CHAPTER 2

RECONNAISSANCE

A. GENERAL

The Tropical Cyclone Warning Service depends on aircraft reconnaissance to fix the location and to determine the intensity of tropical cyclones. Due to their physical characteristics, their development and movement over vast oceanic areas, land and ship reports are not sufficient for these determinations. Satellite pictures are an increasingly valuable aid, particularly in the initial detection of the formative stages of tropical cyclones, but at the present time the interpretation of cyclone intensity and center location is not sufficiently accurate for operational use. Satellite data is used primarily as the basis for scheduling aircraft investigative flights.

B. RECONNAISSANCE REQUIREMENTS

JTWC reconnaissance requirements for investigations, fixes, and/or synoptic tracks are relayed to the Tropical Cyclone Reconnaissance Coordinator (TCRC) each day by phone with message confirmation. This includes the area for investigation, the forecast position of the cyclone at the levied fix times, and/or a standard synoptic track. The TCRC then assigns the missions to the Air Force's 54th Weather Reconnaissance Squadron (54WRS) operating WC-130 aircraft and/or the Navy's Airborne Early Warning Squadron ONE (VW-1) operating WC-121 aircraft. Both squadrons are based on Guam but often stage from other bases according to the relative location of the reconnaissance area and assets.

Four fixes per day are levied on all tropical cyclones within the JTWC area of responsibility. Fixes are scheduled at six hourly intervals for two hours before warning time. Additional fixes and other information may be requested by operational commanders through the TCRC when such additional information is needed to make operational decisions. These requests are honored as resources permit.

C. EVALUATION OF DATA

Eye data from tropical cyclones are provided by low level penetration, intermediate level penetration, or radar fixes from outside the center. Penetration fixes provide the most data about the cyclone. Of particular interest is the minimum sea level pressure in the center of the cyclone. Radar fixes are made from outside the cyclone center and are based on a "hole" in the radar presentation or the estimated center of the spiral banding. Penetration fixes are made whenever possible but often the small size of the eye combined with the intensity of the winds prohibit penetration for safety of flight.

An evaluation was made of the deviations of the tropical cyclone center fixes from the best track of the storm. (See Chapter 3.) Only right angle deviation was considered. Aircraft fixes from 1967 through 1969 were used along with satellite bulletin positions for 1969 and 1970. The median deviation for aircraft penetration fixes was 3 N.M.; for aircraft radar fixes, 5 N.M.; and for satellite bulletin positions, 16 N.M. The other percentiles and extremes are as shown in Table 2-1.

FIX RIGHT ANGLE DEVIATION FROM BEST TRACK (NM)

	ACFT PENETRATION -- 681 CASES 1967-70	ACFT RADAR -- 229 CASES 1967-69	SATELLITE -- 174 CASES 1969-70
MEDIAN	3	5	16
68% WITHIN	5	9	28
95% WITHIN	15	21	72
EXTREME	40	58	83

TABLE 2-1

Aircraft penetrations are considered the most accurate followed closely by aircraft radar with satellite fixes a distant third. From these figures one can see that while satellite data are extremely valuable in the initial detection of tropical cyclogenesis, aircraft fixes must continue to be the primary source for locating tropical cyclones as the initial position from which forecasts are made.

D. PERIPHERAL DATA

In order to gather more useful peripheral data from around the cyclone center, standard peripheral data tracks were developed by JTWC in coordination with the reconnaissance squadrons. Figure 2-1 shows the tracks agreed on. Tracks Alfa, Bravo, and Charlie are essentially box patterns of different sizes with the pattern to be flown depending on the extent and intensity of the storm. Track Delta is used for rapidly accelerating cyclones or for ridge investigations along a specified radial from the cyclone center. Normally, the tracks can only be used when the same aircraft is making two fixes six hours apart. JTWC recommends a track to be flown but the ultimate decision as to peripheral track rests with the aircraft commander after arrival on the scene.

