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COLD and WET:

ESTIMATED SURVIVAL TIME

in GLOBAL WATERS

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MAXWELL AIR FORCE BASE AL 36112-5001

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17 June 85

SUBJECT Security & Policy Review

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ALAN J. ROD, GS-12
Deputy Director
Public Affairs

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ADTIC PUBLICATION G-112

COLD AND WET

Estimated Survival Time in Global Waters

by

EDWARD V. SAUNDERS, MSgt USAF

May 1962

Arctic, Desert, Tropic Information Center
Research Studies Institute
Maxwell Air Force Base, Alabama

COLD AND WET

Estimated Survival Time in Global Waters

Introduction

How long can a man survive off the Kamchatka coast? How long can a crew of three survive in a liferaft? How much time does a rescue team have to make a successful pickup? These and similar inquiries are frequently received by the Arctic, Desert, Tropic Information Center from agencies all over the world. Because most such inquiries involve the relationship between water temperature and estimated survival time, a graphic and descriptive analysis of the problem has been prepared. The length of time an individual can survive in water and hence the amount of time rescue units have available to effect recovery have been predicated for the seas and oceans of all climatic zones.

The results of this study will be of value to groups and units operating in areas where water survival is of primary concern.

PAUL H. NESBITT
Chief, ADTIC
Research Studies Institute

THE PROBLEM

Two-thirds of the earth's surface is covered with water and the chances of aircrews having to ditch are of such odds as to warrant serious consideration of the problems involved in water survival. Approximately one-third of this water is located in regions where the surface temperature is 70° F or higher—regions where survival depends on the length of time a person can keep afloat and can keep from being attacked by sharks or other dangerous marine animals.

In northern waters the survivor's greatest danger after abandoning the aircraft will be the effects of the cold. The most serious immediate effect will be extreme body cooling which may quickly result in death. Cooling takes place more rapidly in water than in air for two reasons: (1) wetting greatly decreases the insulating effect of clothing; and (2) water displaces the layer of still air that normally surrounds the body. Thus water rapidly conducts heat away from the body. A second serious danger is that of local injury by cold, i.e., frostbite, immersion foot, etc.

In most cases of exposure, the factors of low air and water temperatures, high winds, wetness, and inadequate clothing often exist in combination to complicate the problem of water survival. Where climatic conditions are extreme such as sea surface temperatures ranging from 30° to 68° F additional cooling effects are produced by winds, often mounting to gale force, and by rain, sleet, or snow. Even in latitudes near the equator a keen sensation of cold is often experienced after nightfall. Fatal chilling may also occur in cold air, if insufficient clothing is worn or if clothing becomes wet. Since chilling interferes with sleep and increases exhaustion, every effort should be made to keep one's clothing dry.

The lethal factors of being immersed in cold water have been vividly brought out in a recent summary of survival experiences compiled by the Directorate of Flight and Missile Safety Research. Out of 393 survival experiences, 80% occurred over land and 20% over water. Of all survival incidents over land only 3% of the crewmen suffered fatal injuries while in those

cases of over water egress 13% of the crewmen experienced fatal injuries. Over 40% of all personnel who egressed over water were found to be distressed by the cold or other forms of exposure, 39% experienced problems in submersion, and 8% drowned.

The relation of survival time to water temperature is not a simple one. Each individual will vary in his reaction to cold stresses. The type of clothing worn, the extent of activity on the part of the survivor while in the water, and the body temperature of the individual when he enters the water will all affect his survival time. Likewise the following physio-psychological stresses will be determining factors: (1) excessive cold and wetness and their accompanying effects; (2) thirst due to inadequate water supply; (3) exhaustion and hunger from a lack of food; (4) humidity and intense heat; and (5) various psychological stresses such as isolation, loneliness, and remoteness.

Emergency survivors who die within 10 to 15 minutes apparently do not succumb because of reduced body temperature, but rather from the shock of rapid entry into cold water. Fifteen minutes is too short a time for the body temperature to fall to a fatal level. This is substantiated by the reports of survivors who state that the initial shock of entering cold water left them gasping and exhausted, and was followed by a numbness which gradually spread through their bodies as a false sense of warmth.

Despite the cold and formidable nature of the sea numerous persons have conquered her seemingly insurmountable obstacles and survived. The following examples are but a few of the cases of those who succeeded: (1) twenty-three seamen survived in water of 47° F for four hours; (2) one seaman survived an hour of immersion in water of 29° F; (3) an RCAF crew survived for three days on a raft in the North Atlantic in a snow and sleet blizzard and an additional 48 hours of sub-zero temperature which froze their flying suits and underclothing. After making land the group survived still ten more days in a shelter dug in the snow; (4) the late Sir Hubert Wilkens, famous arctic explorer, fell into near-freezing water and was rescued by eskimos in a few minutes time, with no ill effects; (5) fourteen crewmen of a Norwegian vessel fell into icy antarctic waters and swam 200 yards to an iceberg where they remained for two weeks subsisting on penguin; (6) in World War II a United States Army

Air Force surgeon recorded fifty instances of water exposure in a subarctic region in which the average monthly temperature ranged from 36° to 50° F. Most of the victims were involved in plane crashes and were rescued after periods of immersion ranging from a few minutes to over an hour; (7) General Twining and 14 companions survived seven days in tropical waters with a minimum of rations and water; (8) Captain Rick nbacker and seven of his crew survived 21 days in the south Pacific ocean under the most adverse conditions; (9) a man of 31, clad in flannel trousers and dungarees, remained on a raft for 48 hours at a sea temperature of 32° F and an air temperature below zero; (10) an F-86D pilot survived for one hour in water of 33° F; and (11) an F-89 observer survived approximately one hour and 45 minutes in water of 40° F. In all these cases men withstood some of the most adverse conditions the sea has to offer. Chief among the factors that enabled these survivors to make it through their ordeal was the will to live.

HOW TO INCREASE YOUR WATER SURVIVAL TIME

The necessity for a good indoctrination program on water survival stresses cannot be overemphasized. Careful indoctrination can do much to allay unnecessary fears and increase survival time in water. In survival tests conducted by the U. S. Navy, a seaman not briefed on what to expect and do in water of 40° F, suffered extreme agony for 3½ minutes and had to be hauled out. A second seaman, briefed on the subject, endured the same water temperature for 40 minutes. The general conclusion of this test was that if men are properly briefed on the subject they should be able to climb aboard a liferaft unaided after ten minutes exposure in water temperatures as low as 40° F. The accounts of airmen picked up after long periods of immersion in winter seas during the Korean operations provide additional evidence on the value of careful water survival indoctrination.

All personnel flying over water in the arctic or subarctic in aircraft, from which bailout or ejection is the only means of escape in an emergency, should wear an antiexposure suit at all times. In planes that have ditching capabilities all personnel should have antiexposure

suits ready for instant donning. The protection from the cold afforded by these suits facilitates the accomplishment of difficult operations, and extends the time a survivor can remain in the water without discomfort. Case histories reveal that even if crash victims succeed in boarding a liferaft without an antiexposure suit they will be unable to make use of the various items of emergency equipment provided because of the incapacitating effect of evaporative cooling.

Numerous survivors have stated how difficult it is to climb aboard a liferaft after being in the water without an antiexposure suit. The numbing effects of the cold water make the operation severely fatiguing or impossible. The exposure suit protects the body from the cold water, keeps the clothing light and dry, protects the survivor from the elements while in the liferaft, and by virtue of its great bouyancy aids in lifting him into the raft.

Personnel abandoning aircraft should take with them as much clothing as possible, especially waterproof clothing. Survivors on liferafts should huddle together for warmth, shield their bodies from wind and spray, eat as much as rations will permit, and exercise if at all possible.

Downed USAF crewmen, who survived under the rigorous conditions during the Korean War, stress the fact that a successful survival story usually begins long before a man climbs into his plane. Based on their comments and recommendations there are ten musts to successful survival:

1. A crew member must be mentally prepared for the fact he may go down.

2. He must be in good physical condition.

3. He must have serviceable survival equipment attached to his chute harness or easily accessible in the aircraft.

4. He must be proficient in the use of this equipment, especially the water survival gear and signaling devices.

5. He must know how to inflate and board a liferaft.

6. He must be dressed for the environmental conditions.

7. He must be thoroughly familiar with ejection, bailout, ditching, and crash landing procedures—so familiar that he will know, without undue deliberation, exactly what he must do in any given situation.

8. He must know how to guide his parachute in the air, how to make a parachute landing in water or on land, how to release parachute canopy and get out of the harness after landing.

9. He must have enough information about the water area or terrain over which he is flying to know what to expect if he comes down.

10. He must know the operating limitations of rescue aircraft so that he can assist in his own rescue.

The above requirements are valid for any survival situation and the man that can meet these requirements "when the chips are down" has the survival battle well in hand.

ESTIMATED SURVIVAL TIME IN GLOBAL WATERS

The estimated survival time of man downed at sea is presented graphically by means of maps which reflect sea surface temperatures for every month of the year throughout the entire world, except the equatorial regions lying between 5° N and 15° N. The February map represents the extreme of winter conditions in the northern hemisphere and the extreme of summer conditions in the southern hemisphere. The August map represents the reverse—extreme of summer conditions for the northern hemisphere and the extreme of winter conditions for the southern hemisphere.

Isothermic data for the accompanying maps were obtained from the U. S. Navy Hydrographic Office. Other data are based upon articles and books on file in the Air University Library and the Arctic, Desert, Tropic Information Center. Holdings were screened for pertinent information on hypothermia, windchill, exposure to cold, body temperatures, metabolism and body heat production, survival of men immersed in the sea, laboratory cold experiments on men and animals, controlled outdoor exposure experiments on men, fatigue and exhaustion, cold injuries, and physiological and pathological effects of cold on man.

By examining the accompanying maps one can determine at a glance the approximate time of survival in any given area of open ocean water. It should be realized, of course, that the time of survival in any body of water will be modified by a number of variables including wind velocity, temperature of air and water, degree of clothing saturation, humidity, physical activity of the individual, duration of exposure and individual variations concerning sex, age, body build, amount of fat, and mental attitude.

A human body cools when immersed in water having a temperature of less than 92° F. The warmest open ocean water that can be expected at any time of the year is 84° F. Even individuals immersed in water of this temperature undergo significant cooling, and may need the protection of an antiexposure suit.* The survivor sitting in a liferaft in warm climates may lose body heat rapidly due to evaporative cooling, unless provided with an antiexposure suit. The rate of loss of body heat increases as the temperature of air and water decreases.

The ranges of survival time are based upon the assumption that the crewmember is clothed in ordinary flying clothing or uniform, is in good physical condition, and when immersed in the ocean has a life preserver. The physiological limit of survival is reached when the rectal temperature reaches 78.6° F. At this temperature the average individual will die, although a few individuals may continue to live. In some cases, for example, individuals have survived with rectal temperatures as low as 64° F.

Area A (see maps) is considered the most dangerous survival-wise. In this region of 30° to 35° F water temperature, the individual suffers severe shock upon entering the water. This shock in some instances may be fatal owing to loss of consciousness and subsequent drowning. Area B, where water temperature ranges from 35° to 40° F, also imposes severe conditions for survival. In Area C, where water temperature ranges from 40° to 50° F, it is estimated that an individual should be able to survive up to three hours, although from

*Antiexposure suits are designed to protect the wearer from extreme cold on land or water. The Air Force has in its current inventory an Antiexposure Coverall, Type CWU-3/P, which will protect personnel down to a minimum of 50° F. The insulation garment for the CWU-3/P is the Antiexposure Immediate Coverall, Type CWU-2/P, which is used in the temperature range of 14° to 40° F. Air Force publications do not list the maximum time this ensemble will protect the wearer. However, the U. S. Navy has performed experiments with the current issue of antiexposure suit and have found that personnel can be protected from one to two hours at water temperatures of 28° F, and for longer periods aboard a liferaft. Time can be extended if head and hands are kept dry. Proper fitting is emphasized for the most efficient use of this suit.

actual observations at this temperature range only 50% of a group can be expected to survive longer than one hour. This zone is a transition area where only personnel in the best physical condition can survive the maximum period. Area D is also a transition area. Here where water temperatures range from 50° to 60° F, the individual has a reasonably good chance of survival if rescue is effected within six hours. In Area E, where water temperatures range from 60° to 70° F, an individual can survive up to twelve hours. Survival in this region is primarily an endurance contest. Finally, in Area F, where water temperatures are 70° F or higher, survival time depends solely upon the fatigue factor.*

*According to available survival information the longest period of immersion in this area has been 84 hours.

JANUARY

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

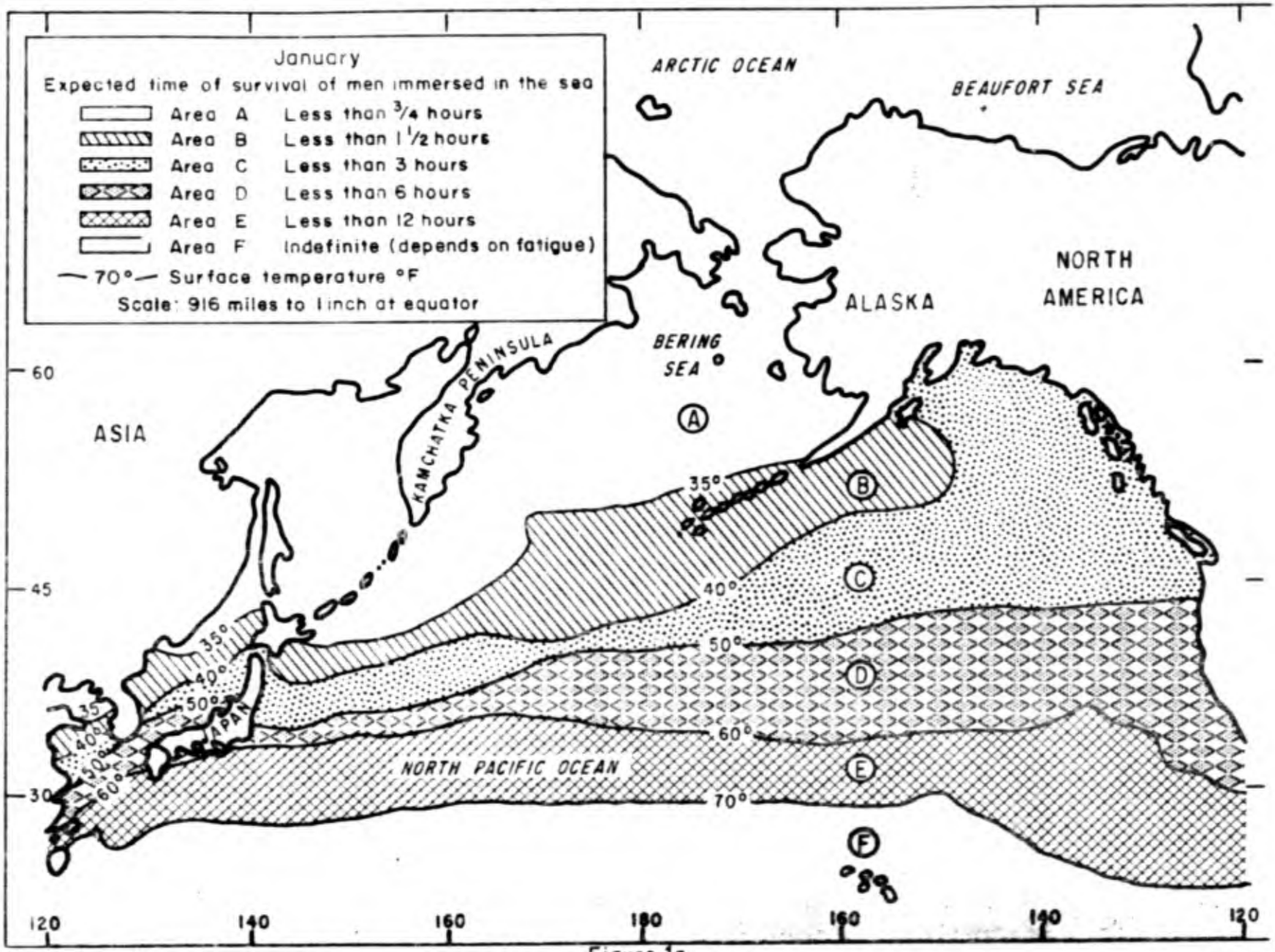
January
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
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Figure 1a

