fly as far as possible from the scene, the ejection altitudes would undoubtedly increase.

[redacted]

Seventy percent of personnel subsequently captured ejected within five miles of where hit, and therefore remained in the defensive environment responsible for the loss of the aircraft. Penetration of such an environment would require a SAR vehicle with very low vulnerability. Pilots who managed to fly more than 5 miles from where hit before ejecting increased their probability of rescue from 55 to 76 percent.

In 50 percent of the incidents studied, SAR forces were alerted within 5 minutes of the time the lost aircraft was hit. After-down alert times averaged longest for incidents resulting in missing personnel, and least for incidents in which personnel were recovered. The Command and Control network of SAR forces works well, and fairly rapidly. However, breakdowns do occur; these breakdowns usually result in missing personnel.

Median time from pilot down to SAR support arrival was 15 minutes. Seventy-five percent of captures for which times are known occurred in less than 15 minutes, and 50 percent occurred in less than 5 minutes, indicating a need for faster SAR support and rescue vehicle arrival on the scene.

For Navy incidents within 5 miles of the coast or over land, median time-late of the SAR rescue vehicle was 25 minutes, indicating a need for reduction of this time. The reduction in time could be accomplished by a tactic change, a change in SAR vehicle speed, or a combination of both.

Considering only opposed rescues, the time required for the rescue vehicle to localize the downed pilot after it arrived on the scene averaged

[redacted]

9 minutes, with a median of 6 minutes. Presence of the wingman lowered the average time to 8 minutes, with a median of 7 minutes.

The median elapsed time between pilot down and pickup averages 15 minutes overall, and approximately 60 minutes in over-land incidents.

The recovery rate at night is very poor. A major problem encountered in night operation attempts has been the lack of knowledge of the downed pilot's location and rescue potential.

There is no significant correlation between long SAR alert times and the number of aircraft in the flight in which the loss is sustained.

Twenty-four percent of NAVY/USMC pickups in the sea required a member of the crew of the rescue vehicle to enter the water to aid the downed pilot.

The primary cause of aircraft loss is fire. Ninety percent of those subsequently captured ejected due to fire; the other 10 percent ejected for unknown reasons.

When opposed rescues were considered, incidents in which suppressive fire was reported had twice the recovery rate of incidents where no suppressive fire was reported.

Six different equipment types were frequently reported as being instrumental in sighting downed personnel. The three most frequently mentioned were chute, flare, and radio. Thirty-four attempts to use personal survival radios at sea resulted in 15 total or partial failures. This represents a 44 percent failure rate.

The recovery rate of personnel was much higher if SAR was alerted by the hit aircraft, the aircraft's wingman, or by another source in visual contact, than it was if SAR was alerted by a ramp check or a lost contact.

The concept-oriented examination of the cases of 25 prisoners is summarized in table B-26. In 12 of the cases, SAR forces had difficulty in localization of downed personnel.

TABLE B-26. POTENTIAL RECOVERIES OF PERSONNEL NOW PRISONERS

Vehicle/tactic	Potential Recoveries
Heavy helo	2*
Strike Group SAR	2+
SAR Team Concept	4*
Light helo	0*

* One might be added if there were improvement in night localization over water

\+ Another might be added with air snatch

There is no time trend in the overall recovery rate. The large variation in monthly loss rates within any given route packages precludes establishment of a correlation between NVN attack sortie distribution and losses on a month-to-month basis. There is no discernable trend in losses due to changes in the number of multi-place aircraft flown into NVN.

[redacted]