PERIPHERAL TRACKS

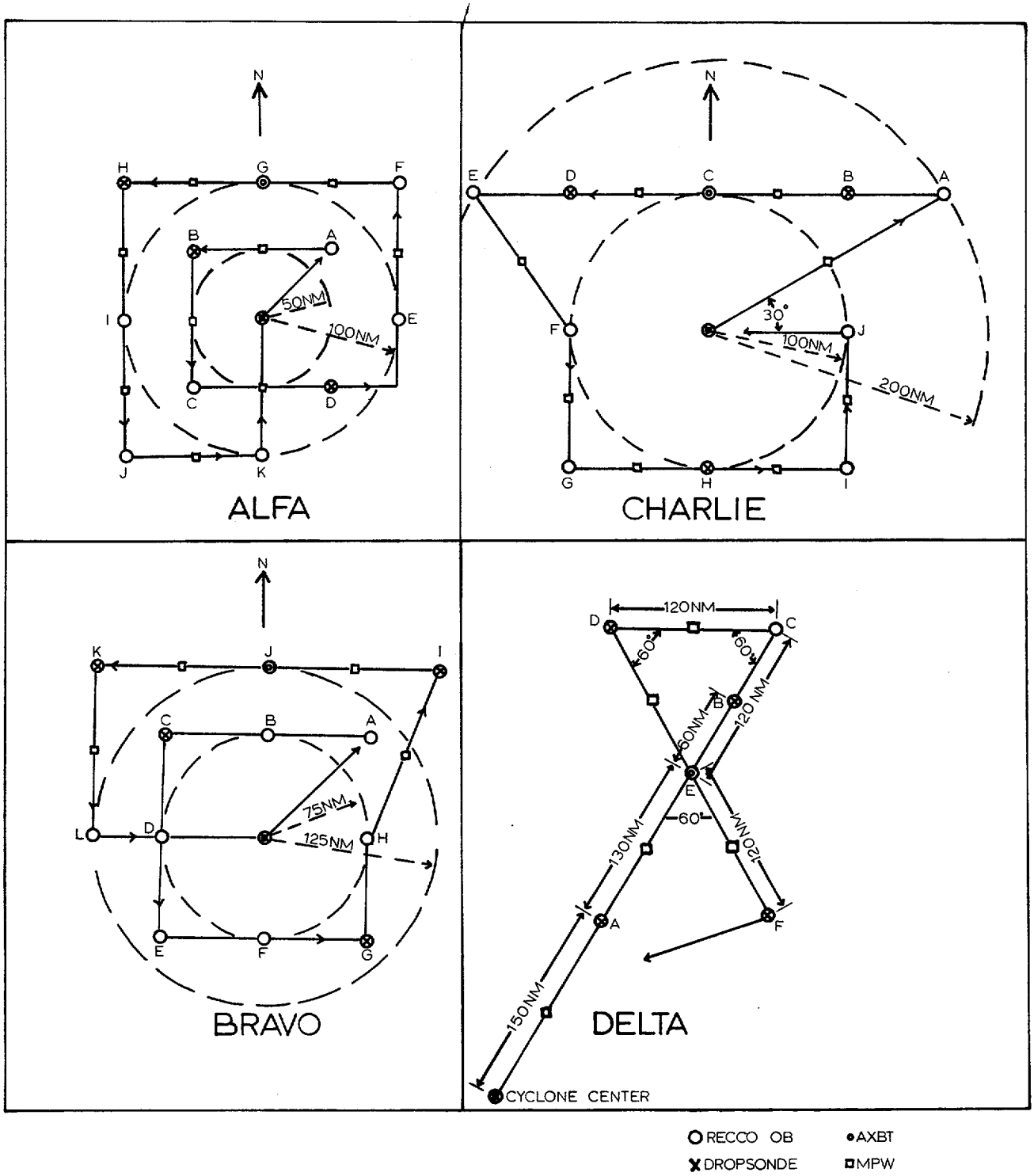

FIGURE 2-1

Figure 2-2 shows an example of Track Bravo flown around Typhoon Hope on 25 September 1970. For clarity, only the winds are plotted around the fixes in this example. Previously, the standard peripheral track was a circle of 150 N.M. radius around the storm. This was often too far from the storm center to provide useful data. With these new tracks, the observations are taken as close to the storm center as flight safety and crew comfort will permit. In the example, Typhoon Hope had maximum surface winds of 120 knots on the first fix and 100 knots on the second fix. The aircrew was able to fly Track Bravo without difficulty. This was at one half of the previous standard radius of 150 N.M.

E. COMMUNICATIONS

The primary method for relay of the eye/center message from the aircraft to JTWC is by means of a direct phone patch with the aircraft. Andersen Airways is the primary center and is used whenever possible. Other centers are Clark, Kadena, and Fuchu Airways. JTWC and the weather monitor at Andersen copy the eye/center message simultaneously. Routine reconnaissance observations are copied by the weather monitor and transmitted over the teletype without a phone patch to JTWC.

Table 2-2 shows a summary of the delay times for the receipt of fix data for 1970.