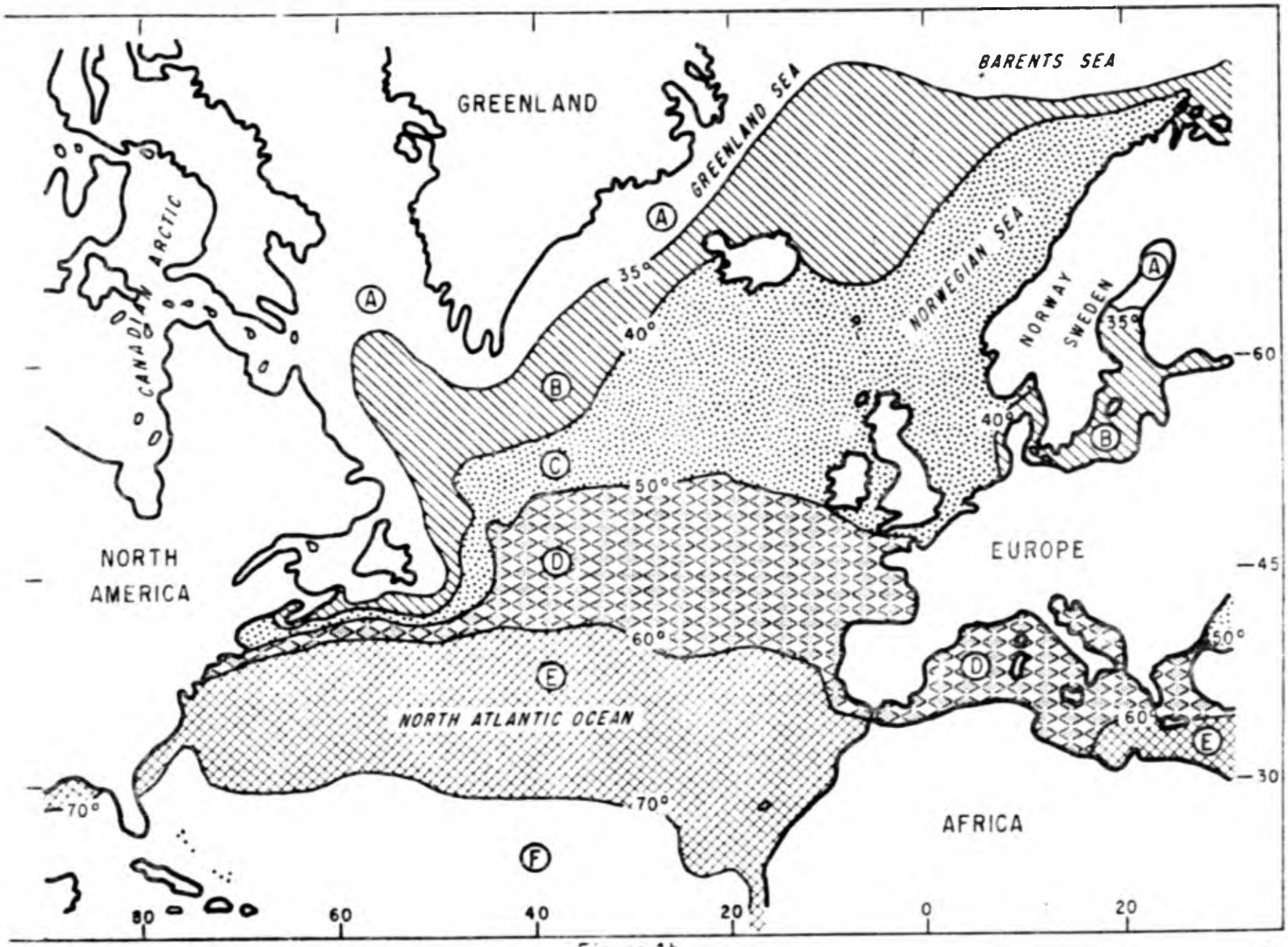
GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
CANADIAN ARCTIC
NORWAY
SWEDEN
NORTH AMERICA
EUROPE
NORTH ATLANTIC OCEAN
AFRICA
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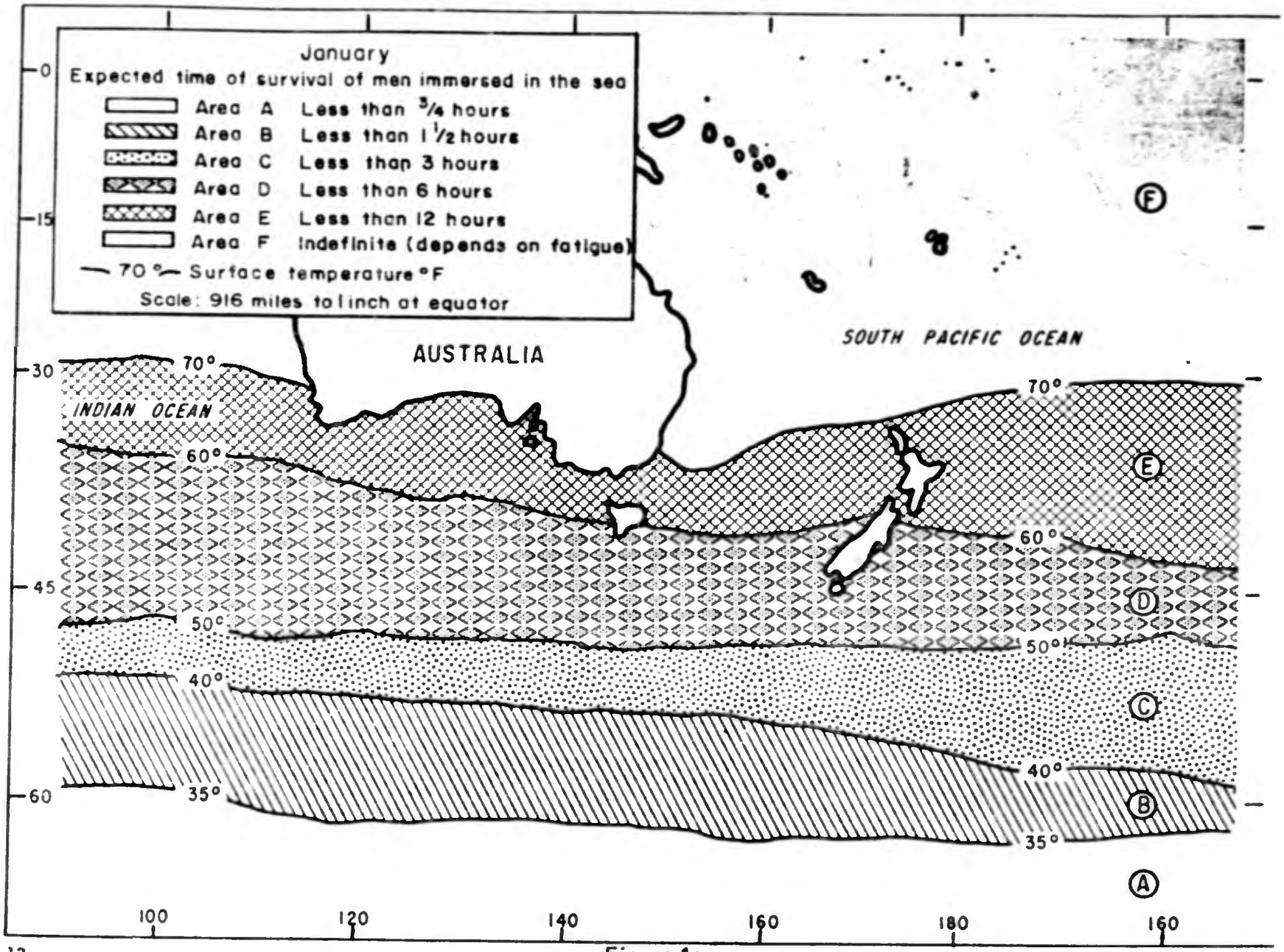
Figure 1b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70 Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
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Figure 1c

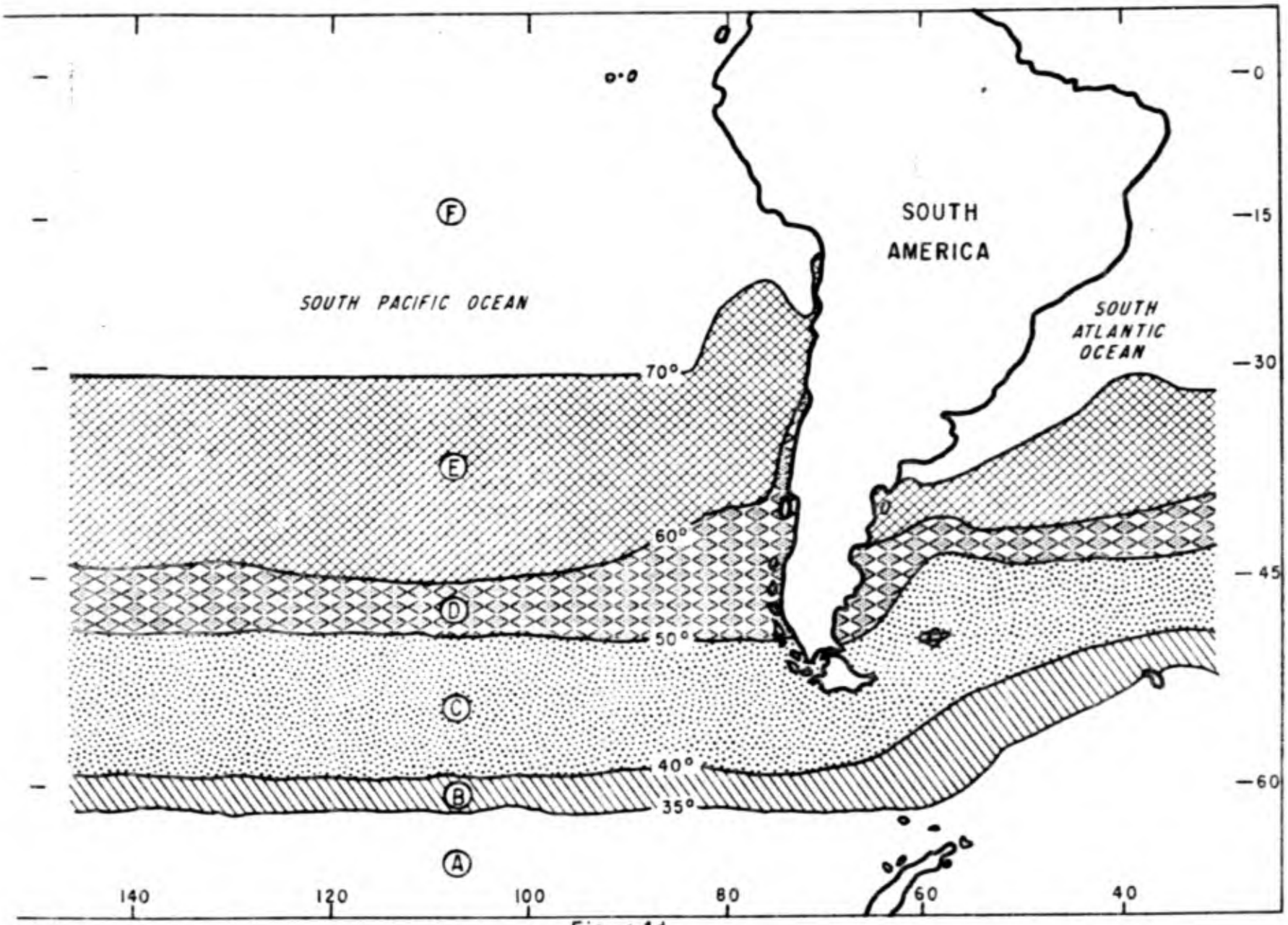
SOUTH AMERICA
SOUTH PACIFIC OCEAN
SOUTH ATLANTIC OCEAN
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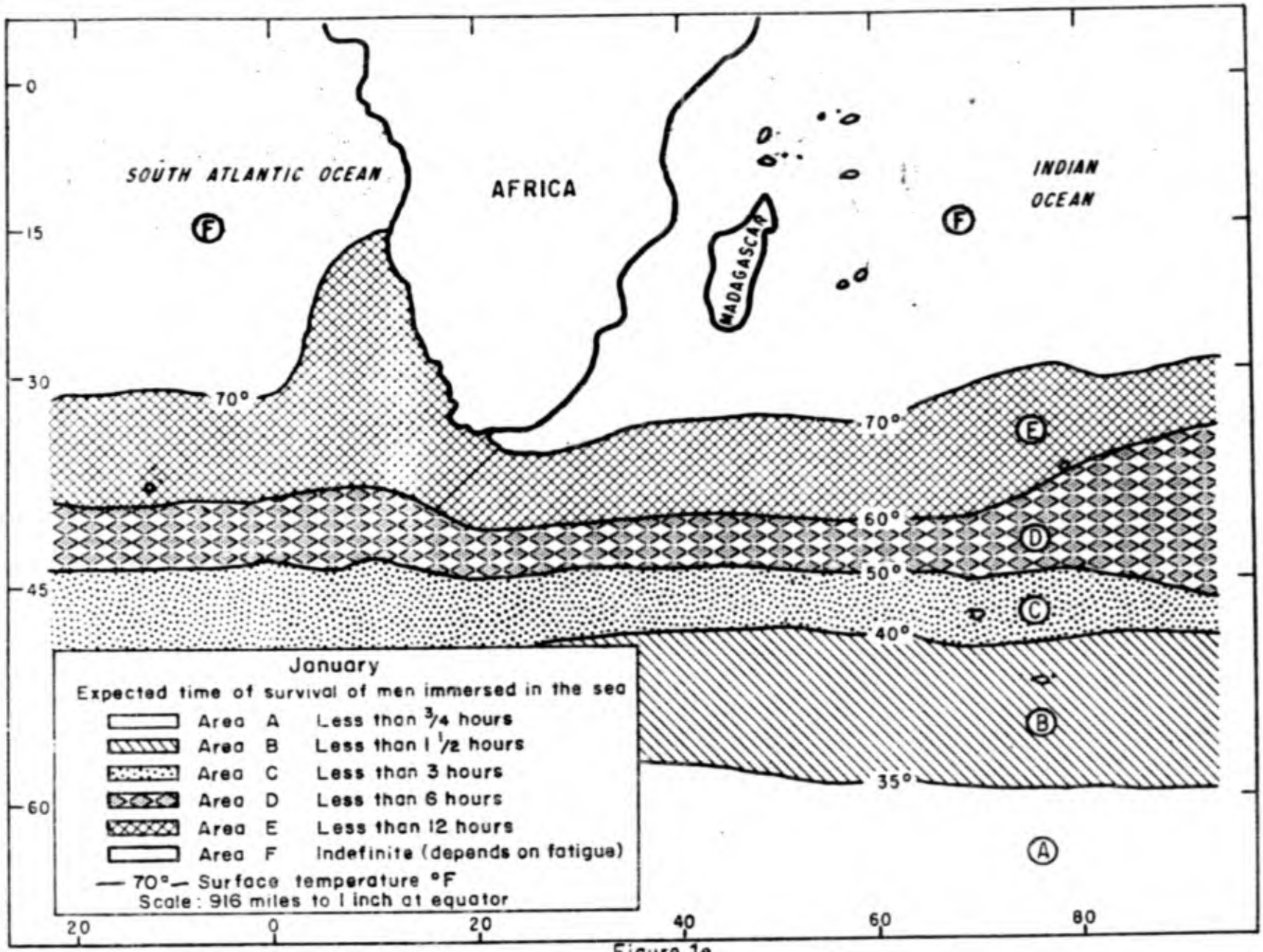
Figure 1d


SOUTH ATLANTIC OCEAN
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INDIAN OCEAN
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Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale : 916 miles to 1 inch at equator
20
0
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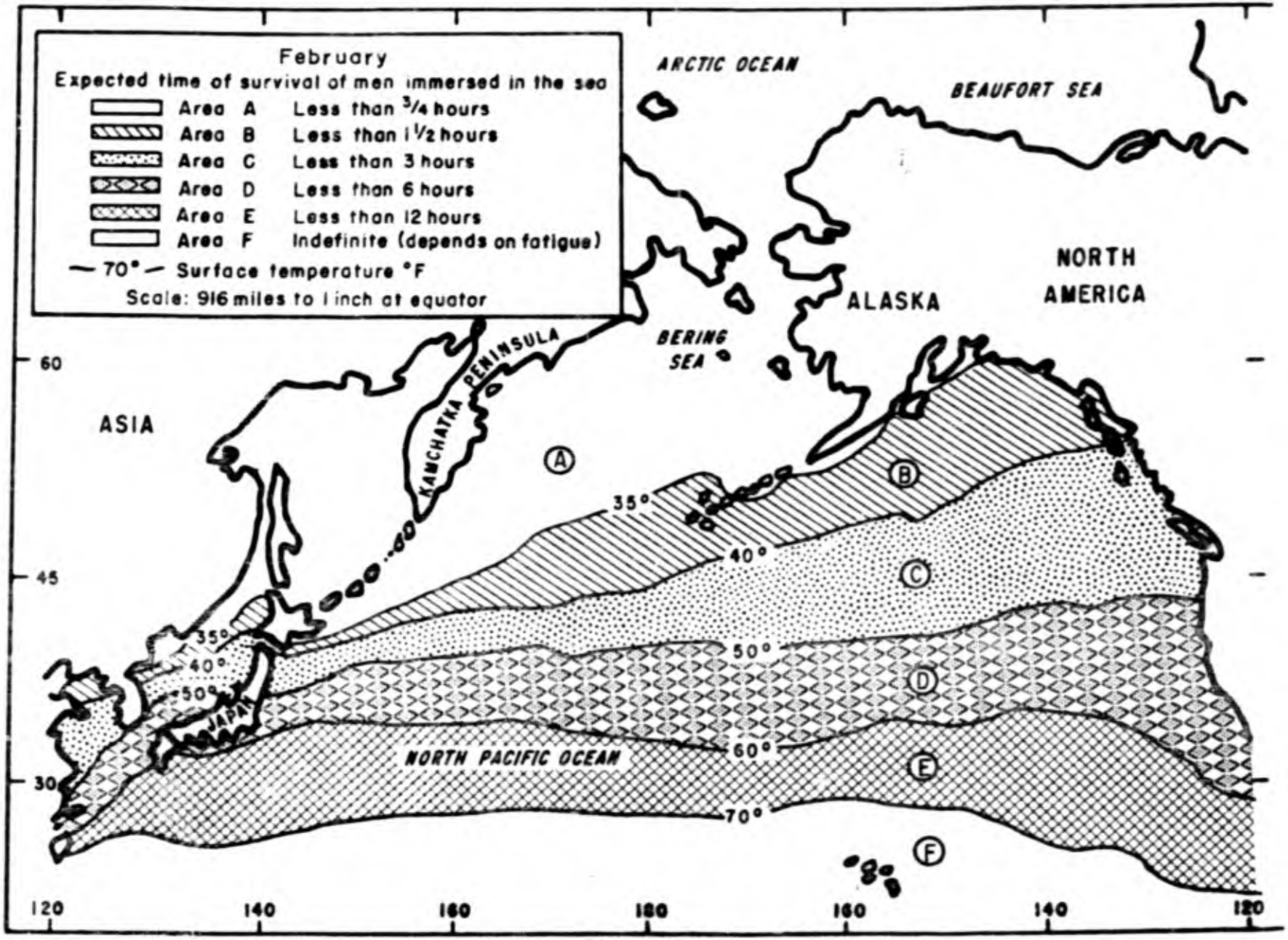
Figure 1e

FEBRUARY

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.