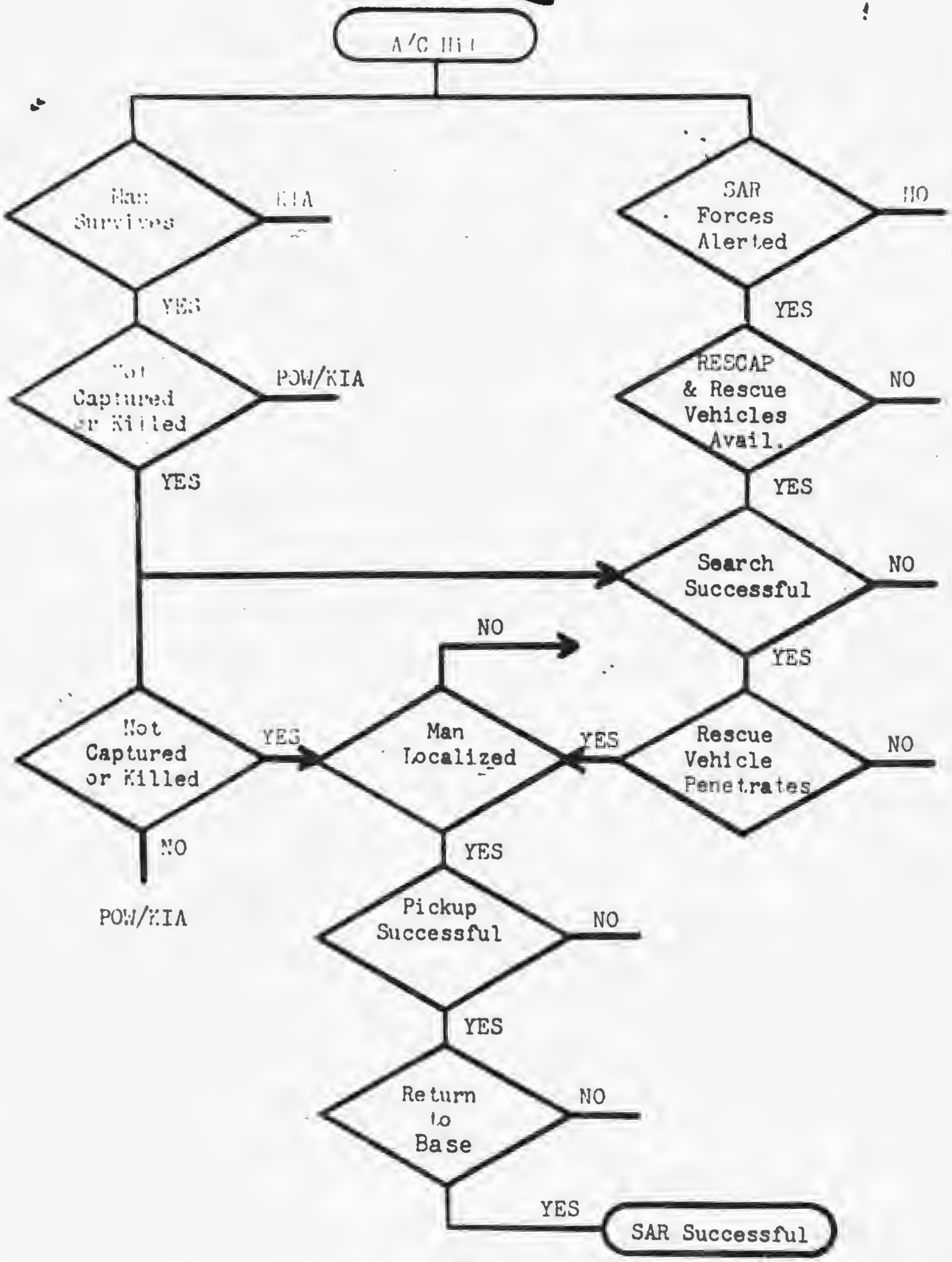


Figure C-1. SAR Process Flow Chart.

[redacted]

[redacted]