DELAY IN RECEIPT OF RECONNAISSANCE DATA FOR 1970

METHOD	NUMBER OF CASES	MAX DELAY TIME	AVG DELAY TIME	MIN DELAY TIME
PHONE PATCH OR PHONE RELAY	481	2hr 03min	0hr 23min	0hr 02min
SDE9	54	3hr 30min	0hr 37min	0hr 10min*
AUTODIN	2	2hr 05min	1hr 45min	1hr 25min
DALS**	1	0hr 25min	0hr 25min	0hr 25min

*Preliminary eye fix
**Two partial eye messages also received

TABLE 2-2

The delay time is defined as the difference between the time of the fix and the time of receipt of the completed message in JTWC. About ninety percent of the fixes were received by phone patch or phone relay with an average delay of 23 minutes. (Phone relay method from the weather monitor was

TYPHOON HOPE TRACK
BRAVO 25 SEP 1970

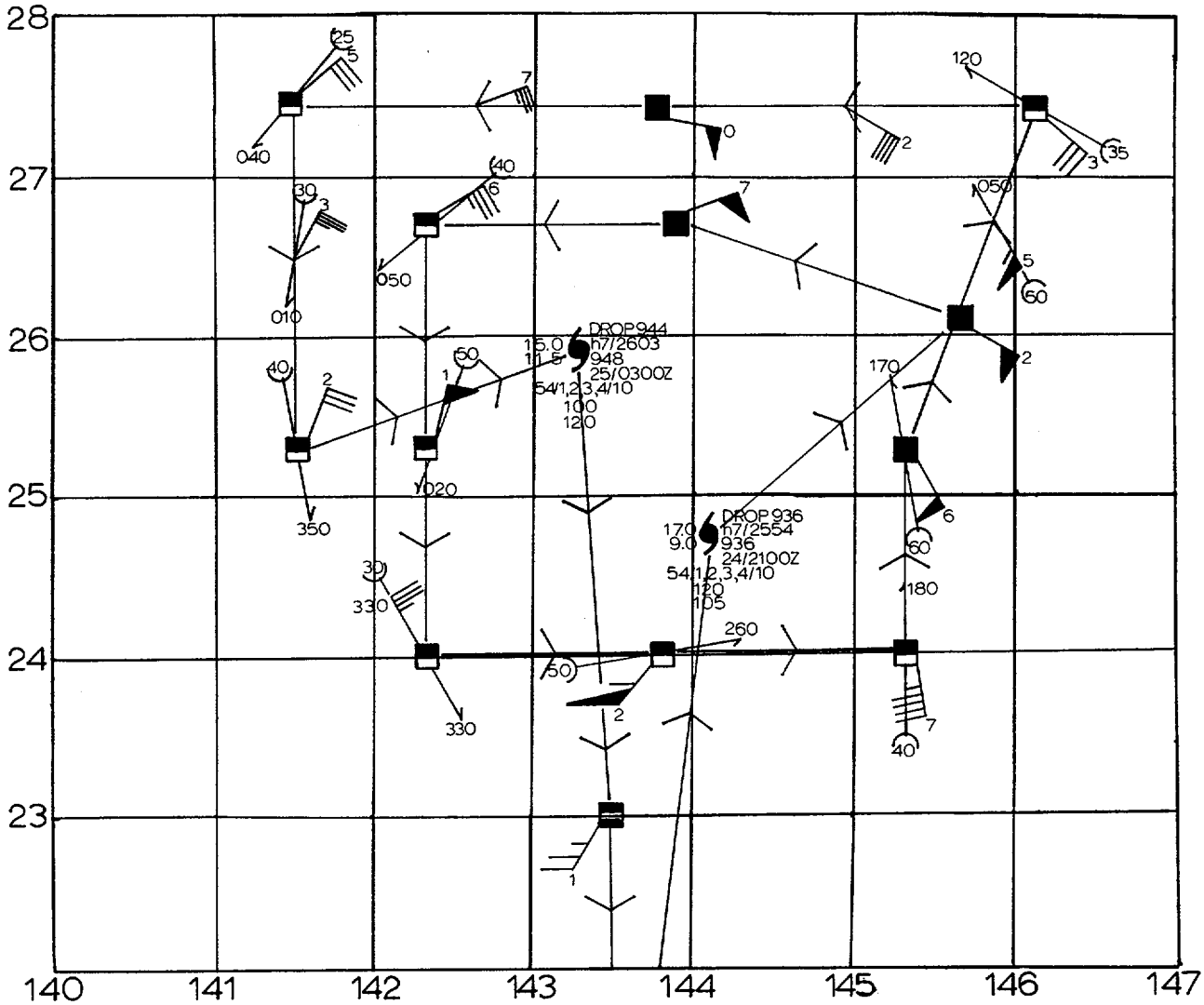

FIGURE 2-2

used in a few cases when the signal from the aircraft was too weak to be copied by JTWC.) About ten percent of the eye fixes were passed from the weather monitor to JTWC via the on-island teletype circuit (SDE9) with an average delay of 37 minutes. Most of these were preliminary fixes in an abbreviated format.

