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This study is an evaluation of the port of Yokosuka, Japan as a typhoon "haven." Characteristics of the port discussed include the topographical effects on winds during the passage of tropical cyclones, port facilities, wave action and storm surge. Problems to be considered when remaining in port and possible evasion procedures for ships sortieing are examined.

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20. Abstract (con't)

Tropical cyclone tracks from 1947-1973 for the western North Pacific were analyzed to determine the probability of threat to the port. Observations by the author and conversations with harbor authorities are utilized in arriving at conclusions.

The results show that the port of Yokosuka is a safe typhoon haven. To aid in decision making, an operationally oriented flow diagram is presented which summarize the location of various sections of the test.

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AN EVALUATION OF THE HARBOR OF YOKOSUKA, JAPAN AS A TYPHOON HAVEN

by

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JUNE 1975

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CONTENTS (continued)

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1. INTRODUCTION

The hazard associated with a mature tropical cyclone is serious to all ships, no matter their size. The foremost thought of commanders when confronted with the threat imposed by a typhoon is that when the threat has abated will his unit(s) be able to proceed as directed to complete its assigned mission. The usual practice is to try to avoid the typhoon and its far ranging danger area entirely which usually implies an evasion at sea.

This study examines the Japanese port of Yokosuka as a typhoon haven. An attempt is made to answer the following questions when a typhoon threatens Yokosuka. Should a unit remain in port rather than put to sea, or when a typhoon threatens a ship at sea should that ship seek the shelter of Yokosuka? The intent is to provide an aid to the commander in his decision-making process.

The decision includes the weighing of many factors. Items to be considered, for example, may include the U.S. Fleet Weather Central/Joint Typhoon Warning Center (FWC/JTWC), Guam warnings, the climatology for the time of year, the physical features of the port itself, and the options if the ship puts out to sea.

An operationally oriented flow chart is found on page 61 in Figure 33. This chart identifies pertinent pages of this study as a quick reference guide.

2. TROPICAL CYCLONES

2.1 LIFE CYCLE

An informative and convenient method to view the typhoon is to look at its evolution from a weak tropical disturbance to its dissipating stage. The evolution from a tropical disturbance to a mature typhoon and subsequent dissipation is usually a slow process but it can at times be very rapid. Several of the terms used to describe the life cycle are as follows (adapted from Crutcher and Quayle, 1974):

1. Tropical Disturbance

A tropical disturbance, the formative stage from which a typhoon may develop, is a weak low pressure area characterized by below normal pressure, abnormal cloudiness, shower activity and weak cyclonic wind flow. The disturbance forms in the low latitudes over a warm sea surface. The fall of barometric pressure is generally a slow, gradual process to about 1000 millibars (mb). The strongest winds occur to the north of the developing vortex in the Northern Hemisphere.

2. Tropical Cyclone

A tropical cyclone is a cyclone originating over the tropical ocean. Weather fronts are not associated with the tropical cyclone as with temperate latitude cyclones and most of its energy is derived from an intricate system which, to a large extent, is dependent upon the sea-surface temperature (SST). The SST is usually greater than 26°C. In the Northern Hemisphere the wind rotates counterclockwise around the warm center core of low pressure.

3. Tropical Depression

A tropical depression defines the situation when there is a closed circulation (a closed isobar generally locates the center of the depression) and the maximum sustained wind speed is below 34 kt (gusts may exceed 34 kt). Warnings are issued on depressions only when intensification is expected.

4. Tropical Storm

If a tropical cyclone has maximum sustained winds of 34 to 63 kt it is termed a tropical storm and is assigned a name by the FWC/JTWC, Guam. Not all tropical cyclones reach this stage.

Assuming that the cyclone intensifies, the center pressure falls rapidly below 1000 mb and the winds form a tight band around the center. Cloud and rain patterns develop into narrow organized bands, spiraling inward toward the center.

5. Typhoon

A tropical cyclone in which the maximum sustained winds are 64 kt or greater is called a typhoon. The tropical cyclone is considered immature as long as the barometric pressure falls and the speed of the gusty winds increases. In an immature stage the typhoon strength winds may exist within a relatively small area.

When the center surface pressure stops falling, and the sustained wind speed regime stabilizes, the mature stage is reached; however the size of the storm may still increase and do so over a number of days. The circulation of a mature typhoon may be over 1000 n mi in diameter.

The right side of a tropical cyclone in the Northern Hemisphere is known as the "dangerous semicircle," while the left side is known as the "navigable semicircle" (navigable does not imply that a ship can maneuver without difficulty and the left side is still extremely dangerous and hazardous). Figure 1 gives an overall view of the wind pattern around the eye of a Northern Hemisphere 150-kt typhoon. Note the relationship between the wind intensity and the direction of movement.

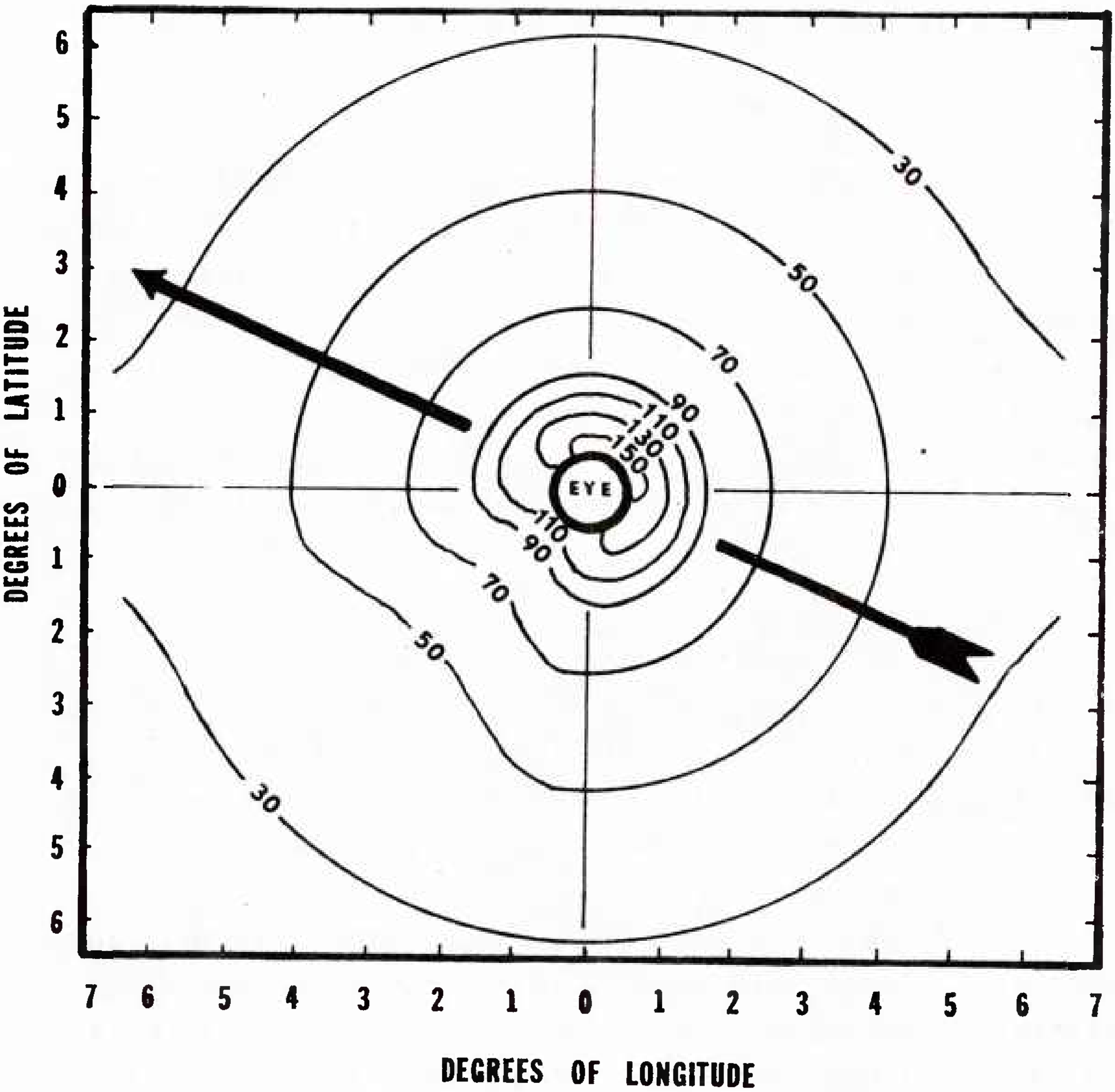

Figure 1. Distribution of surface wind speeds (in knots) around a large, intense typhoon in the northern hemisphere over open water. The arrow indicates direction of movement (after Harding and Kotsch, 1965).

Figure 2 depicts the general wind field about a 150-kt Northern Hemisphere typhoon. The angle of inflow varies considerably with each typhoon. Note the tightening of the pressure gradient in the right semicircle relative to the direction of motion.

6. Dissipation Stage

Dissipation occurs when the maximum wind speed declines steadily along with a rising central barometric pressure.

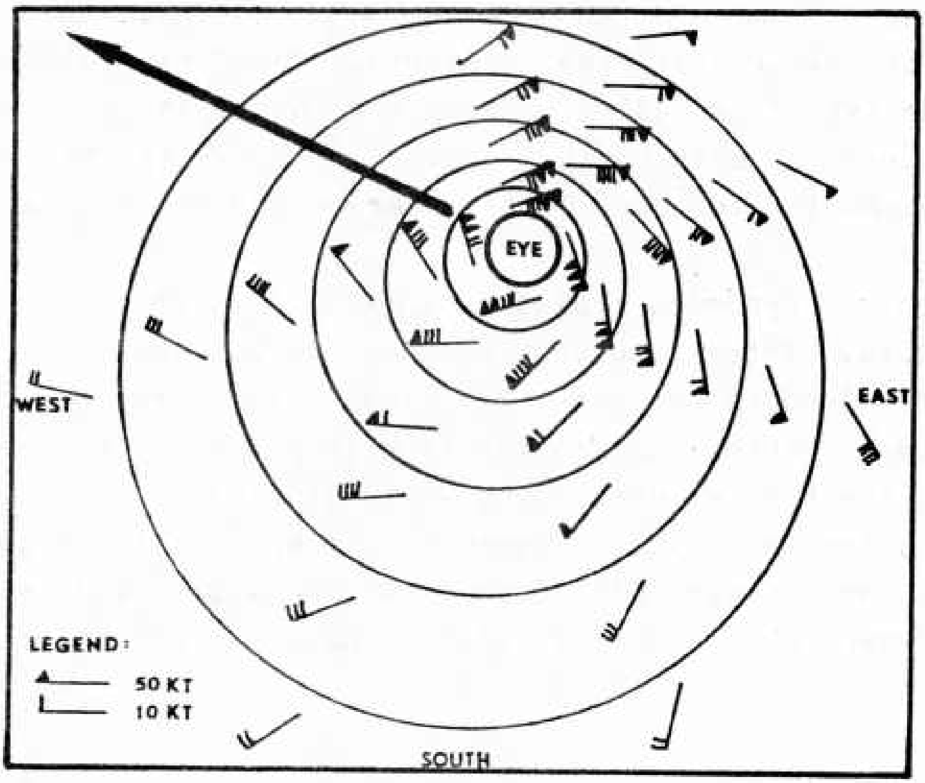

Figure 2. Wind circulation around a 150-kt typhoon in the Northern Hemisphere. Each pennant indicates 50 kt of wind and each barb indicates 10 kt (after Harding and Kotsch, 1965).

2.2 MOVEMENT

Individual tropical cyclones (henceforth the term tropical cyclone refers to tropical depressions, tropical storms, and typhoons) may follow irregular and widely differing tracks. In general they begin in the tropics and usually move west-northwest. Some cyclones move from the tropical latitudes to the temperate latitudes, their northwest movement becoming northward and finally northeastward. This change in direction through north to the northeast is termed "recurvature." In a study of 586 tropical storms and typhoons which occurred during the months of May-December 1945-1969, Burroughs and Brand (1972) found that 236 (40%) of them recurved. The majority of typhoons which are a matter of concern to Yokosuka are the recurvers. The above value of 40% is derived from Table 1. Note the change in the percent that recurve for each month. Appendix A shows the tracks of all typhoons for the June-October period for the 24 years 1946-1969.

Tropical cyclones typically move at 8-14 kt prior to recurvature. After recurvature, they can accelerate within a period of 48 hours to speeds 2-3 times that at the point of recurvature. This acceleration is mainly due to the system entering the belt of prevailing westerly winds.

As a tropical cyclone moves into temperate latitudes, it comes into contact with cooler surface waters and cooler air is drawn into its circulation. These factors hasten its dissipation.

Table 1. Recurving tropical storms and typhoons versus total number of tropical storms and typhoons separated by monthly periods for the period 1945-1969 (after Burroughs and Brand, 1972).

Period	Recurving Tropical Storms & Typhoons Per Period	Total Tropical Storms & Typhoons Per Period	Percent That Recurve
May	14	24	58%
June	14	40	35
July	17	88	20
August	39	113	35
September	53	123	43
October	52	94	55
November	34	70	48
December	13	34	38
May-December	236	586	40%

2.3 SEA STATE AROUND TROPICAL CYCLONES

Wind is the driving force which generates the waves and produces the state of the sea. Swell, which affects ship movement, extends well beyond the wind field associated with a tropical cyclone. A miscalculation or imprudent decision concerning sea conditions may lead to a destructive rendezvous with the storm. Though the tropical cyclone's wind pattern can be forecasted with fair accuracy for any direction and distance relative to the center, a forecast of the sea state is more difficult. The character of the sea state is primarily a function of storm size, duration and intensity.

Figure 3 shows the combined sea height[1] associated with 21 tropical storms and typhoons (based on 173 analyses for the year 1971) plotted as a function distance from the storm center and storm intensity (Brand, et al., 1973). There is an obvious relationship between the sea state and storm intensity. A tropical storm (wind category 35-64 kt) can produce 12-ft seas 210 n mi from the storm center, while an intense typhoon (wind category ≥100 kt) can produce 12-ft seas 450 n mi from the center. The distances given are mean distances since the isopleths of combined sea height are not symmetric about the storm center. Brand et al. (1973) found that the actual wave heights are at least partially dependent on the direction in which the storm is moving. For example, Figure 4 shows the average combined sea-height pattern for recurved storms moving on headings between 001° and 090° and is based on 24 sea-state analyses for tropical storms and typhoons that occurred during 1971. The mean speed of movement and mean wind speed for these analyses were 12.1 kt and 64.2 kt, respectively. Note that the greatest area of higher seas (9-15 ft range) exists in the right (dangerous) semicircle of the storm.

---

[1]The combined sea height is defined as the square root of the sum of the squares of "significant" sea and swell height. Sea is wind waves and swell consists of wind generated waves which have advanced into regions of weaker or calm winds. "Significant" will be defined here as the average height of the highest one-third of the waves observed over a specified time.

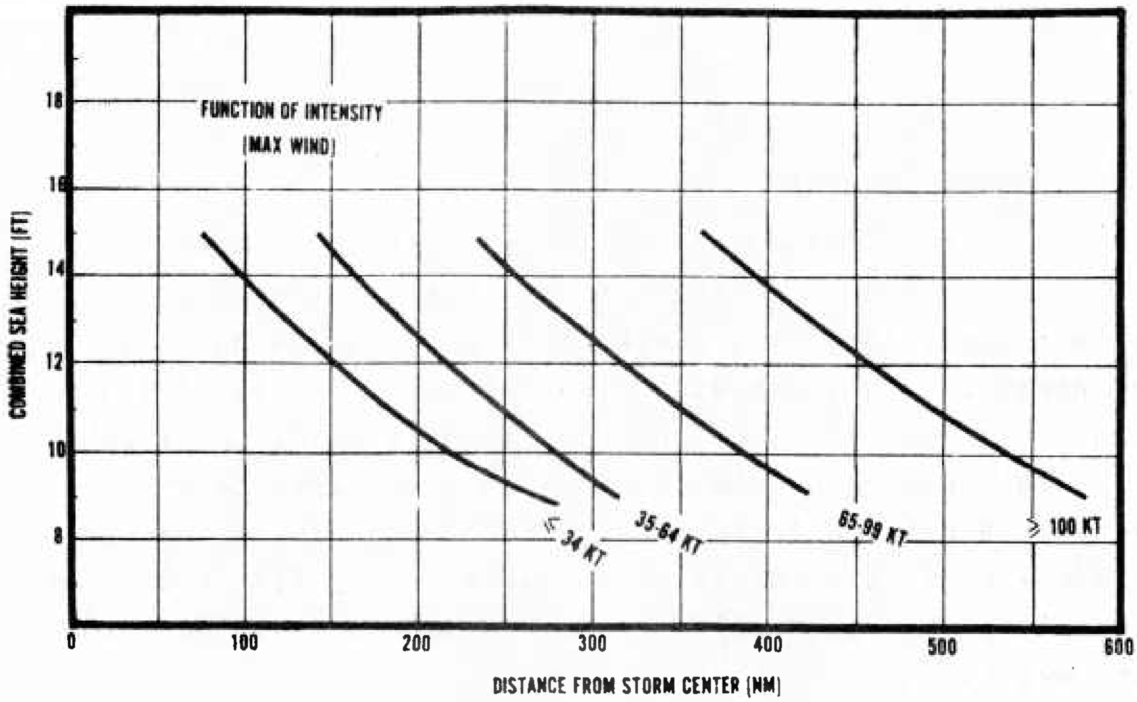

Figure 3. Combined sea height plotted against distance from storm center and given as a function of storm intensity (Brand, et al., 1973).

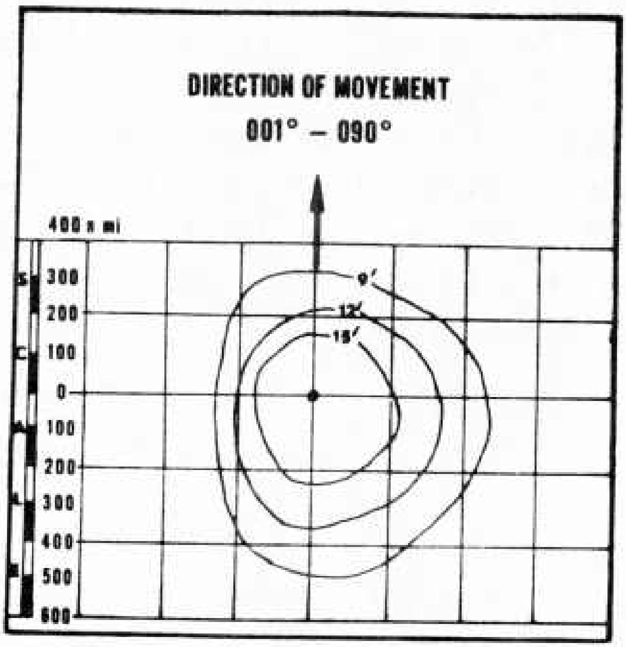

Figure 4. Combined sea-height isopleths (9-15 ft) based on 24 analyses of tropical storms and typhoons heading between 001°-090°. The mean speed of movement and mean wind speeds for these 24 analyses were 12.1 and 64.6 kt, respectively (after Brand, et al., 1973).

3. JAPAN

3.1 JAPANESE ISLANDS

Japan is an island nation in the western part of the North Pacific Ocean off the eastern coast of the Asiatic mainland consisting of a chain of islands extending in an arc from northeast to southwest. The northeastern tip of the chain is at 46N, 143E and the southernmost point is at 26N, 131E. The four main islands of Japan from north to south are Hokkaido, Honshu, Shikoku and Kyushu. Hundreds of smaller islands lie off the coasts of the main ones. Figure 5 shows the position of Japan relative to the surrounding land and water masses.

3.2 HONSHU

Honshu is the largest of the main Japanese Islands. Yokosuka, a major port city in southeast Honshu, is used continuously by the U.S. Navy. It is currently homeport for a number of SEVENTH Fleet units.

A detailed description of the coasts and harbors of Honshu can be found in the Sailing Directions (Enroute) for Japan, Pub. No. 156. For specific guidance on navigational aids and additional features in the vicinity of Yokosuka, consult Section 4 of the above.

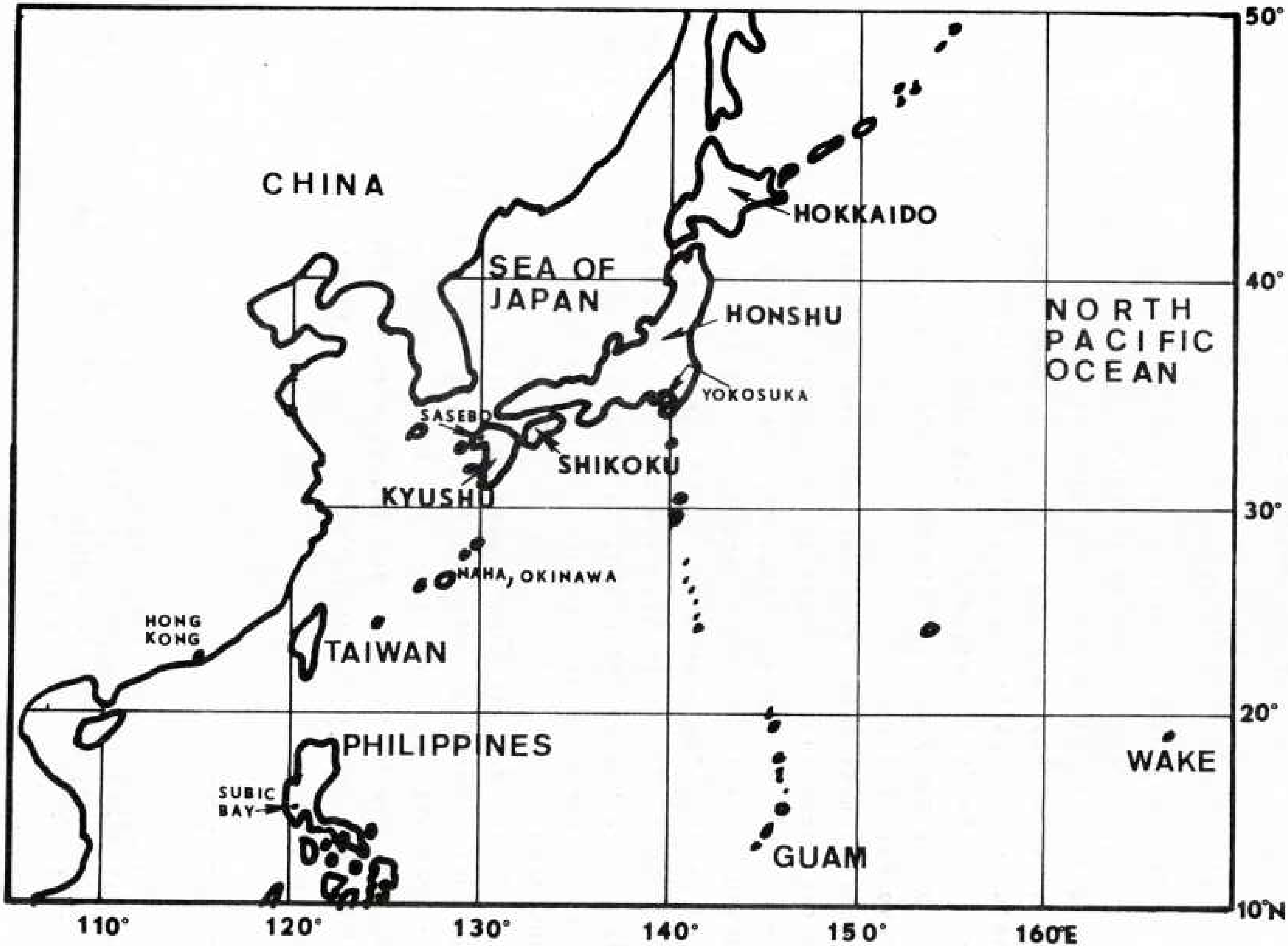

Figure 5. Map of western North Pacific Ocean, main Japanese Islands, and some major Western Pacific ports.

4. YOKOSUKA-GENERAL DESCRIPTION

4.1 LOCATION AND TOPOGRAPHY

The port of Yokosuka is located at 35°17'N, 139°40'E in the central part of the Miura Peninsula on the southwest side of landlocked Tokyo Bay. The harbors of Yokohama and Tokyo are also in Tokyo Bay and Figure 6 locates some pertinent features. Tokyo Bay penetrates the southeast coast of Honshu in a northerly direction for a distance of almost 35 n mi. Approximately 200 ships transit Uraga Suido, the entrance to Tokyo Bay, daily.[2]

The coast immediately adjacent to Tokyo Bay is low, but to the north and northwest are high mountains. Figure 7 depicts the predominant topographical features of central Honshu. The island of Honshu is one of the most rugged of land areas. The mountains in the north central area average 5,000 to 10,000 ft in height and are often called the Japanese Alps. The highest mountain, Fujiyama (12,395 ft), is located 60 miles due west of Yokosuka. Northern Honshu is less mountainous.

Figure 8 shows the topography to the north and east of Yokosuka. Note the relative flatness of this terrain as compared with the terrain to the west and northwest of Yokosuka. Southern Honshu is even less jagged with no peaks rising over 5,000 ft. The rugged terrain of Honshu influences the weather at Yokosuka.

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[2] Uraga Suido is a controlled traffic route, one of several controlled routes established by the Japanese Maritime Safety Agency to regulate shipping traffic in highly congested areas in an effort to avert marine accidents.

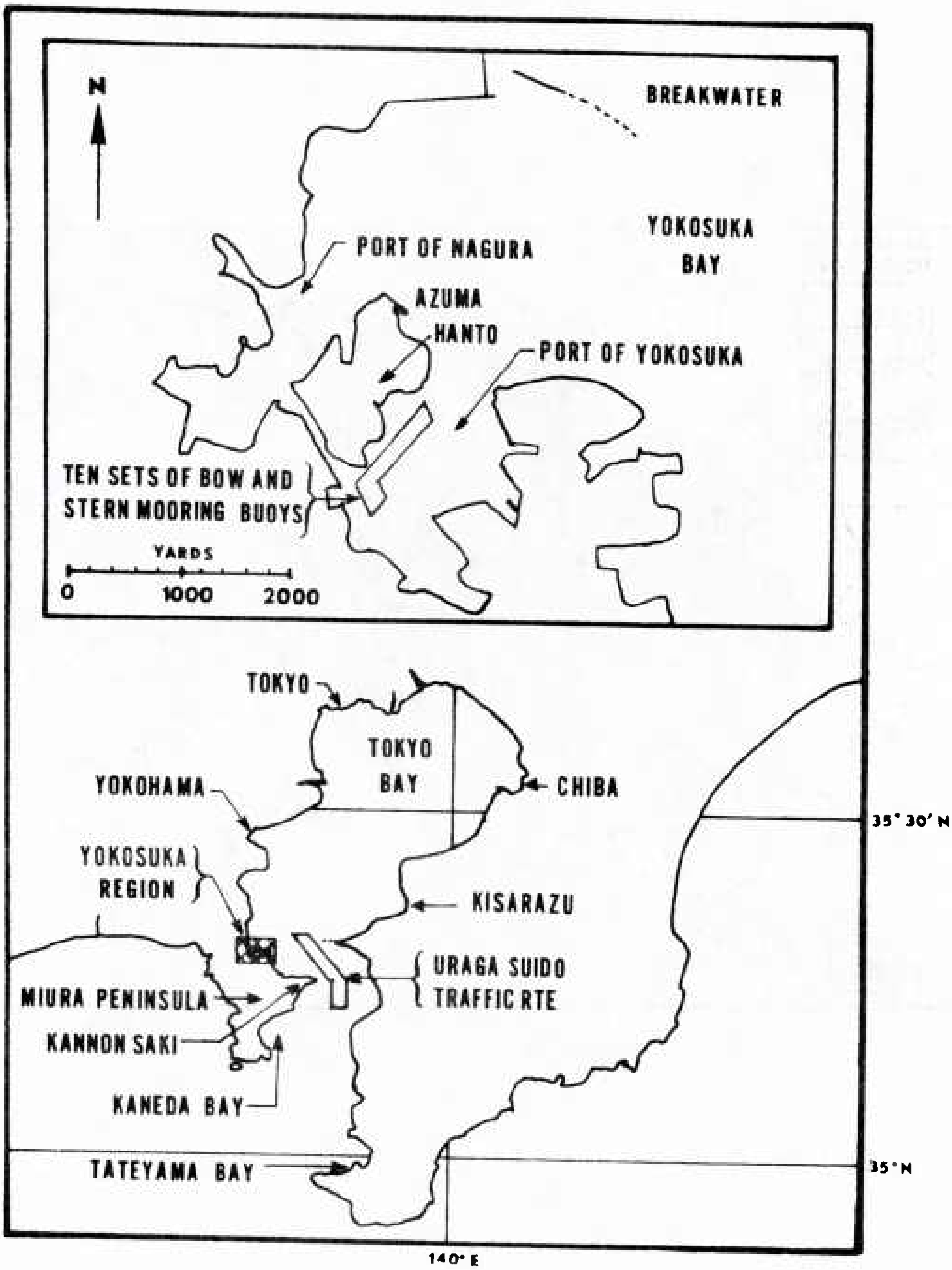

Figure 6. Tokyo Bay and the surrounding land area. The hatched area (Yokosuka region) is enlarged at top of the figure.