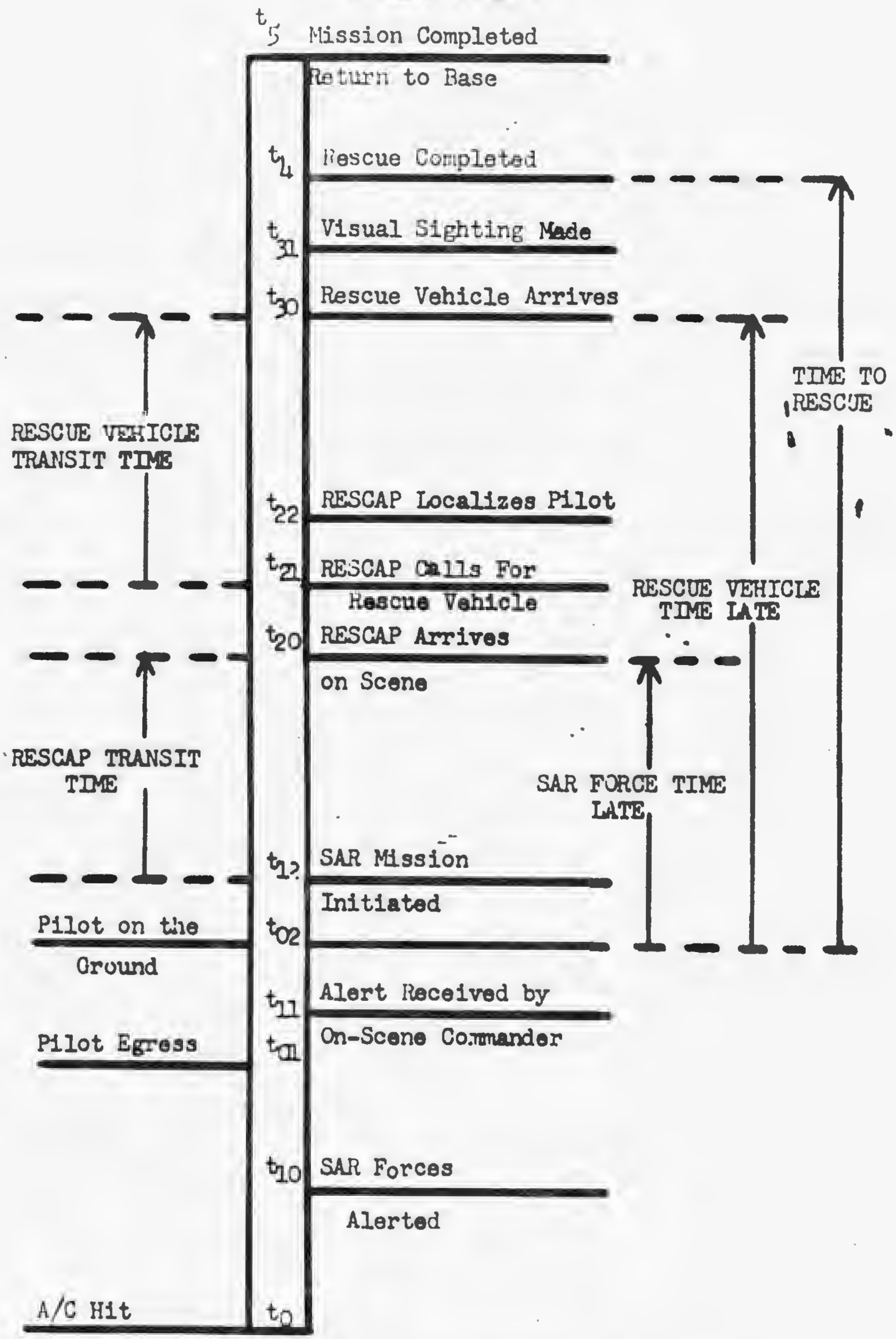


Figure 2. General Time and Event Sequence of a Typical SAR Mission

[redacted]

Appendix D
LIMITED WARFARE ENVIRONMENT

GENERAL

The characteristics of the limited warfare environment have a considerable effect upon the required Navy combat search and rescue capabilities. Four geographic areas are considered in evaluating the environment for combat search and rescue missions. The first type is represented by the North Vietnam area. This will be considered as the baseline type. It will be shown that the NVN area represents a difficult situation for combat SAR from most viewpoints. The other three areas have been selected as representative of different environments to provide a wide range of conditions which could possibly exist some time in the near future, that is, from the present until 1975. The other areas selected for consideration are in the Middle East, Mediterranean, and Far East, and have been designated as areas C, I, and K. The names of the countries are not important. Their environments have been somewhat generalized. It has not been the intention to select areas for extremes in temperature or defenses.

The limited warfare environment can be categorized according to the following factors and considerations:

- country's location, size, and shape
- proximity to the open seas
- standoff distance
- defenses, nature and quantity
- population density and distribution

- terrain
- temperature, altitude distribution, and weather

The country's location, size, shape, proximity to the open seas, and required standoff distance can be used to determine area coverage as a function of combat radius and required SAR vehicle one-way distance. Table D-1, area coverage versus combat radius, shows the results for NVN and the other three selected limited warfare environments. For example, for NVN, there are 40,000, 46,000, 51,000, and 52,800 square miles within 200-, 250-, 300-, and 340-n.mi combat radii, respectively. For a 200-n.mi combat radius with 20-n.mi offshore standoff, 74 percent of the country will be covered. For a 250-n.mi combat radius with 20-n.mi offshore standoff, 87 percent of the country will be covered. For a 300-n.mi combat radius, 96 percent of the country will be covered. At 340 n.mi, the whole country is covered. Coverage for the other areas is determined similarly.

The enemy defenses that directly concern the effectiveness of the SAR mission are antiaircraft artillery (AAA), surface-to-air missiles (SAMs), and MIG aircraft. The nature and quantity of the defenses for NVN are described as they exist at present (April 1967).