February
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
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BEAUFORT SEA
NORTH AMERICA
ALASKA
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JAPAN
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35°
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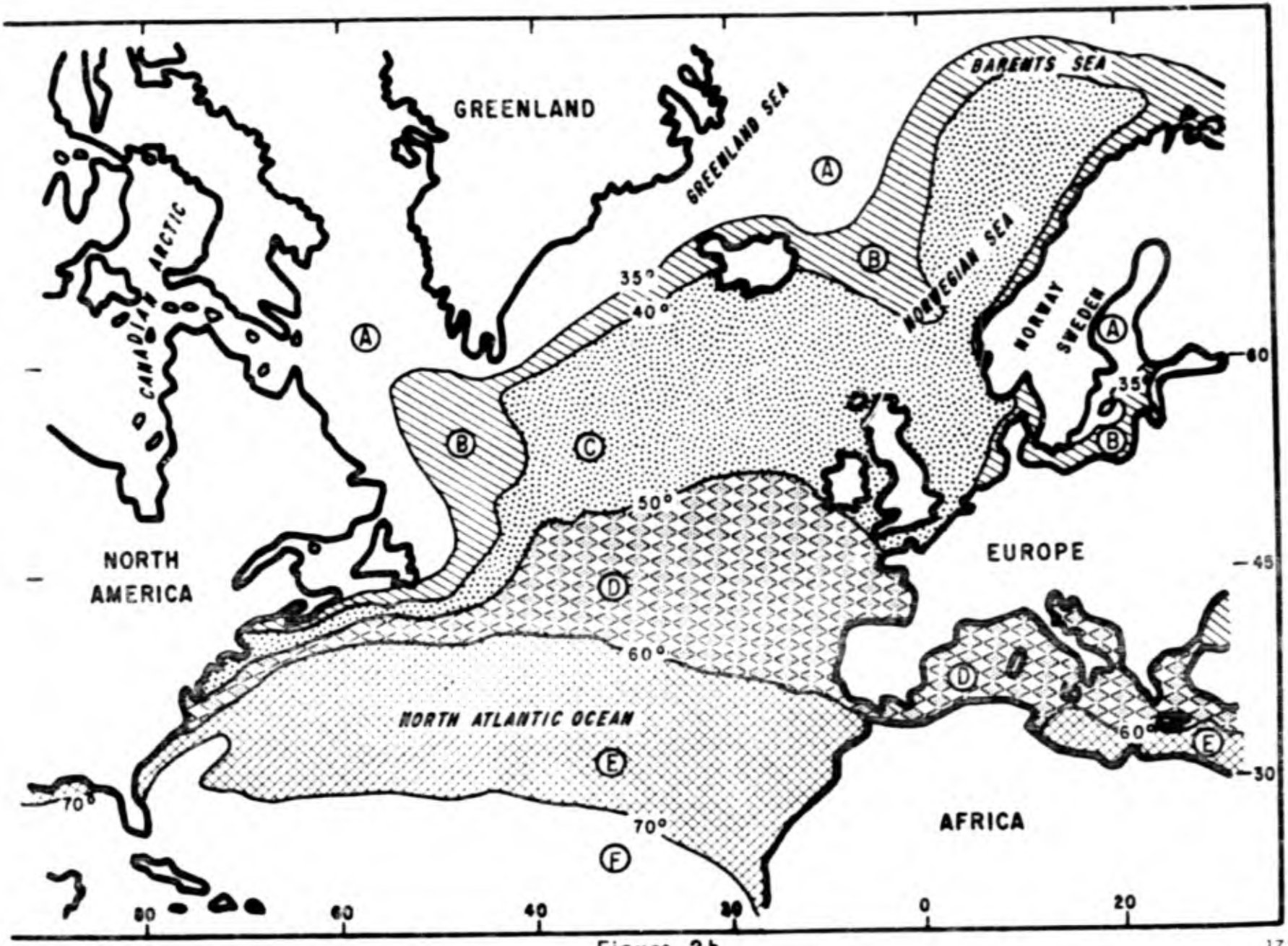
Figure 2a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GREENLAND SEA
BARENTS SEA
CANADIAN ARCTIC
NORWEGIAN SEA
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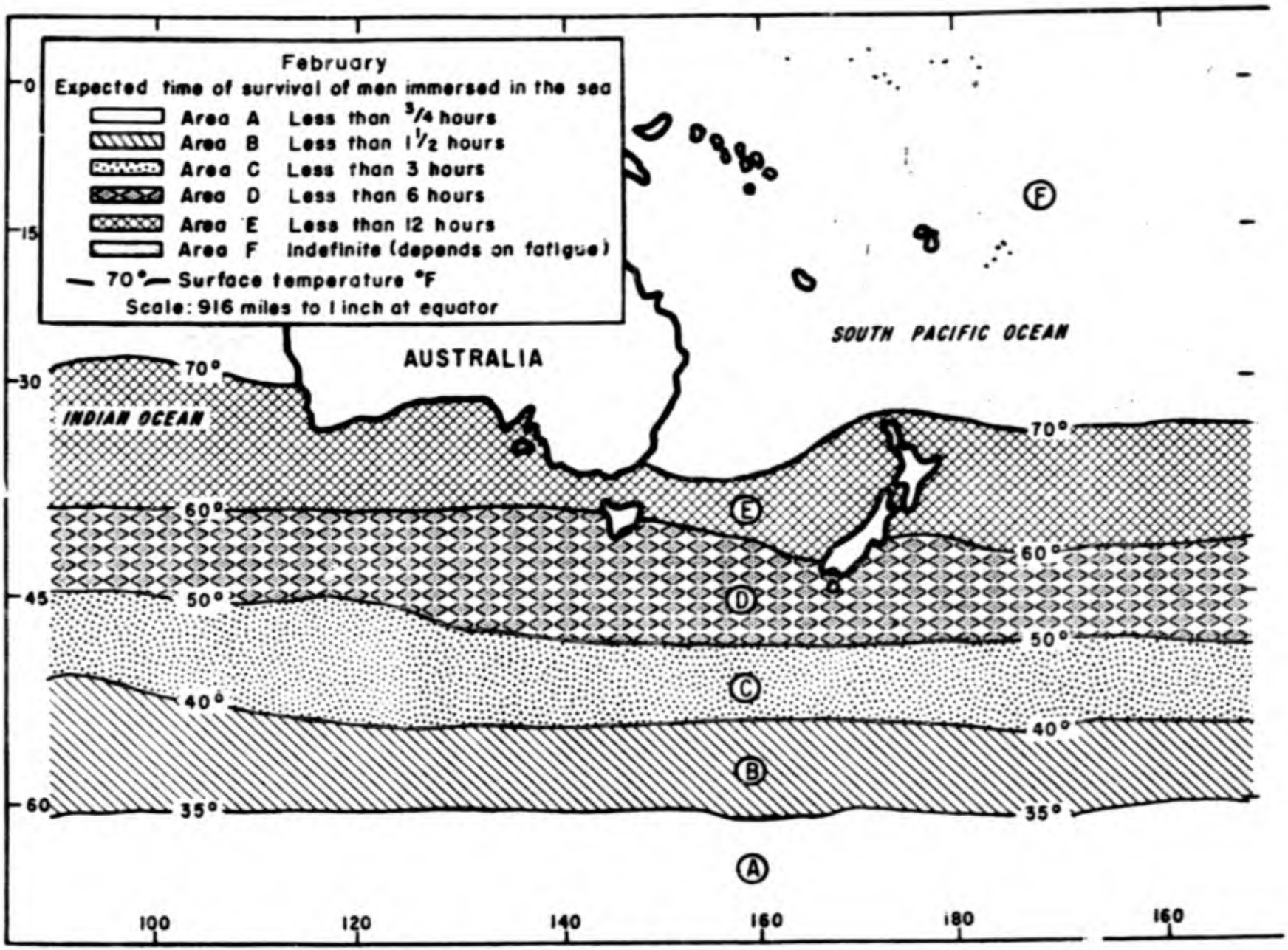
Figure 2b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70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
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SOUTH PACIFIC OCEAN
INDIAN OCEAN
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Figure 2c

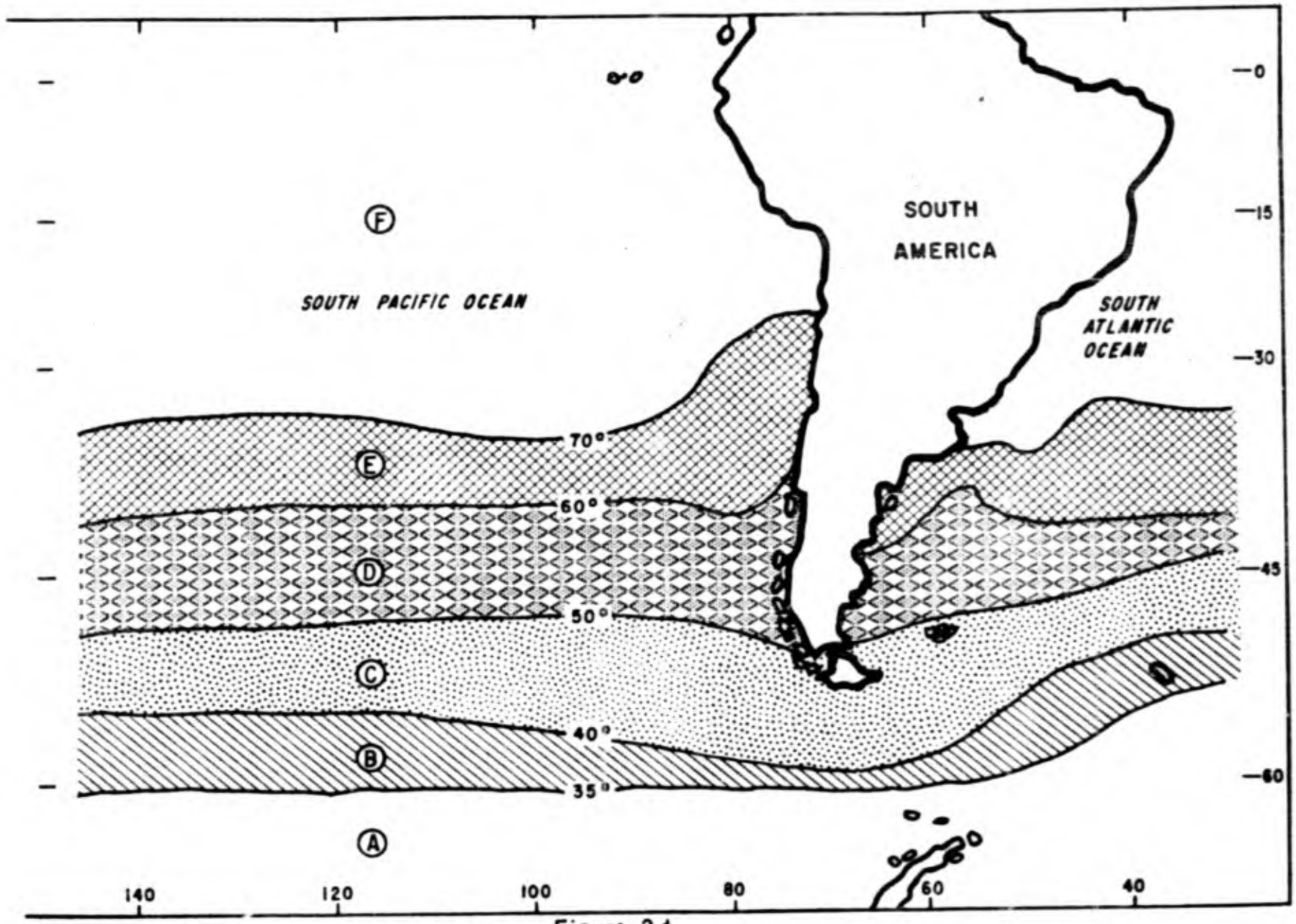
SOUTH
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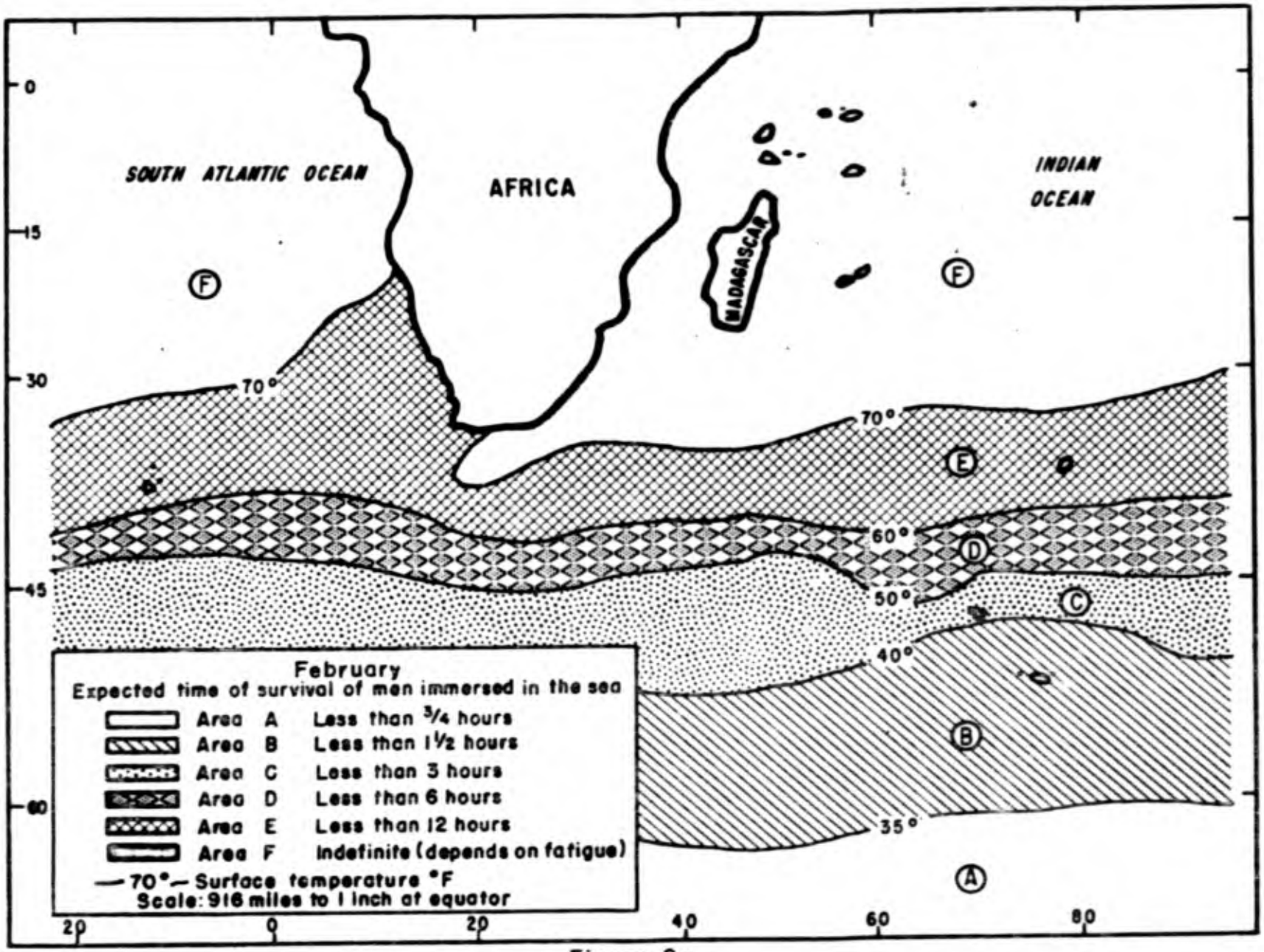
Figure 2d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— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
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Figure 2e