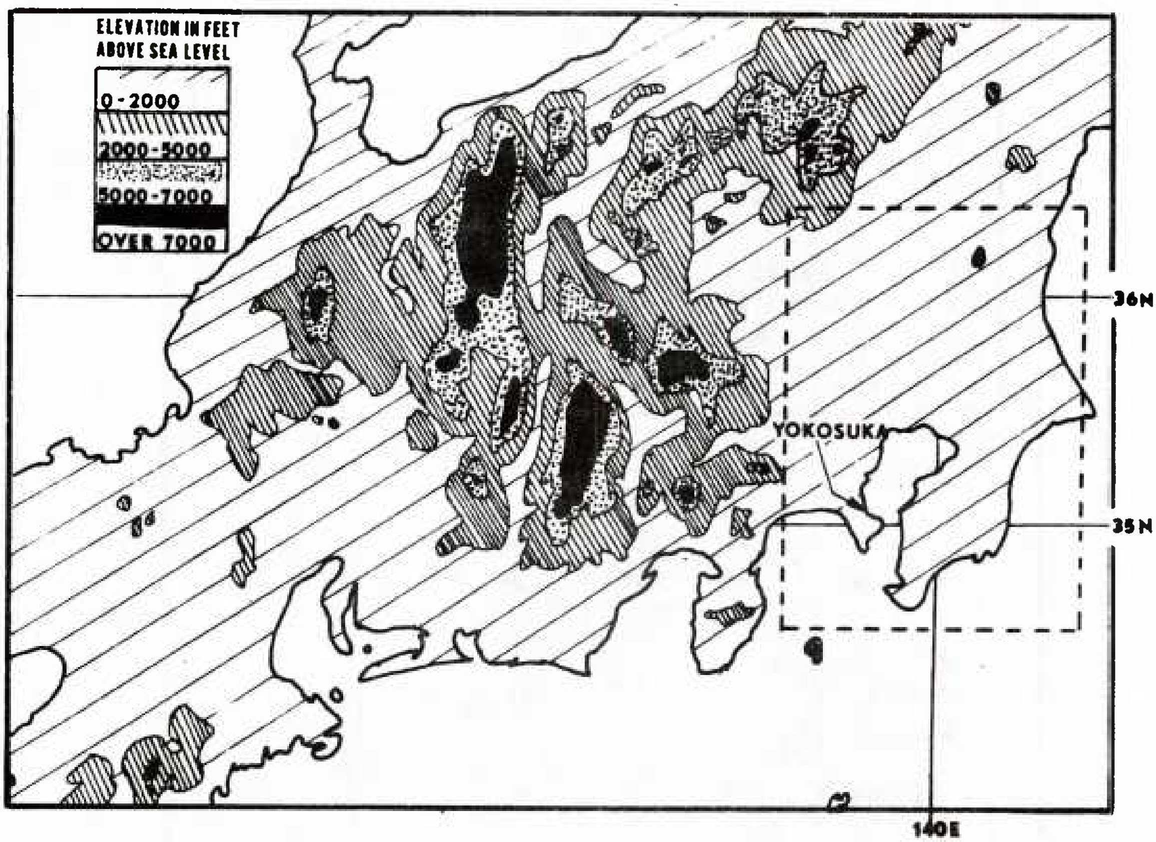

Figure 7. Topographical map of central Honshu in vicinity of Yokosuka (the topography of the outlined area is enlarged in Figure 8).

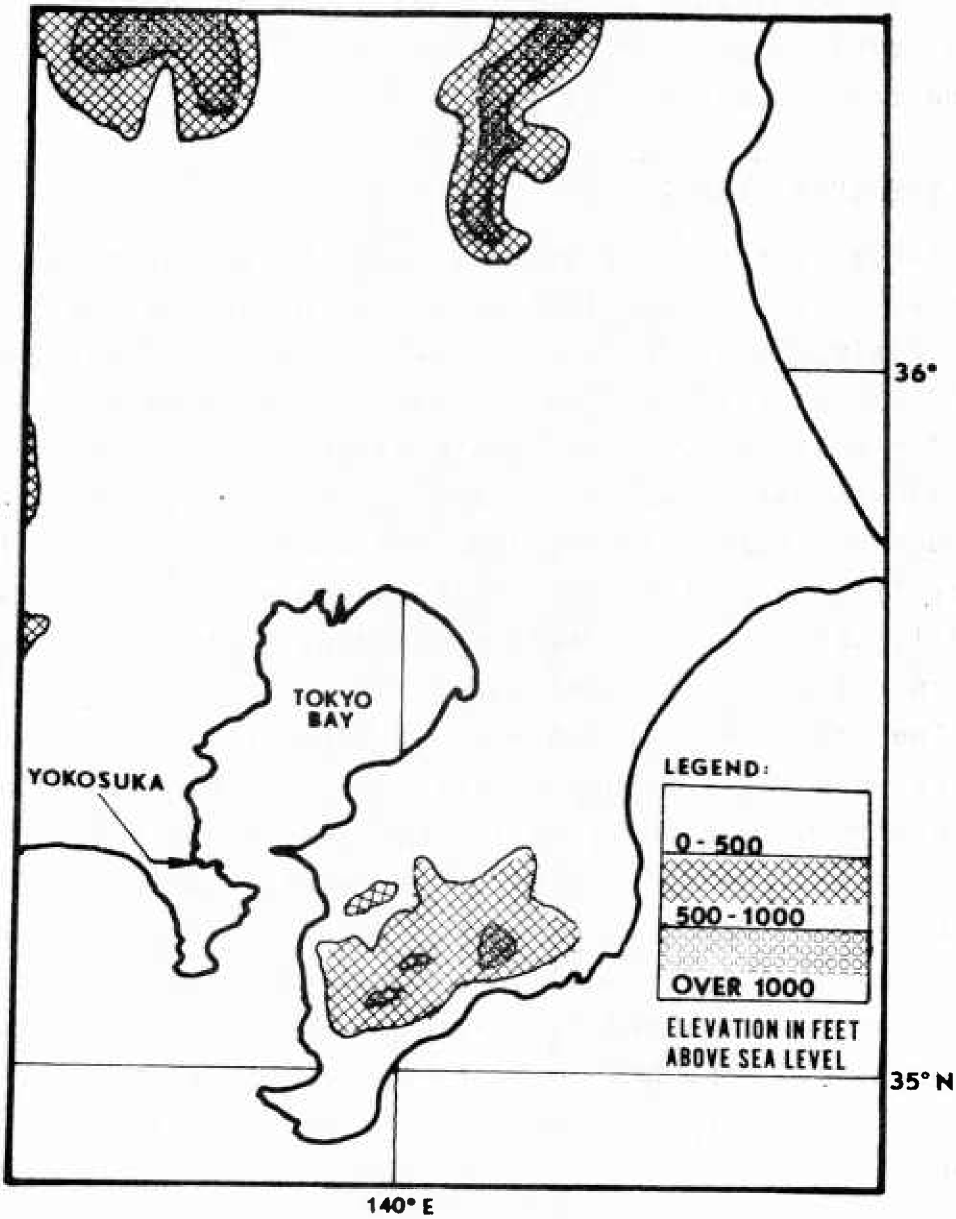

Figure 8. Topographical map of area to the north and east of Yokosuka.

Yokosuka Bay is at the southwestern end of the inner part of Tokyo Bay. The harbor of Yokohama, a large commercial port, is about 10 n mi northward of Yokosuka Bay. Tokyo Harbor is about 20 n mi north-northeastward of Yokosuka. The harbor of Yokosuka can be classified as a medium-sized harbor of the coast breakwater type.

4.2 YOKOSUKA HARBOR

Yokosuka Harbor is entered from the southern part of Tokyo Bay. The harbor is bounded on the east by part of the Miura Peninsula which is the site of the U.S. Fleet Activities (FLEACTS) Yokosuka, and on the west by Azuma Hanto which is actually an island. Azuma Hanto separates Yokosuka Harbor from Nagura Harbor which is used by the Japanese Maritime Self Defense Force (JMSDF) and is a commercial port. Nagura Harbor is entered from the southwestern part of Yokosuka Bay. A small, narrow channel separates Azuma Hanto at its southwestern end from the mainland.

The entrance to the harbor of Yokosuka is about 500 yards wide between the 5-fathom curves. Depths in the harbor decrease from 11 fathoms in the entrance to less than 5 fathoms near the head. A pilot is required when proceeding into or out of drydocks and their services are recommended when a vessel exceeds 5000 tons and/or has a single screw. The harbor can accommodate about 20 ships of various types at any one time.[3] Appendix B lists the harbor facilities of Yokosuka. The buoys in the Yokosuka region are listed in Appendix C.

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[3]The trend toward larger ship types has reduced the pierside berthing capacity inside the port. The optimum load out for the port has been suggested as 1 CVA, 1 CLG and 14-18 other various ship types.

Figure 9 is a photograph of Yokosuka Harbor which shows the local topographical features in the immediate vicinity of the port of Yokosuka. Note the protection afforded berths 8, 9, 10, 11, and 12 and drydock 6 from northerly winds clockwise to southerly direction winds.

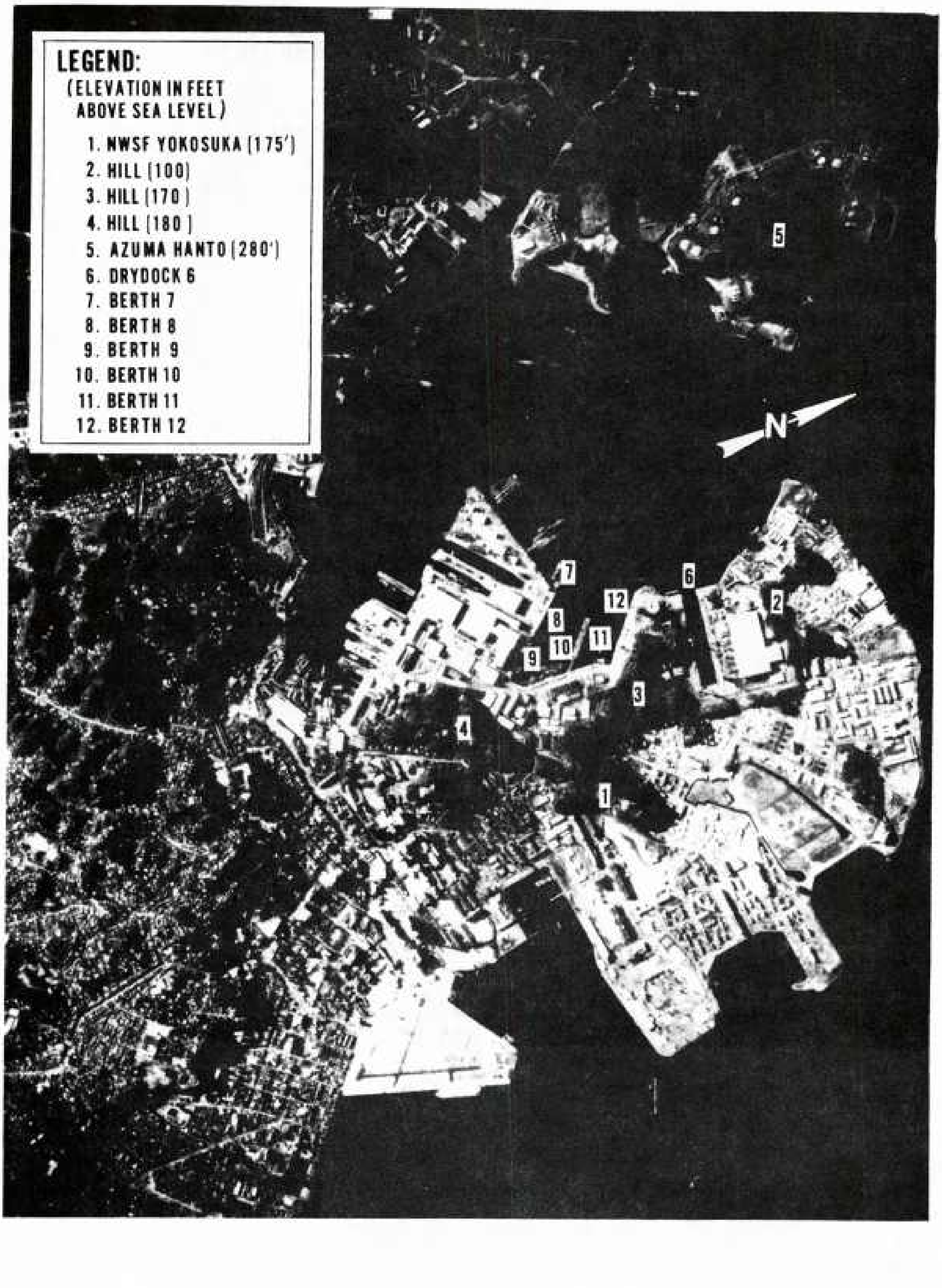

Figure 9. Aerial photograph of the Port of Yokosuka.

5. TROPICAL CYCLONES AFFECTING YOKOSUKA

5.1 CLIMATOLOGY

Tropical cyclones which affect Yokosuka generally form in an area bounded by the latitudes 5N and 30N and the longitudes 120E and 165E. The latitudinal boundaries shift poleward during the summer months and then equatorward in winter in response to the seasonal changes of the synoptic environment. The great contrast between the cold continental air masses of winter and the warm maritime tropical circulation in summer is the fundamental key to the seasonal changes.

In the genesis area mentioned above typhoons have occurred in all months but, with rare exceptions, those affecting the main Japanese Islands are confined to the period of May to November. Late summer and early autumn are the likeliest seasons. Size and intensity of the storms vary widely.

The majority of those that pose a threat to Yokosuka (any tropical cyclone approaching within 180 n mi of Yokosuka is defined as a "threat" for the purpose of this study) occur during the months June-October. Figure 10(a) gives the frequency distribution of threat occurrences by 5-day periods. This summary is based on data for the 27 years 1947-1973. Note that the maximum number occur during August and September.[4]

Figure 10(b) depicts on an 8-point compass the "threat" tropical cyclones according to the octant from which they approached Yokosuka. The circled numbers indicate the total that approached from an individual octant. The count for an

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[4]A total of 82 tropical cyclones passed within 180 n mi of Yokosuka during the May-November period for the years 1947-1973. Seventy-six (93%) of these tropical cyclones passed within 180 n mi during the 5 months, June-October, and the remaining 6 passed in the months of May and November, 3 each month.

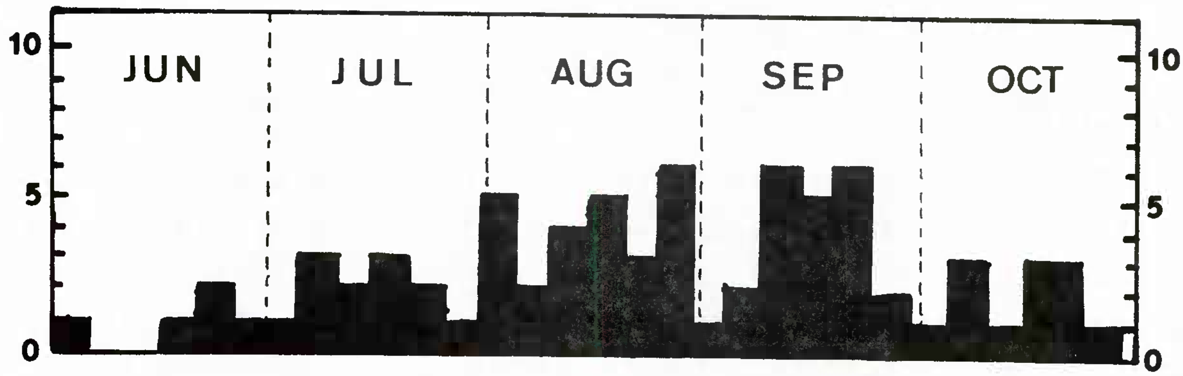

Figure 10(a). Frequency distribution of the number of tropical cyclones that passed within 180 n mi of Yokosuka. Subtotals are based on 5-day periods for tropical cyclones that occurred during 1947-1973.

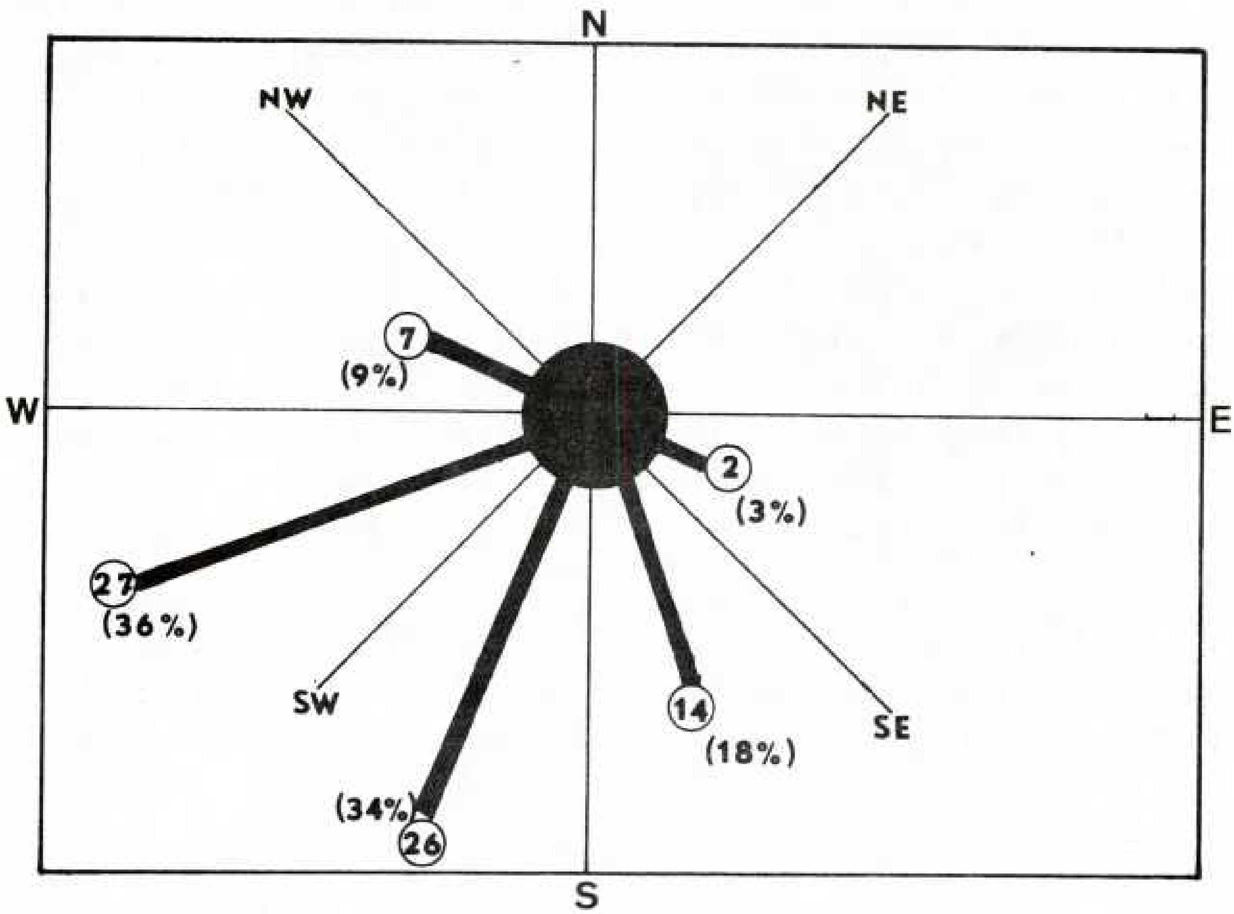

Figure 10(b). Octant from which tropical cyclones (June-October, 1947-1973) approached to within 180 n mi of Yokosuka. Circled numbers indicate the number that approach from each octant. The number in parenthesis is the percentage of the total sample of 76 that approached from that octant.

octant of approach includes both recurvers and non-recurvers. Note that a majority of these approach from the south-southwest and west-southwest. A more detailed inspection of the sample of 76 tracks revealed that only 9 (12%) did not recurve before passing within 180 n mi of Yokosuka.

Figure 11 depicts the tracks of these nine tropical cyclones and are presented for general information. A number of them, however, did recurve at a later time. The latitude of recurvature is generally higher for the months of July and August. Since the speed of advance and wind intensities of these tropical cyclones vary considerably, significant conclusions about these systems could not be reached.

An overview of the climatology of tropical cyclones that passed within 180 n mi of Yokosuka is provided in Figures 12 to 16 and shows a statistical summary based on tropical cyclone tracks for the years 1947-1973.[5] The data are grouped by months, June to October. Since tracks were recorded for 5-day periods, exact calendar months could not be used.

In Figures 12 to 16 the total number of tropical cyclones, N, that passed through each 3° lat/long square for a given month is printed at the top of each square. To aid in the analysis of the tracks, an arbitrarily chosen line oriented southeast (SE) to northwest (NW) is passed through Yokosuka. A circle of radius 3° latitude (180 n mi) is drawn centered on Yokosuka as shown in Figures 12 to 16. At the bottom of each 3°X3° square is a number, RAD, which represents the percent of those tropical cyclones that passed through the square and subsequently passed within 180 n mi of Yokosuka.

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[5]From Chin for the years 1947-1970, and FWC/JTWC Annual Typhoon Reports for the years 1971-1973.

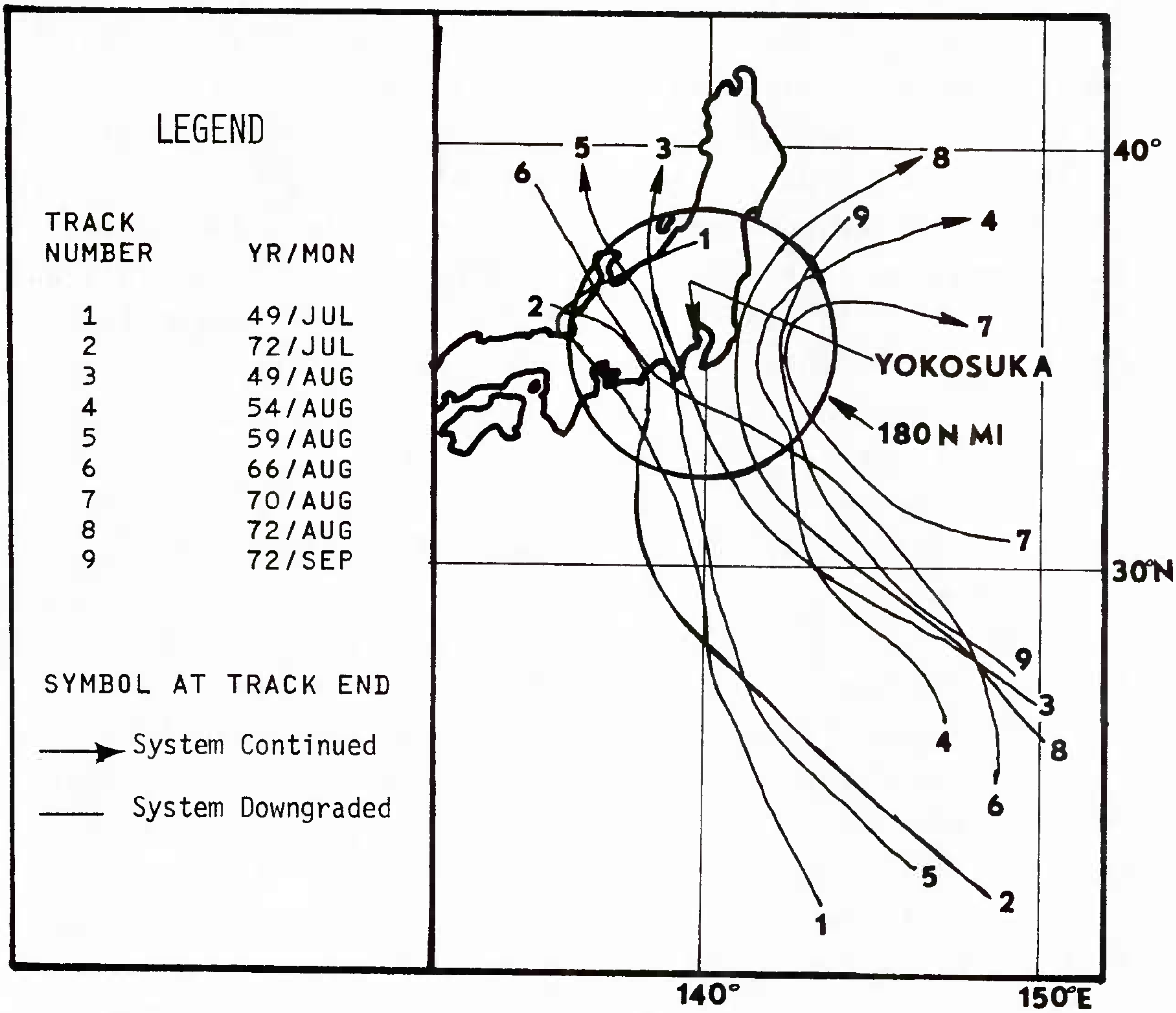

Figure 11. Tracks of the 9 tropical cyclones that had some westerly motion within 180 n mi of Yokosuka (based on data from 1947-1973). Track number 2 is marginal.

Four other parameters, in addition to N and RAD, are used to assess the "threat" to Yokosuka. The four parameters, L_1, L_3, R_1, and R_3 are defined as:

L_1: Percentage of all tropical cyclones that passed through the square and subsequently crossed a line extending northwest from Yokosuka within a distance of 60 n mi.

L_2: Percentage of all tropical cyclones that passed through the square and subsequently crossed a line extending northwest from Yokosuka within a distance of 180 n mi.

R_1: Percentage of all tropical cyclones that passed through the square and subsequently crossed a line extending southeast from Yokosuka within a distance of 60 n mi.

R_3: Percentage of all tropical cyclones that passed through the square and subsequently crossed a line extending southeast from Yokosuka within a distance of 180 n mi.

L_1, L_3, R_1, and R_3 are printed at the left and right edges of the square respectively.[6] For example, in Figure 12, the outlined square located between 27 and 30N, 126 and 129E had 8 tropical cyclones pass through it during the years 1947-1973. Of these, 25% (2 tropical cyclones) subsequently approached within 180 n mi of Yokosuka. Both of these tropical cyclones (that is, 25%) passed within 180 n mi to the northwest and 12% (only one) passed within 60 n mi to the northwest of Yokosuka; none passed to the southeast of Yokosuka.

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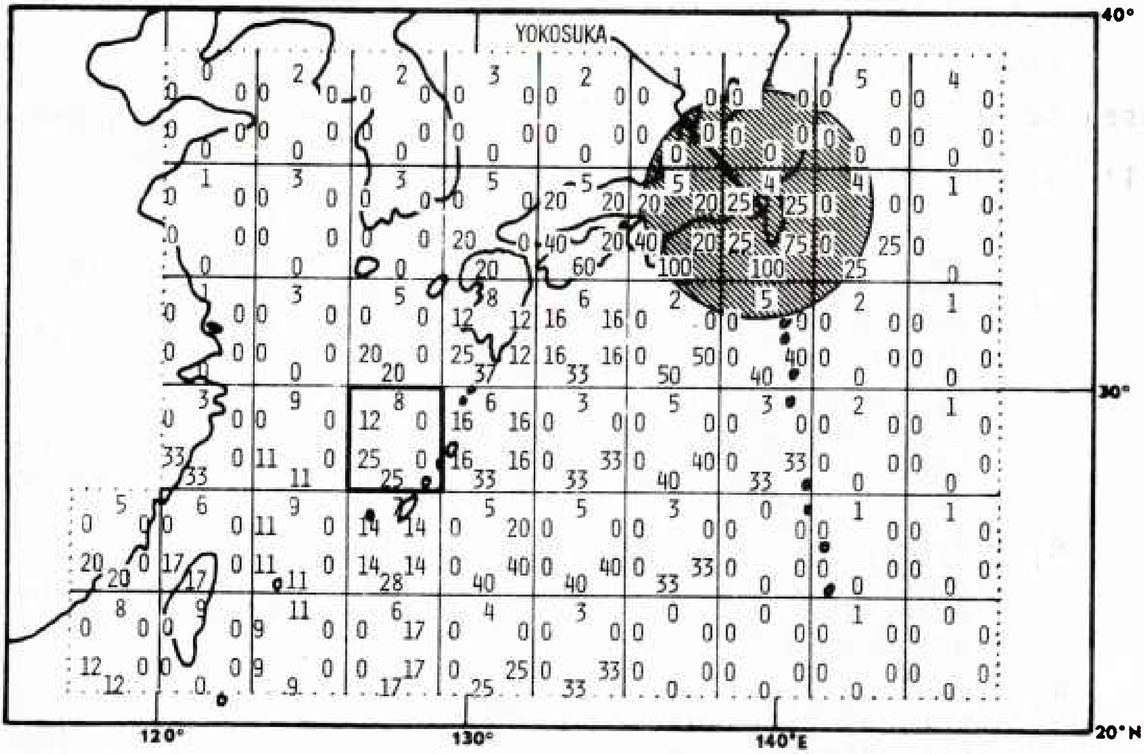
[6]Note that L_3 + R_3 need not equal RAD since a tropical cyclone may enter the 180 n mi circle but not cross the SE/NW line.