<u>AAA Order of Battle, NVN.</u> Light and medium AAA, which includes 37mm guns on down, forms an almost continuous carpet at 5,000-6,000 feet in heavily defended areas such as Thai Nguyen. The 37mm AA gun has a maximum effective range of 5,600 feet against a maneuvering 400-knot aircraft. Maximum vertical range is 19,685 feet, with destruct at 14,400 feet.

TABLE D-1. AREA COVERAGE VERSUS COMBAT RADIUS

Country	Combat Radius (n.mi)	Area Coverage	One-Way SAR Vehicle Distance* (n.mi)
North Vietnam	200	0.74	300
	250	0.87	375
	300	0.96	450
	340	1.00	510
Area K	200	1.00	300
Area C	200	1.00	300
Area I	200	0.25	300
	300	0.42	450
	400	0.58	600
	800	1.00	1,200

*Assuming an offshore standoff distance of 20 n.mi in all cases and a 1.5 factor to convert combat radius to one-way vehicle distance.

Heavy AAA installation, including 57, 85, and 100mm guns, are also dense in populated areas. The 57mm AA gun has a maximum effective range of 19,700 feet and a maximum vertical range of 28,873 feet. Destruct is set for 24,000 feet. The 85mm AA gun has a maximum effective range of 27,500 feet and a destruct altitude of 34,450 feet. The 100mm AA gun has a maximum effective range of 39,000 feet and a destruct altitude of 50,500 feet.

There are approximately 1,100 37/57mm sites operating independently and about 60 85/100mm complexes. Thus, North Vietnam has 10,650 square miles protected by AA guns. The fractional coverages of North Vietnam for 200-, 250-, 300-, and 340-n.mi combat radii are 0.26, 0.23, 0.21, and 0.20, respectively. See figure D-1 for AAA sites.

WHIFF or FIRE CAN may be used with 57mm AA guns. FIRE CAN is probably a reengineered version of WHIFF radar which, in turn, was developed from U.S. lend-leased SCR-584. There are two versions for FIRE CAN: SON 9 and SON 9A. SON 9A has improved performance in an ECM environment. SON 9A has a fast-frequency change capability. The magnetron used is believed capable of being tuned from 2688 to 2857 mc. A self-tuning antijam feature is probably included.

SON 9 is operated at one of four nominal S-band frequencies: 2720, 2760, 2800, and 2890 mc. Changing the frequency involves changing the magnetron.

There appears to be no coding or modulation on radiated pulse. There is no pulse stretch nor pulse-to-pulse coherence.