MARCH

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

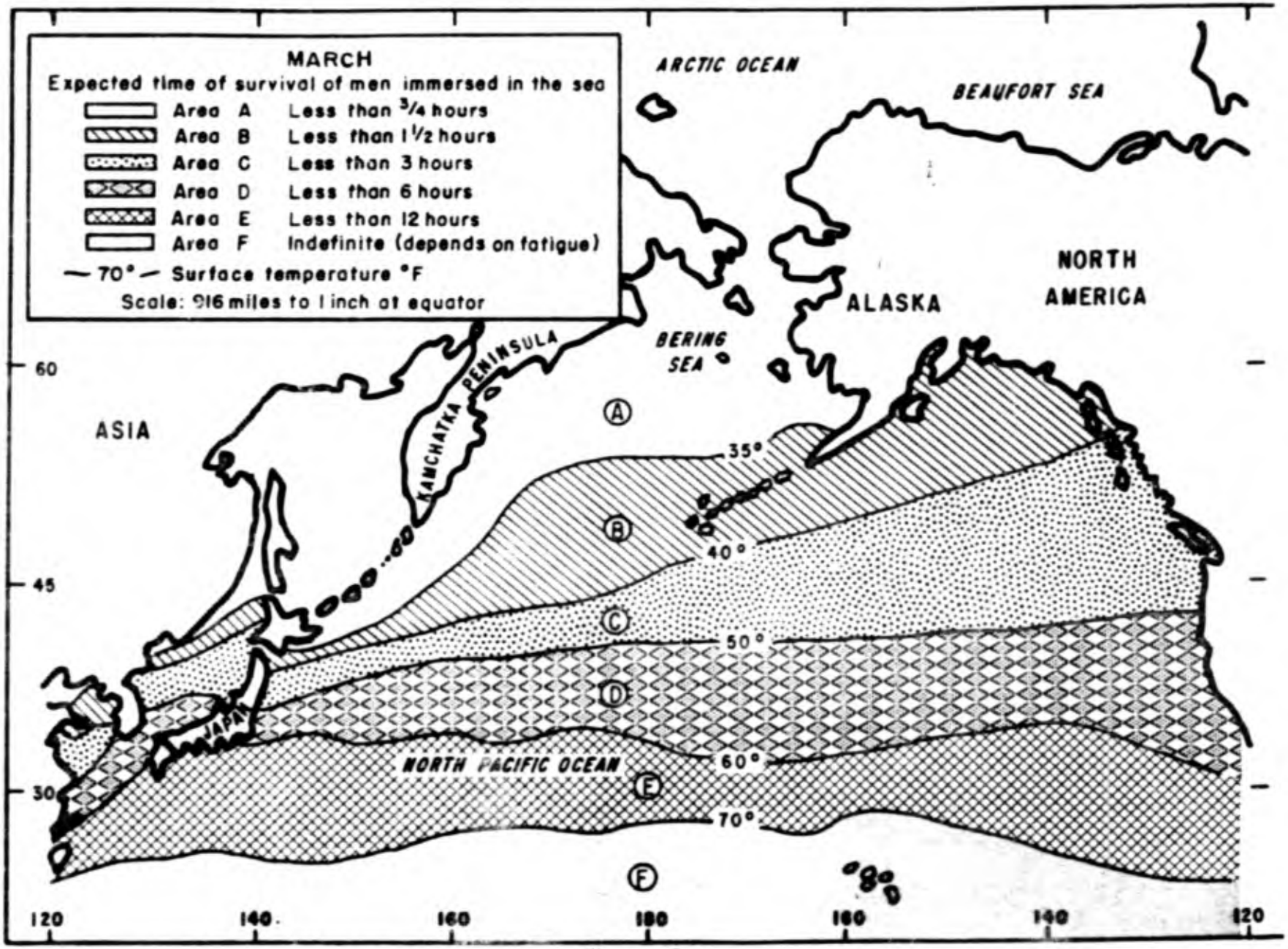
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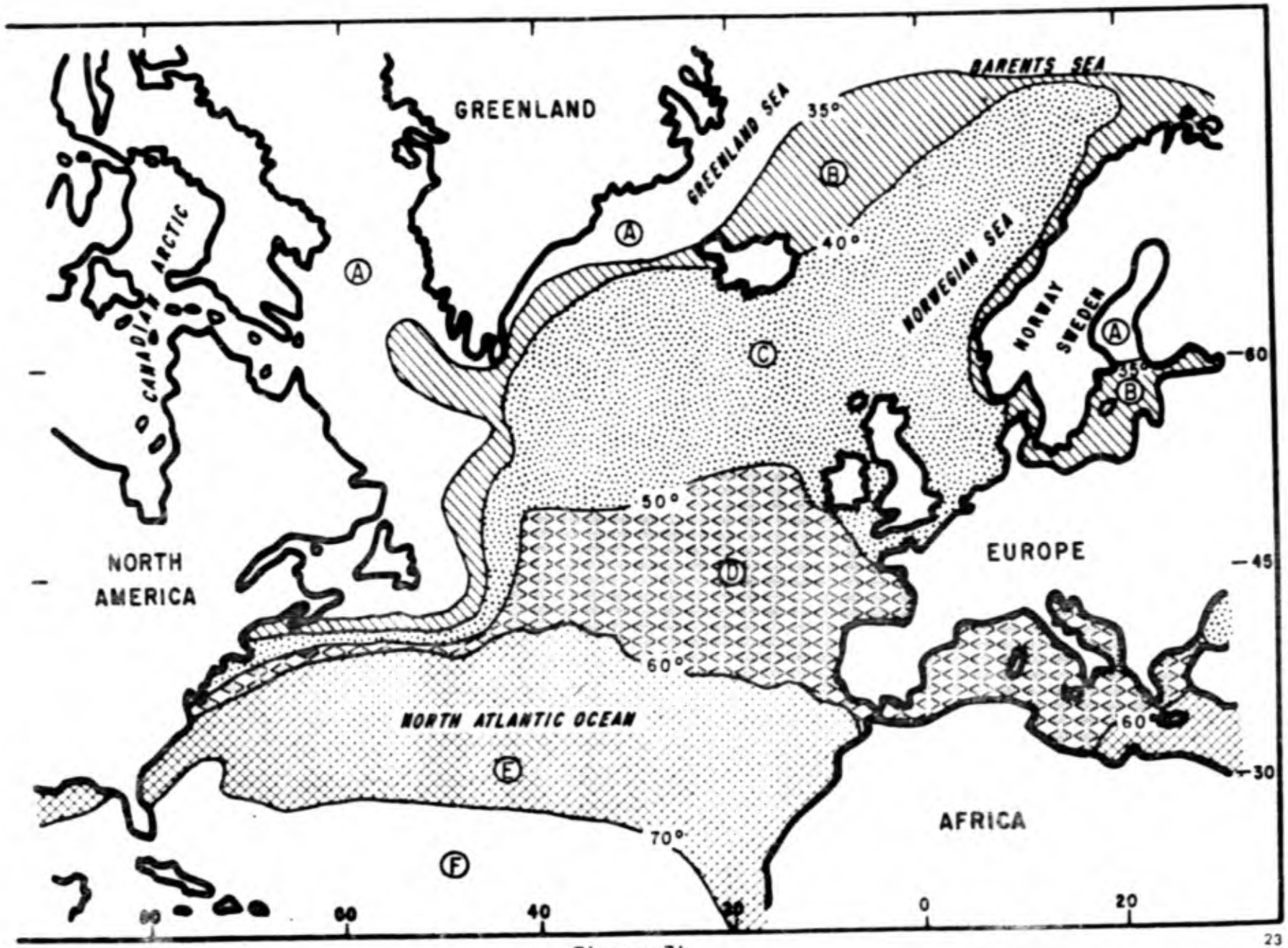
Figure 3a


GREENLAND
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BARENTS SEA
CANADIAN ARCTIC
NORWEGIAN SEA
NORWAY
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NORTH AMERICA
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NORTH ATLANTIC OCEAN
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Figure 3b

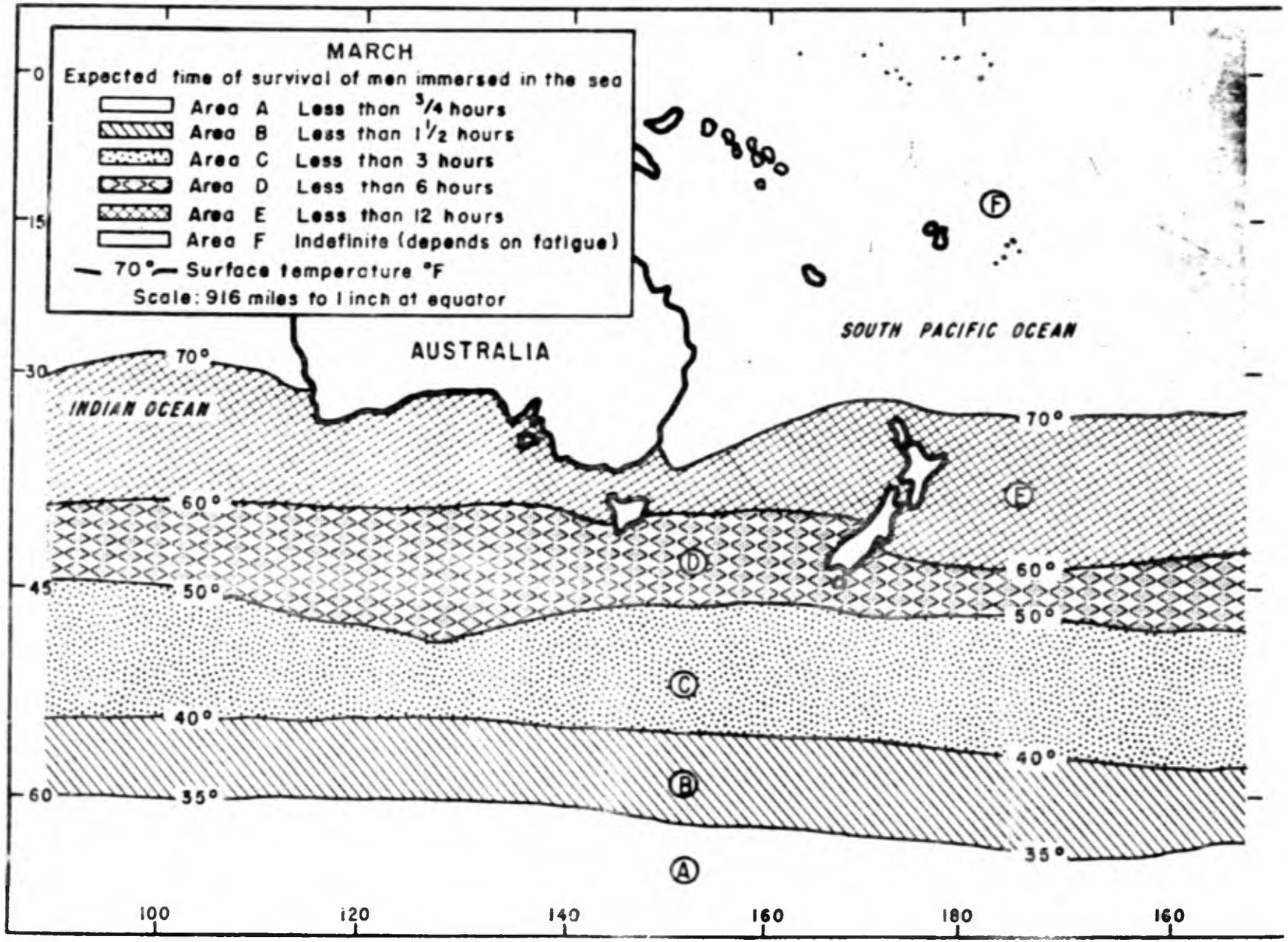
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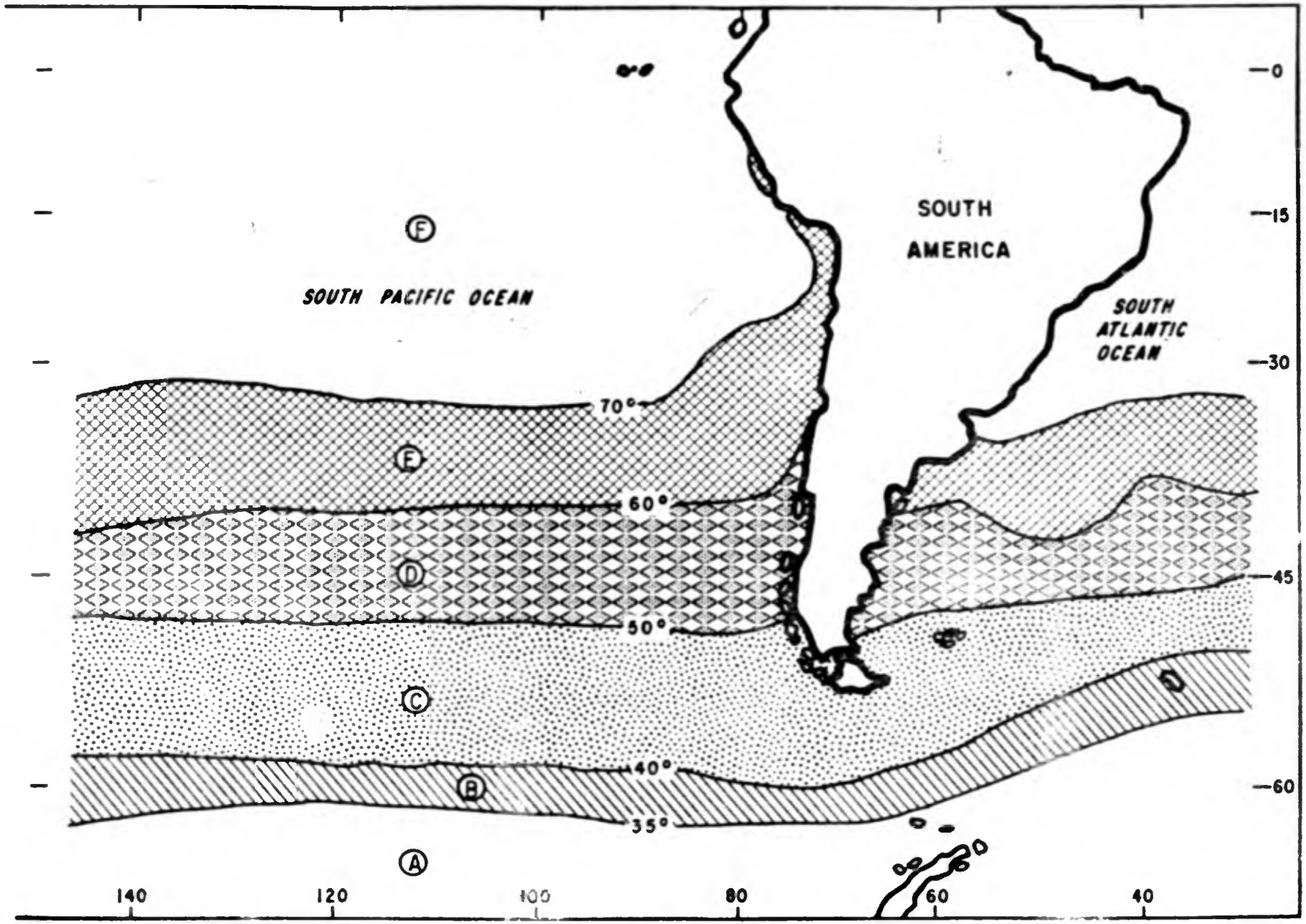
Figure 3c


SOUTH
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60°
50°
40°
35°
0
15
30
45
60
140
120
100
80
60
40

Figure 3d

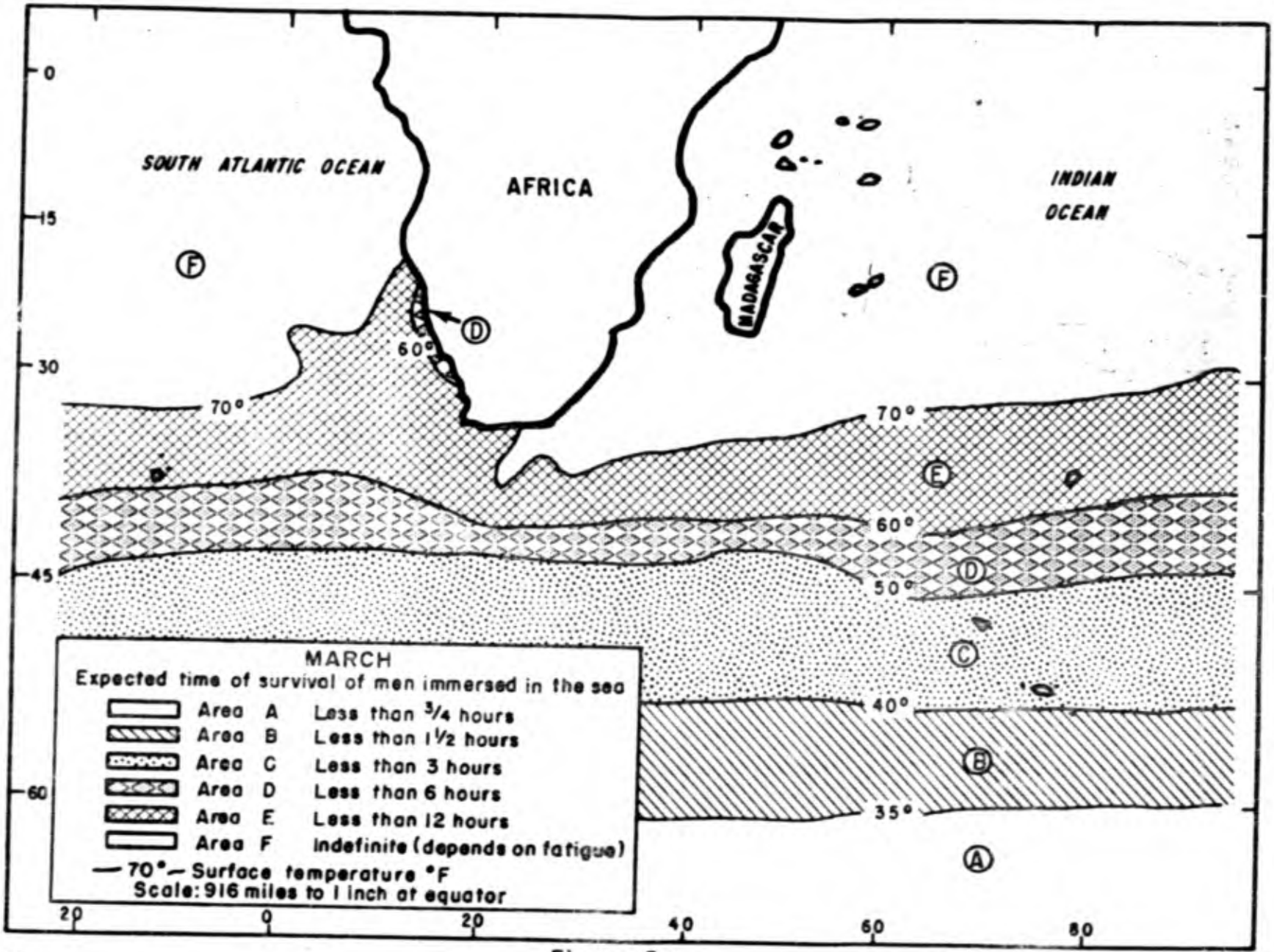

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
0
15
30
45
60
70°
60°
50°
40°
35°
F
D
E
C
B
A
MARCH
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 3e