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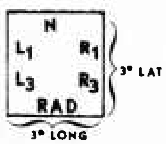
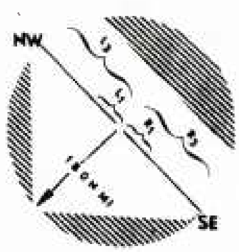




N = NUMBER OF TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE FOR THE MONTH

L_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

L_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

R_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

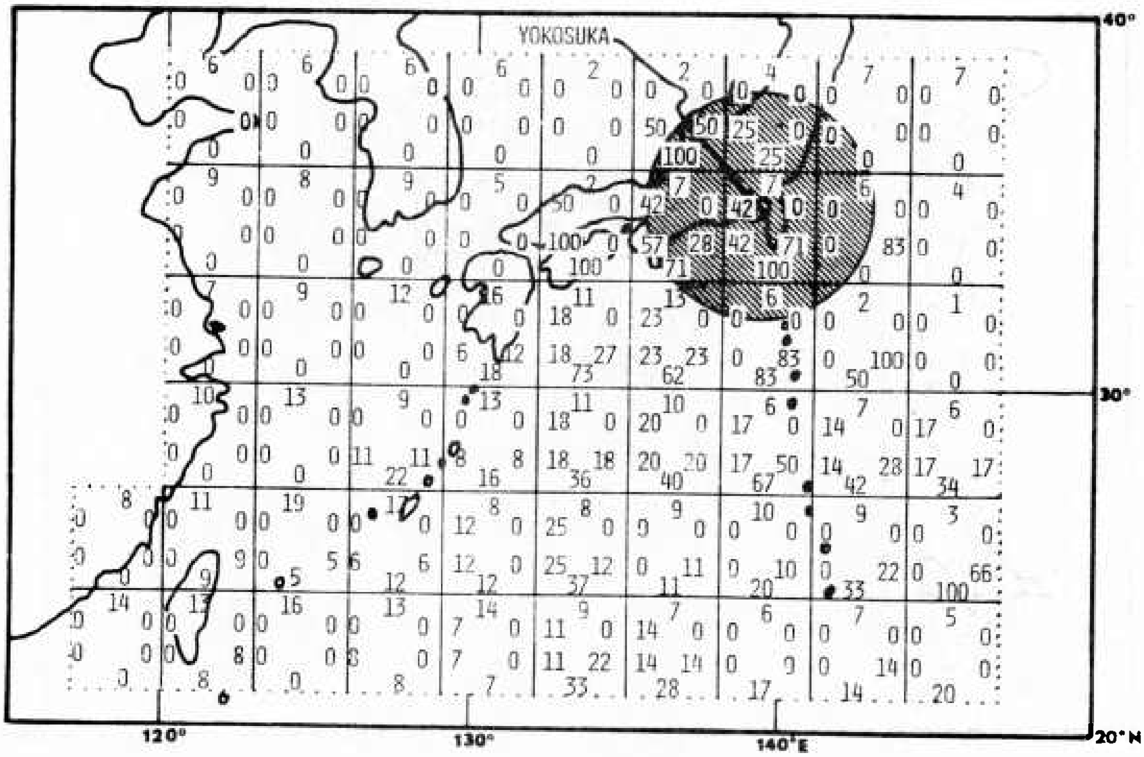
R_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

RAD = PERCENT OF TROPICAL CYCLONES THAT PASSED THROUGH THE SQUARE AND SUBSEQUENTLY PASSED WITHIN 180 N MI OF YOKOSUKA

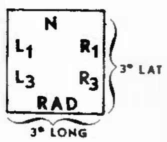
FOR THE MONTH OF:

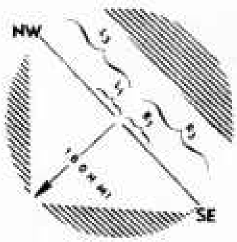
JUN (31 MAY - 29 JUN)

Figure 12. Statistical summary of tropical cyclones for the month of June (based on data from the years 1947-1973).



LEGEND:





N = NUMBER OF TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE FOR THE MONTH

L_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

L_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

R_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

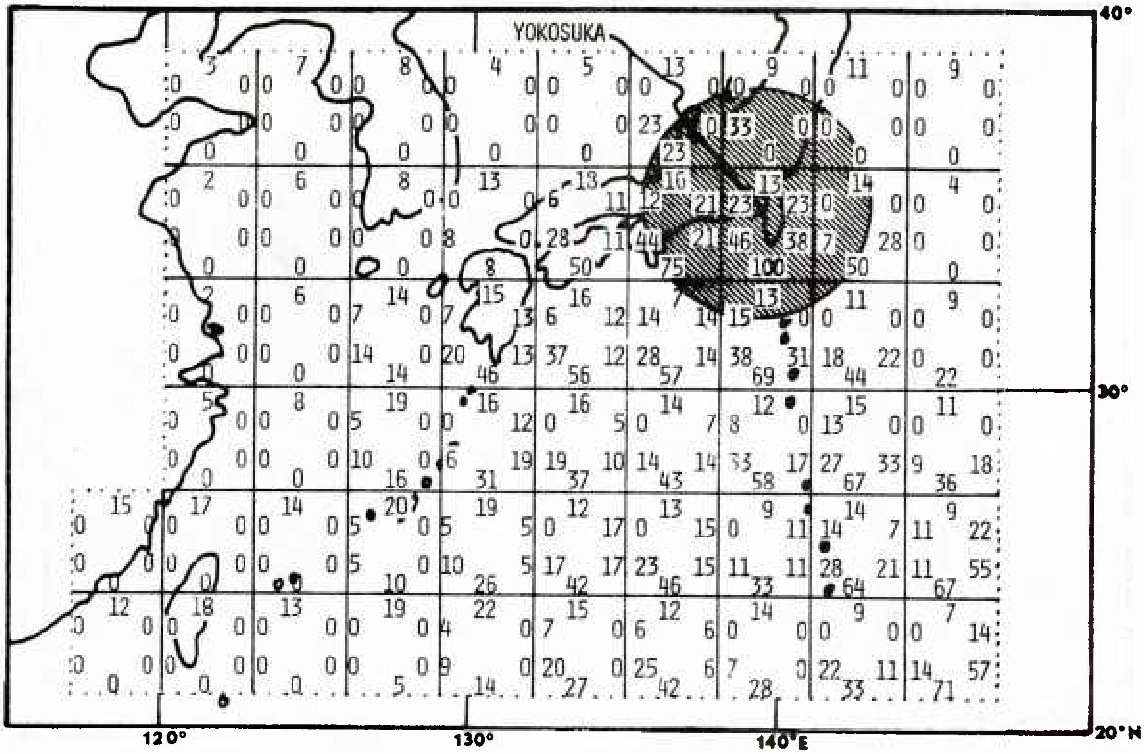
R_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

RAD = PERCENT OF TROPICAL CYCLONES THAT PASSED THROUGH THE SQUARE AND SUBSEQUENTLY PASSED WITHIN 180 N MI OF YOKOSUKA

FOR THE MONTH OF:

JUL (30 JUN - 29 JUL)

Figure 13. Statistical summary of tropical cyclones for the month of July (based on data from the years 1947-1973).



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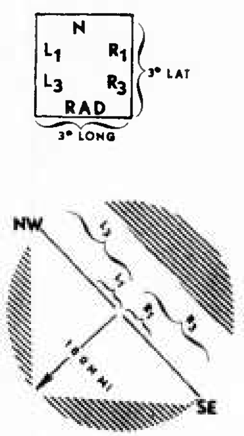


N = NUMBER OF TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE FOR THE MONTH

L_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

L_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

R_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

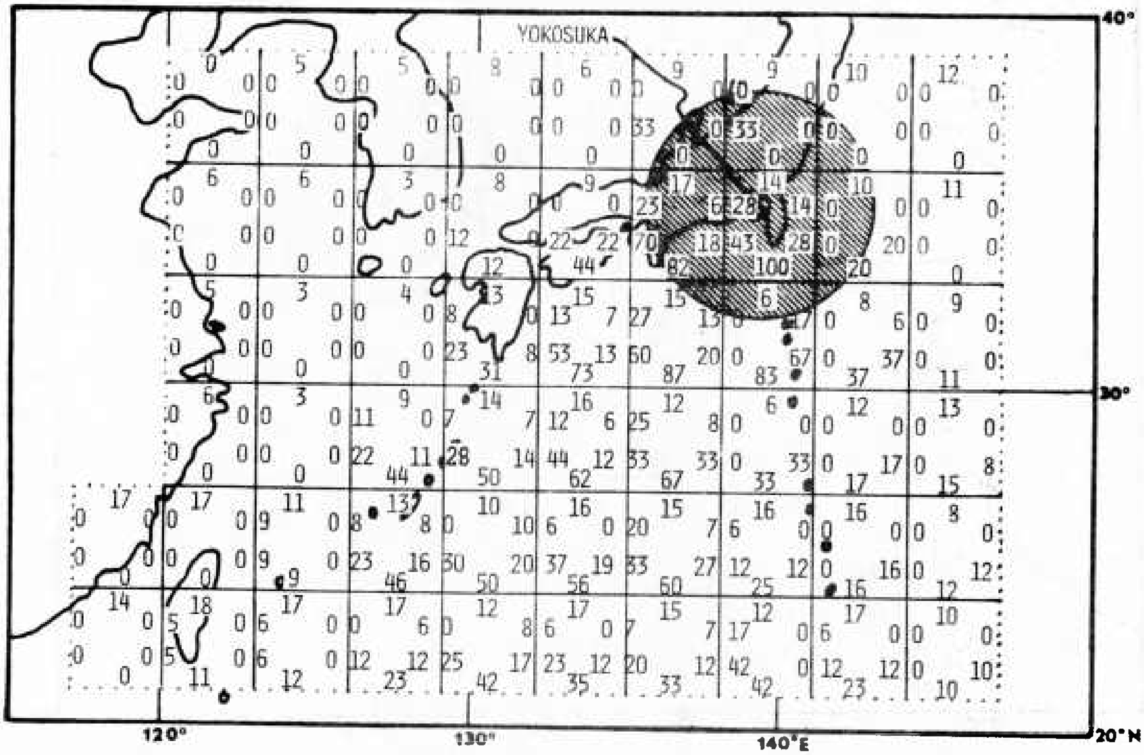
R_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

RAD = PERCENT OF TROPICAL CYCLONES THAT PASSED THROUGH THE SQUARE AND SUBSEQUENTLY PASSED WITHIN 180 N MI OF YOKOSUKA

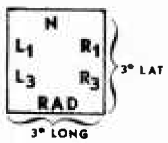
FOR THE MONTH OF:

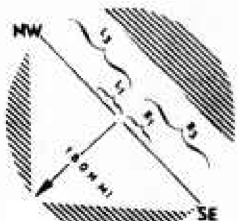
AUG (30 JUL - 28 AUG)

Figure 14. Statistical summary of tropical cyclones for the month of August (based on data from the years 1947-1973).



LEGEND:





N = NUMBER OF TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE FOR THE MONTH

L_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

L_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

R_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

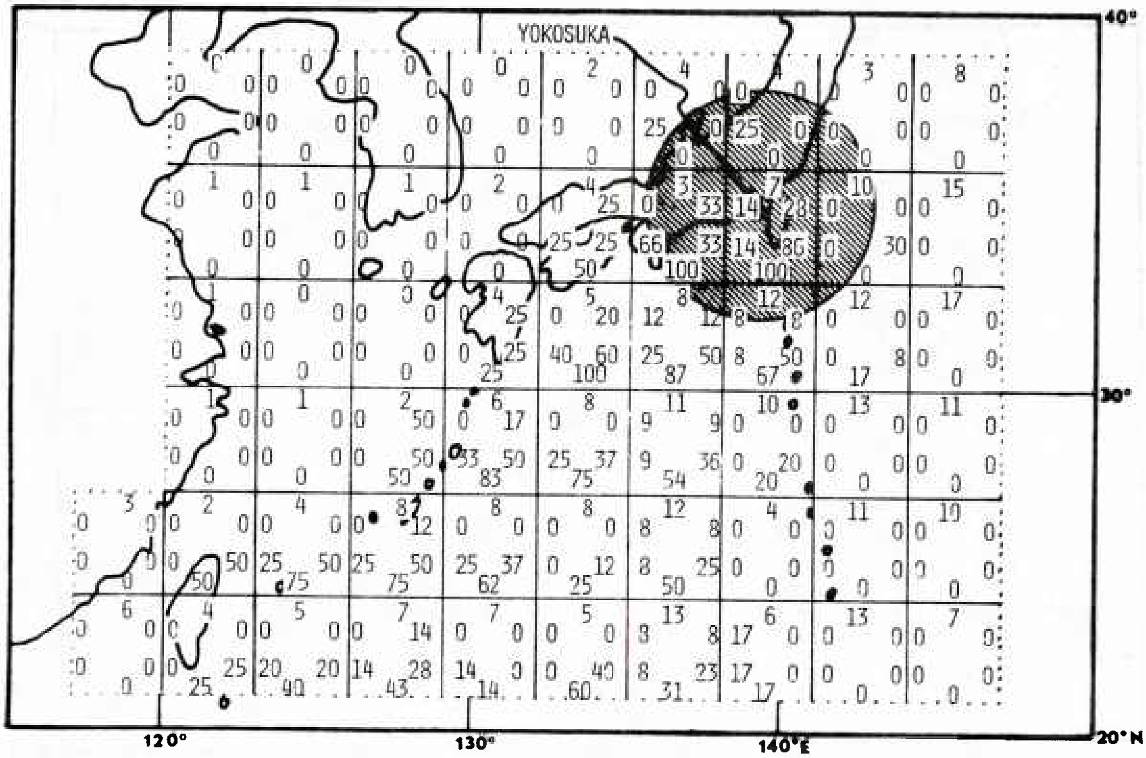
R_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

RAD = PERCENT OF TROPICAL CYCLONES THAT PASSED THROUGH THE SQUARE AND SUBSEQUENTLY PASSED WITHIN 180 N MI OF YOKOSUKA

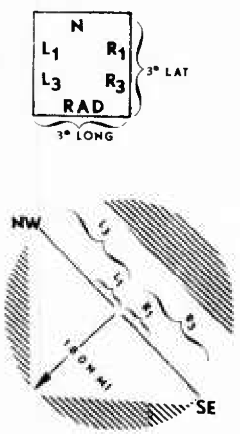
FOR THE MONTH OF:

SEP (29 AUG - 27 SEP)

Figure 15. Statistical summary of tropical cyclones for the month of September (based on data from the years 1947-1973).



LEGEND:



N = NUMBER OF TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE FOR THE MONTH

L_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

L_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING NW FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

R_1 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 60 N MI (1° LAT)

R_3 = PERCENT OF ALL TROPICAL CYCLONES THAT PASSED THROUGH THIS SQUARE AND SUBSEQUENTLY CROSSED A LINE EXTENDING SE FROM YOKOSUKA WITHIN A DISTANCE OF 180 N MI (3° LAT)

RAD = PERCENT OF TROPICAL CYCLONES THAT PASSED THROUGH THE SQUARE AND SUBSEQUENTLY PASSED WITHIN 180 N MI OF YOKOSUKA

FOR THE MONTH OF:

OCT (28 SEP - 27 OCT)

Figure 16. Statistical summary of tropical cyclones for the month of October (based on data from the years 1947-1973).

Figures 17 to 21 represent an analysis of the RAD numbers from the above figures. The solid lines show a "percent threat" for any tropical cyclone location within the area examined. The dashed lines represent the approximate time in days for a system to reach Yokosuka. For example, in Figure 17, a tropical cyclone located at 28N, 136E has approximately a 50% probability of passing within 180 n mi of Yokosuka and will reach Yokosuka in about one day.

The speed range was arrived at by considering that as tropical cyclones recurve, their forward speed characteristically, but not always, slows to about 10 kt during the recurvature period. It should be expected that the system will subsequently accelerate rapidly toward the north or northeast. Speeds of 20 to 30 kt are common and speeds as great as 50 kt have been observed (Somervell and Jarrell, 1970). Table 2 presents the information from which the approximate time in days for a tropical cyclone to reach Yokosuka was computed.

Table 2. Listing of average climatological speeds of tropical cyclones by 5-degree latitude bands for the months of June-October.

Latitude Band (°N)	Average Forward Speed of Movement (kt)					Average of the 5 Months (kt)
	Jun	Jul	Aug	Sep	Oct	
30-35 N	23 kt	15	13	20	28	19.8 kt
25-30	17	12	11	14	21	15.0
20-25	13	10	11	11	13	11.6
15-20	10	10	10	11	12	10.6

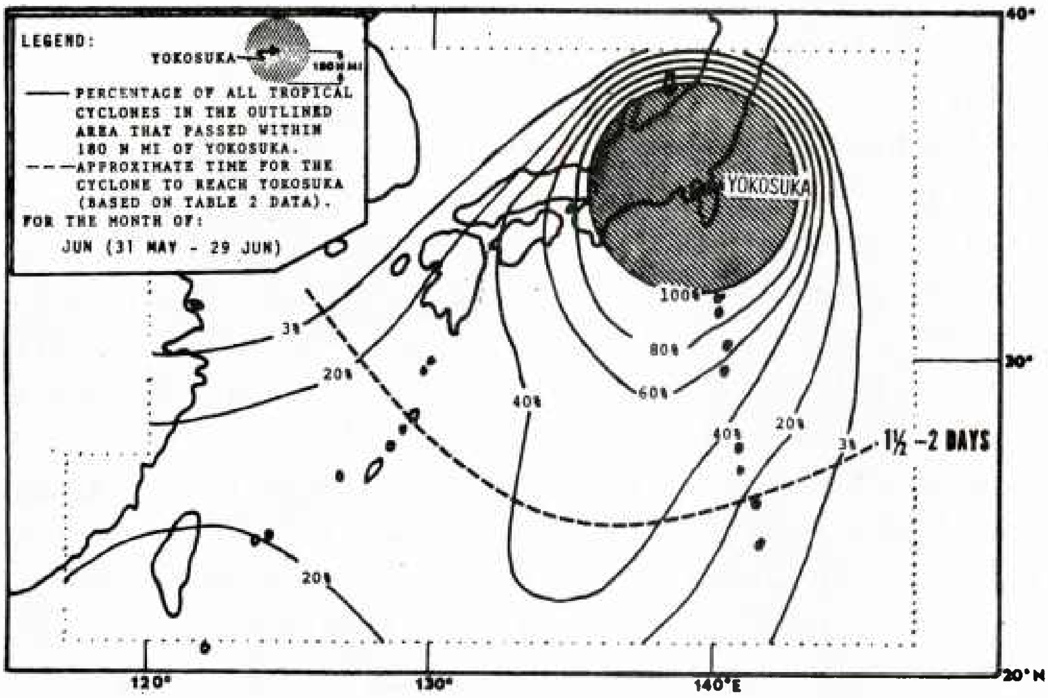


Figure 17. Percentage of tropical cyclones that passed within 180 n mi of Yokosuka for the month of June (based on data from 1947-1973).

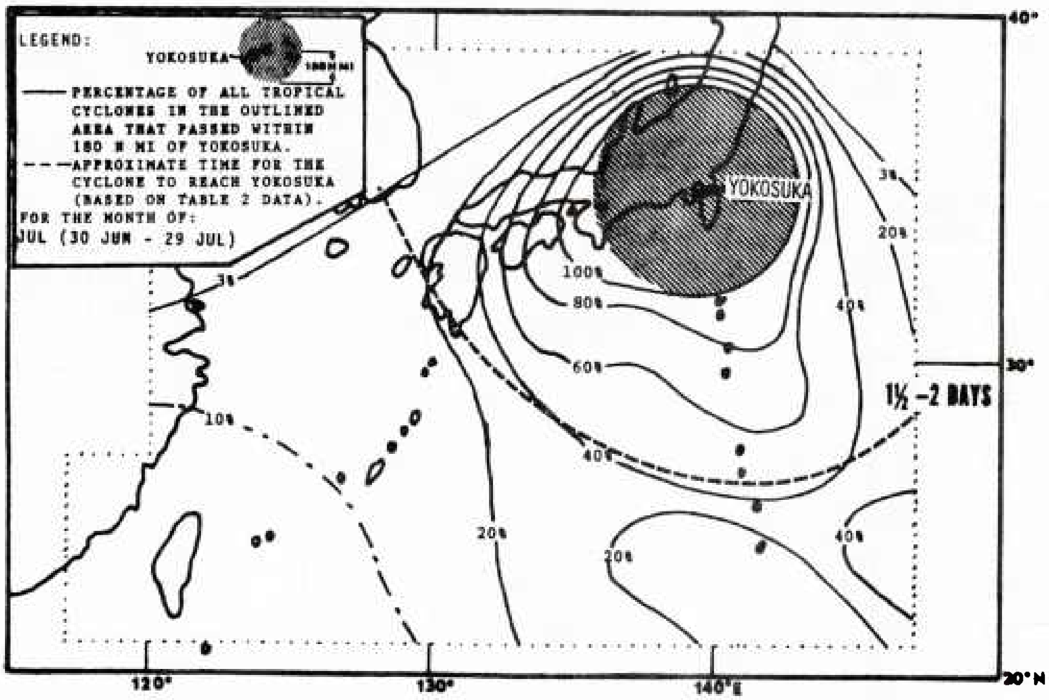


Figure 18. Percentage of tropical cyclones that passed within 180 n mi of Yokosuka for the month of July. The dash-dot line is an intermediate value (based on data from 1947-1973).

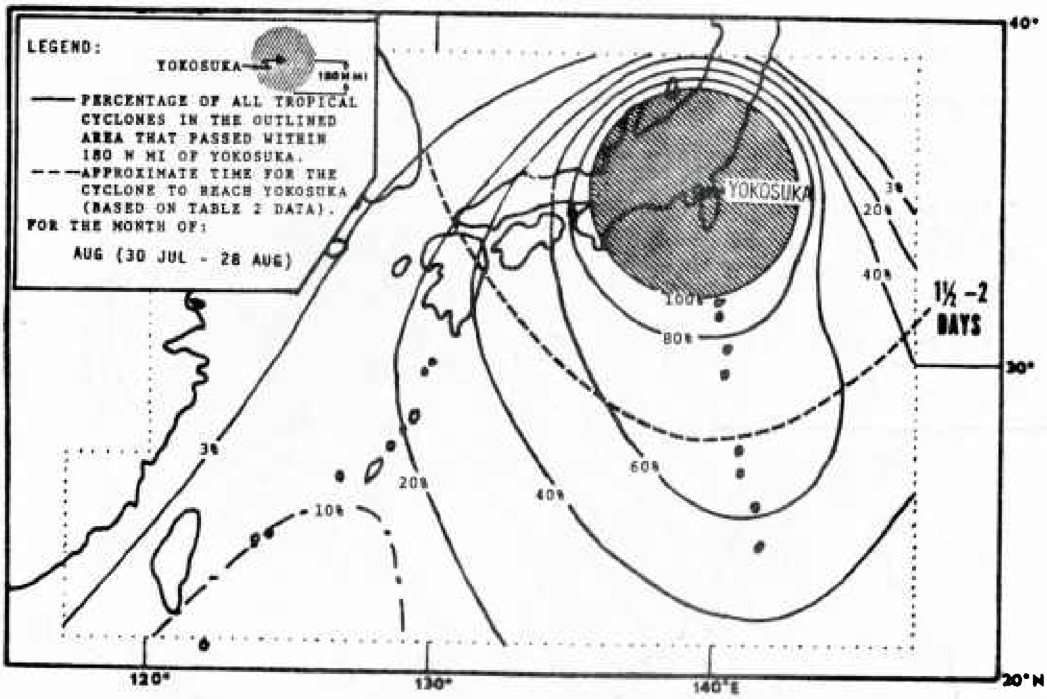


Figure 19. Percentage of tropical cyclones that passed within 180 n mi of Yokosuka for the month of August. The dash-dot line is an intermediate value (based on data from 1947-1973).

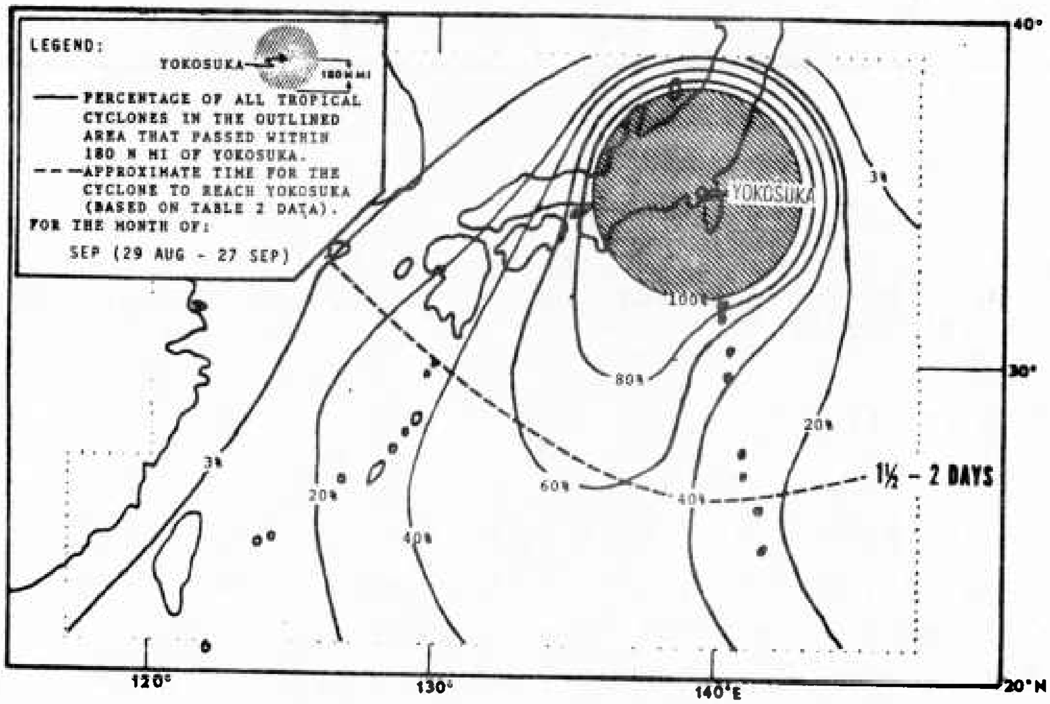


Figure 20. Percentage of tropical cyclones that passed within 180 n mi of Yokosuka for the month of September (based on data from 1947-1973).

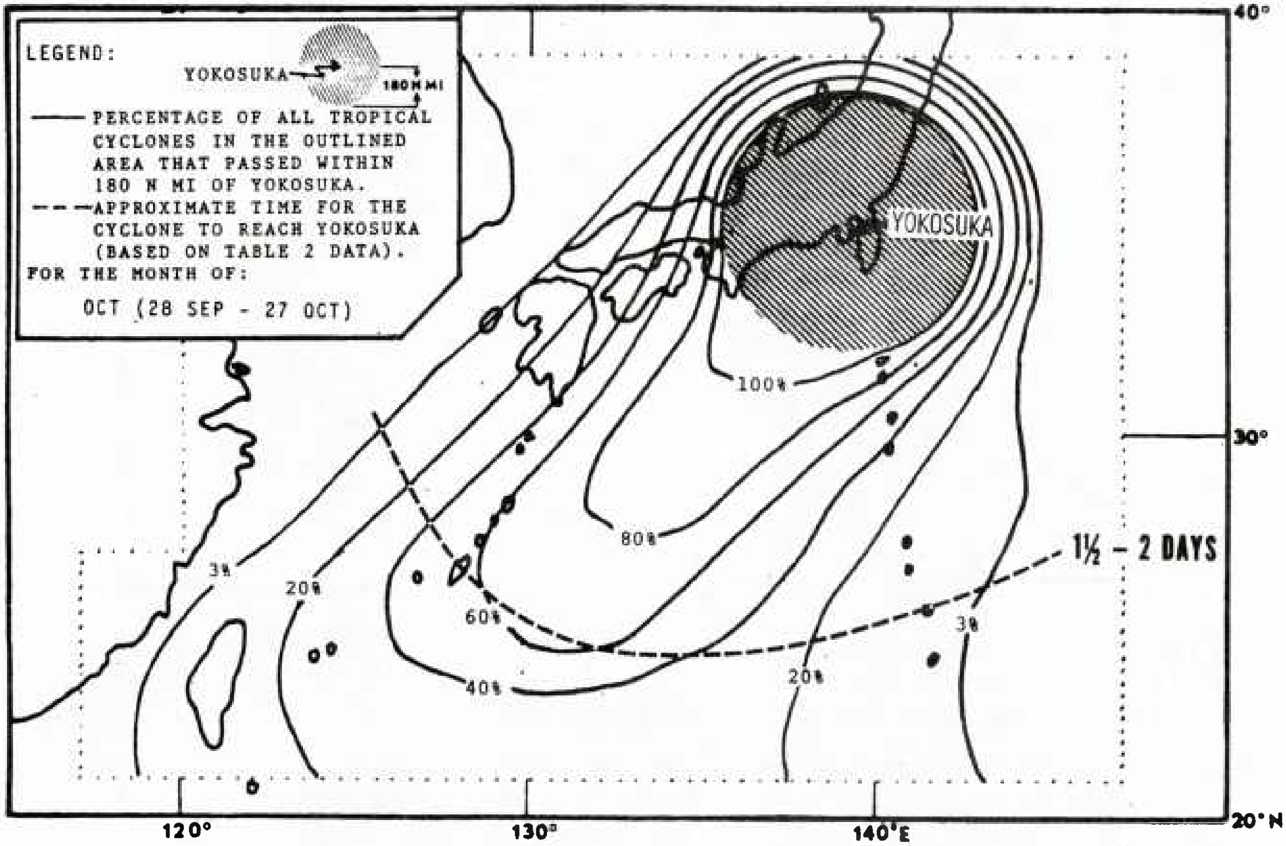


Figure 21. Percentage of tropical cyclones that passed within 180 n mi of Yokosuka for the month of October (based on data from 1947-1973).

5.2 INTENSITY

In an examination of 66 recurving typhoons (1957-1968), Riehl (1971) found that most typhoons reach their maximum intensity at, or just prior to, the point of recurvature (see Table 3). Since the mean latitude of recurvature in WESTPAC is approximately 23°N, most typhoons are decreasing in intensity as they are approaching Japan.

Table 3. Point of reaching typhoon maximum intensity for 66 cases of recurving typhoons based on 12-hourly observations (1957-1968) (after Riehl, 1971).

	Number of Cases
Maximum intensity occurred within 12 hours of recurvature	43
Maximum intensity occurred one day or more before recurvature	22
Maximum intensity occurred one day or more after recurvature	1
Total	66

5.3 WIND AND TOPOGRAPHICAL EFFECTS

In the 5 months June-October for the 22 years 1952-1973, a total of 64 tropical cyclones passed within 180 n mi of Yokosuka, or about 3 per year. Table 4 groups the 64 tropical cyclones by strong (≥22 kt) and gale force (≥34 kt) wind intensities they produced at Yokosuka.[7] Tropical cyclone activity within 180 n mi of Yokosuka is maximum during the months of August and September and these individual monthly values are also shown.

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[7] Data provided by Naval Weather Service Detachment, Asheville, N.C.

Table 4. Extent to which tropical cyclones affected Yokosuka during the period 1952-1973, June-October and for the individual months of August and September.

	Jun-Oct	Aug	Sep
Number of tropical cyclones that passed within 180 n mi of Yokosuka	64	22	19
Number of tropical cyclones resulting in strong (≥22 kt) winds at Yokosuka	47 (73%)	14 (64%)	15 (79%)
Number of tropical cyclones resulting in gale force (≥34 kt) winds at Yokosuka	20 (31%)	5 (23%)	11 (58%)

It can be discerned from Table 4 that only 20 (31%) of the total 64 tropical cyclones for the period June-October (1952-1973) resulted in winds of 34 kt or greater at Yokosuka. However, note that of the 19 tropical cyclones in September, 11 (58%) of these resulted in winds of 34 kt or greater.