A comparison of delay times for the past five years is shown in Table 2-3.

COMPARISON OF DELAY TIMES WITH PREVIOUS YEARS

	1966	1967	1968	1969	1970
MAX DELAY TIME	4HR 33M	11HR 20M	6HR 25M	2HR 11M	3HR 30M
AVG DELAY TIME	1HR 02M	0HR 43M	0HR 25M	0HR 22M	0HR 25M
MIN DELAY TIME	FEW MIN	FEW MIN	FEW MIN	0HR 01M	0HR 02M
% EYE MSGS DELAYED OVER 1 HOUR	38%	16%	4%	2.8%	5%
# FIXES RECEIVED AFTER WARNING TIME	30*	23	6	3	5
% FIXES RECEIVED AFTER WARNING TIME	5.4%	3.1%	0.7%	0.6%	0.9%

*Fixes scheduled 3 hours prior to warning time vice 2 hours after 1966.

TABLE 2-3

Statistics for the past three years show a leveling off in all values. These are all within acceptable limits. Little or no reduction in delay times can be foreseen within the present system.

F. AIRCRAFT RECONNAISSANCE SUMMARY

Aircraft reconnaissance missions for 1970 included 211 synoptic tracks, 168 investigations, and 439 levied fix missions completed. There were also 60 nonlevied preliminary and intermediate fixes made. A total of 10 levied fixes or investigatives were missed; five of these were for fixes when two storms were in progress at the same time. This gives a total of 607 levied fixes and investigatives completed which is only slightly below the average of 644 for the period 1962 through 1970. Figure 2-3 shows the monthly distribution of