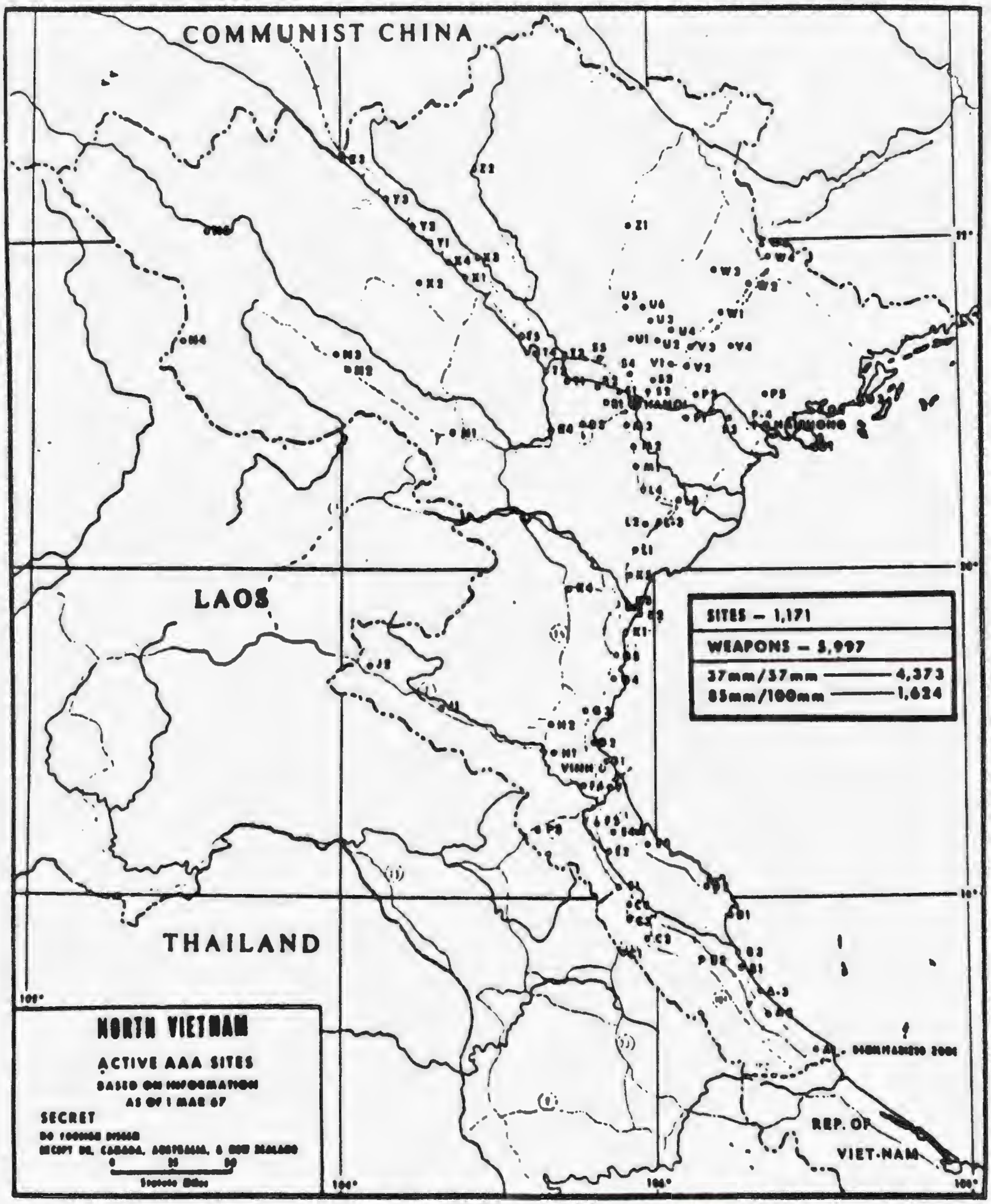


Figure D-1. Active AAA Sites.

The radar employed with 85mm AA guns can be either SON 4 (WHIFF) or, more generally, FIRE CAN. The radar employed with 100mm AA guns is FIRE CAN.

SAM Order of Battle, NVN. SA-2's are commonly thought to have an envelope 25 miles in radius and 80,000 feet in altitude. They can be fired at aircraft flying at 1,000 feet, but the system is relatively ineffective at altitudes below 3,000 feet. Of 1,937 missiles fired at U.S. aircraft over NVN as of 4 April, 37 aircraft were known shot down and 12 more considered possible victims. Thus, the probability of being shot down by an SA-2 is 2.6 percent.

The SAM envelopes cover approximately 20,000 square miles. Thus, approximately 50 percent of the country within 180 miles of the coast is within range of SA-2 sites. Approximately 40 percent of NVN is protected by SA-2 sites. Figure D-2 shows the SA-2 envelope coverage.

The SA-2 site has a surveillance/acquisition radar (SPOONREST) and a fire control radar (FANSONG). FANSONG is C- or S-band radar.

Aircraft Order of Battle, NVN. There were 94 MIG 15/17's and 18 MIG 21's in North Vietnam as of 14 April 1967. Some of the MIG 21's are all-weather aircraft. MIG 17/21's may be armed with AA-2 or AA-3's. The AA-3 uses IR homing, has a range of 12 n.mi, and has a 25- to 50-foot CEP and a 4-n.mi range. MIG 17's also can carry AA-1, which uses radar beam guidance. It has a 20-foot CEP.