Figures 22 and 23 show the tracks of the 20 tropical cyclones that resulted in gale force winds or greater at Yokosuka for the period June-October, 1952-1973. Figure 23 isolates the 11 tracks of September in order to show that most of these passed west of Yokosuka and initially struck Japan on the south coast of Honshu. Note in Figures 22 and 23 that recurvature generally occurs further south for the September and October tropical cyclones than do the July and August systems. Also, in Figure 22 note the track of the tropical cyclone which is headed in an easterly direction and then looped back toward Honshu again!

When the tracks in Figures 22 and 23 are compared with all the tracks for the same monthly period in Appendix A, it can be seen that while tropical cyclones have approached Yokosuka from virtually all southerly directions, the vast

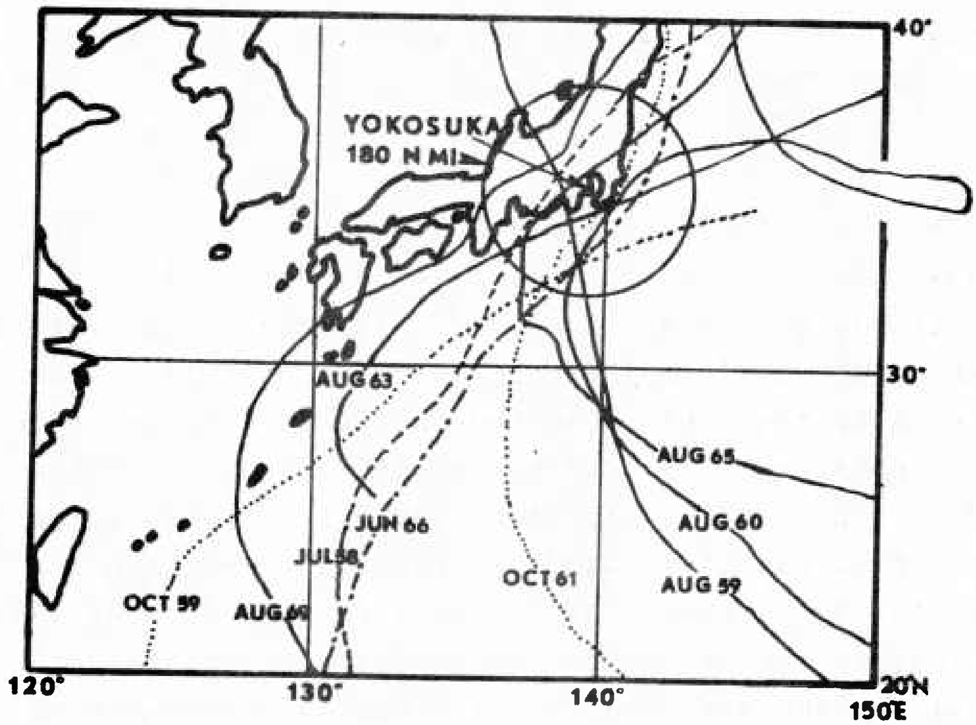

Figure 22. Tracks of 9 tropical cyclones resulting in winds >34 kt at Yokosuka for the months June-August and October (based on data from 1952-1973).

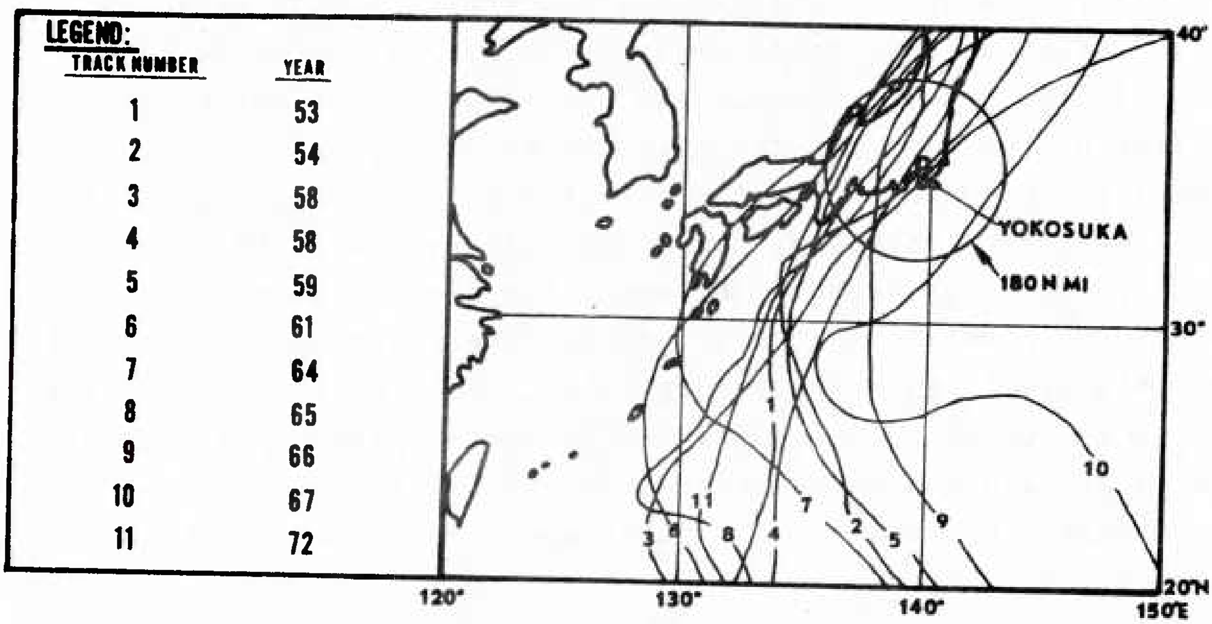

Figure 23. Tracks of 11 tropical cyclones resulting in winds >34 kt at Yokosuka for the month of September (based on data from 1952-1973).

majority approach along a threat axis that is oriented generally southeast to west-southwest from Yokosuka. This threat axis is evident in Figures 17-21 by the "percent threat" lines.

The observation station for the Naval Weather Service Facility (NWSF), Yokosuka is located on top of a 175 ft hill at FLEACTS Yokosuka, and the wind instrument is another 55 feet above the staion; the observed wind velocity is about 10 kt greater than that observed in the harbor, but otherwise is representative.[8] In the period 1953-1973, the highest recorded wind (gust) in Yokosuka was 96 kt. The southerly gust of 96 kt was attributed to Typhoon Ida which passed about 20 n mi to the northwest of Yokosuka on 26 September 1958.

Winds in the harbor during the passage of a severe tropical cyclone are greatly influenced by the surrounding topography and the extent of this influence is dictated by the direction of approach of the storm and the passage relative to Yokosuka. From an analysis of the tropical cyclone tracks in Figures 22 and 23, it is apparent that tropical cyclones that result in gale force winds or greater at Yokosuka can pass to the east or pass to the west of Yokosuka. The basic difference between the two passages is the direction of the resultant wind on the harbor. If the tropical cyclone passes to the west of Yokosuka, the winds will generally be from the south. For a passage to the west, the storm must necessarily cross the mountain ranges of Honshu (see Figure 7). An example of this was Typhoon Nancy (September, 1961) which had a closest point of approach (CPA) of 140 n mi west-northwest of Yokosuka. Nancy pounded the harbor with gusts of 71 kt from the south-southwest and a sustained wind of about 50 kt for a 4-hour period.

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[8] Personal communication with NWSF, Yokosuka.

If the tropical cyclone passes to the east of Yokosuka, the path will be over water and the winds will be generally northerly. An example of this was Typhoon Violet (Oct, 1961) which had a CPA of 30 n mi to the southeast of Yokosuka. As a result of Violet, the harbor experienced gusts of 74 kt from the north-northeast.

Units of the SEVENTH Fleet in port Yokosuka during the threatening times of Nancy and Violet reported negligible damage. Appendix D summarizes some of the pertinent factors of these two typhoons and Command comments with regard to selected berths.

The beginning and end point of the arrows in Figure 24 give the positions of tropical cyclone centers when winds $\geq$22 kt occurred at Yokosuka for 47 of the 64 tropical cyclones (June-December, 1952-1973) that passed within 180 n mi of Yokosuka. Seventeen of these 64 tropical cyclones did not result in winds $\geq$22 kt. Similarly, Figure 25 shows the positions of tropical cyclone centers when winds $\geq$34 kt occurred at Yokosuka.

In Figure 24, it appears that 22-kt winds or greater do not generally occur until the tropical cyclone center has reached 32°N. The best tracks of the 64 tropical cyclones indicate that 47% passed to the west of Yokosuka and the remainder passed to the east. A high concentration of line segments is found in the northeast and southeast quadrants, relative to Yokosuka, implying that centers located in this region tend to cause $\geq$22-kt winds in more instances than centers located in other quadrants. The relative flat regions to the north and northeast of Yokosuka account for this (see Figures 7 and 8). Several of the centers over 600 n mi from Yokosuka continued to generate 22-kt or greater winds at Yokosuka.

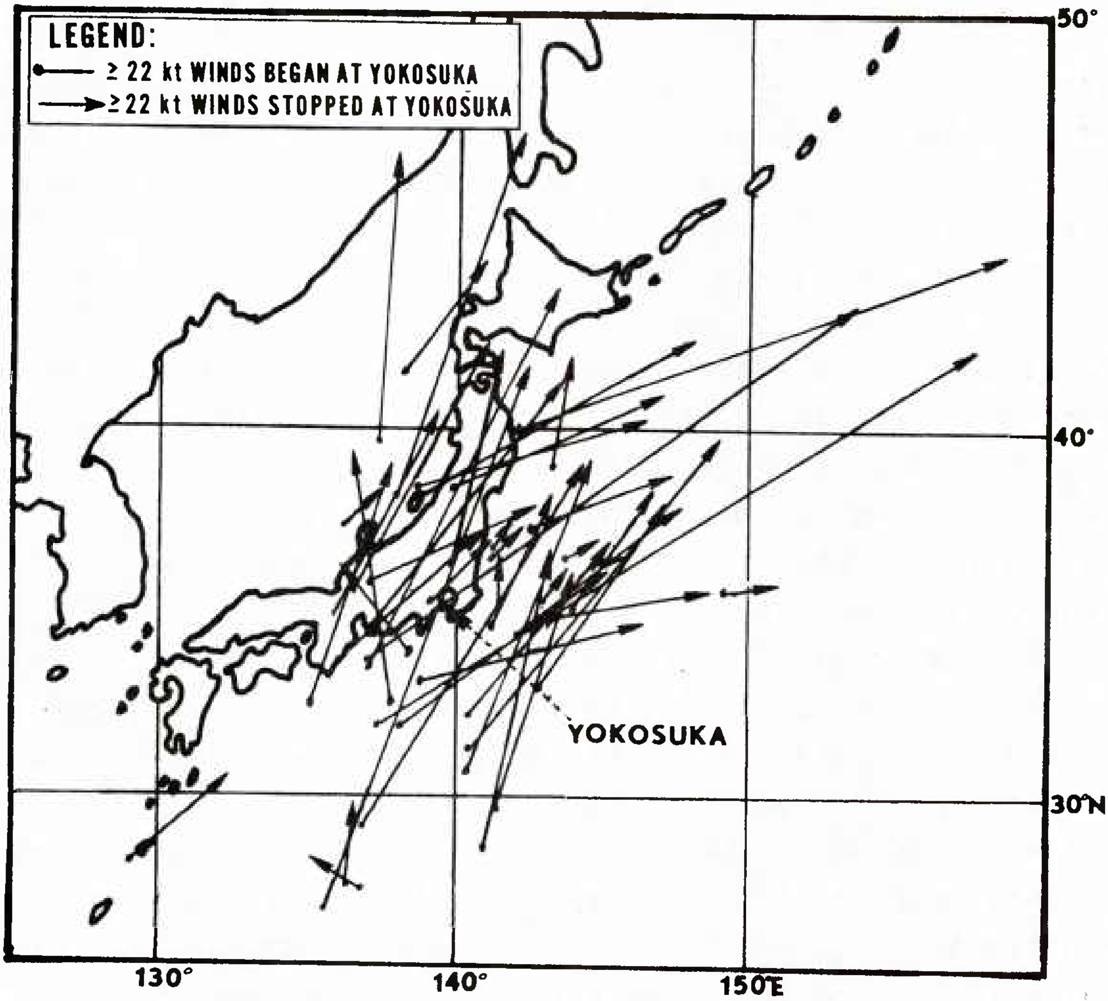

Figure 24. Positions of 47 tropical cyclone centers when $\geq$22 kt winds first and last occurred at Yokosuka (based on hourly wind data for the months June-October for the years 1952-1973).

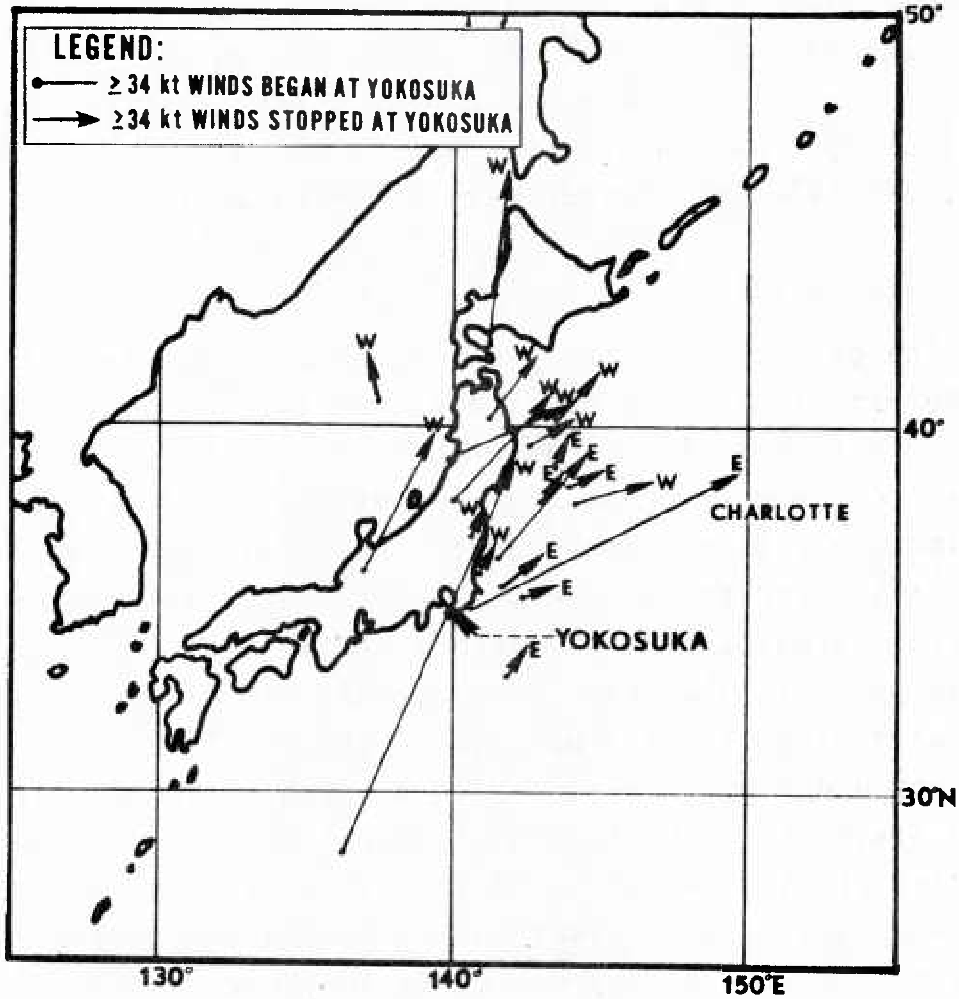

Figure 25. Positions of 20 tropical cyclone centers when $\geq$34 kt winds first and last occurred at Yokosuka (based on hourly wind data for the months June-October for the years 1952-1973). Note: The letter at the arrowhead shows the direction of the closest point of approach which the associated tropical cyclone had with respect to Yokosuka.

Note in Figure 25 that 12 (60%) of the 20 tracks associated with the positions of tropical cyclone centers passed to the west of Yokosuka. The observed gale force wind velocities in Yokosuka resulting from these tropical cyclones generally first exceeded 33 kt when the center was to the north and east of Yokosuka. There are a number of situations when the tropical cyclone centers were nearly 300 n mi to the north and east, yet gale force winds were observed at Yokosuka.[9]

5.4 WAVE ACTION

The port of Yokosuka experiences very little wave action as the result of a typhoon transiting the vicinity. The amount of wave action will vary according to whether the typhoon passes to the west or to the east of the port with the resulting southerly or northerly winds, respectively. The surrounding land masses and the breakwater located near the entrance to Yokosuka Harbor are major factors in limiting the wave action in the port of Yokosuka. Wave action will be greater for a northerly wind (typhoon passage to the east). The port of Yokosuka opens onto Tokyo Bay in a north-northeast direction for a distance of about 25 n mi (see Figure 6). Prior to arriving at Yokosuka any wind-generated waves from a northerly direction must traverse various natural and man-made obstacles, hence much of the energy contained in these waves is depleted.

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[9]Although the topic of this study has been the tropical cyclone, mainly the typhoon, a word of caution is needed. Extratropical cyclone activity in the Yokosuka and Yokohama regions, particularly in the four months of January-April, can also cause destructive winds. Although typhoon-associated winds normally can be forecasted quite well in advance, such is not always the case for maximum winds generated by extratropical cyclones. In the latter case, as little as 2 or 3 hours warning may be all that is possible. In 1974, the maximum peak gust associated with a tropical cyclone (typhoon) was 54 kt in August, while the maximum peak gust attributed to an extratropical system was 68 kt in April.

An estimate of the maximum wave height that may be encountered for typhoon force winds in the region about Yokosuka and Tokyo Bay is summarized in Table 5. The major factors considered in this listing was the direction of tropical cyclone passage relative to Yokosuka, the direction and velocity of the resultant typhoon force winds, the length of fetch, a duration greater than 1 hour but less than 5 hours, and the location of obstacles in the path of the progressing waves. There is no single theoretical development for determining the actual growth of waves generated by winds over relatively shallow water (U.S. Army Coastal Engineering Research Center, 1973).

Table 5. Approximate maximum wave heights in feet about the Yokosuka region and Tokyo Bay.

Wave Height (ft) in the Vicinity of	Direction of Passage of Tropical Cyclone Passage Relative to Yokosuka	
	East	West
Port of Yokosuka	6 ft	3 ft
Yokosuka Bay	9	5
Tokyo Bay (about 10 n mi north-northeast of Yokosuka)	12	11

5.5 STORM SURGE

Storm surge may be defined as an abnormal rise of the sea along a shore as the result of the winds of a storm and the pressure drop. The piling up of water on a coast ahead of a tropical storm or typhoon is more apparent in the dangerous semicircle, the region of most intense winds. The port of Yokosuka will be placed in the dangerous semicircle, when a typhoon passes to the west of the area.

The storm surges are more pronounced along the south coast of the Japanese Islands to the west of Tokyo Bay. Tokyo Bay opens onto the south coast of Honshu (see Figure 26). The surge forms to a large extent after entering the inland bays since the width of the continental shelf is generally narrow along the Japanese coast. Most of the surge occurs, therefore, at the inshore side of these bays, not along the open coasts nor near the mouth of the bays. Figure 26 depicts the 100-, 500-, 1000-, and 2000-fathom curves about Honshu. During the period 1900 to 1973, peak surges of 7.6 ft (Oct, 1919) and 7.3 ft (Sept, 1938) were observed at the inshore side of Tokyo Bay.[10] They were the result of southerly winds caused by typhoons passing generally to the west of Tokyo Bay.

Due to its sheltered position within Tokyo Bay and its location near the entrance, Yokosuka experiences little storm surge. Conversations with a knowledgeable civilian employee in the Port Services Office, Yokosuka, indicate that storm surges of about 3 ft have been felt within the harbor but have not been a problem. Surges of this magnitude coupled with the normal tide range of 4-5 ft for the months of June-October do not present any unusual difficulty to vessels, if mooring lines are tended.

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[10] From a paper by Miyazaki (1974).

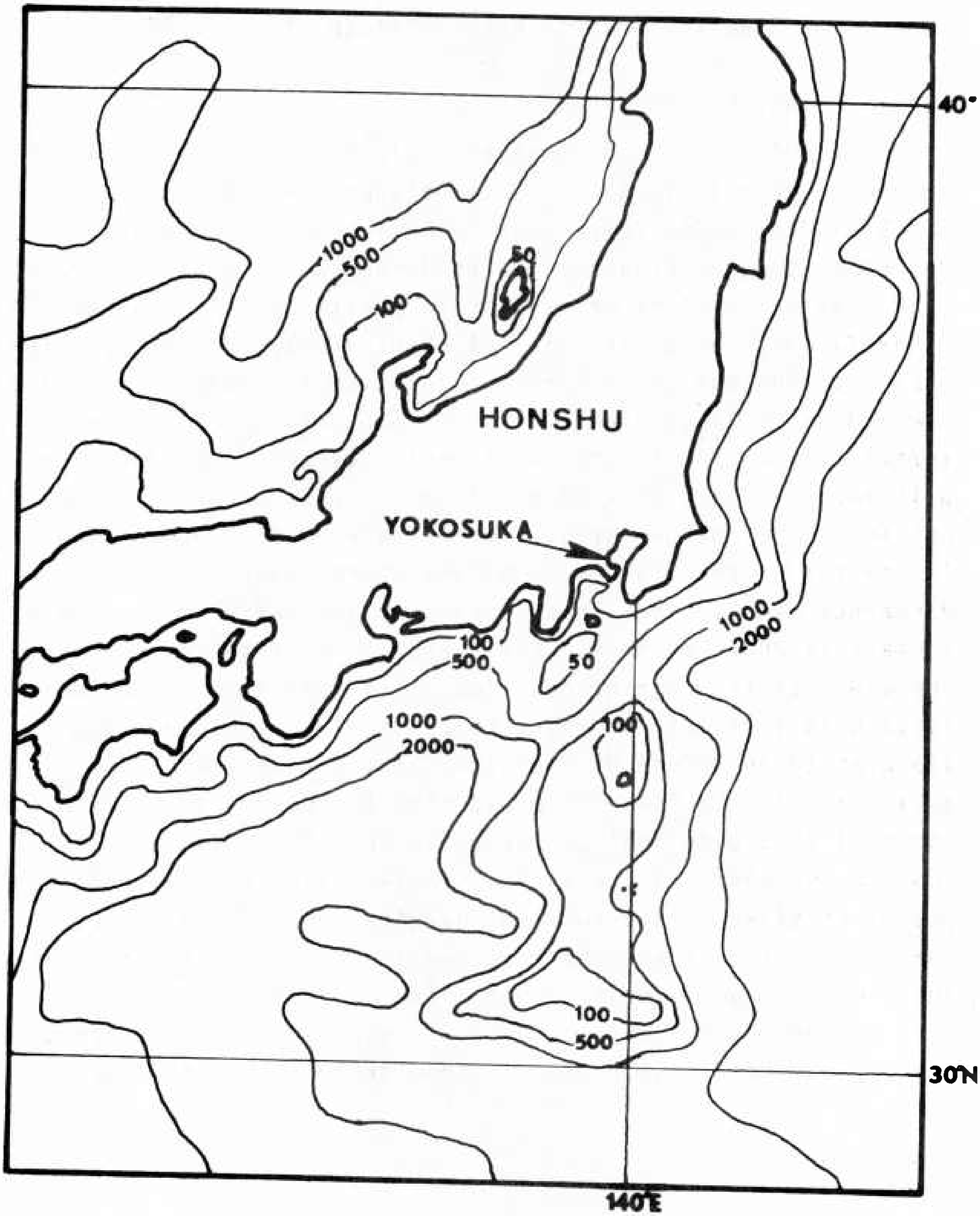

Figure 26. Smoothed depth contours (in fathoms) in the region about Honshu.

6. PREPARATION FOR HEAVY WEATHER AT YOKOSUKA

6.1 TROPICAL CYCLONE WARNINGS

The FWC/JTWC, Guam Tropical Cyclone Warnings are based on the most accurate forecasting techniques available. COMSEVENTHFLT OPORD 201, Annex H (Environmental Services), describes the techniques to be used when plotting the FWC/JTWC, Guam tropical cyclone warning track positions. An average 24-hr forecast error of 135 n mi should always be incorporated when plotting the 24-hr forecast position in order to expand the radius of 30-kt winds, given in the warning, by the average forecast error.[11] Figure 27 demonstrates this procedure and utilizes the 135 n mi average 24-hr forecast position error in obtaining the "danger area." Note the radius of 30-kt winds is greater on the right side of the storm track -- the dangerous semicircle. In this example the radius to the 30-kt isotach is 200 n mi to the north and 150 n mi to the south of the storm at the current position. The radius to the 30-kt isotach is forecast to expand to 225 n mi to the north and 175 n mi to the south of the storm at the 24-hr forecast position. At the 24-hr forecast time the danger area is then 360 n mi (225 plus 135) to the north and 310 n mi (175 plus 135) to the south of the storm. The 48- and 72-hr forecasted positions given in the FWC/JTWC warning provide a planning forecast, but must also be adjusted to consider a 275 n mi and 400 n mi average forecast error, respectively.

The responsibility for overall coordination of action to be taken by Naval activities in the Yokosuka area has been

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[11] This figure is based on 18 years of forecasts.

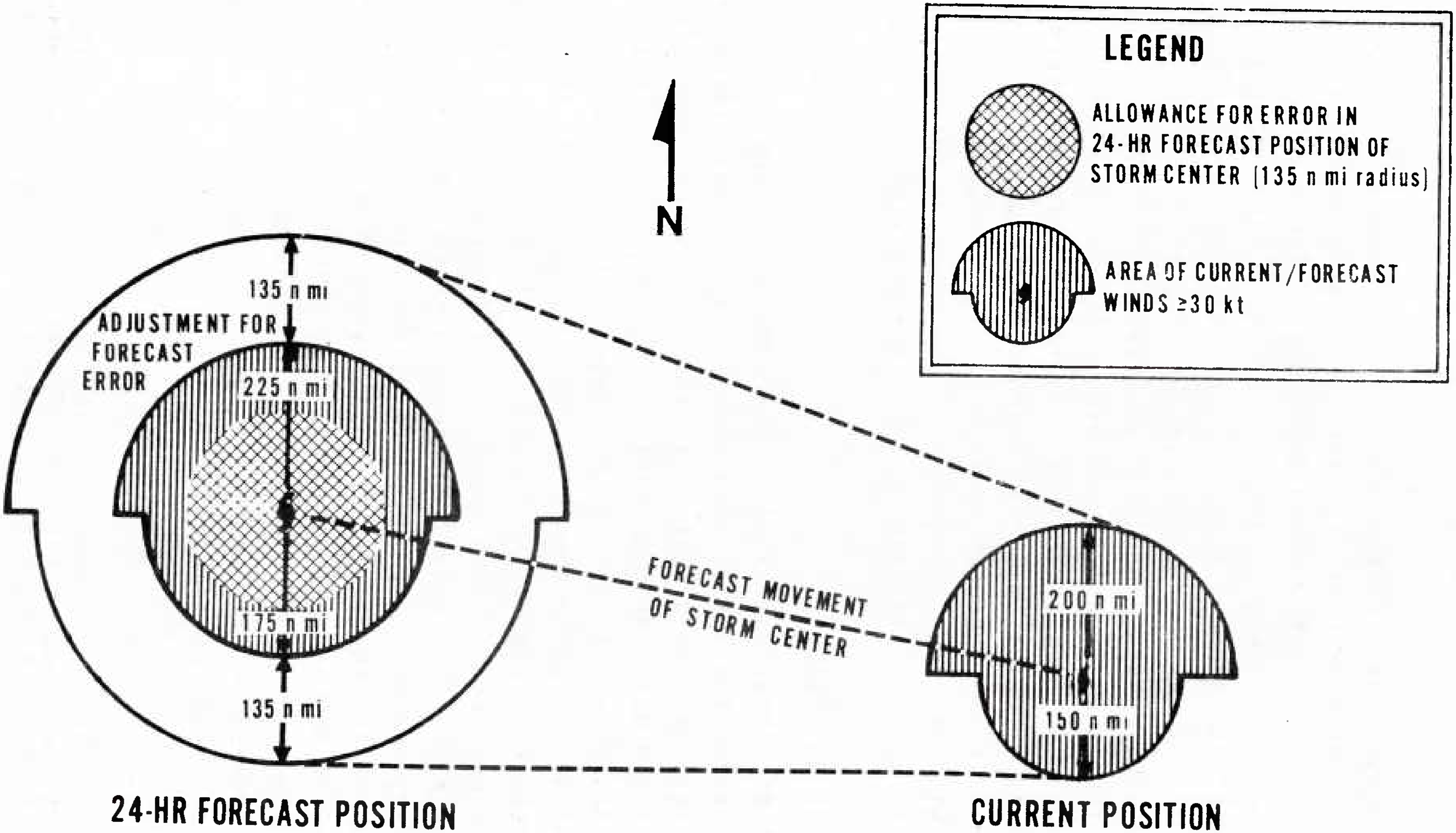

Figure 27. Method of calculating the danger area for moving typhoons and tropical storms (from Commander, Seventh Fleet, OPORD 201-Yr).

assigned to Commander, Fleet Activities, Yokosuka.[12] The Naval Weather Service Facility, Yokosuka issues the local wind warnings. The established procedures in the event hazardous weather is expected is contained in SOPA (ADMIN) YOKOSUKA INSTRUCTION 5000.1 series. For easy reference, portions of Annex W to this instruction concerning conditions of readiness have been reproduced as Appendix C to this study.

Wind from any direction with expected sustained speeds of 48 kt or gusts in excess of 55 kt is sufficient to set storm conditions as directed by SOPA. Typhoon conditions will be set as above for an approaching typhoon, i.e., expected sustained winds of 64 kt or greater. The same precautions taken for a typhoon will also be taken for any storm.