MONTHLY DISTRIBUTION OF RECONNAISSANCE REQUIREMENTS FOR 1970

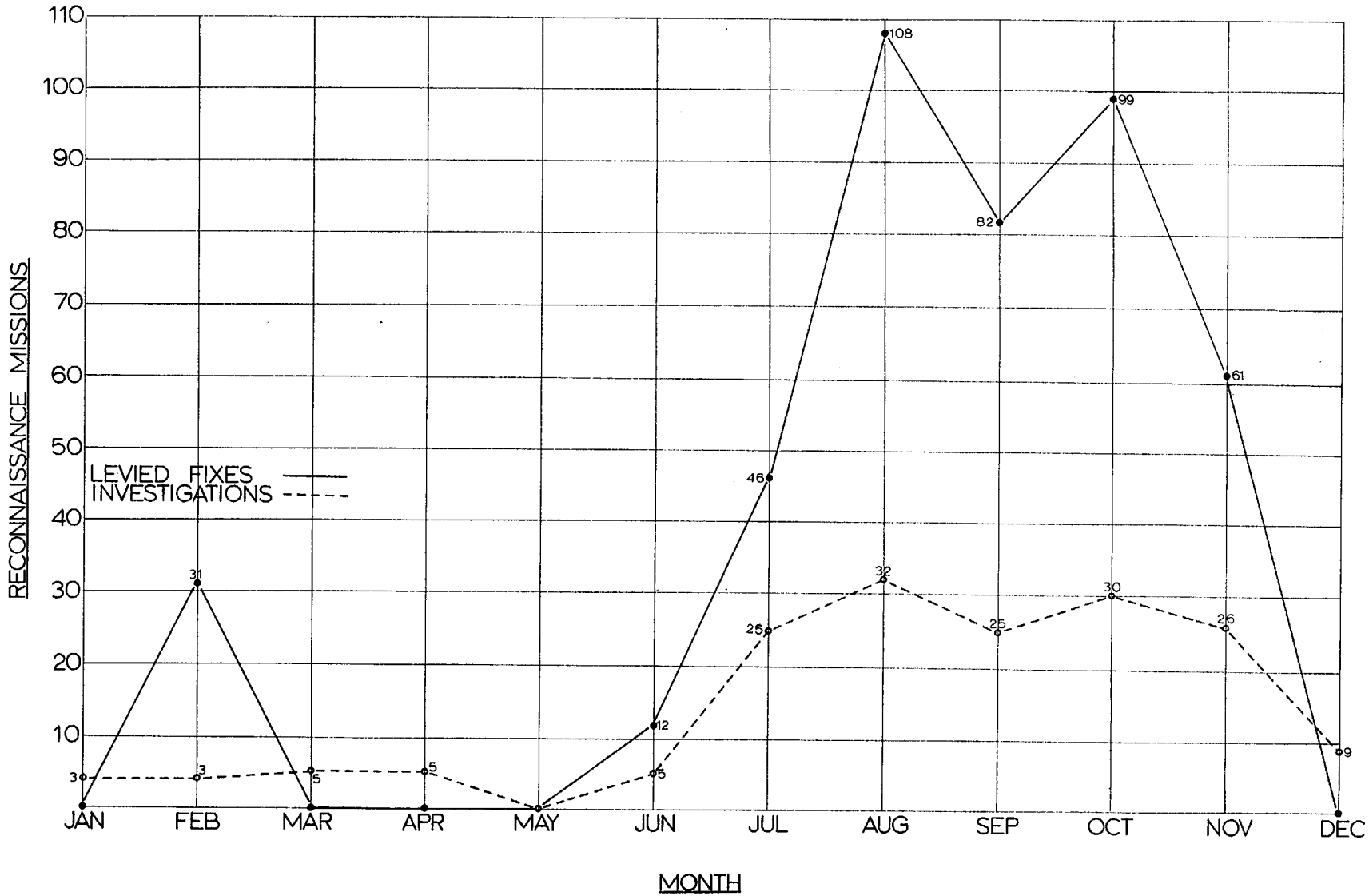

FIGURE 2-3

reconnaissance requirements for 1970. Few missions were required during the first half of the year with 88% of the requirements occurring during the five-month period July through November. Fixes for this past year show a peak caused by Typhoon Nancy in February. Cyclones may occur during any month of the year but normally there is not more than one typhoon occurring during the first four months. About 80% of the reconnaissance requirements normally occur during July through November.

G. RECONNAISSANCE EFFECTIVENESS

Based on the credit system shown in Table 2-4, a percent effectiveness was computed for cyclone fixes, investigations, and for the combined effectiveness. This system is only an evaluation of the time the fix was made compared to the levied fix time. No provision is included for type or quality of fix.

Of 470 levied cyclone fixes, 415 were made on time with another 23 missions falling into the Class 2 category. Twenty fixes were made either early or late, 8 fixes were missed completely while the remaining four missions failed to fix an existing center. Out of 1,410 points possible, 1,341 were earned or a fix effectiveness of 95.1%. Of the 170 levied investigations, 2 missions were missed, 46 resulted in center fixes, and 122 missions were flown into suspect areas without a detectable center. A total of 502 points were earned out of a possible 510 for a 98.4% investigative effectiveness. The combined effectiveness for fixes and investigatives was 96.0%. The average recon effectiveness for the last five years is 96.6% with very little deviation from year to year. This average value apparently approaches optimum utilization of reconnaissance resources available to WESTPAC.

RECON CREDIT DEFINITIONS WITH MISSIONS FOR 1970

CLASS	DEFINITION	POINTS	CRITERIA	1970
1	Full Credit Fix	+3	Fix made from 1 hour before to ½ hour after levied time.	415
2	Full Credit Fix	+3	Aircraft in area assigned from 1 hour before to ½ hour after levied time but unable to locate a center or unforecast cyclone acceleration caused the cyclone to be too distant to reach on time. Also fix attempted but not made due to reasons beyond the control of the squadron such as cyclone moved over land, restricted flying area, clearance problems, etc.	23
3	Early/Late Fix	+2	Fix made more than 1 hour but not more than 1½ hours before or more than ½ hour but not more than 2 hours after levied time.	15
4	Very Early/ Very Late Fix	+1	Fix made more than 1½ hours before or more than 2 hours after levied time.	5
5	Fix Attempted But Not Made	0	Recon provided some useful peripheral data but no fix was made. Reasons may include such things as mechanical trouble, low fuel, etc.	4
6	Missed Fix or Investigative	-1	Missed fix not covered by classes above or missed investigative.	8/2
7	Full Credit Fix	+3	Fix made on investigative flight or synoptic track. Detailed eye/ center message received.	46
8	Full Credit Investigative	+3	Investigative flight about a point; no fix made.	122
9	No Credit Fix	0	Preliminary or intermediate fix not levied.	60

NOTE: All levied fixes and investigatives have a potential of +3 points.

TABLE 2-4