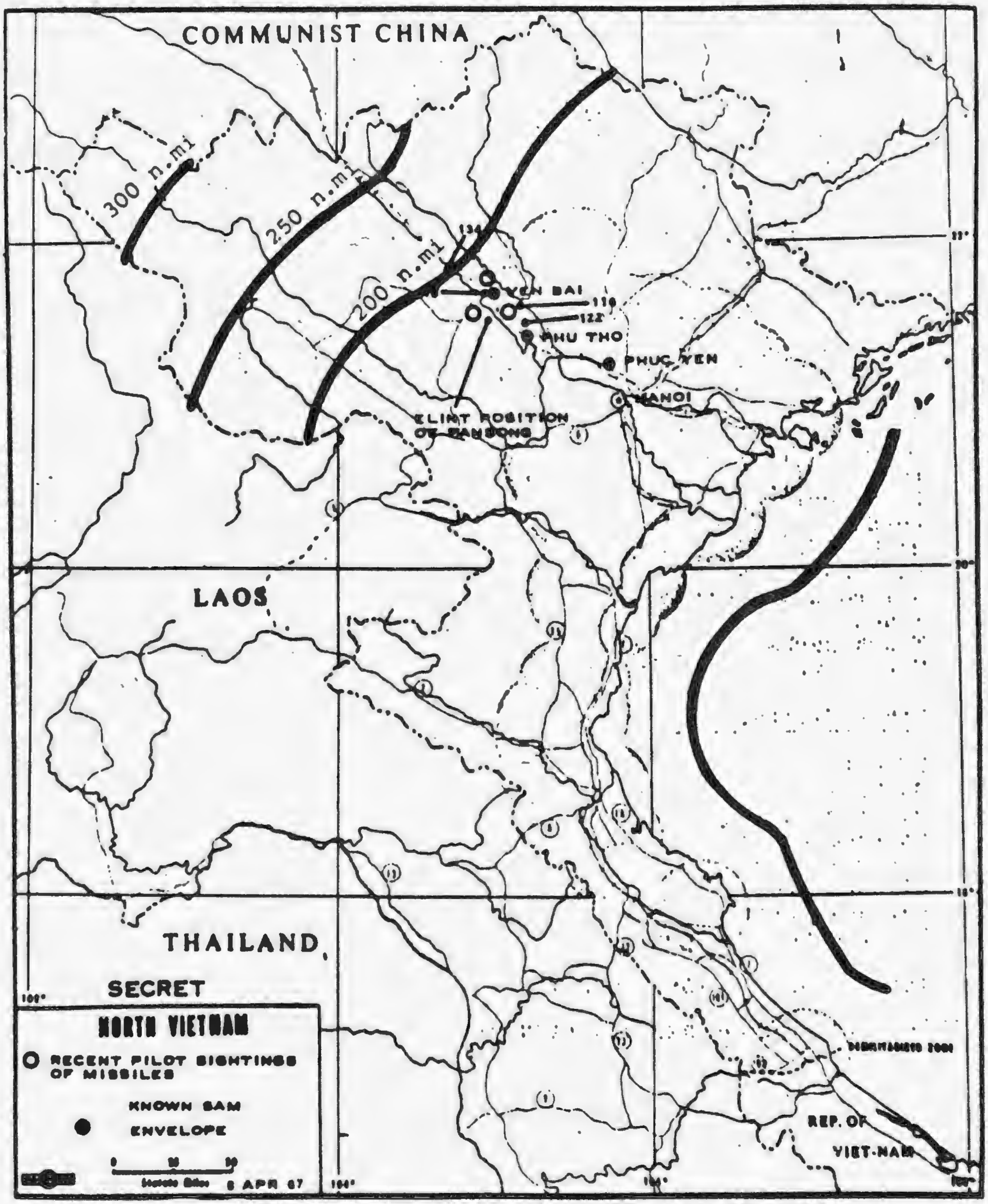


Figure D-2. Recent Pilot Sightings of Missiles.

TRENDS

It is estimated that by mid-1968 the number of fighter aircraft will double, the SAM sites will increase by 20 to 25 percent, and the quantity of antiaircraft artillery will increase by 20 to 25 percent. Information pertinent to enemy defenses is summarized in table D-2 for NVN and the other areas studied. Except for area K, which has more aircraft, NVN is the most heavily defended.

POPULATION

The factors of population density and distribution affect the ability for successful search and rescue. However, it is very difficult to translate these factors directly into statistics of the pilot's ability to avoid being captured on the ground as a function of time. More important than the statistics of average population density is the enemy's organization and ability to observe, locate, and capture downed U.S. airmen who are forced to egress over NVN.

The map in figure D-3 illustrates the NVN population density and distribution. Case studies of NVN incidents indicate that the populace is organized and armed, compounding the problem of pilot survival.

Terrain is a factor when coupled with population density and distribution, since it affects the probability of being observed during parachute descent, being observed on the ground, and being accessible to hostile forces on the ground. Remote areas, high places, and jungle are, relatively speaking, safe havens for downed U.S. airmen, while cities, villages, and rice paddies mean

TABLE D-2. LIMITED WARFARE SUMMARY OF ENEMY DEFENSES AS OF APRIL 1967

Country	AAA	SAMs	Aircraft
North Vietnam	1,171 sites, 20% area coverage	Hundreds of sites, 40% area coverage	112 MIGs, 15/17/21 type
Area K	60 sites, 9% area coverage	11 sites, 28% area coverage	434 MIGs, 15/17/19/21 type
Area C	5 sites	0	15
Area I	0	0	90

Figure D-3. Population and Administrative Divisions.

almost immediate capture.

Like population density, it is difficult to quantify the effect of terrain. In appendix C, pilot survival on the ground is treated in an empirical and statistical manner, using known capture and rescue times from the data base of USN and USAF losses in NVN.