6.2 EVASION RATIONALE

Of utmost importance is that the commander recognize the inherent dangers that exist when exposed to the possibility of hazardous weather. By proper utilization of the meteorological products of the Naval Weather Service Command, especially the FWC/JTWC, Guam Tropical Cyclone Warnings, and a basic understanding of weather, the commander will be able to act in the best interest of his unit and to complete his mission when the unfavorable weather subsides. The following time table (in conjunction with Figures 28-32 corresponding to the five months June-October) has been set up to aid in these actions. The orientation of the threat axis in Figures 28-32 was arrived at by considering the general direction from which the tropical cyclones approached to within 180 n mi of Yokosuka as determined in Figures 17-21. The time in days to reach Yokosuka was based on speeds contained in Table 2.

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[12]Storm/typhoon doctrine and coordination procedures for naval forces operating in the COMNAVFORJAPAN area of responsibility has been established by COMNAVFORJAPAN INST 3140.1J of 26 February 1974.

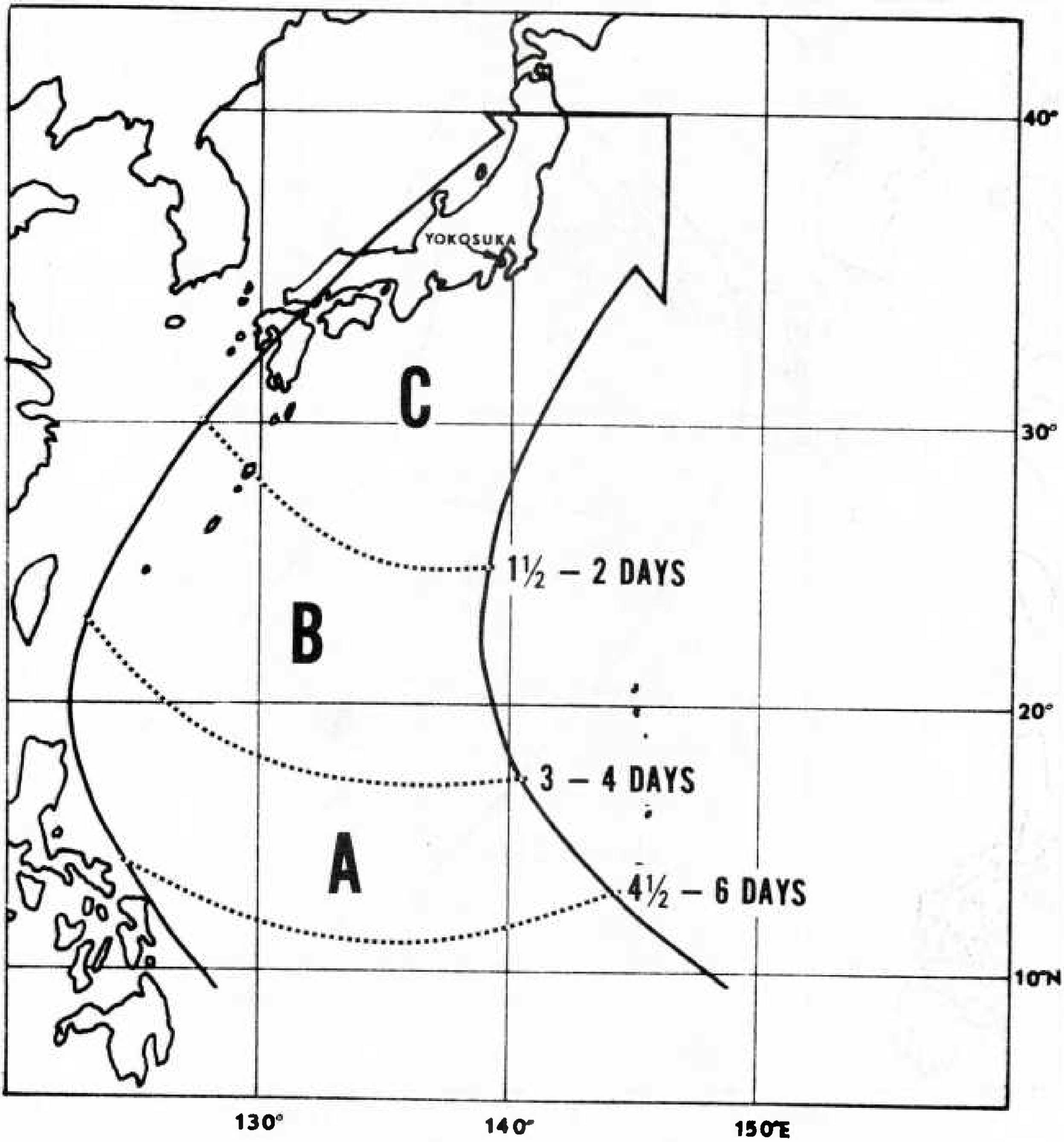

Figure 28. Tropical cyclone threat axis for Yokosuka for the month of June. Approach times to Yokosuka are based on Table 2 information.

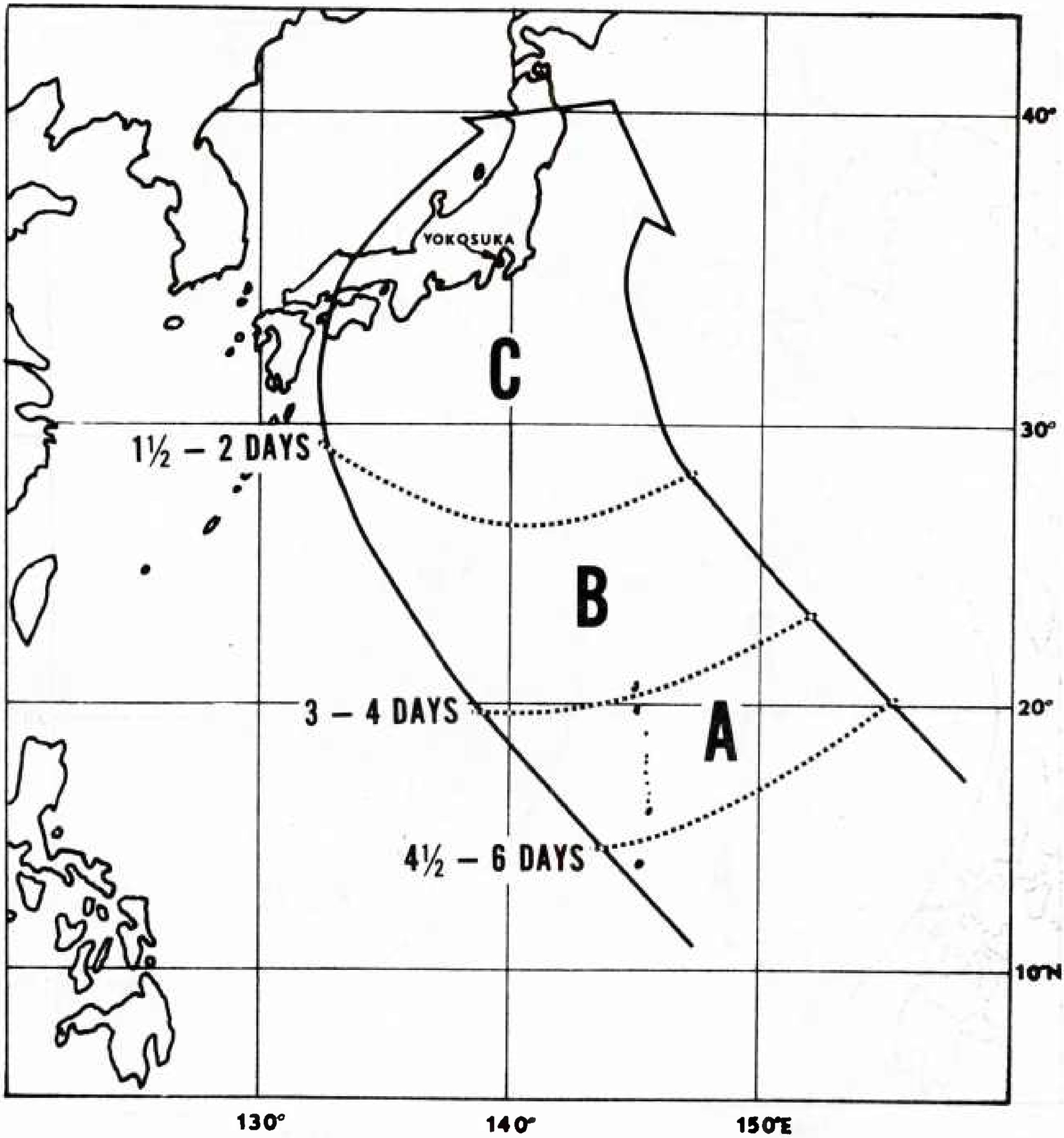

Figure 29. Tropical cyclone threat axis for Yokosuka for the month of July. Approach times to Yokosuka are based on Table 2 information.

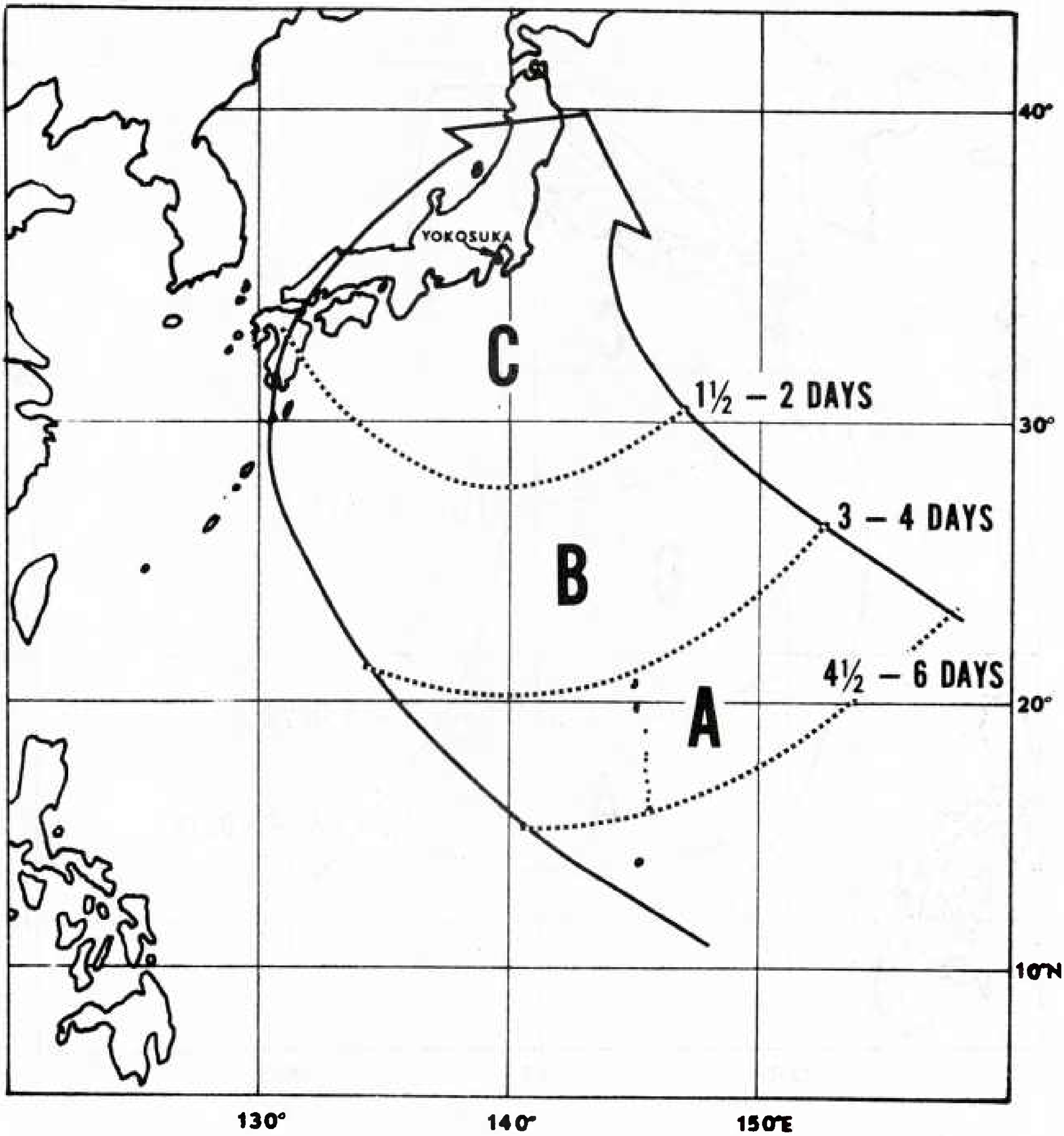

Figure 30. Tropical cyclone threat axis for Yokosuka for the month of August. Approach times to Yokosuka are based on Table 2 information.

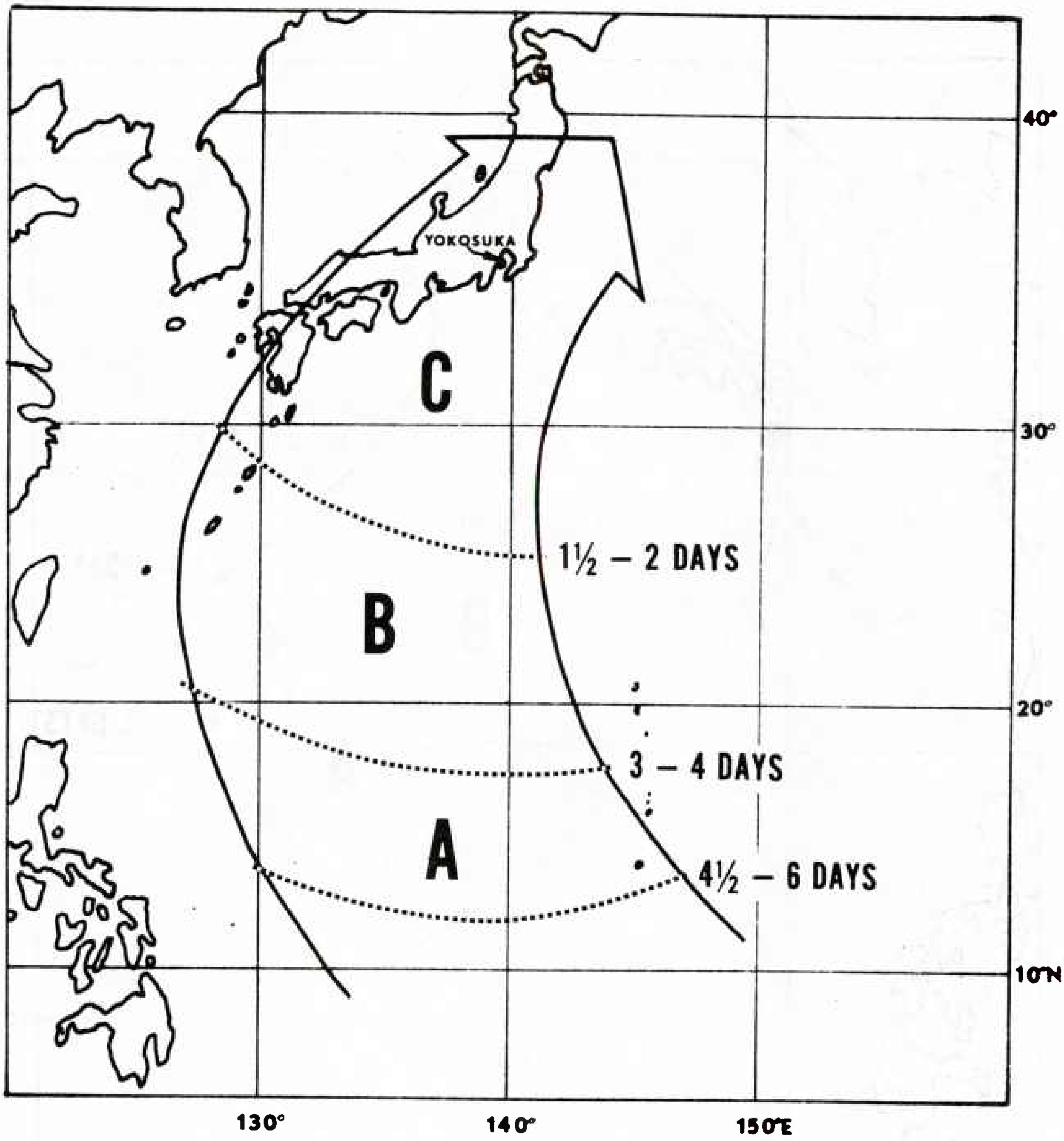

Figure 31. Tropical cyclone threat axis for Yokosuka for the month of September. Approach times to Yokosuka are based on Table 2 information.

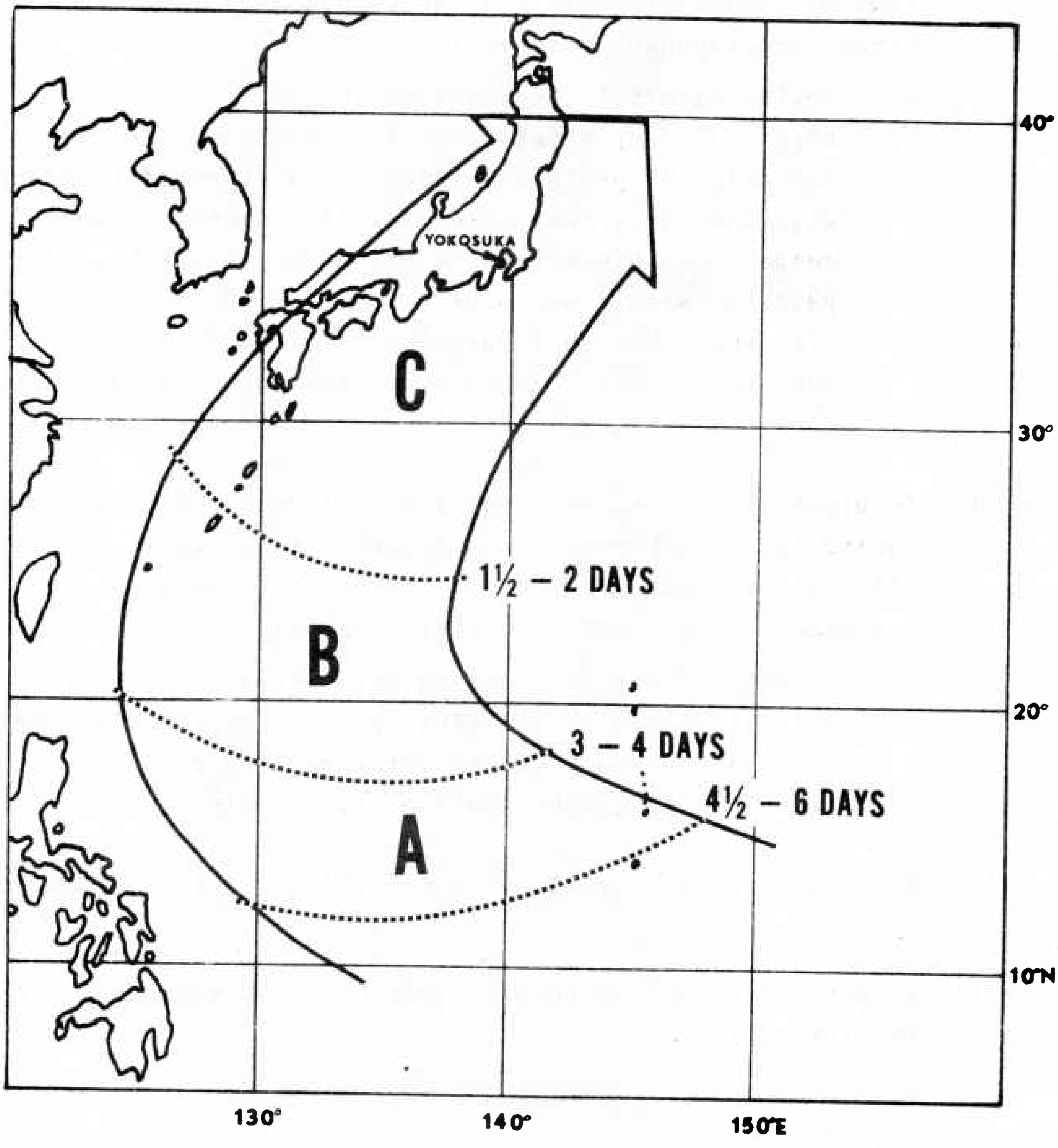

Figure 32. Tropical cyclone threat axis for Yokosuka for the month of October. Approach times to Yokosuka are based on Table 2 information.

I. An existing tropical cyclone moves into or development takes place in area A with long range forecast movement toward Yokosuka (recall that about 40% of all tropical storms and typhoons recurve):

a. Review material condition of ship.

b. Reconsider any maintenance that would render the the ship incapable of riding out a storm or typhoon with the electrical load on ship's power, or would render the ship incapable of getting underway, if need be, within 48 hours.

c. Plot FWC/JTWC, Guam warnings if issued and construct the danger area. Reconstruct the danger area for each new warning.

II. Tropical cyclone enters area B with forecast movement toward Yokosuka (recall that prior to recurvature tropical cyclones tend to slow in their forward motion and after recurvature accelerate rapidly):

a. Reconsider any maintenance that would render the ship incapable of shifting to a new berth assignment, anchorage or buoy or otherwise getting underway, prior to the commencement of strong winds within the harbor.

b. Anticipate Storm/Typhoon Condition III (see Appendix C).

III. Tropical cyclone has entered area C and is moving toward the Yokosuka area;

a. Anticipate Storm/Typhoon Conditions II and I (see Appendix C).[13]

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[13]Additional factors that should be considered are contained in COMSEVENTHFLT OPORD 201, Annex H.

A high velocity wind is the single most important factor to be considered. The effects of wave action and storm surge are negligible to the port of Yokosuka.

6.3 REMAINING IN PORT

The final decision whether to sortie (if a general sortie has not been ordered) or not rests with the Commanding Officer, His decision-making process is indeed a careful and deliberate consideration of all aspects relating the port of Yokosuka to be a "safe" typhoon haven. These aspects are best summarized in a paragraph contained in a pamphlet entitled, The Measure of a Harbor, prepared by the Fleet Weather Facility, Yokosuka (now the NWSF) in 1963.

> "The measure of a harbor is the sum total of many individual factors. It is in the extent of its shelter, depth of water at the piers, quantity and condition of its service craft and the efficiency of its port services. It is measured by the experience level of its Port Services Officer. It is in the skill, spirit and will of his crews. It is in the emergency capability of the Ship Repair Facility to make a ship ready for sea. It is the quality of the typhoon warning service and the lead time provided the SOPA to make sound command decisions and to the Port Services Officer to carry out smoothly and efficiently his flexible plan of action. Finally, the measure of a harbor is knowledge of that harbor and all that it connotes in the mind of the Senior Officer Present Afloat who, by his decisions, will stamp it as a vital refuge to be taken or as an inanimate limited shelter to refuse as a harbor for the ships under his charge."

Remaining in port is in almost all instances, in the opinion of the author, the recommended course of action when a tropical storm or typhoon threatens Yokosuka. The following items must be considered:

(1) Berth reassignments, if necessary, should be accomplished before 20-kt winds begin.

(2) Ships with extremely large sail areas should be assigned preferred berthing depending on the direction of the closest point of approach (CPA); i.e., if a typhoon is forecast to pass to the east, use berth 8, and use berth 12 if the forecast passage is to the west.[14]

(3) Some flooding caused by heavy precipitation of the U.S. Fleet Activities land complex may occur; therefore, all ships should be providing their own electrical power.

(4) A ship with a large sail area, for example a LPD that is berthed at the floating pier (berth 10 or 11) may want to have a tug standing by during the period of highest winds.

(5) Ships should put out extra line and wire as deemed necessary and should be ready to tend mooring lines.

(6) Although the rated holding strengths of the mooring buoys inside the confines of the port are good (see Appendix C), they are not the preferred location to be when high velocity winds are expected. Their orientation with respect to the surrounding land masses does not give them the same protection as do the pierside berths (see Figure 6).

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[14] See SOPA (ADMIN) YOKOSUKA INSTRUCTION 5000.1, Harbor Movements - Entering and Leaving Harbor.

(7) The anchorages within Yokosuka Bay have mud and sand bottoms, hence their holding quality would be poor in the event of typhoon intensity winds. In addition, anchorages and mooring buoys in Yokosuka Bay are unprotected from northerly winds and relatively unprotected from southerly winds.

Where there are crowded conditions within the Port of Yokosuka and thus limited pierside facilities, this may be an instance when a ship would elect to evade the typhoon at sea or anchor in Tokyo Bay.

Ships of the JMSDF consider their port of Nagura (see Figure 6) a good typhoon haven if a ship is pierside and, generally, do not sortie to avoid a typhoon. However, ships anchored in the vicinity of Nagura or moored to a buoy usually get underway and proceed to anchorages in various parts of Tokyo Bay.

6.4 EVASION IN TOKYO BAY

JMSDF ships in the past have anchored in Tateyama Bay for typhoon passage to the east of Tokyo Bay. They also make use of Kisarazu Harbor (see Figure 6).

Merchant vessels have, at times, depending on the direction of the tropical storm or typhoon CPA, anchored in the following areas:[15]

(1) Tropical cyclone passage to the east or south of Tokyo Bay - anchor in Chiba Harbor or Kisarazu Harbor.

(2) Tropical cyclone passage to the west or north of Tokyo Bay - anchor in Kaneda Bay.

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[15] See Defense Mapping Agency Hydrographic Center charts N.O. 97151 and N.O. 97143.

Vessels carrying a dangerous cargo must anchor as directed by the Japanese Maritime Safety Office.

Ships requiring a pilot to transit the Uraga Suido Traffic Route may be unable to secure pilot services if winds are greater than about 35 kt because pilots embark and debark from small motor launches.

6.5 EVASION AT SEA

The widely held doctrine of evasion at sea rather than remaining in port for the single purpose of minimizing typhoon-related damage is not generally recommended when in port at Yokosuka. However, if putting to sea is desirous each tropical storm or typhoon must be considered as differing from those preceding it. The accompanying synoptic situation must be fully understood. To establish one technique or rule to avoid the danger area is not practical. The Japanese say that, "the only solution is that there is no one solution."

In general, the effects of wave/swell generated by a tropical cyclone generally begin to be felt in the vicinity of Kannon Saki and may reduce the speed of advance (SOA) thereby increasing the time required to reach the open sea (see Figure 6). If a ship is caught in the wave/swell pattern ahead of a tropical cyclone, in particular an intense tropical storm or typhoon, the SOA may be reduced to the point that the ship will be unable to maneuver to clear the danger area (see Appendix E).

If the typhoon is forecast to follow a recurving track, with a CPA to the east of Yokosuka, then a course downsea/downwind, in the left or navigable semicirle may be advisable.

Any course to the north along the east coast of Honshu is considered unwise. The possibility of being overrun exists if the storm accelerates and/or turns suddenly to the north. The average speed of advance in the higher latitudes (30-40°N) of tropical cyclones is about 25 kt; however, they have been tracked as fast as 50 kt. Typhoon wind intensities tend to decrease as the system moves into the northern latitudes but nevertheless can be quite destructive.

7. CONCLUSIONS

The conclusion reached in this study is that the port of Yokosuka is a "safe" typhoon haven; a port in which to remain if already there or to seek its shelter if at sea when threatened by a typhoon. The primary factors in reaching this conclusion are:

(1) The port provides shelter from wind and sea due to the surrounding land masses.

(2) Wave action induced by typhoons has been negligible in the port.

(3) Storm surge has negligible effect.

(4) The orientation of the berths and drydocks with respect to the local topography is good.

(5) The experience level and the high degree of competence of the Port Services personnel.

(6) The only situation in which the port would not be a safe haven is when a very intense typhoon passed directly over Yokosuka.

(7) The history of the port. Conversations with Japanese employees at Fleet Activities, Yokosuka indicated that since 1945 there is no recollection of U.S. Navy, Japanese Maritime Self Defense Force or merchant ships sortieing from the port of Yokosuka due to a typhoon.[16]

Figure 33 has been devised to assist in the usage of this study and to point out those sections which have relevance in a number of threat situations that tropical cyclones impose on the port of Yokosuka.

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[16]Based on a letter dated 21 March 1974 by Commander, Fleet Activities, Yokosuka, serial 510, to Commanding Officer, Environmental Prediction Research Facility, Monterey, CA.