APRIL

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

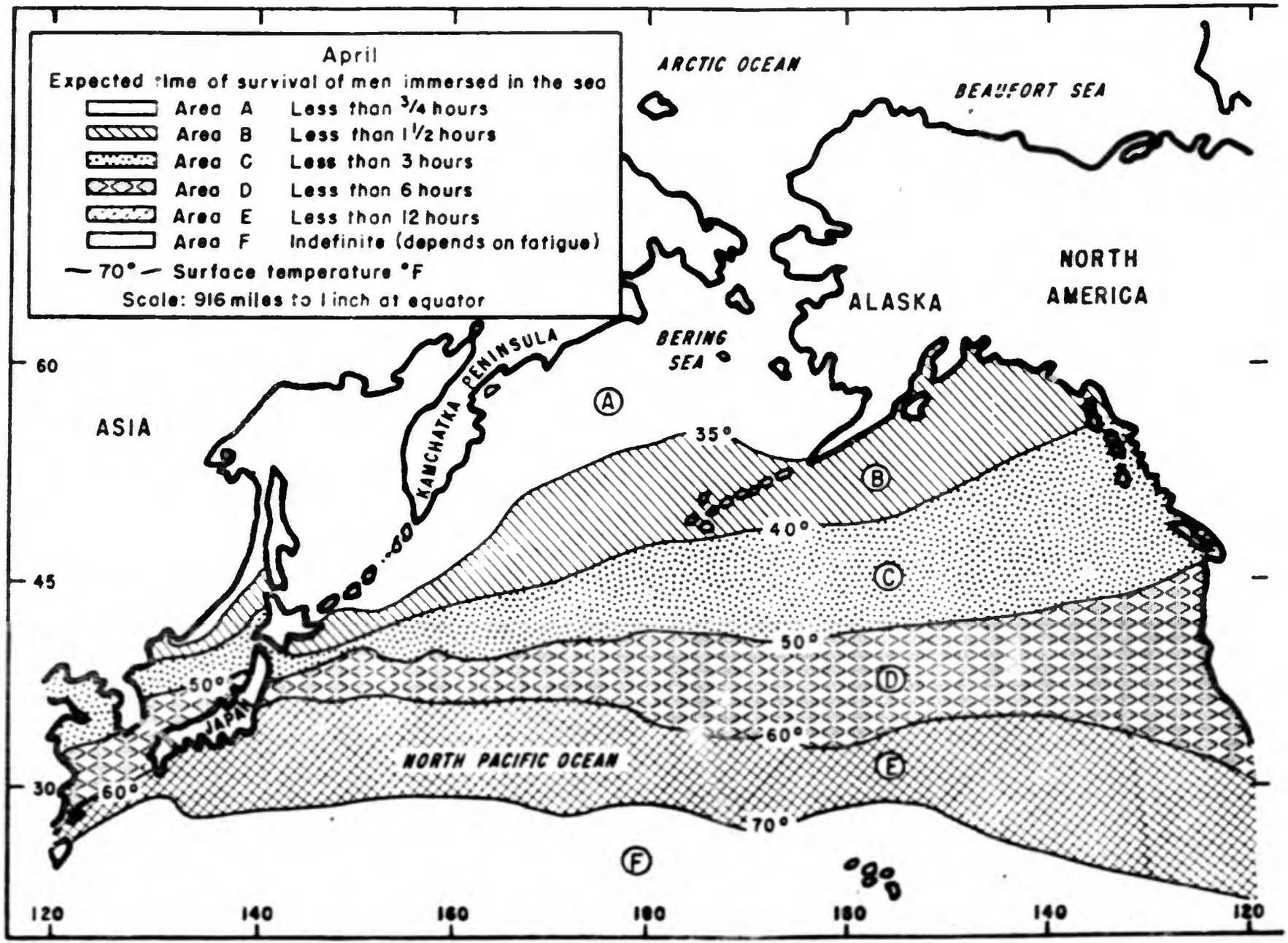

April
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
50°
60°
60°
70°
A
B
C
D
E
F
F
60
45
30
120
140
160
180
180
140
120

Figure 4a

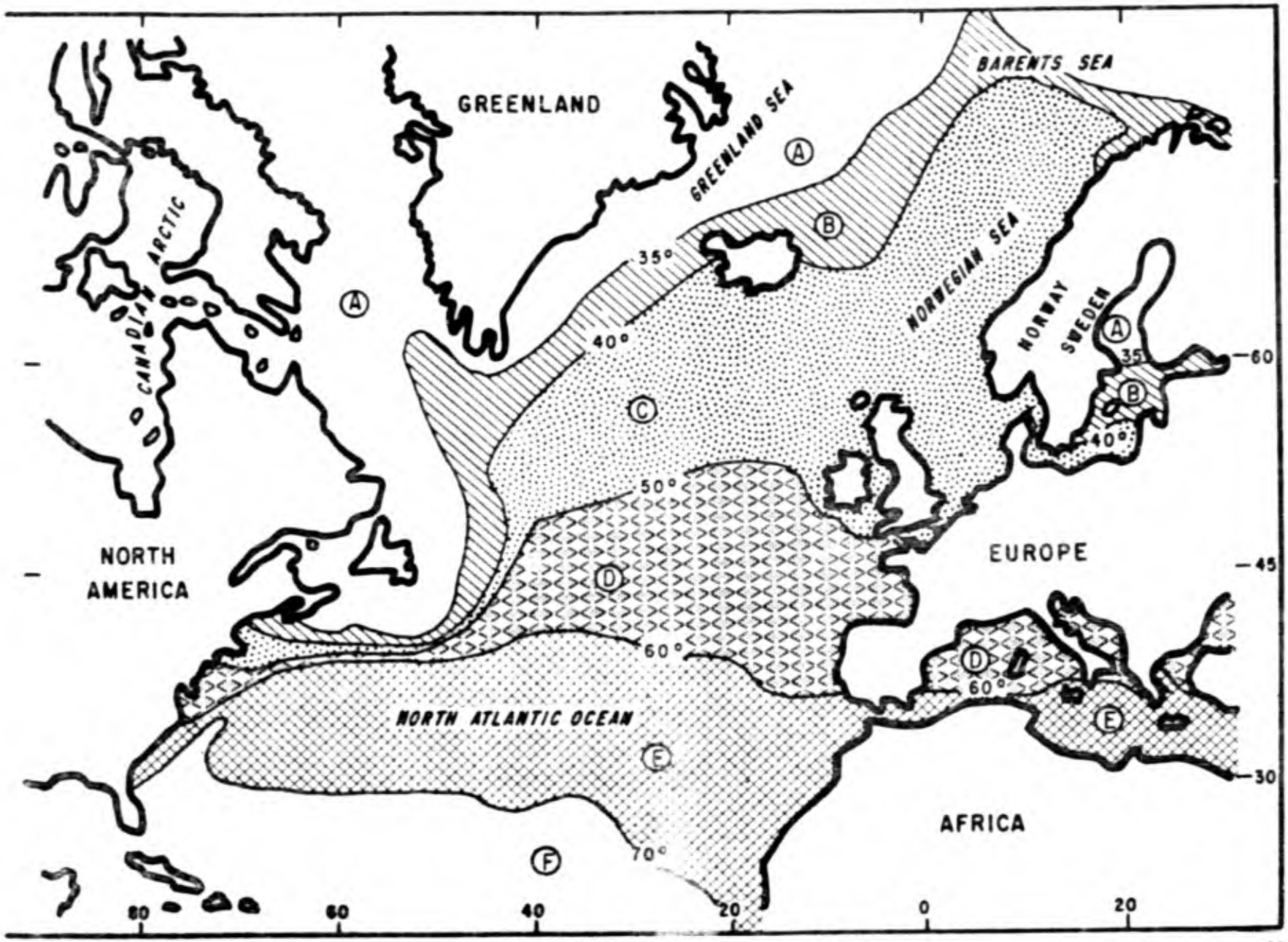

GREENLAND
GREENLAND SEA
BARENTS SEA
CANADIAN ARCTIC
NORWEGIAN SEA
NORWAY
SWEDEN
NORTH AMERICA
EUROPE
NORTH ATLANTIC OCEAN
AFRICA
A
B
C
D
E
F
35°
40°
50°
60°
70°
80
60
40
20
0
20
60
45
30

Figure 15

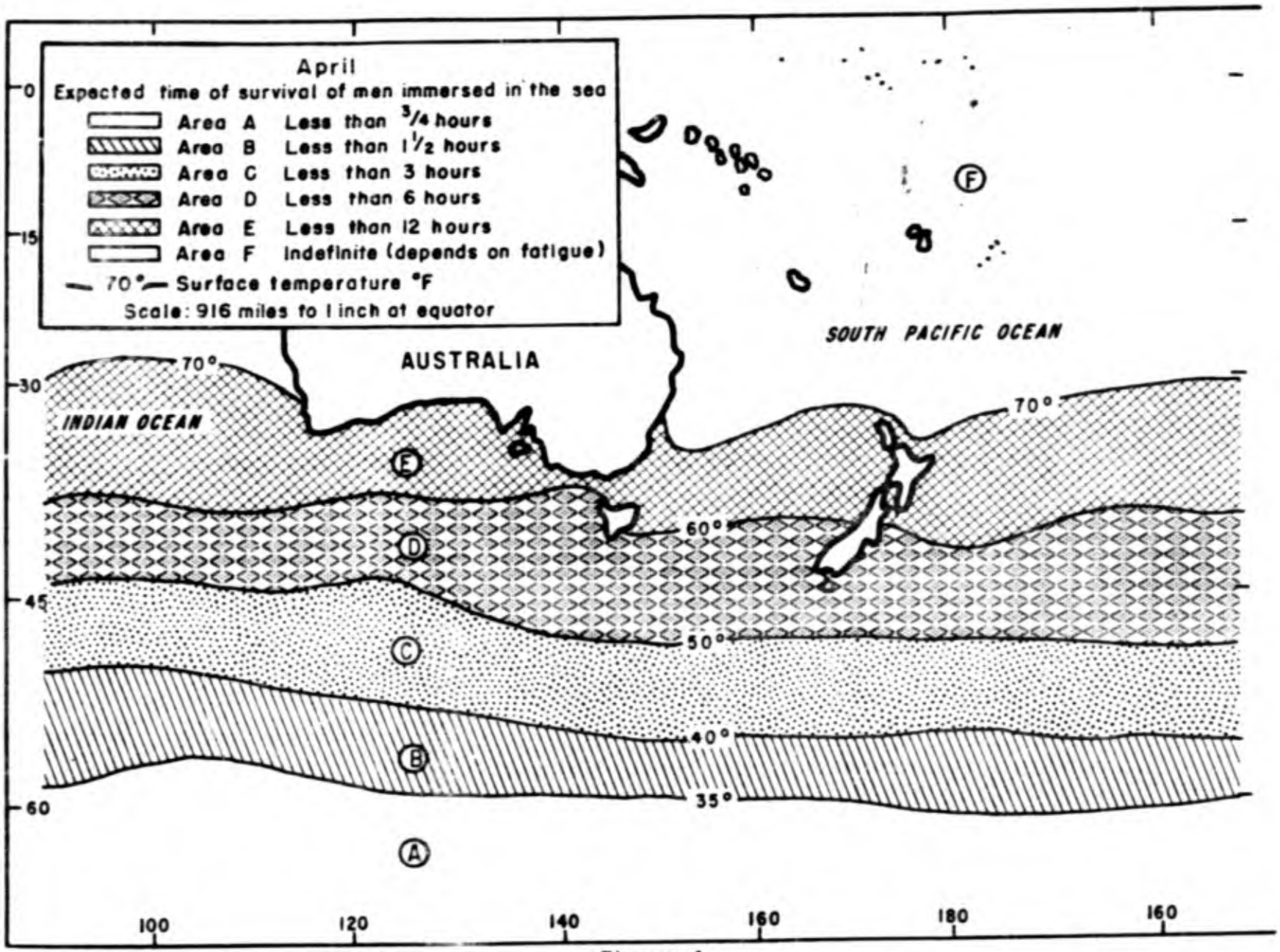

April
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
0
15
30
45
60
100
120
140
160
180
160
F
D
C
B
A