TEMPERATURE AND ALTITUDE

Specification of temperature and altitude is necessary in establishing SAR vehicle hover requirements. From references 1 and 2, curves of cummulative time below temperature versus temperature and elevation distribution were obtained for each area considered. The curves for NVN are reproduced as figures D-4 and D-5. From figure D-5, it can be seen that almost all the country is below 3,000 feet for 0-100 miles from the coast. Figure D-4 is essentially for sea level. The temperature curve is thus shifted 6°F to the left to account for the 3,000-foot altitude condition. Thus, at 3,000 feet the temperature is below 90°F 99 percent of the time.

Similarly, the following results were obtained for the other areas considered:

- <u>Area C</u> - 95 percent of the time, the temperature is below 90°F at 3,000 feet.
- <u>Area I</u> - 84 percent of the time, the temperature is below 90°F at 3,000 feet.
- <u>Area K</u> - 99 percent of the time, the temperature is below 90°F at 3,000 feet.

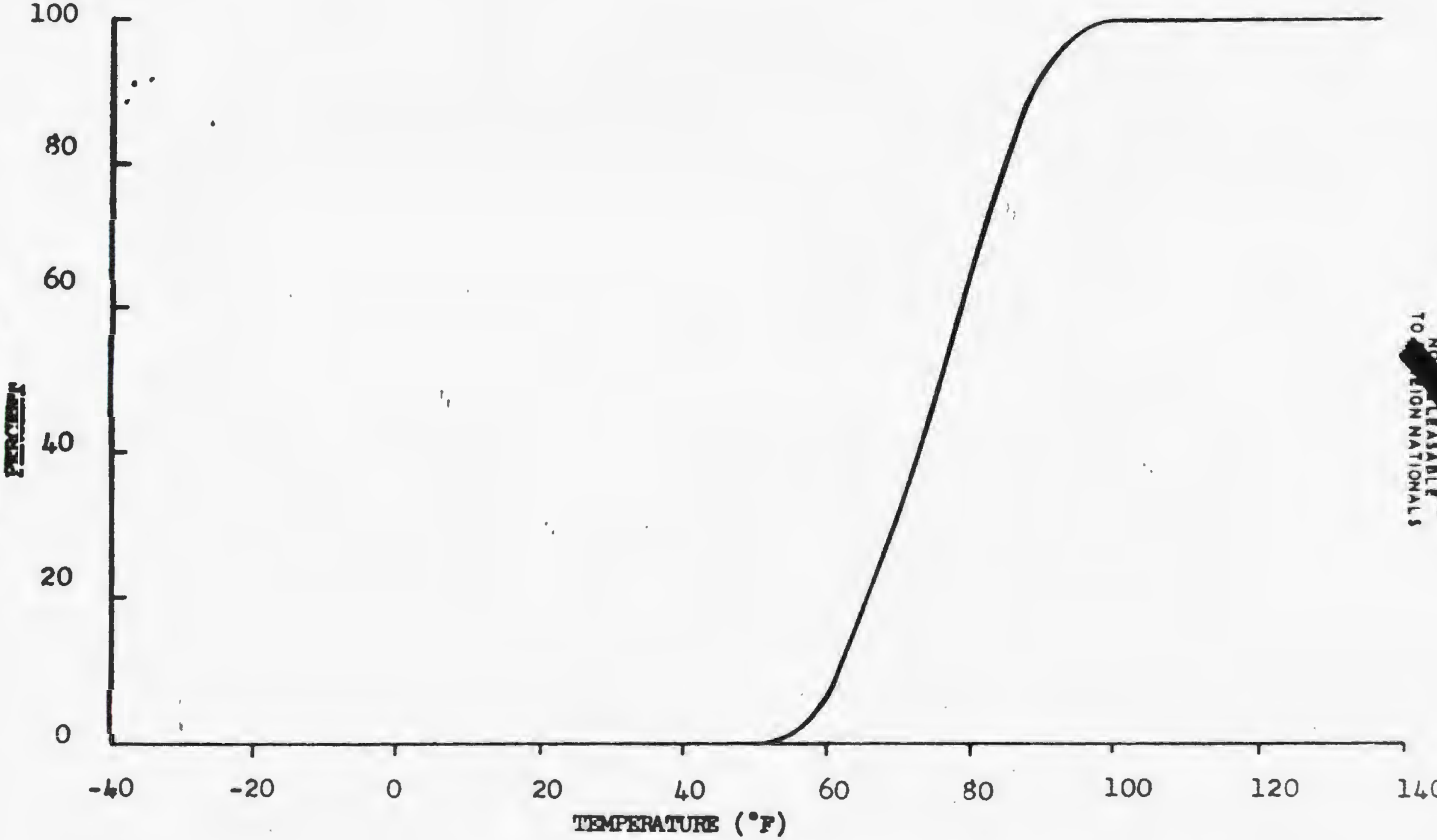


Figure D-4. Cumulative Percent of Time Below a Temperature vs Temperature, North Vietnam Annual Average.