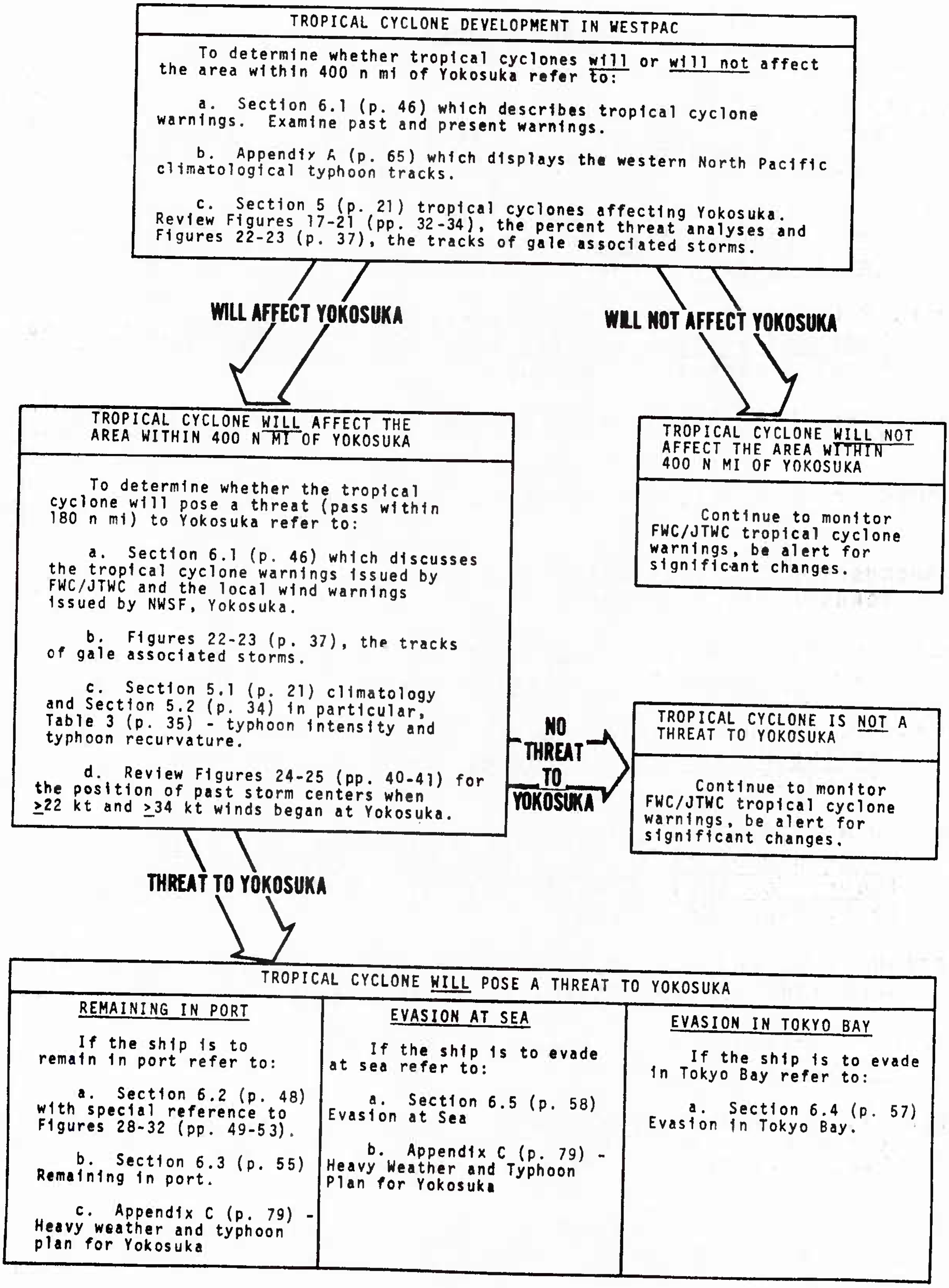

Figure 33. Decision flow chart.

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APPENDIX A

MONTHLY TYPHOON TRACKS FOR YEARS 1946-1969

Figures A-1 through A-9 show monthly and semi-monthly (June to October) tracks of western North Pacific tropical cyclones (1946-1969) which were at one time of typhoon intensity (from Gray, 1970).

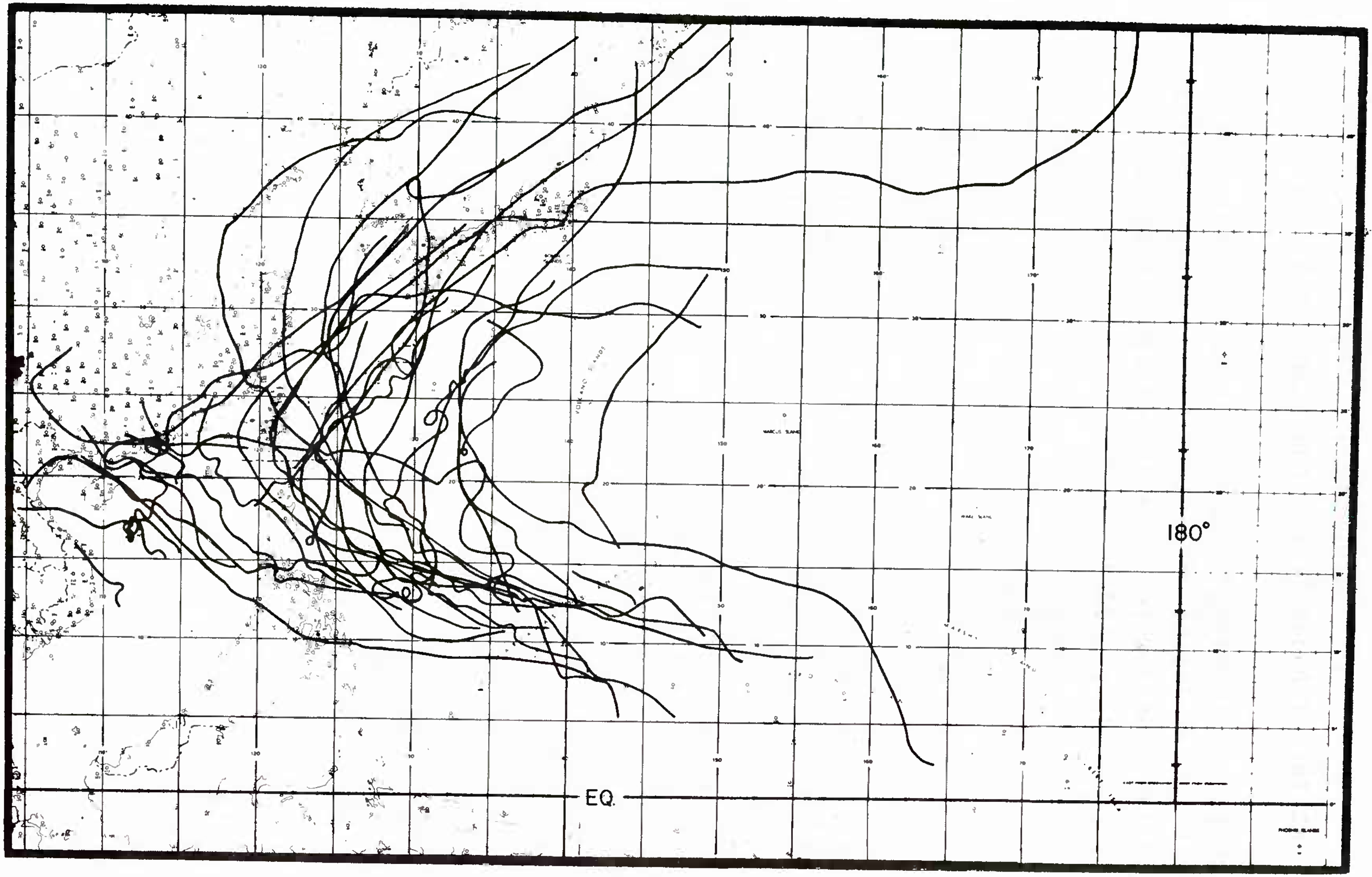

Figure A - 1. June tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

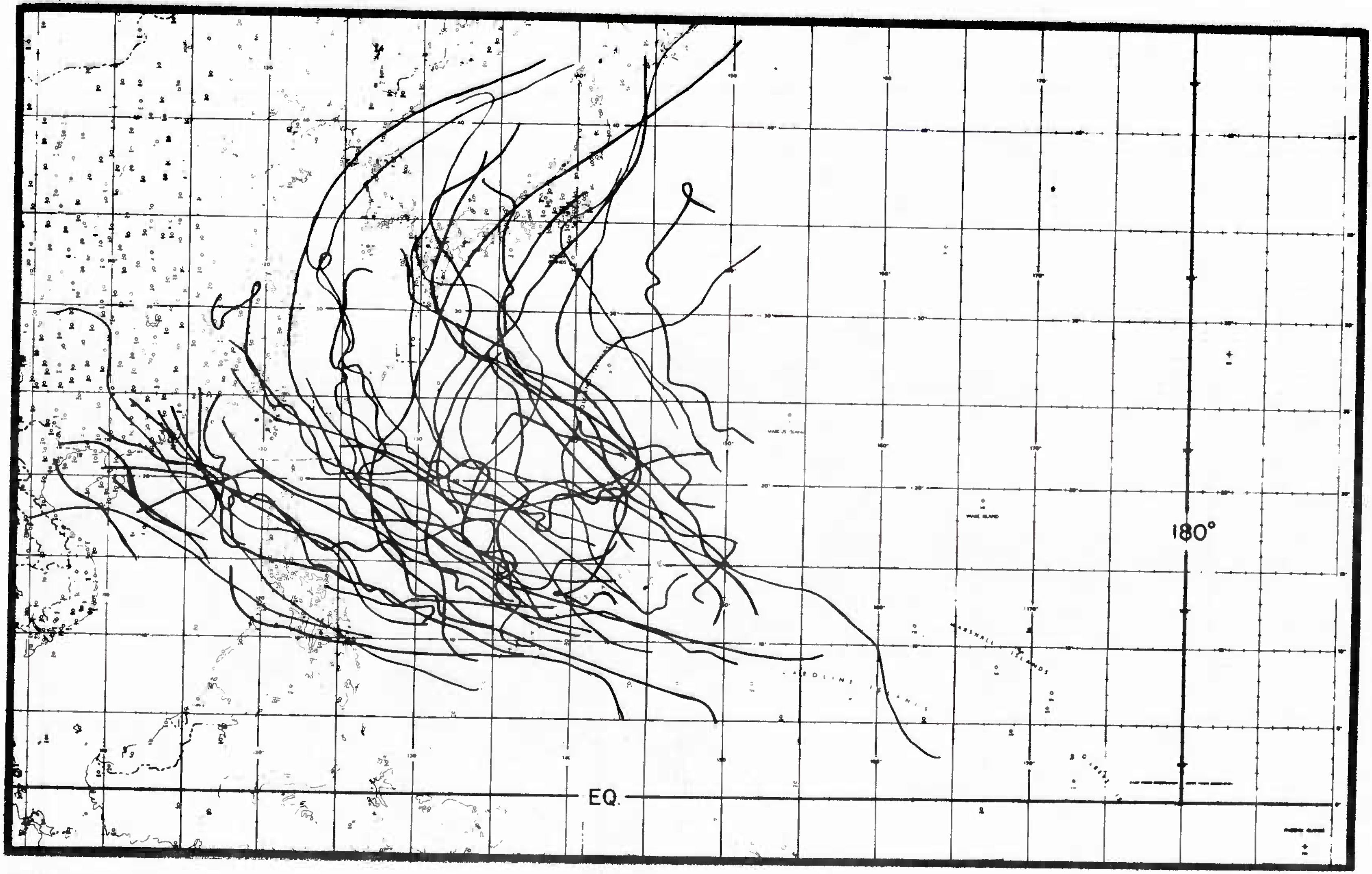

Figure A -2. July (first half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

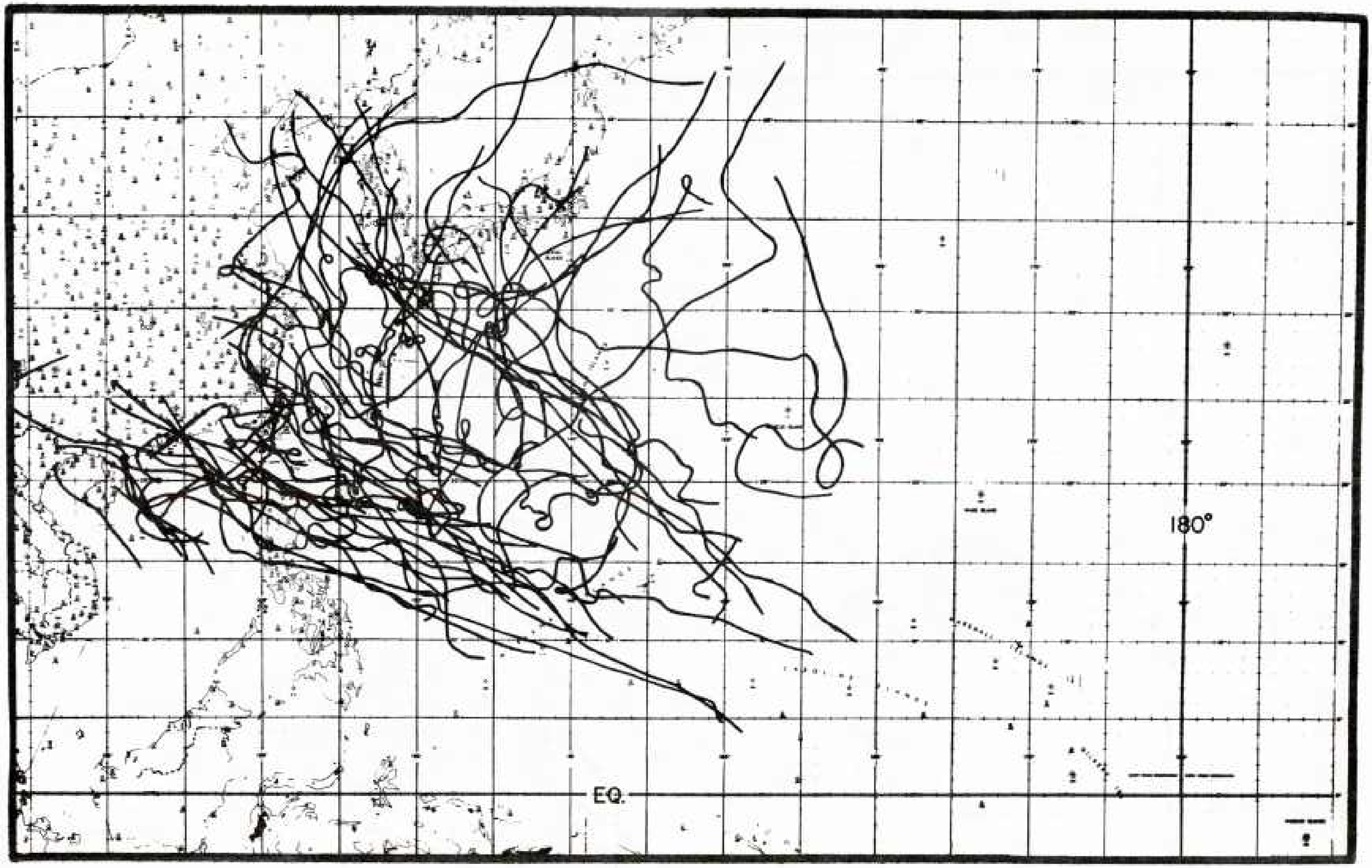

Figure A-3. July (second half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

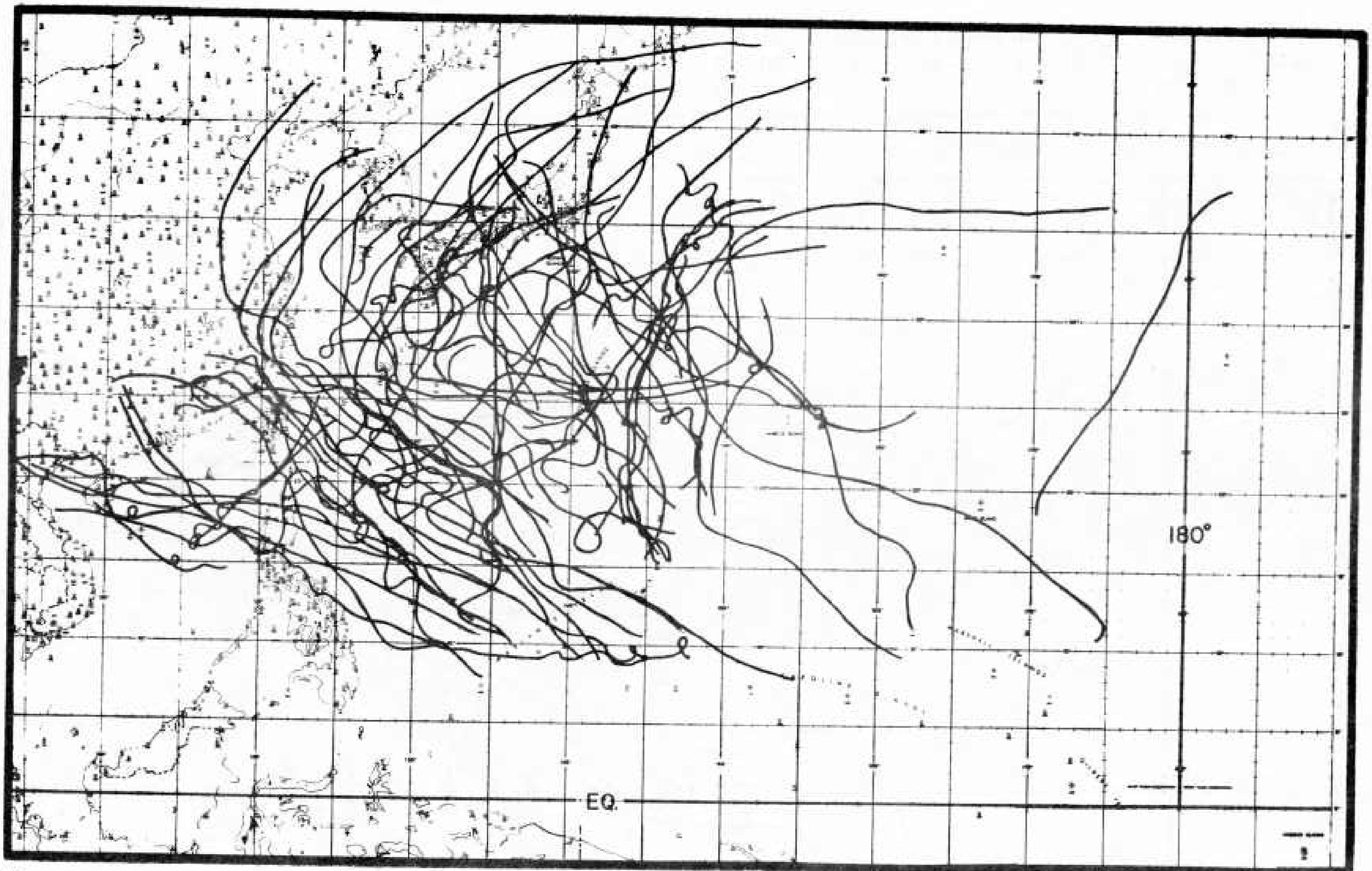

Figure A-4. August (first half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

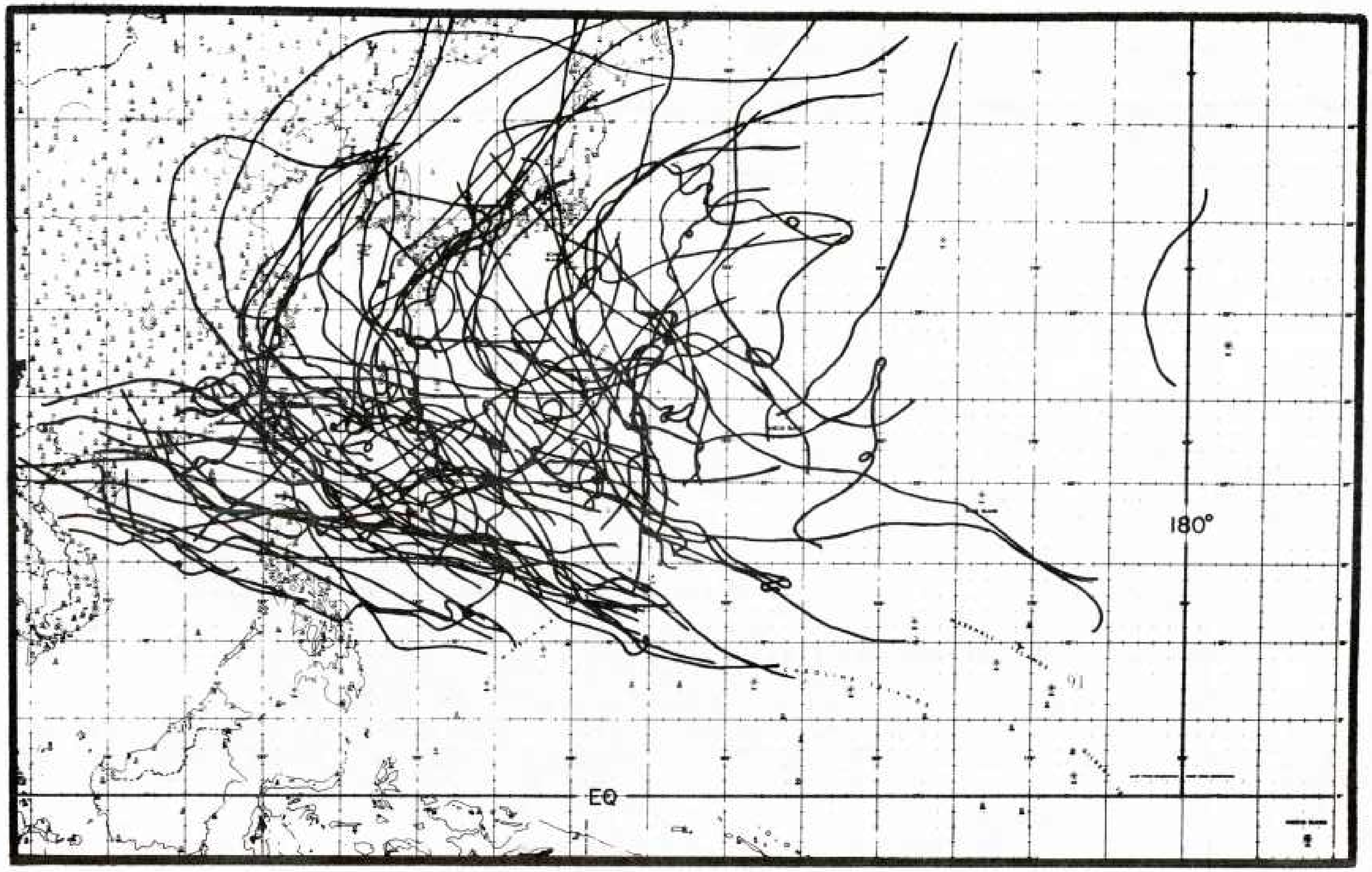

Figure A-5. August (second half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

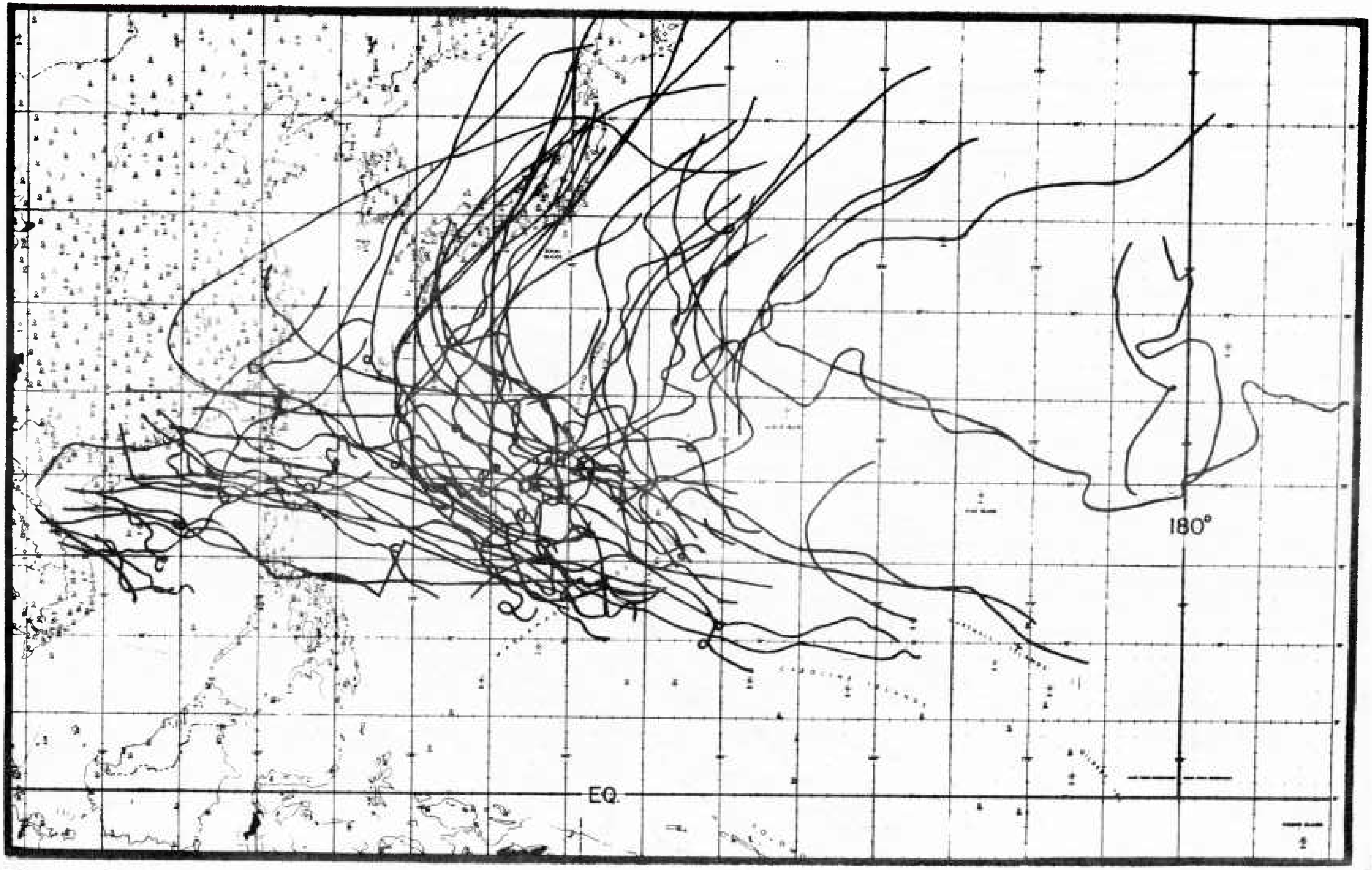

Figure A-6. September (first half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

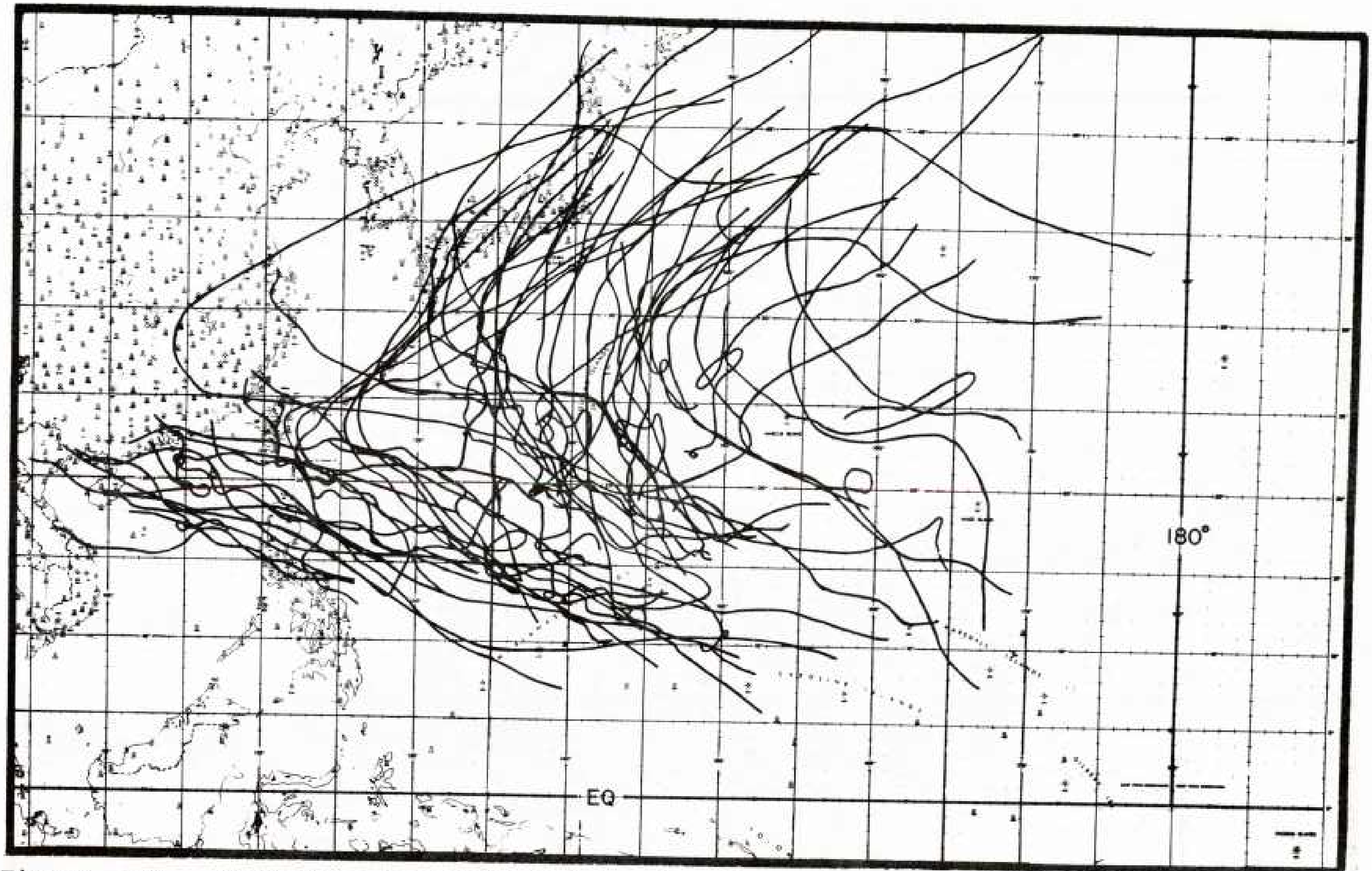

Figure A-7. September (second half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