Figure 4c

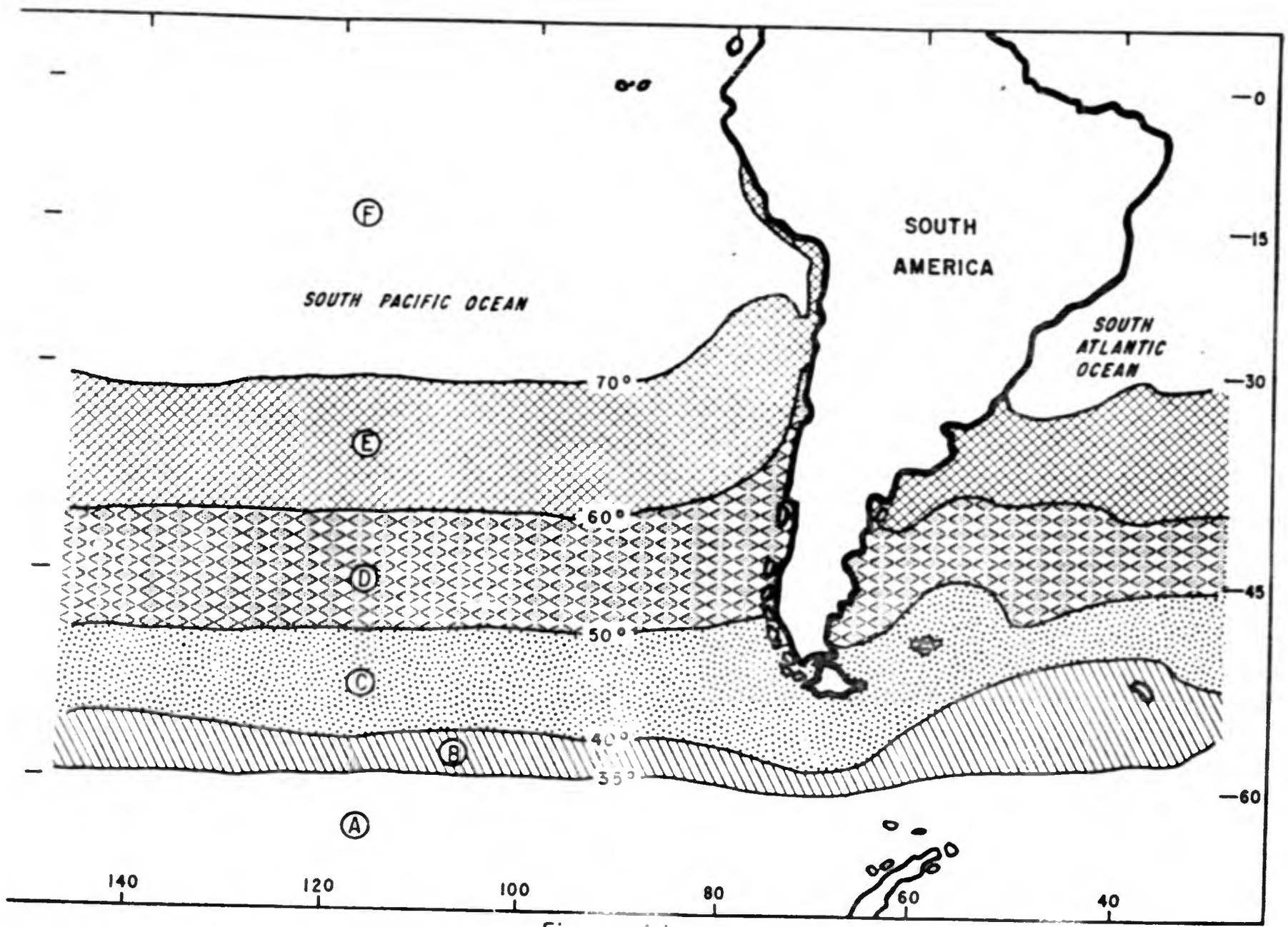

SOUTH PACIFIC OCEAN
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 4d

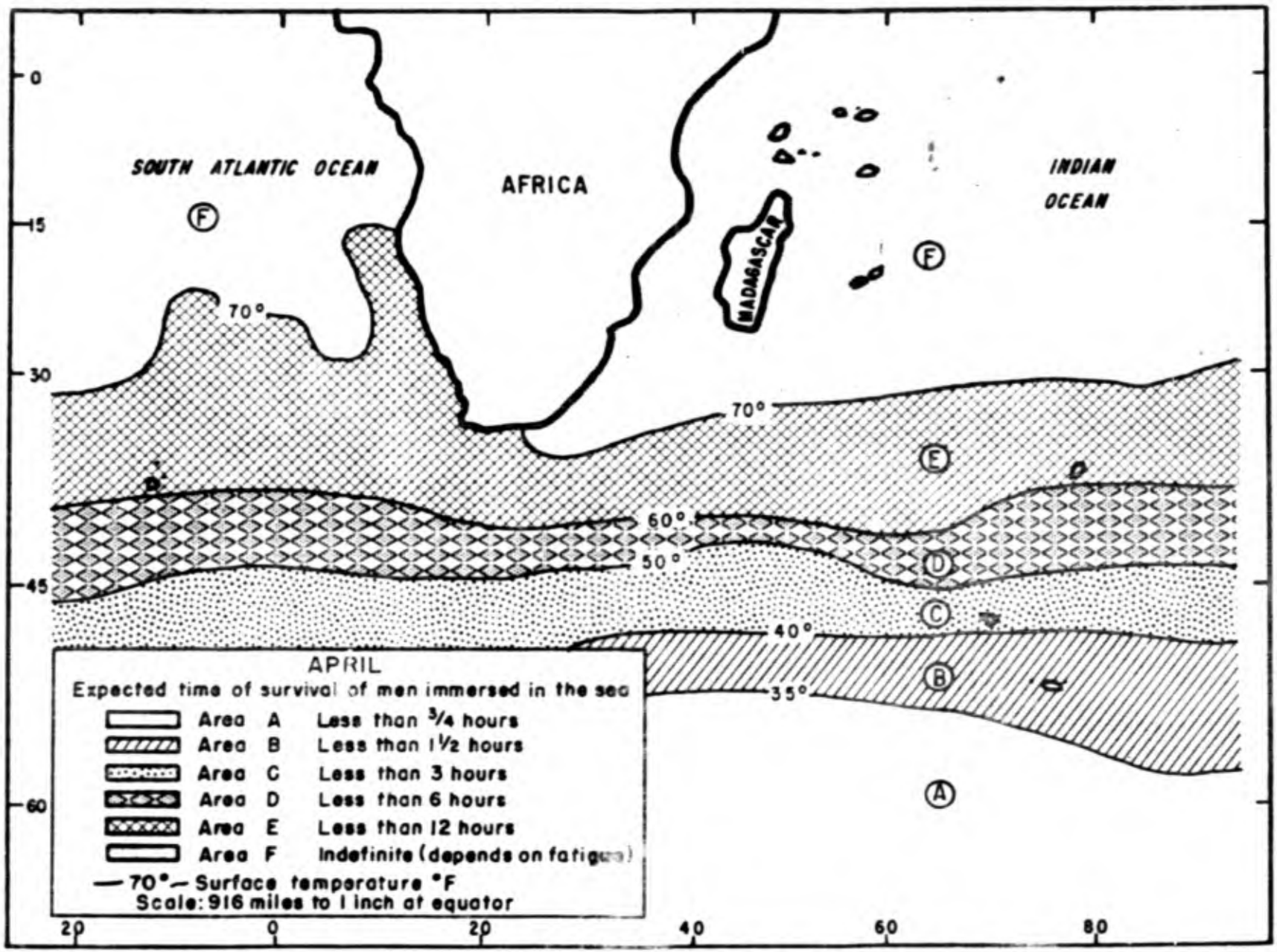

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
0
15
30
45
60
70°
70°
60°
50°
40°
35°
F
F
E
D
C
B
A
APRIL
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 4c

MAY

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

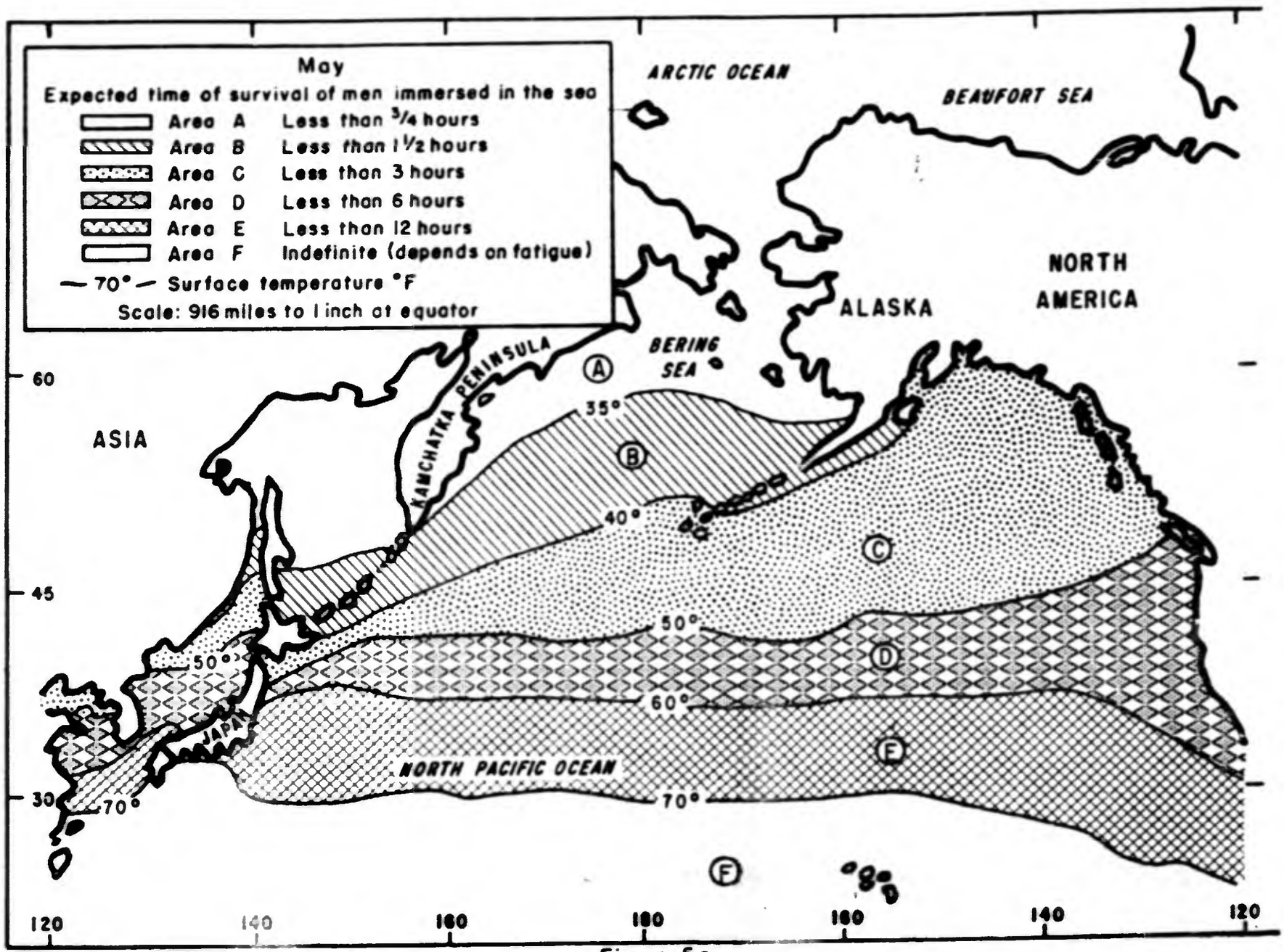

May
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
70°
50°
70°
A
B
C
D
E
F
F
60
45
30
120
140
160
180
160
140
120

Figure 5a

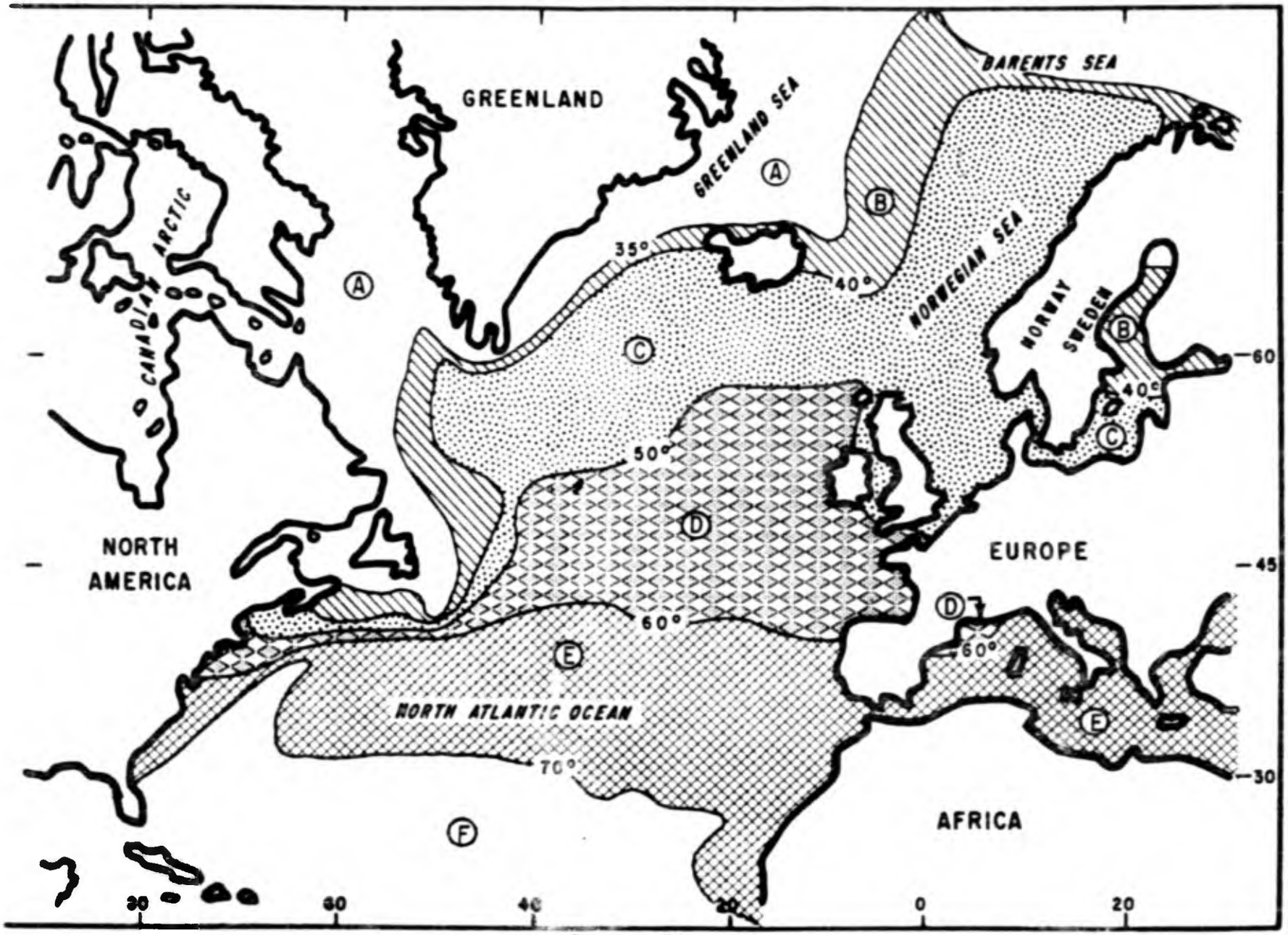

GREENLAND
GREENLAND SEA
BARENTS SEA
CANADIAN ARCTIC
NORWEGIAN SEA
NORWAY
SWEDEN
NORTH AMERICA
EUROPE
AFRICA
NORTH ATLANTIC OCEAN
35°
40°
50°
60°
70°
A
B
C
D
E
F
60
45
30
80
60
40
20
0
20

Figure 5b

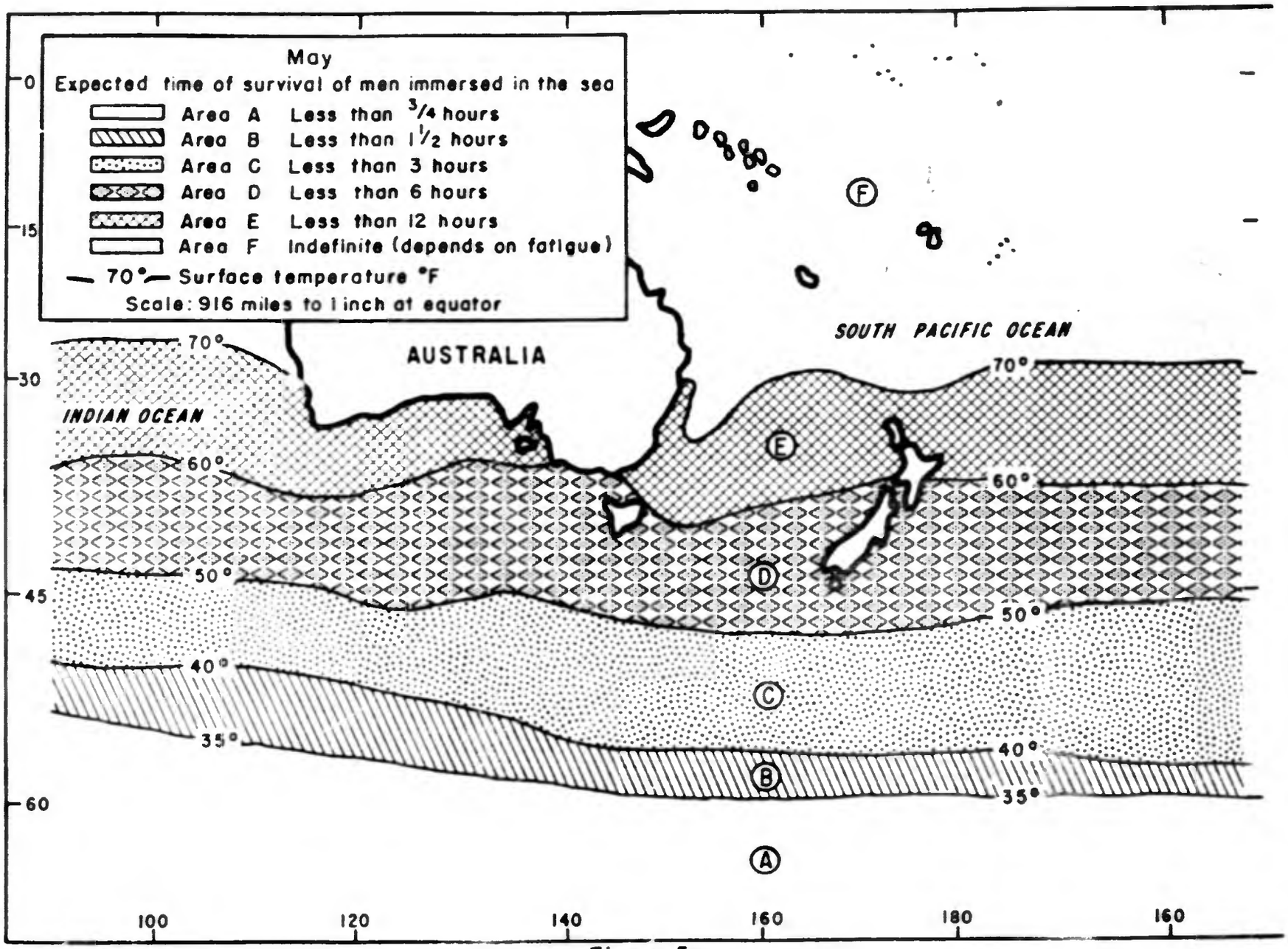

May
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
100
120
140
160
180
160