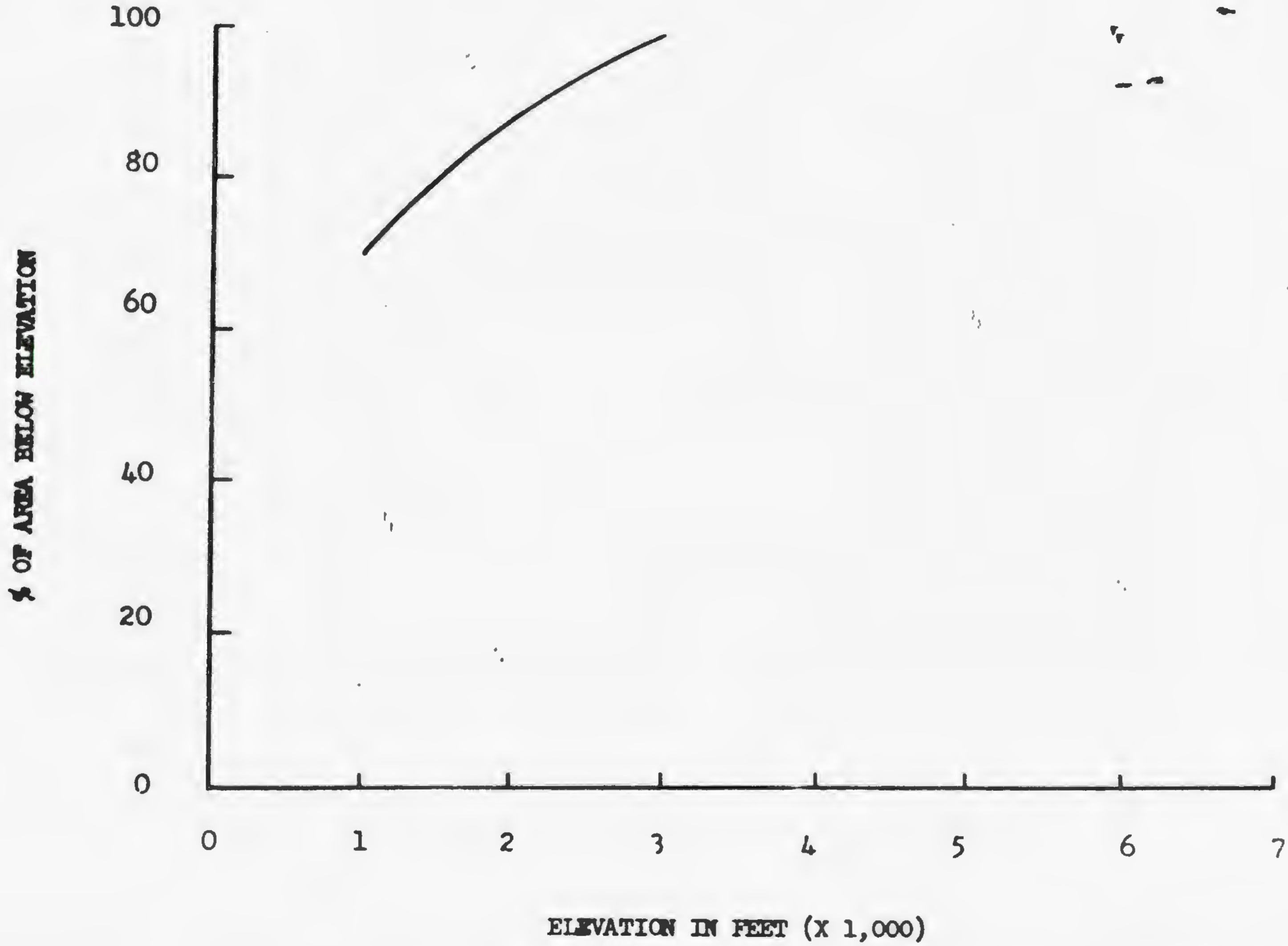


Figure D-5. Elevation of North Vietnam Area Within 100 Miles of the Coast.