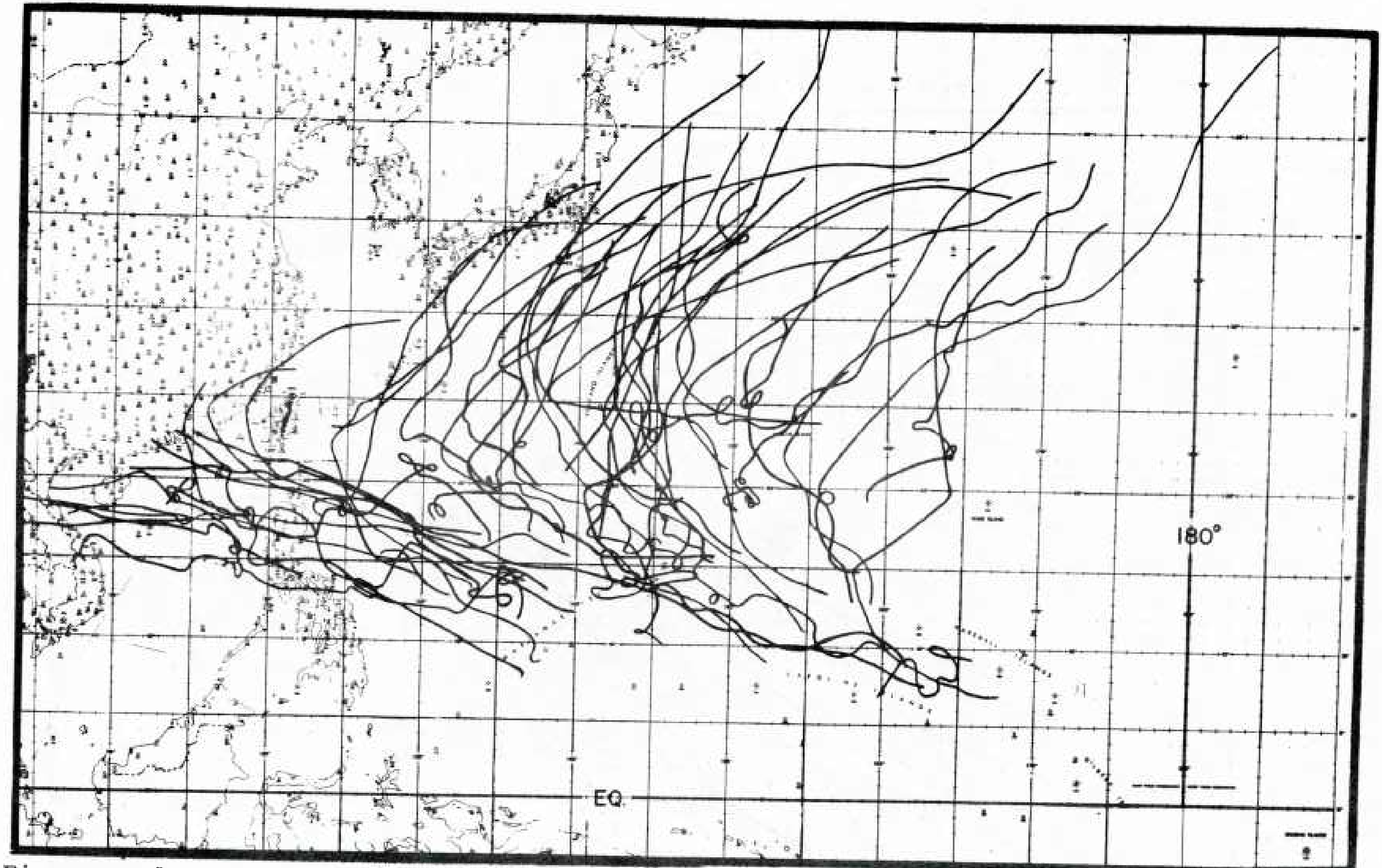

Figure A- 8 . October (first half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

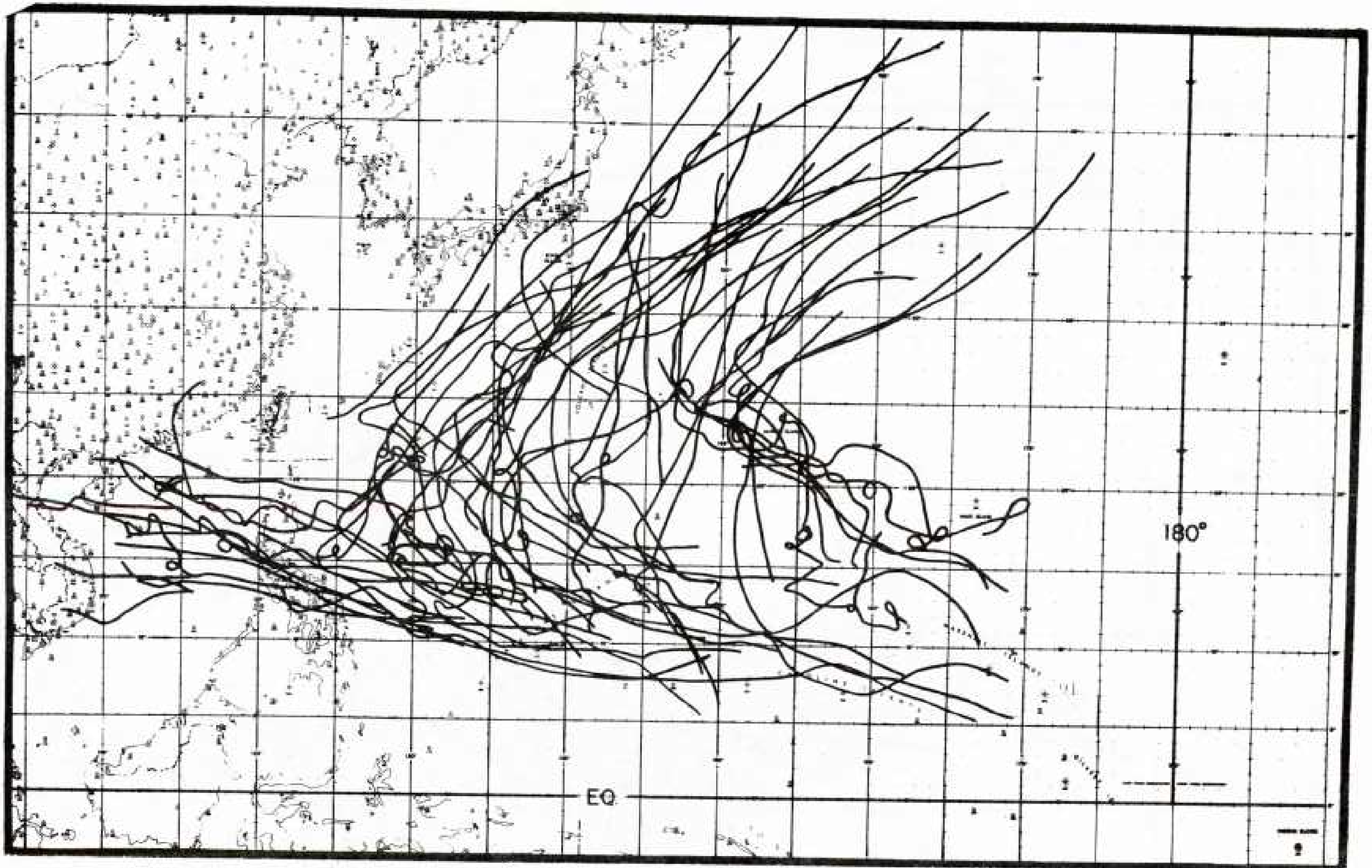

Figure A- 9 . October (second half) tracks of tropical cyclones which at some time were typhoons during the years 1946-1969. Tropical cyclones have been placed into monthly categories according to the median date of their existence.

APPENDIX B

YOKOSUKA HARBOR FACILITIES

The following is a partial listing of the harbor facilities available at Yokosuka. For a complete discussion see the Port Directory, Volume V, Pacific Ocean and the Fleet Guide, Tokyo Wan, H. O. 916, current edition.

1. BERTHING AND FACILITIES

a. Moorings, Docks, Etc. There are five inshore designated anchorages for large vessels and a quarantine anchorage area for numerous large vessels. Anchorages have mud and sand bottom, poor protection and depth range of 11 to 25 fathoms of water. There are four inshore mooring buoys for vessels in 8 to 14 fathoms of water. A fuel buoy (IMODCO) is located at 35° 18'37"N, 139° 40'01"E for deep draft tankers to pump fuel to Azuma Island.

In Yokosuka Ko there are ten sets of bow and stern mooring buoys which afford fair portection. These buoys are in depths ranging from 3-1/2 to 7-3/4 fathoms. Note: JMSDF ships use these mooring buoys on a regular basis. When the port is threatened with typhoon winds, USN ships move pierside and the JMSDF ships will generally anchor in a preferred location within Tokyo Bay.

BERTH NO.			
1	320'	15'	Sea Wall
2	492'	37'	Floating Pier, 67' Wide
3	492'	37'	Floating Pier, 67' Wide
4 North	160'	31'	Sea Wall
4 South	170'	31'	Sea Wall
5	450'	21'	Sea Wall
6 (Destroyer Repair Pier)	387'	30'	Concrete Pier, 62' Wide
7 (Destroyer Repair Pier)	387'	30'	Concrete Pier, 62' Wide
8 South	200'	25'	Sea Wall
8 (Forrestal Causwy)	837'	35'	Sea Wall
9 (Forrestal Causwy)	526'	25'	Sea Wall
10	492'	36'	Floating Pier, 67' Wide
11	492'	36'	Floating Pier, 67' Wide

BERTH NO.	LENGTH	DEPTH ALONGSIDE IN FEET AT MLW	CONSTRUCTION
12 Piedmont Pier	900' (Plus 270' to Buoy X-15)	28'	Sea Wall
13	200'	42'	Sea Wall
14, 15, 16, 17	556'	41'	DD No. 6 (Wet Berth)
18	240'	18'	Sea Wall
Flag Flotilla (FFB) (Normally Tender Berth)		31'	Sea Wall (Med Moor)

Brows are available at all berths. Depths indicated are alongside depths. Desired depths are achieved by utilizing camels.

b. Fuel. COMFLEACTS operations port control furnishes fuel requirements and schedules delivery by yard services craft: however, AVGAS can be delivered only at Army fuel pier at Hakozaki Terminal on Azuma Island, adjacent to Fleet Activities, Yokosuka. Sludge barges with 200,000 gallons capacity are available under contract from Yokohama on 48 hour notice. Reserve stocks of fuel hose are available from NSD, Yokosuka.

One fuel barge (Yo) is available as follows:

YO-49 USS WHIPSTOCK
10,171 Barrels NSFO (472,182 Gallons)
1,694 Barrels Diesel (71,148 Gallons)

c. Mechanical Handling Facilities. Permanent dockside cranes are available at all berths except 1, 2, 3, 6, 7, 10, and 11, which are serviced by mobile cranes. Three floating cranes are available to ships at anchorage and berths: one 150 ton and two 30 ton. All three self-propelled.[1]

Dockside cranes vary from 350 tons at Piedmont pier to 27-1/2 tons at Dry Dock No. 1. Crane capacity at majority of berths is 60 tons.

d. Dry docks and repair facilities. Naval ship repair facility, Yokosuka has the following dry docks.

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[1]Mobile dockside cranes are secured when not in use and when wind exceeds 20 kts from any direction.

NUMBER	LENGTH (FT)	LARGEST SHIP WIDTH (FT)	ACCOMMODATE DRAFT (FT)
1	436	67	16
2	498	66	24
3	298	38	14
4	785	85	30
5	1,056	114	37
6	1,099	156	45

See Figure B-1. Dry Dock 6 can be pumped dry in about 4 hours and flooded in 3 hours.

e. Stevedores. Stevedores are available to issue ships for loading resupply and off-loading cargo only.

f. Port Capacity. The NSD cargo branch can moor between two and four merchant type ships simultaneously in dry Dry Dock No. 6 when used as a wet basin, depending upon the vessels L.O.A., Beam and Draft. Under the present Stevedore contract, six gangs are guaranteed per 24-hour period. Each gang averages 30 M/T per hour when loading or discharging general cargo.

2. SERVICES, LOGISTICS AND OPERATIONS

a. Lighterage. Tugs, vehicle lighters, pilots, berthing arrangements, camels, and brows will be arranged by Commander Fleet Activities, Yokosuka. Port services should be requested in the LOGREQ, and by contacting the operations department.

Four tugs (YTM type) are available with 1,000 horsepower each, and two YTB with 2000 horsepower plus 10 pusher boats with 500 horsepower each.

Four barges are available: Two YCV (aircraft lighters, three feet draft) 200' X 65' and one YC (cargo lighters, three feet draft with three and one-half feet freeboard) 109'X35'.

b. Airfields. Air Force Base, Tachikawa and Naval Air Station, Atsugi are the principal air terminals for overseas passenger and freight traffic. A hard surfaced runway 8,000 feet by 150 feet is available at Atsugi while the runway at Tachikawa is 5,000 by 150 feet. GCA is available at both places. Both facilities are capable of making major repairs. Carrier-based aircraft customarily use NAS, Atsugi. Atsugi is not a designated port of entry and is unable to process passports that require a Japanese visa.

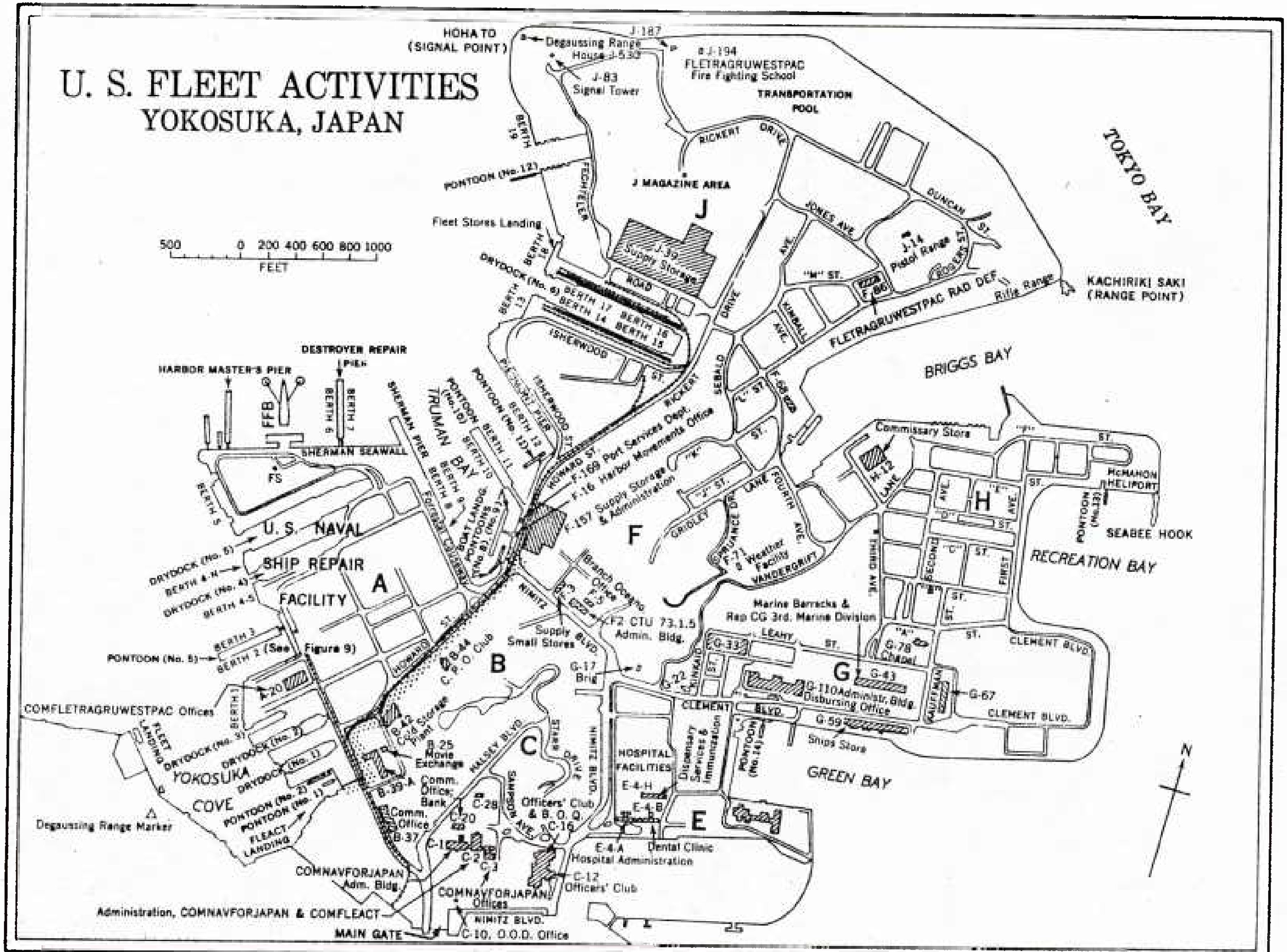

Figure B-1. Location of berths and drydocks at U.S. Fleet Activities, Yokosuka

APPENDIX C

HEAVY WEATHER PLAN FROM SOPA (ADMIN) INST

The following paragraphs are portions of the Heavy Weather and Typhoon Plan to SOPA (ADMIN) YOKOSUKA INSTRUCTION 5000.1 dated 30 November 1972. Subparagraphs marked with an asterisk (*) indicate the proposed changes to the current instruction which may appear in the new Heavy Weather and Typhoon Plan.

The buoys in Yokosuka Bay, the port of Yokosuka and Nagura Harbor are found in Appendix IV to Annex W of the YOKOSUKAINST 5000.1. They are listed in this Appendix.

Ref: (a) OPNAVINST 3140.24A
(b) Annex H to CINCPACFLT OPORD 201-(YR)
(c) COMNAVFORJAPANINST 3140.1 J
(d) Pamphlet "Measure of a Harbor," by Fleet Weather Facility, Yokosuka, Japan
(e) Annex H to COMSEVENTHFLT OPORD 201-(YR)

1. Purpose. . .

2. Basic Instructions. . .

3. General Weather Information. . .

4. Receipt and Dissemination of Warnings. . .

5. Conditions of Readiness. During the approach of a typhoon or a destructive storm toward the Yokosuka area, SOPA will normally direct the establishment of such conditions of readiness as may be ordered by COMNAVFORJAPAN. In the absence of COMNAVFORJAPAN orders, SOPA will set appropriate conditions of readiness, together with minimum precautionary action required for each, are described in the following paragraphs.

a. CONDITION IV. Trend indicates possibility of destructive winds within seventy-two hours (see reference (a)). Condition IV is normally set on 1 June and remains in effect through 30 November as directed by reference (c).

b. CONDITION III

(1) Definition: Destructive winds are possible within forty-eight hours.

(2) Considerations: As it is most difficult to foretell the exact location of a typhoon or storm forty-eight hours hence, Condition III is usually set over an extensive area as a precautionary measure. The minimum actions to be taken will usually not interfere unduly with normal routine and consist mainly of insuring that plans are completed and that personnel, power plants and other facilities will be readily available should Condition II or I be set.

(3) Minimum action required of all ships:

(a) Establish continuous watch on 328.2 MHZ, 2716 KHZ, and 277.8 MHZ (Naval Ships) and cease transmitting administrative and low precedence operational traffic on these nets.

(b) All ships capable of evading the typhoon or storm at sea will take on fuel as necessary. Commence preliminary preparations for getting underway should the latter become advisable.

1. Hoist in all small boats not actually in use.

2. Ships disabled due to overhaul of machinery or tender upkeep commence immediately to place main engines in operable condition.

(c) Vessels alongside piers put out extra hawsers, making allowance for rapid changes in height of water.

(4) Minimum action required of COMFLEACTS Yokosuka:

(a) Prepare to place Storm Bills in effect for land and harbor installations.

(b) Make preparations for securing all small boats and service craft and ships not capable of evading the typhoon or storms at sea.

(c) Alert Harbor Tugs for employment in assisting vessels.

(d) Assist ships to shift to previously assigned berths.

(5) Minimum action required for all aircraft: Commanders responsible prepare to evacuate, tie down and/or stow aircraft, establishing contact with Fifty Air Force, Fuchu AF Command Post to insure full coordination.

c. CONDITION II

(1) Definition: Destructive winds are anticipated within twenty-four hours.

(2) Minimum action required of all ships:

(a) If Condition III has not previously been set, carry out pertinent provisions of paragraph 5.b. (3) above.

*(b) Unless otherwise directed by SOPA, liberty may be granted at the discretion of Commanding Officers for those personnel not essential to maintain the readiness required for this condition.

(c) Cease loading and unloading operations.

(d) Hoist all remaining small boats and shift small craft to sheltered berths previously assigned.

(e) Ships nested break up nests and proceed to assigned berths as directed by COMFLEACTS Operations Department, Port Control Office.

(f) If anchored, veer chain to maximum safe scope. If moored to a buoy, veer to maximum safe swinging radius.

(g) Raise steam and be prepared to shift berths if required.

(h) Rig for heavy weather and set normal underway watertight integrity.

(i) Be prepared to sortie if directed. Ships desiring to sortie independently may do so at their discretion informing SOPA and COMFLEACTS Operations Department, Port Control Office, if general sortie is not ordered.

(3) Minimum action required of COMFLEACTS Yokosuka:

(a) Carry out provisions of paragraph 5.b.(4) above if not already accomplished.

(b) Implement Storm Bill for land and harbor installations.

(c) Be prepared to berth and mess small boat crews and liberty parties unable to return to their ships.

*(d) In the event SOPA cancels liberty, direct Shore Patrol Officer to return all liberty parties in the Yokosuka area.

(4) Minimum action required for all aircraft: Evacuate and/or secure all aircraft at the discretion of the operational commander directly responsible.

d. CONDITION I

(1) Definition: Destructive winds are anticipated within twelve hours.

(2) Considerations: When Condition I is set, the odds are greatly in favor of the near passage of the typhoon or storm. Periodic oscillations and small scale erratic movements of the eye of a typhoon make it almost impossible to foretell whether the center will pass or miss any given position near the mean track.

(3) Minimum action required of all ships and commands: Complete the actions required under paragraphs 5.b. and 5.c. above, and take all additional precautions necessary to sortie or ride out the storm as directed or necessary.

6. Merchant Shipping Present. Commander Fleet Activities, Yokosuka, will keep all U.S. merchant ships present advised of the receipt of typhoon advisories, the setting of typhoon conditions of readiness, require that they take adequate precautions commensurate with the condition set, and if considered advisable SOPA will invite them to join the sortie groups.

APPENDIX IV TO ANNEX W

ESTIMATE FORCE TO DRAG MOORING[1]

Yokosuka Bay:

Buoy No.	Force in Tons
1	120
3	120
10	180
11	180

Yokosuka Harbor:

Buoy No.	Force in Tons
D-2 n	100
D-2 s	100
D-3 n	70
D-3 s	70
D-4 n	100
D-4 s	100
D-5 n	60
D-5 s	60
D-6 n	50
D-6 s	50
D-8 n	50
D-8 s	50
D-9 n	60
D-9 s	60
D-10 n	80
D-10 s	70
D-11 n	75
D-11 s	75
D-12 n	75
D-12 s	70

Nagura Harbor:

Buoy No.	Force in Tons
C-1 n	100
C-1 s	100
C-3 n	100
C-3 s	100
C-4 n	100
C-4 s	70
C-5 n	70
C-5 s	70
C-6 n	70
C-6 s	70
C-7 n	50
C-7 s	50
C-8 n	50
C-8 s	50

[1] See Defense Mapping Agency Hydrographic Center Chart N.O. 97147 for the exact location of these buoys.

APPENDIX D

CASE STUDIES OF TYPHOONS NANCY (SEPTEMBER 1961) AND VIOLET (OCTOBER 1961)[1]

The case histories of Typhoons Nancy and Violet of 1961 are of interest in that they resulted in typhoon strength wind gusts of 71 kt from the south-southwest and 74 kt from the north-northwest, respectively, in the port of Yokosuka. Nancy passed 130 n mi to the northwest and Violet passed 30 n mi to the southeast of Yokosuka. Figure D-1 shows the best track and intensity of Typhoon Nancy as it approached and departed the Yokosuka area and, likewise, Figure D-2 for Typhoon Violet.[2]

CASE I

TYPHOON NANCY

The tropical depression which was to be Typhoon Nancy was upgraded to a tropical storm on 8 September at ØØØØZ (Ø8ØØØØZ) in the vicinity of 5N, 160E. By the time a reconnaissance fix could be made, Nancy had surface winds of 125 kt revealing that she was an "explosive deepener" and probably reached typhoon intensity at Ø718ØØZ. Nancy followed a general northwesterly track, passing some 85 n mi south-southwest of Guam at 1Ø18ØØZ with 180 kt surface winds. A peak intensity of 185 kt was reached prior to recurvature. Nancy began to recurve near 20N, 130E passing about 40 n mi east of Okinawa at 1415ØØZ and then headed north-northeast, accelerating very rapidly. The typhoon entered Honshu near

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[1] From "The Measure of a Harbor", Fleet Weather Facility, Yokosuka, Japan, 1963.

[2] From FWC/JTWC Annual Typhoon Report, 1961.

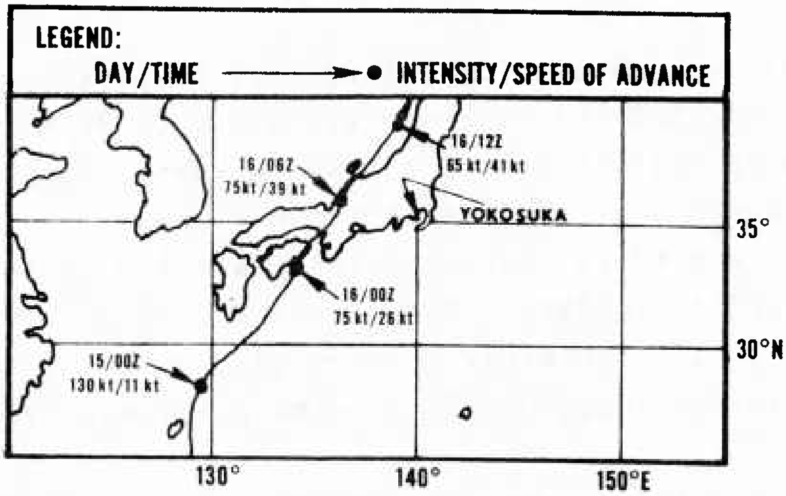


Figure D-1. Best track of Typhoon Nancy (14-16 Sep 1961).

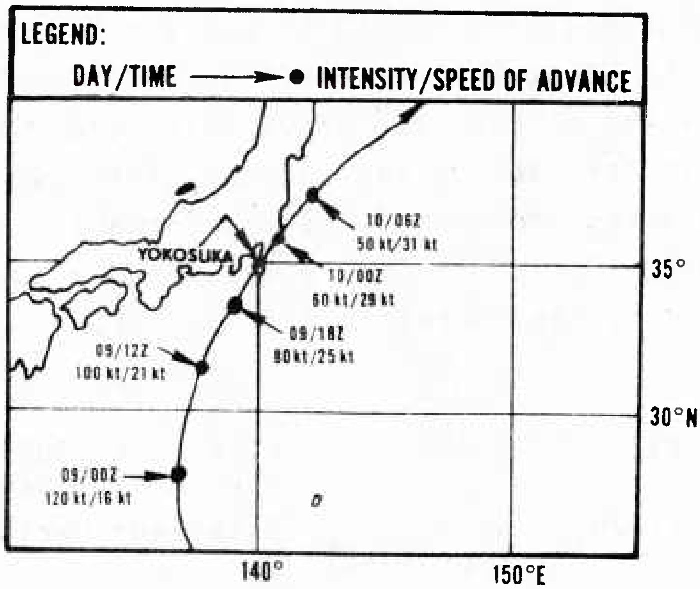


Figure D-2. Best track of Typhoon Violet (9-10 Oct 1961).

Osaka, which is about 210 n mi west of Yokosuka, at 160430Z, moving at about 28 kt with surface winds of 75 kt. She made a rapid transit across Honshu emerging into the Japan Sea near Nanao and continued north-northeast to Hokkaido.

Nancy's surface winds remained over 100 kt for 8 days, from 080000Z to 160000Z. She traveled 4275 mi at an average speed of 18 kt. The minimum speed was 11 kt on 15 September and the maximum speed was 55 kt when Nancy was over northern Japan.

In Japan there were 172 persons reported dead, 18 missing and 3,184 injured. More than 300 ships were sunk and many more damaged. At the end of the 1961 typhoon season, Japanese officials said Nancy was rated sixth in the number of persons killed by an individual typhoon. Typhoon Vera killed 4,464 persons in Nagoya on 26 September 1959, the worst in Japanese history.

Typhoon Nancy tested the port of Yokosuka on 16 September 1961 with sustained winds of 50 kt and gusts up to 71 kt as recorded by the Fleet Weather Facility (FWF), Yokosuka. Figure D-3 is the disposition of 20 ships (18 USN, 1 USCG, and 1 USNS) in port during the passage of Nancy.

The following are some pertinent comments by the various commands listed in Figure D-3. Under the column heading of berth, the DD refers to dry dock.

SHIP	BERTH	REMARKS
EVERSOLE (DD789)	DD#5	Wind 45 kt/200°-No difficulties experienced.
CAYUGA CTY (LST529)	#8 (Outboard)	Excellent berth for a LST
POLLUX (AKS4)	#3	Wind 55kt/180°-The loan of a wire was helpful (for securing).
CAIMAN (SS323)	#1	Wind 45-50 kt/180°-Ideal berth for a sub.