Figure 5c

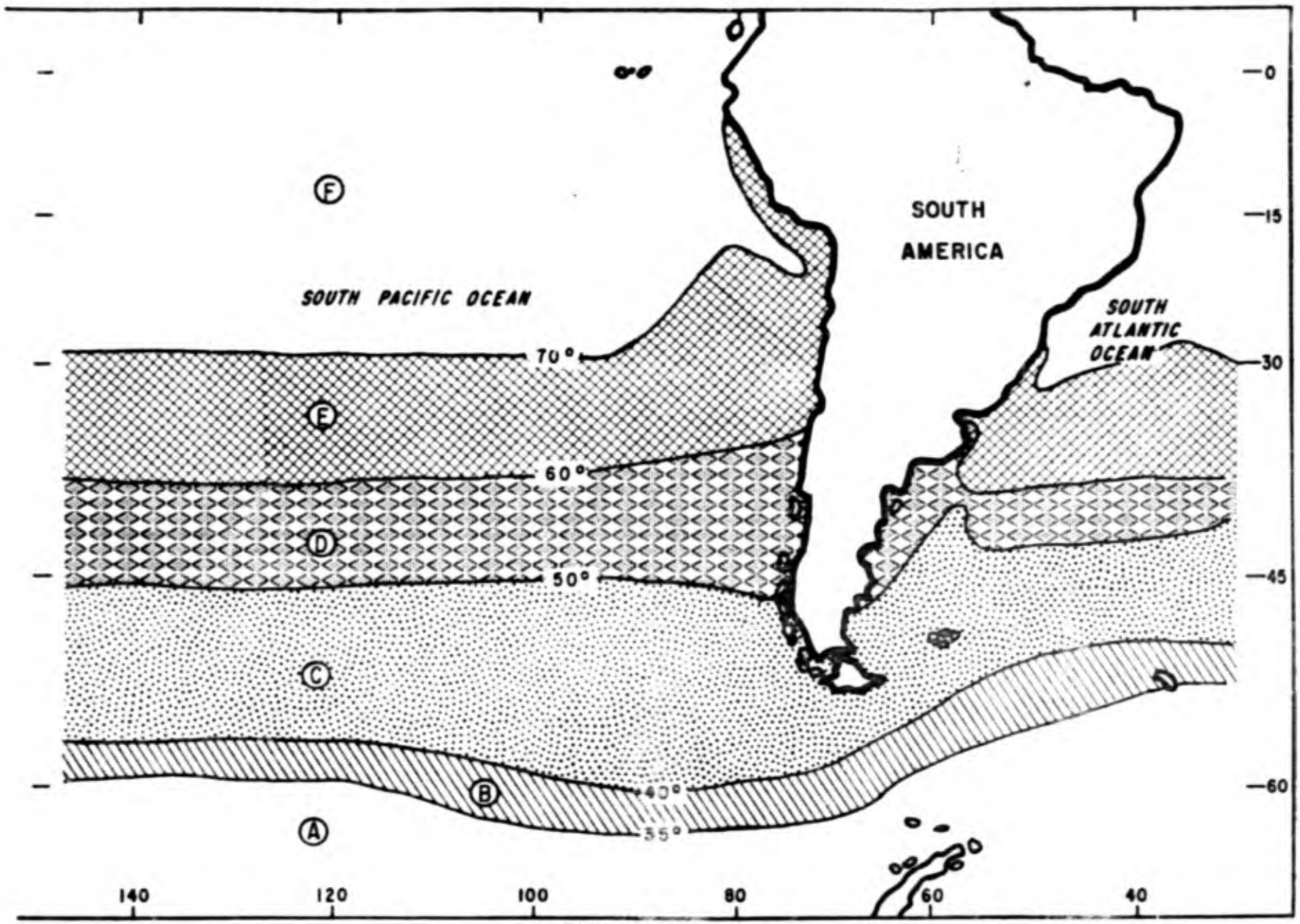

SOUTH
AMERICA
SOUTH PACIFIC OCEAN
SOUTH
ATLANTIC
OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 5d

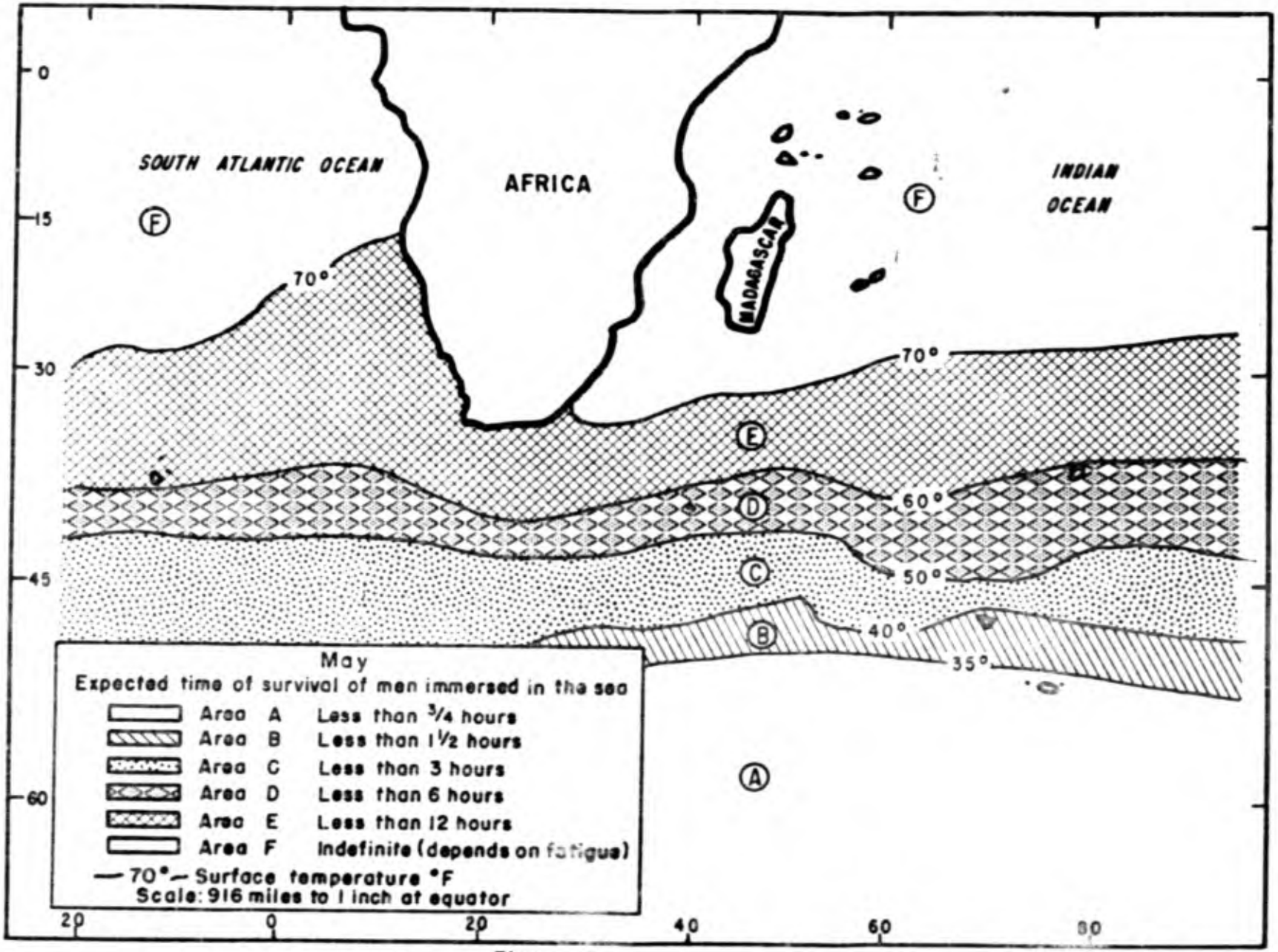

SOUTH ATLANTIC OCEAN
AFRICA
MADAGASCAR
INDIAN OCEAN
0
15
30
45
60
70°
70°
60°
50°
40°
35°
F
F
E
D
C
B
A
May
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 5e

JUNE

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

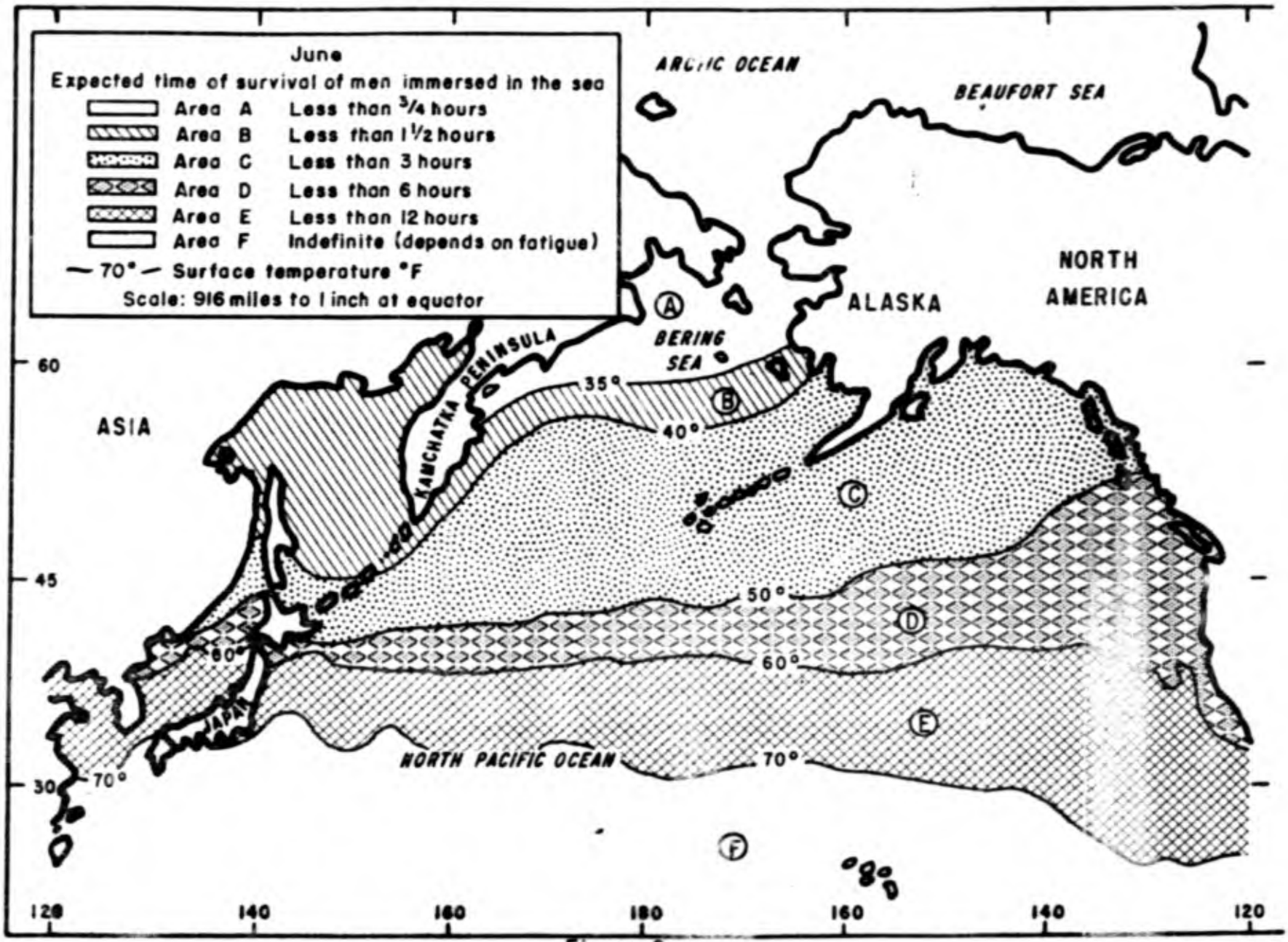

June
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
70°
60
45
30
120
140
160
180
160
140
120

Figure 6a

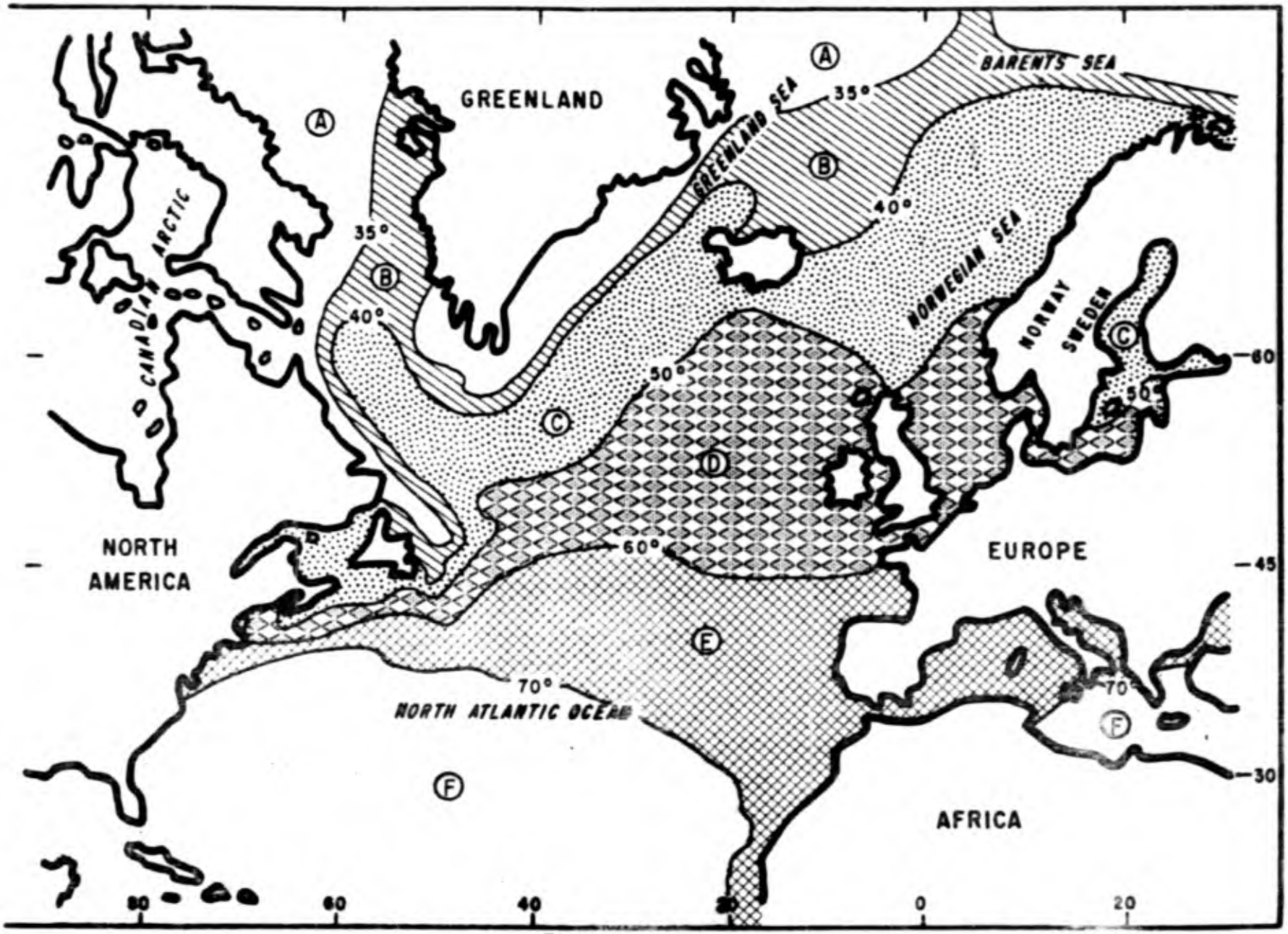

GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
CANADIAN ARCTIC
NORWAY
SWEDEN
NORTH AMERICA
EUROPE
AFRICA
NORTH ATLANTIC OCEAN
35°
40°
50°
60°
70°
A
B
C
D
E
F
80
60
40
20
0
20
60
45
30

Figure 6b

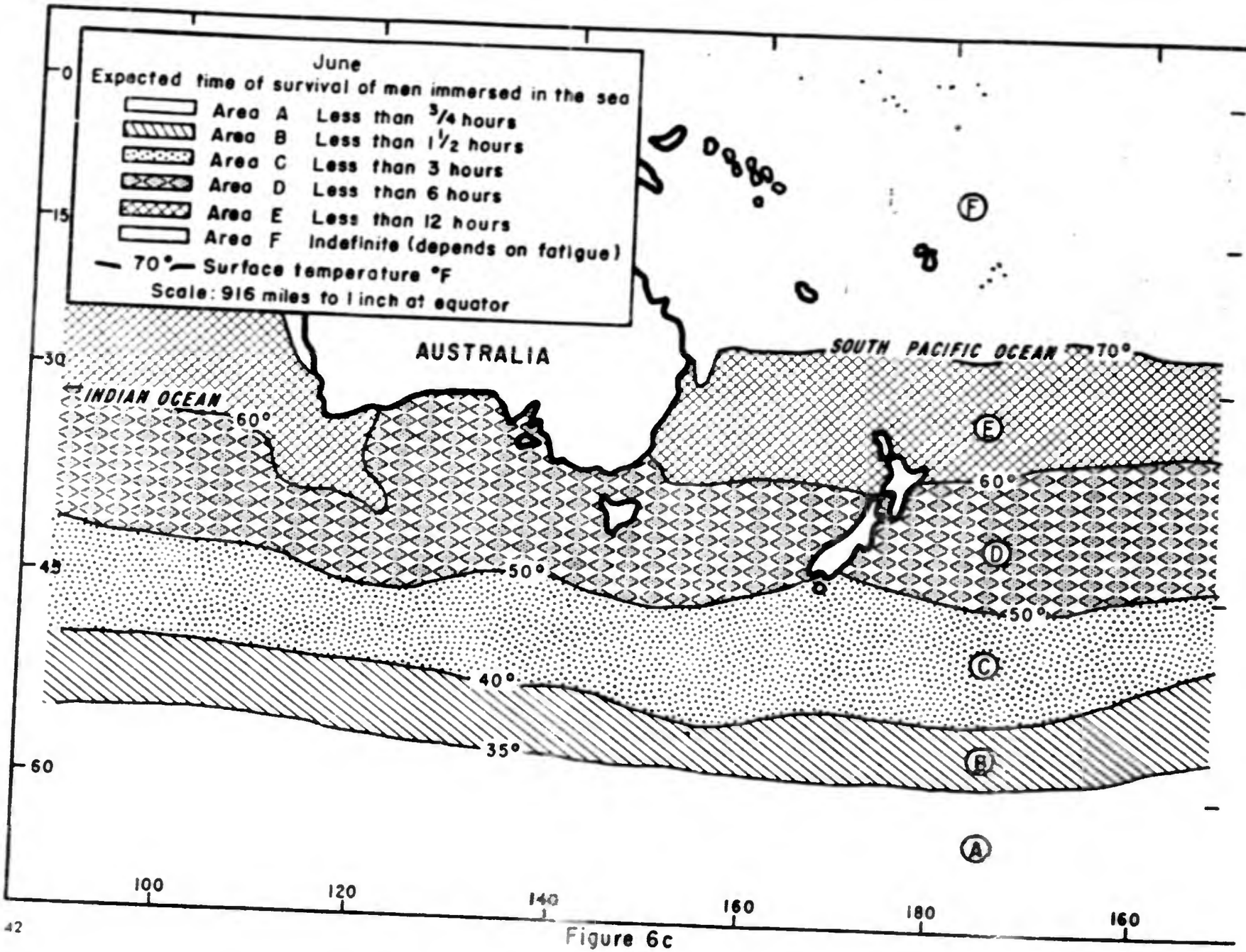

June
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
0
15
30
45
60
100
120
140
160
180
160
F
E
D
C
B
A