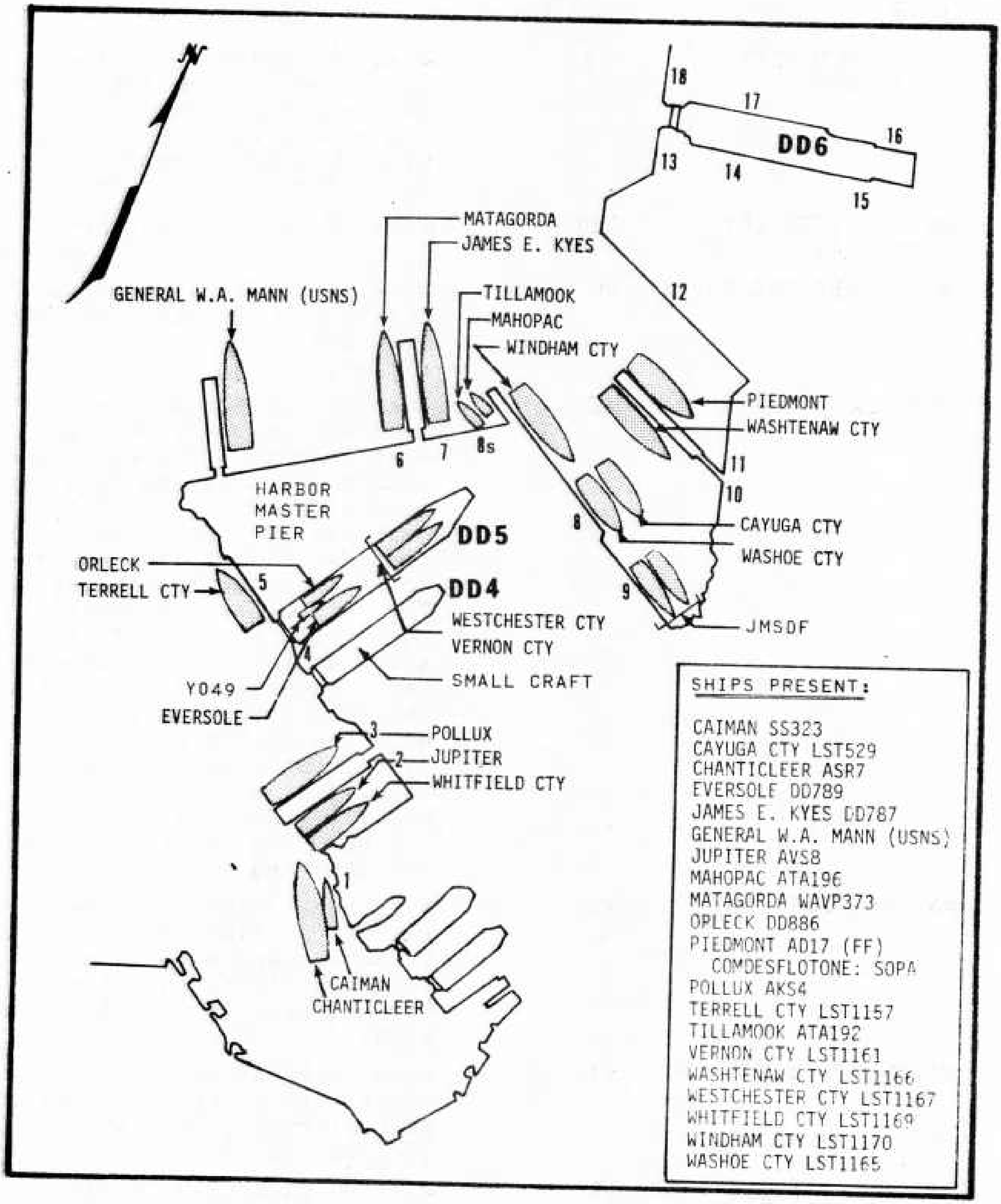


Figure D-3. Ship disposition in port Yokosuka during the passage of Typhoon Nancy (16 Sep 1961).

SHIP	BERTH	REMARKS
WHITFIELD CITY (LST1169)	#2	Wind 55 kt/180°-200°-The ship rode well in this berth. Higher winds might necessitate putting ship in stern to with a FWD anchor out with 45-60 fathoms of chain.
WESTCHESTER CTY (LST 1167)	DD#5	Wind 38 kt-Excellent berth
MATAGORDA (WAVP373)	#6	Wind 55 kt/195°-200°-Barometric pres 29.161. The ship rode the storm in fine condition.
JUPITER (AVS8)	#2	Wind 55 kt/180°-No surge or roll was encountered. The wind over the forecastle and bridge was moderate. The wind across the fantail and flight deck was stronger. Gusts were recorded with a hand anemeter to 53 knots on the flight deck. The ship could have been positioned about 50 ft further ahead at the pier which might have lessened wind force over the flight deck. Ship had been positioned on Friday, 15 September to avoid brow interference with the USS POLLUX (AKS-4) at Pier 3. The position was satisfactory for safe and secure mooring.
MAHOPAC (ATA196)	#8s	Wind 65 kt/180°-This berth was very satisfactory but berth #13 would be more suitable if the ship had to get underway to assist another ship.
PIEDMONT (AD17)	#11	Wind 33-52 kt/190°-220°-Electrical power berth would be preferred-otherwise no difficulties.
TERRELL CTY (LST1157)	#5	Wind 50 kt/200°-No difficulties.

SHIP	BERTH	REMARKS
TILLAMOOK (ATA192)	#8s	Wind 60-70 kt-Gusts from S-SW-Berth #8s is well sheltered.

Below is the text of the final message by the Senior Officer Present Afloat (SOPA) Yokosuka to COMSEVENTHFLT regarding Typhoon Nancy.

BT

UNCLASS

SITREP TYPHOON NANCY

1. NANCY, WITH GUSTS TO 71 KTS, WEATHERED WITHOUT DAMAGE BY ALL FLEET UNITS YOKOSUKA. PROTECTED MOORINGS PROVIDED FOR SHIPS PRESENT BY COMFLEACTS PORT SERVICES PLUS ACCURACY AND EXCELLENCE OF ADVICE BY FLEET WEATHER FACILITY BOTH MOST HELPFUL TO ALL HANDS.

BT

CASE II
TYPHOON VIOLET

Based on a reported surface wind of 45 kt in the vicinity of 20N, 147E the first Tropical Storm Violet warning was issued on 4 October 1961 at ØØØØZ (Ø4ØØØZ). She moved southwest and intensified, reaching typhoon strength at approximately Ø412ØØZ. Violet made an abrupt turn toward the northwest near 16N, 144E at about Ø512ØØZ. She reached maximum strength of 180 kt from Ø7ØØØØZ to Ø712ØØZ while some 1000 n mi south of Yokosuka. Violet then started to weaken slightly and headed to the north-northwest, recurving at about 28N. She continued to follow a smooth parabolic track and passed about 30 n mi to the southeast of Yokosuka at Ø922ØØZ moving at a speed of 27 kt and still had sustained surface winds of 70 kt.

Violet traveled 2050 mi in the 6 days and 18 hours that warnings were being issued. Her minimum speed was 4 kt when she made the turn from a heading of southwest to northwest and her maximum speed of 31 kt occurred after she passed Tokyo.

Only minor damage occurred to Japan in the Tokyo area, due to gusty winds. Two deaths were attributed to the typhoon in Japan.

The resultant winds at Yokosuka from Typhoon Violet lashed the port with 74 kt gust from the north-northeast as reported by FWF on 10 October 1961. Figure D-4 is the disposition of the 36 ships (35 USN, 1 USCG) in port during the passage of Violet. Table D-1 lists the ships in port by ship type and berth assignment.

The following are some pertinent comments by various commands listed in Figure D-4.

SHIP	BERTH	REMARKS
CARBONERO (SS337)	#1	Wind estimated 35 kt. Berth #1 sheltered by building. Secure berth.
MEDREGAL (SS480)	#1	Wind 40 kt gusts to 50/010°. Berth #1 adequate for winds at least 20 kt or higher.
CASTOR (AKS1)	#2	Wind 40 kt gusts to 60 kt. Berth satisfactory.
TOM GREEN CTY (LST1159)	#2	In future recommend LST's be berthed earliest to preclude possible accidents compounded by high winds, large sail area, flat bottom. Berth satisfactory.
REGULUS (AF57)	#3	Winds 38 kt/045°. Excellent berth.
GURKE (DD783)	#4	Wind estimated 60 kt/345°. Berth satisfactory.
WHIPPOORWILL (MSC207)	#4s	Wind 060°-340°. Berth satisfactory.

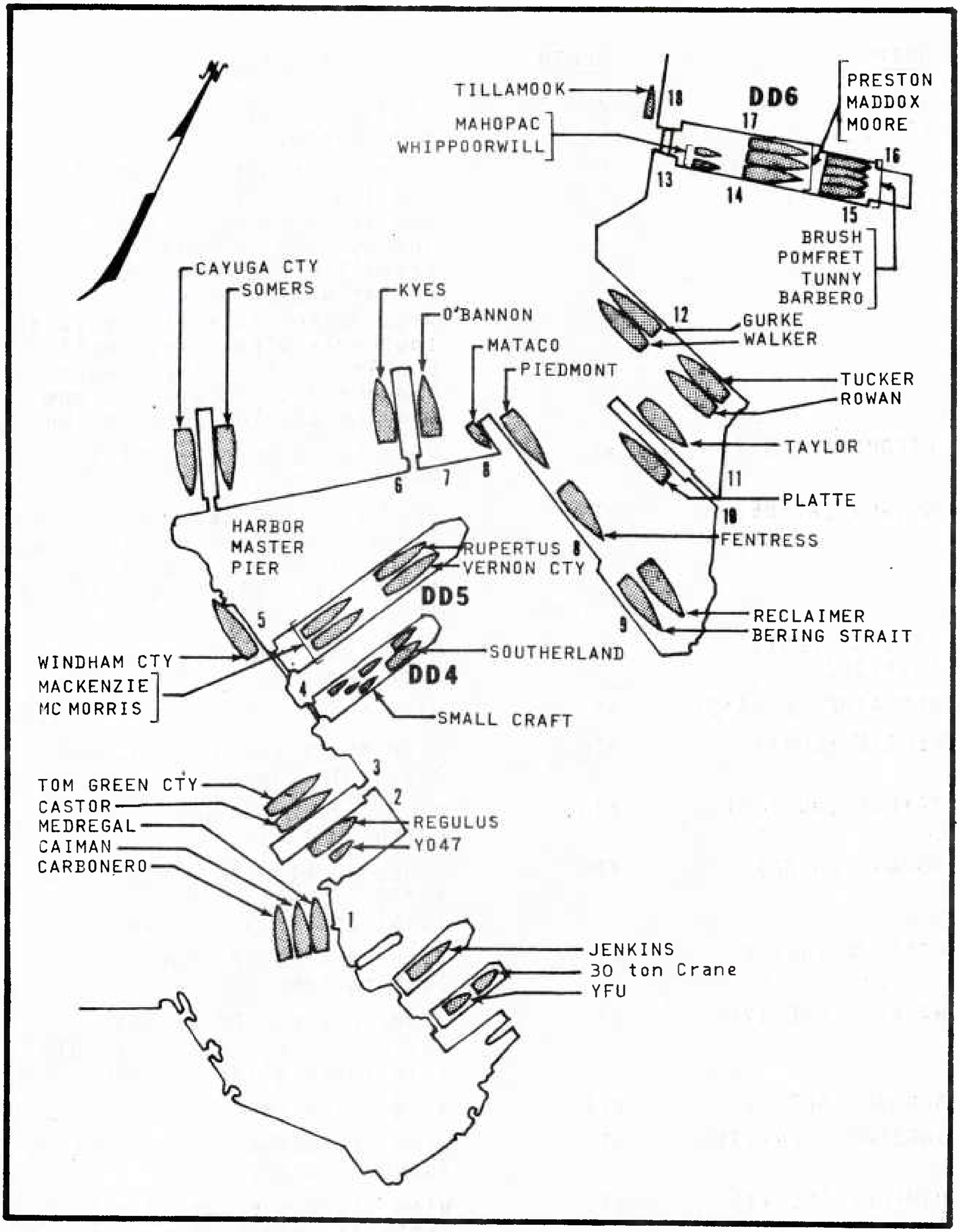


Figure D-4. Ship disposition in port of Yokosuka during the passage of Typhoon Violet (16 Oct 1961).

SHIP	BERTH	REMARKS
JAMES E. KYES (DD787)	#6	Wind 45 kt at 340°. Berth satisfactory.
O'BANNON (DDE450)	#7	Wind 35 kt gusts 55 kt 350°-1/2-101°. Berth satisfactory. Considerable chafing of stern spring line. A bollard on the seawall will be needed for storms whose centers will pass west of Yokosuka with ensuing southerly winds. This will enable passing lines, wire and chain to ensure minimum chafing and leverage action.
PIEDMONT (AD17)	#8	Wind 50 kt gusts to 58kt/340°. Berth suitable.
MATACO (ATF86)	#8s	Wind 50 kt gusts to 65 kt/355°. Berth considered marginal for ships exceeding 150 ft in length with winds exceeding 75 kts.
BERING STRAIT (WAVP382)	#9	Wind indicator in repair. Good berth.
RECLAIMER (ARS42)	#9	Wind 65 kt. Berth satisfactory
PLATTE (AO24)	#10	Wind 40 kt/010°. Berth more than suitable.
TAYLOR (DDE468)	#10	Wind estimated 50 kt/330°. Berth suitable.
ROWAN (DD782)	#12	Winds 30 kt with gusts to 45 kt/330°. Berth considered ideal and well secluded.
HENRY W TUCKER	#12	Wind 30 kt/030°. Berth satisfactory.
WALKER (DDE517)	#12	Winds maximum 70 kt/350°. Berth considered highly suitable for similar typhoons.
MADDOX (DD731)	#14	Wind 32 kt/195°. Berth suitable
BARBERO (SSG317)	#15	Wind estimated 20 kt. Suitable typhoon berth.
POMFRET (SS391)	#15	Wind light and variable by estimate. Berth considered above average shelter.

SHIP	BERTH	REMARKS
TUNNY (SSG282)	#15	Wind 35 kt/090°.Berth satisfactory.
BRUSH (DD745)	#16	Wind maximum 32 kt. Berth excellent.
MAHOPAC (ATA196)	#18	Wind 40 kt/300°. Camels now located at berth #18 not well suited to ATA. Otherwise fine.
TILLAMOOK (ATA192)	#18	Wind 35 kt gusts to 60 kt/040°. Berth satisfactory.
JENKINS (DDE447)	DD#2	Wind 20 kt/320°. Berth excellent.
SOUTHERLAND (DDR743)	DD#4	Wind 30 kt gusts to 60 kt/030°-225°. DD#4 excellent berth
RUPERTUS (DD851)	DD#5	Wind 50 kt/060° estimated. Berth excellent.
CAYUGA CTY (LST529)	HMP-W	Wind maximum 50 kt. Another camel and clearance of protruding equipment near south end of berth needed. Wind and sea on port qtr drove port bow into pier causing minor damage. Consider mooring could not be held if stern had extended past northwest end of pier. 2 chocks 2 bitts 6 manila lines and 4 wires carried away. Stern anchor wire and bow anchor chain held.
SOMERS (DD947)	HMP-E	Line handlers worked through the night tending lines to maintain an even strain on moorings. During heaviest blow had steam to guarding valves, split plant operations, in preparation for easing strain on lines by use of main engines, but did not find this necessary. Berth evaluated adequate. Some difficulty because of tumbling of double camels and clogging of cooling water intakes by debris. Recommend that ships using this berth during heavy weather be moored with bow to sea wall to keep screws clear for backing should lines part.

Table D-1. Ships present list Yokosuka 10 October, 1961.
SOPA in USS Piedmont AD 17.

SHIP	BERTH	SHIP	BERTH
BARBERO SSG317	15	RECLAIMER ARS42	9
BERING STRAIT WAVP382	9	REGULUS AF57	3
BRUSH DD745	16	ROWAN DD782	2
CARBONERO SS337	1	RUPERTUS DD851	DD#5
CASTOR AKS1	2	SAMUEL N MOORE DD747	17
GEORGE K MACKENZIE DD386	DD#5	SOMERS DD947	HMP-E
GURKE DD783	4		
JAMES E KYES DD 787	6	SOUTHERLAND DDR743	DD#5
JENKINS DDE447	DD#2	TAYLOR DDE468	10
		TILLAMOOK ATA192	18
MADDOX DD731	14	TOM GREEN CTY LST1159	2
		HENRY W TUCKER DDR875	3
MATACO ATF86	8s	TUNNY SSG282	15
McMORRIS DE1036	1	VERNON CTY LST1161	DD#5
O'BANNON DDE450	7	WALKER DDE517	11
PLATTE AO24	10	MAHOPAC ATA196	18
PIEDMONT AD17 (FF)	8	CAIMAN SS323	1
COMDESFLOT ONE		MEDREGAL SS480	1
POMFRET SS391	15	CAYUGA CTY LST529	HMP-W
PRESTON DD795	14	WHIPPOORWILL MSC207	4s

Legend: DD = Dry Dock
HMP(E/W) - Harbor Master Pier (East/West)

EFFECTS OF TYPHOON VIOLET IN TRUMAN BAY
(Body of water between berths 8 and 12)

Comment by the Port Services Officer:

The only minor damage received during Typhoon VIOLET was at Berth 9 which has a heading of 139°T. Maximum winds received was 65 knots taken by the RECLAIMER. This berth was accommodating the USCG BERING STRAIT (WAVP 382) and out board was the USS RECLAIMER (ARS 42). The configuration of the ships was compatible but small camels between the ships caused excessive pressure on the BERING STRAIT by the RECLAIMER from the surging of the ship due to rise in the sea level and the pocketing effect at the sea wall end of Berth 9. The damage to the BERING STRAIT could have possibly been averted by the use of cluster fenders between the two ships instead of the small wooden camels. Also added emphasis could possibly have been from the pontoon float at the Boat Pool which undoubtedly redirected some of the force of the water in the direction of Berth 9. The pontoon floats at the Boat Pool received a surge of approximately 4 feet which caused them to part.

Below is the text of the final message by SOPA Yokosuka to COMSEVENTHFLT regarding Typhoon Violet.

BT

UNCLAS

SITREP TYPHOON VIOLET

EYE OF VIOLET PASSED WITHIN 3Ø MILES YOKOSUKA WHICH BROUGHT 74 KT GUSTS TO THIS AREA. STORM WEATHERED WITHOUT DAMAGE BY ALL FLEET UNITS PRESENT. AGAIN FINE WORK BY FLEET WEATHER FACILITY AND COMFLEACTS PORT SERVICES MAJOR FACTOR IN AVOIDANCE DAMAGE.

BT

The decision to remain in port and face the awesome power of Typhoon Violet and the forecasted wind gusts of 70-80 kt at Yokosuka was made while the center was still about 700 n mi south of Yokosuka. The significance of the decision and the after effects prompted COMSEVENTHFLT to say, in part, in a report to Commander in Chief, U.S. Pacific Fleet ". . . At Yokosuka most SEVENTH Fleet ships chose to ride her out in port. There was no damage to ships or significant interruption to SEVENTH Fleet scheuules."

APPENDIX E

SHIP SPEED VS WIND AND SEA STATES

Figures E-1 and E-2 represent the estimated resultant speed-of-advance of a ship in a given sea condition. The original relationships were based on data of speed versus sea state obtained from studies of many ships by James, 1957. They should not be regarded as truly representative of any particular ship (Nagle, 1972).

For example, from Figure E-1, for a ship making 15 kt encountering waves of 16 ft approaching from 030° (relative to the ship's heading) one can expect the speed-of-advance to be slowed to about 9 kt. Twenty foot seas, under the same condition, would result in a speed-of-advance of slightly less than 6 kt. However, it is emphasized that these figures are averages and the true values will vary slightly from ship to ship.

Figure E-3 shows the engine speed required to offset selected wind velocities for various ship types (computed for normal loading conditions).

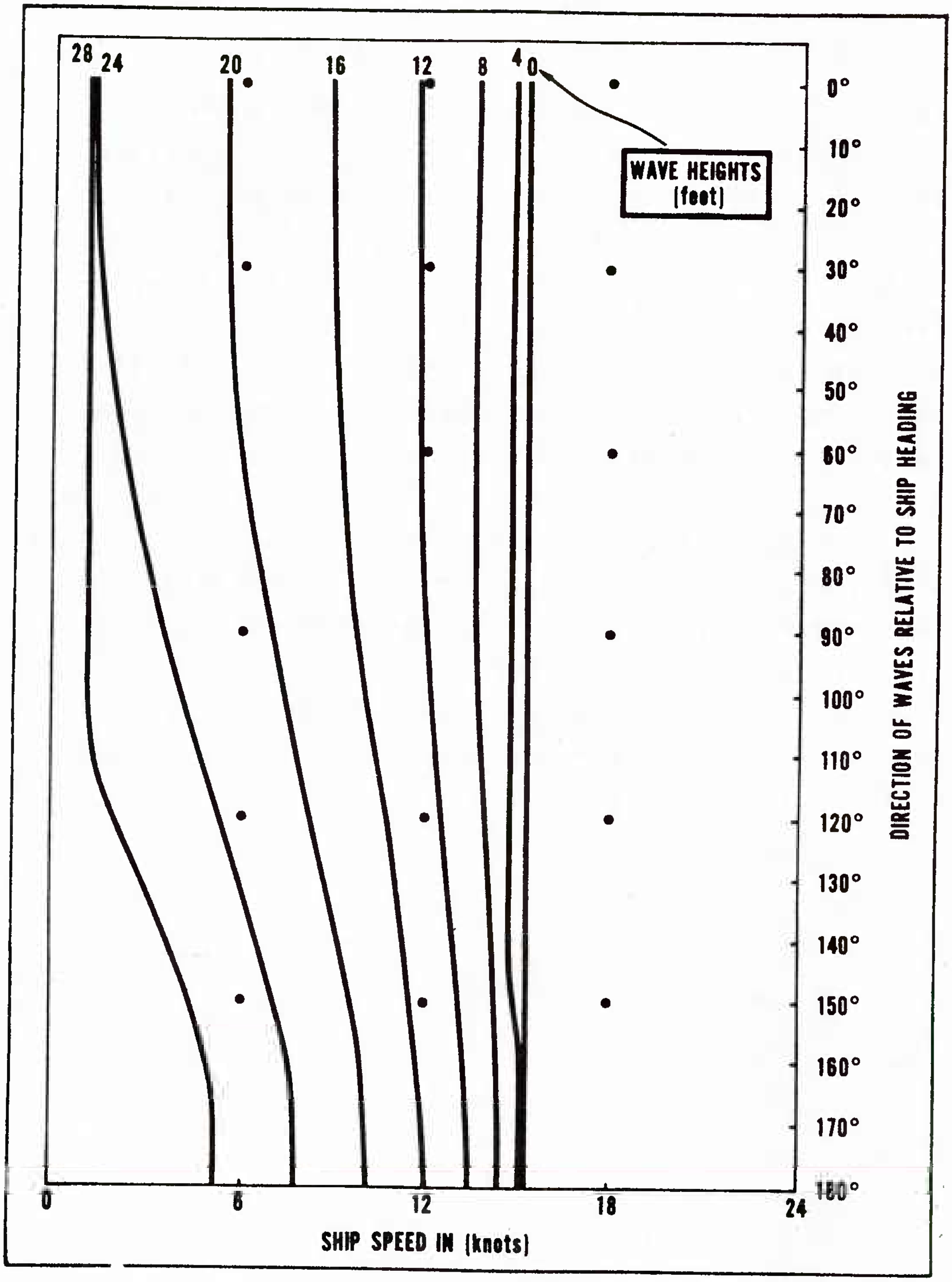


Figure E-1. Ship speed as a function of wave height and wave direction relative to ship's heading (15-kt ship). (From Nagle, 1972.)

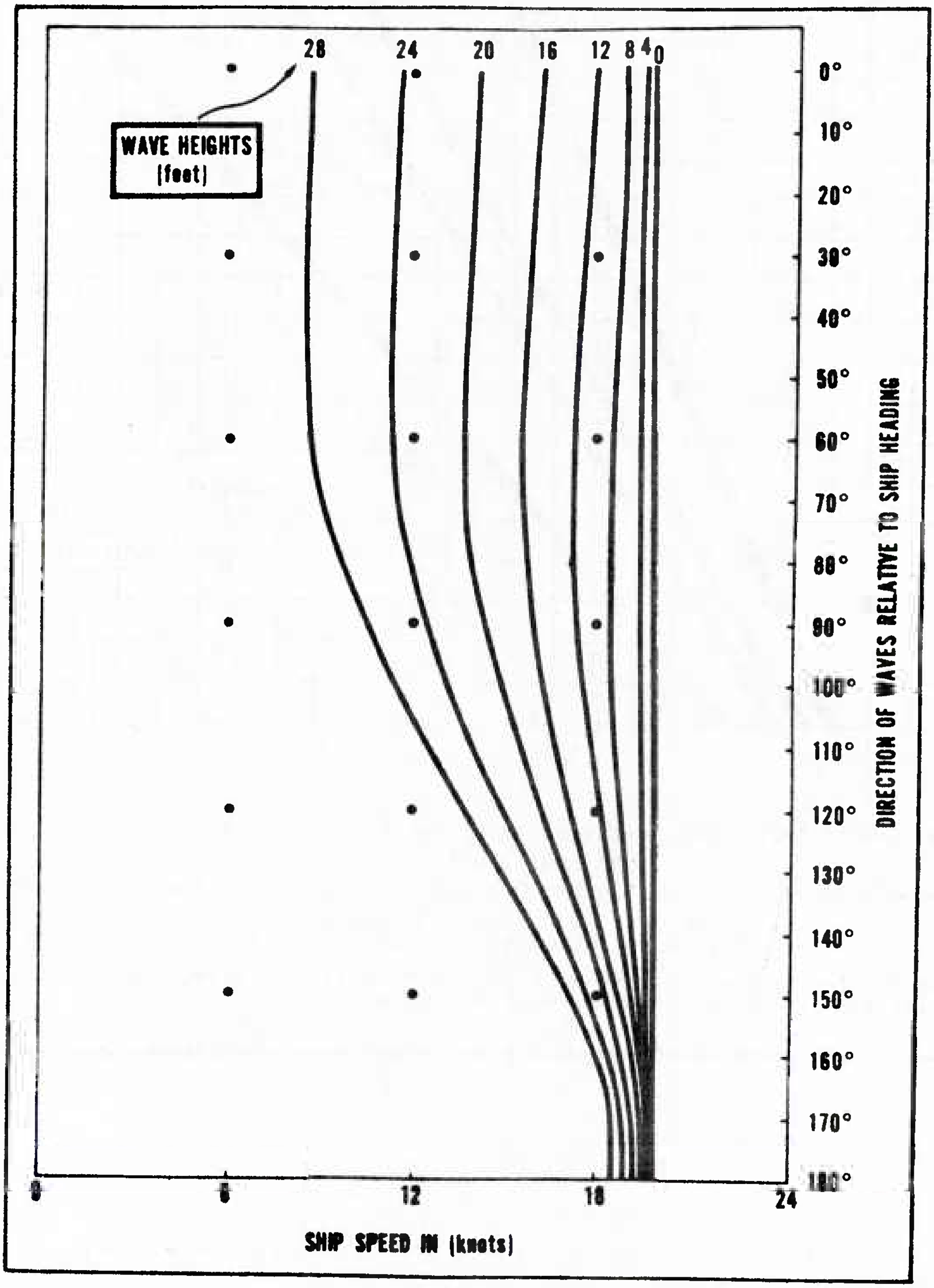
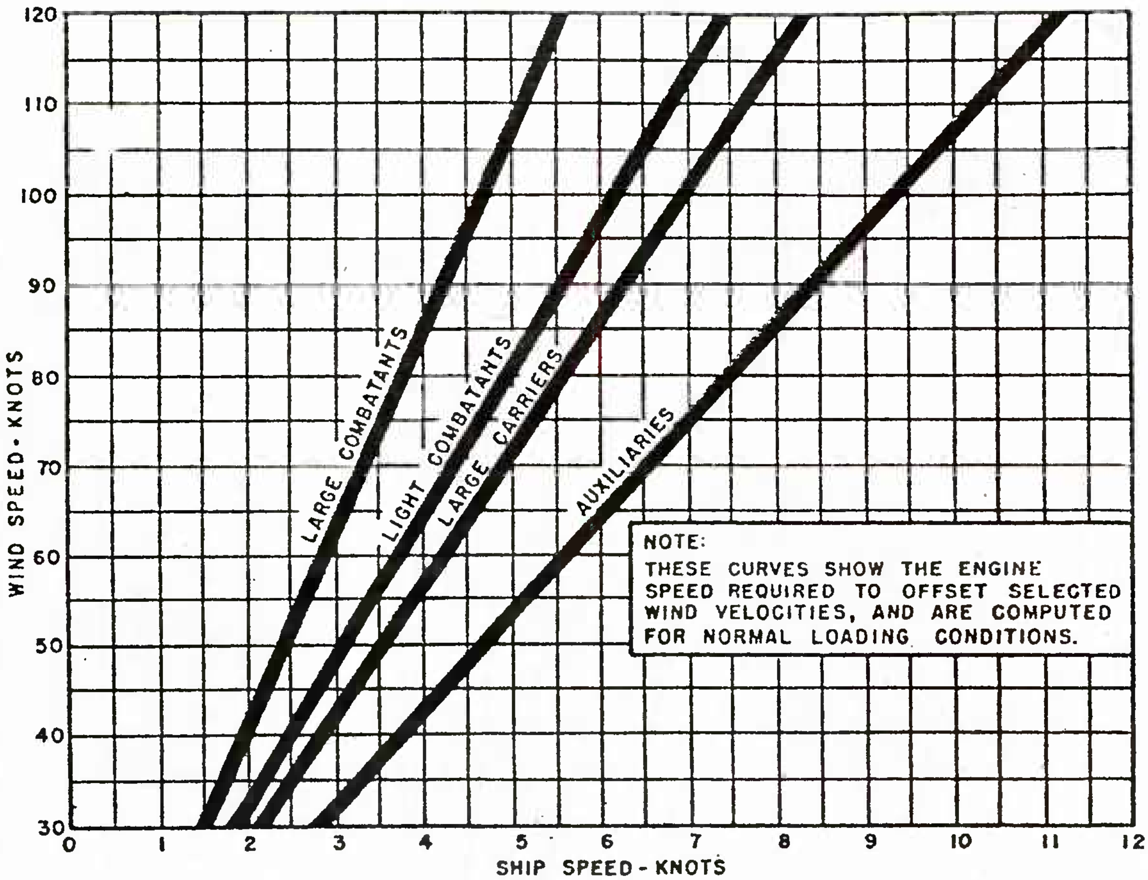


Figure E-2. Ship speed as a function of wave height and wave direction relative to ship's heading (20-kt ship). (From Nagle, 1972.)



THE CURVES SHOWN WERE DEVELOPED USING THE BASIC FORMULA:

$$\text{WIND LOAD} = R_w A V^2$$

WHERE R_w IS EQUAL TO WIND FRICTION FACTOR. (R_w IS GENERALLY TAKEN AS 0.004.)

V IS EQUAL TO WIND VELOCITY IN KNOTS.

A IS EQUAL TO PROJECTED AREA ABOVE THE WATERLINE IN SQ. FT.

THREE SETS OF CALCULATIONS WITH VARYING R_w WERE USED. THE PLOTTED VALUES ILLUSTRATED REPRESENT THE MEAN OF THESE VALUES.

Figure E-3. Engine speed vs. wind velocity for offsetting force of wind. (From Crenshaw, 1965.)