Figure 6c

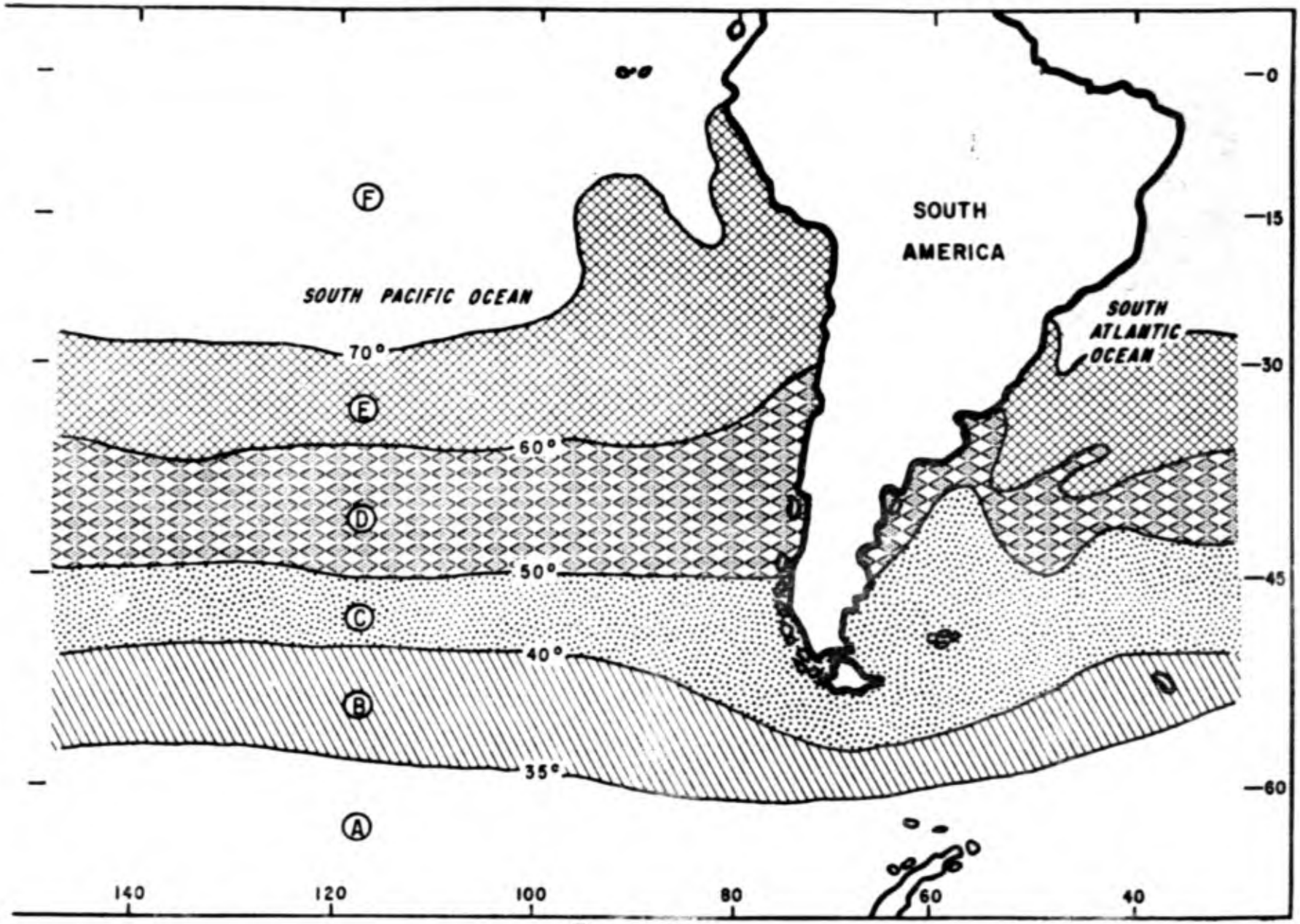

SOUTH PACIFIC OCEAN
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 6d

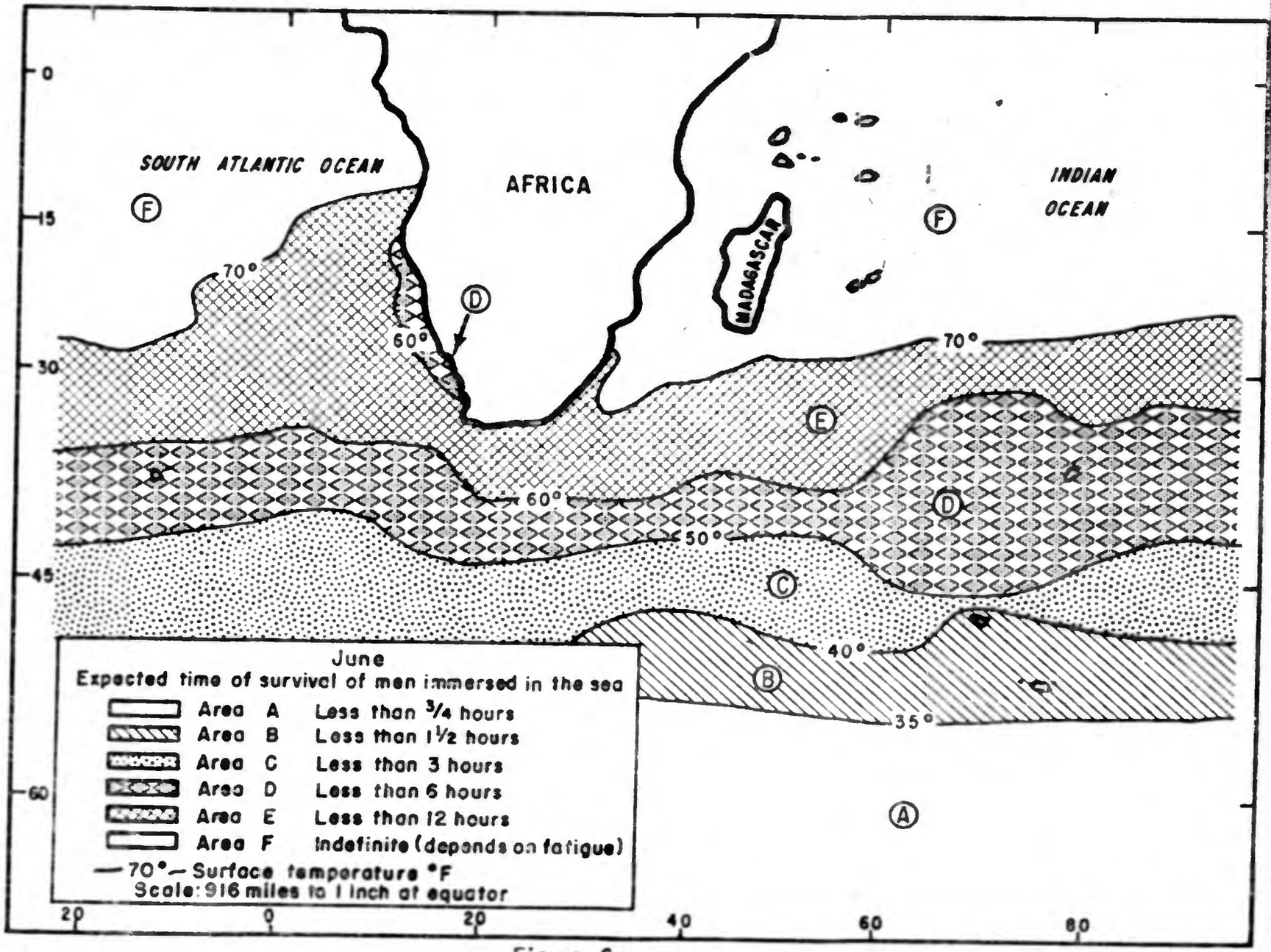

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
0
15
30
45
60
70°
60°
50°
40°
35°
June
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 6e

JULY

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

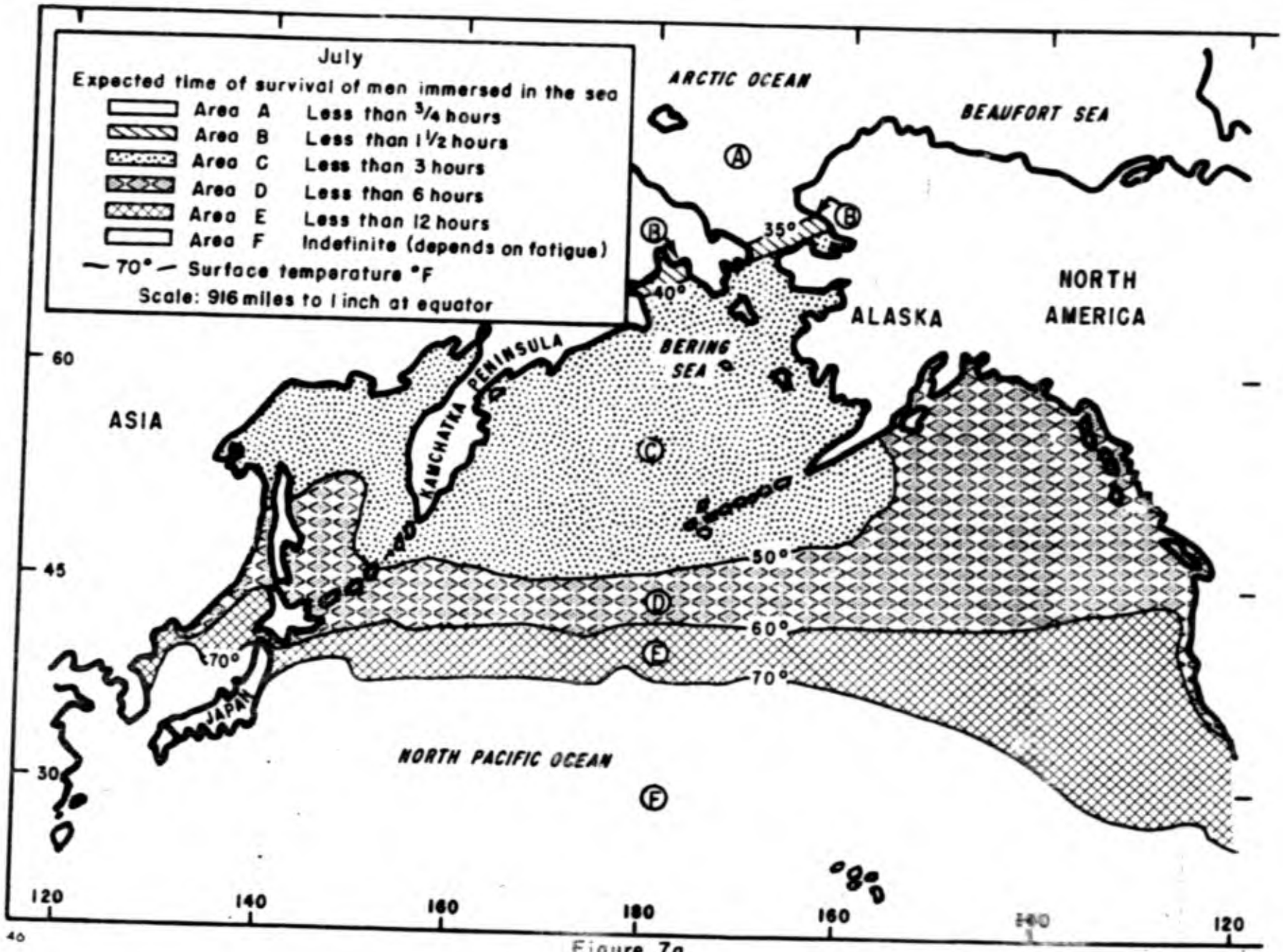

July
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
70°
70°
60
45
30
120
140
160
180
160
120
40

Figure 7a

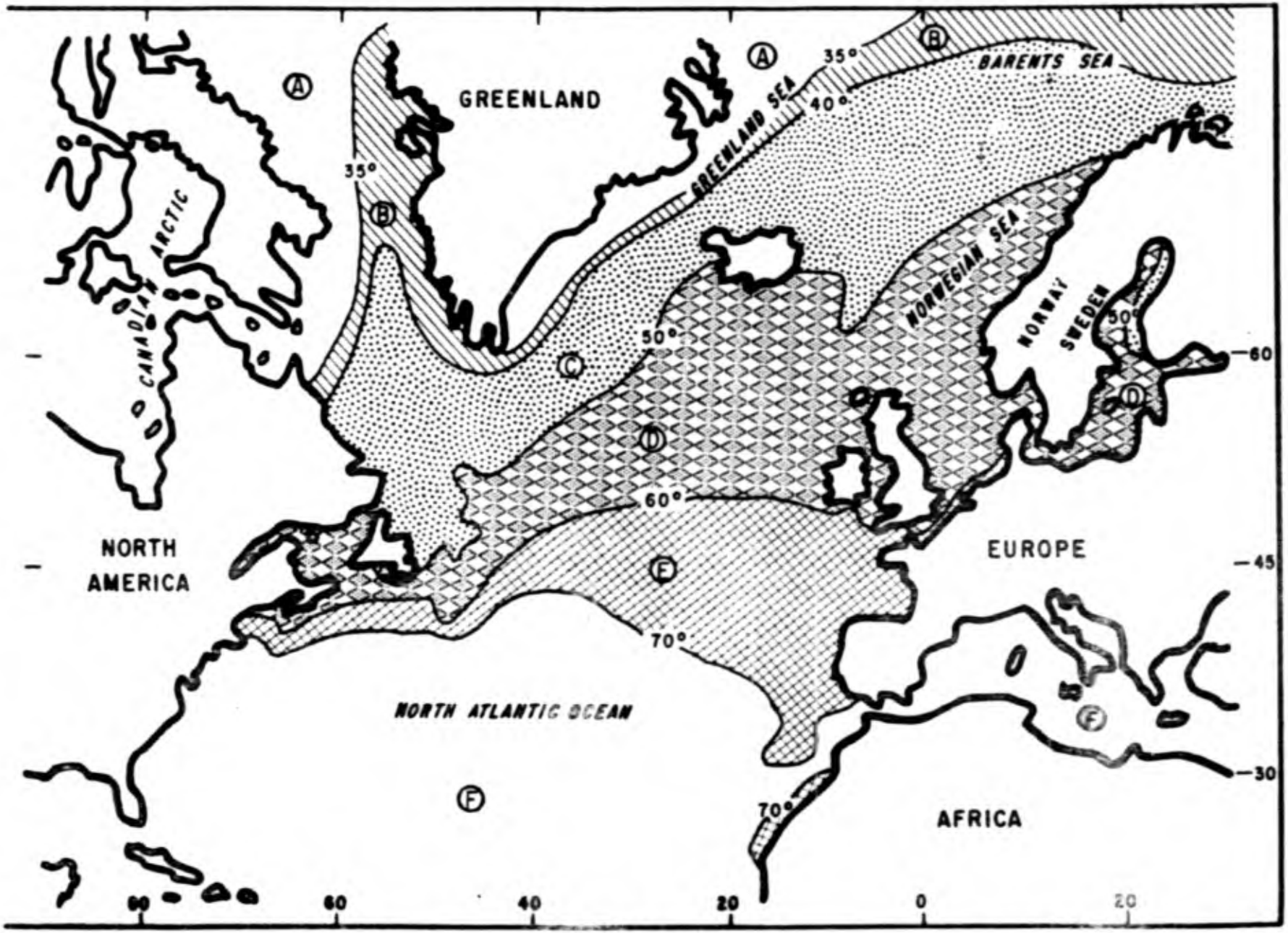

GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
NORWAY
SWEDEN
CANADIAN ARCTIC
NORTH AMERICA
EUROPE
AFRICA
NORTH ATLANTIC OCEAN
35°
40°
50°
60°
70°
80
60
40
20
0
20
60
45
30
A
B
C
D
E
F

Figure 7 b

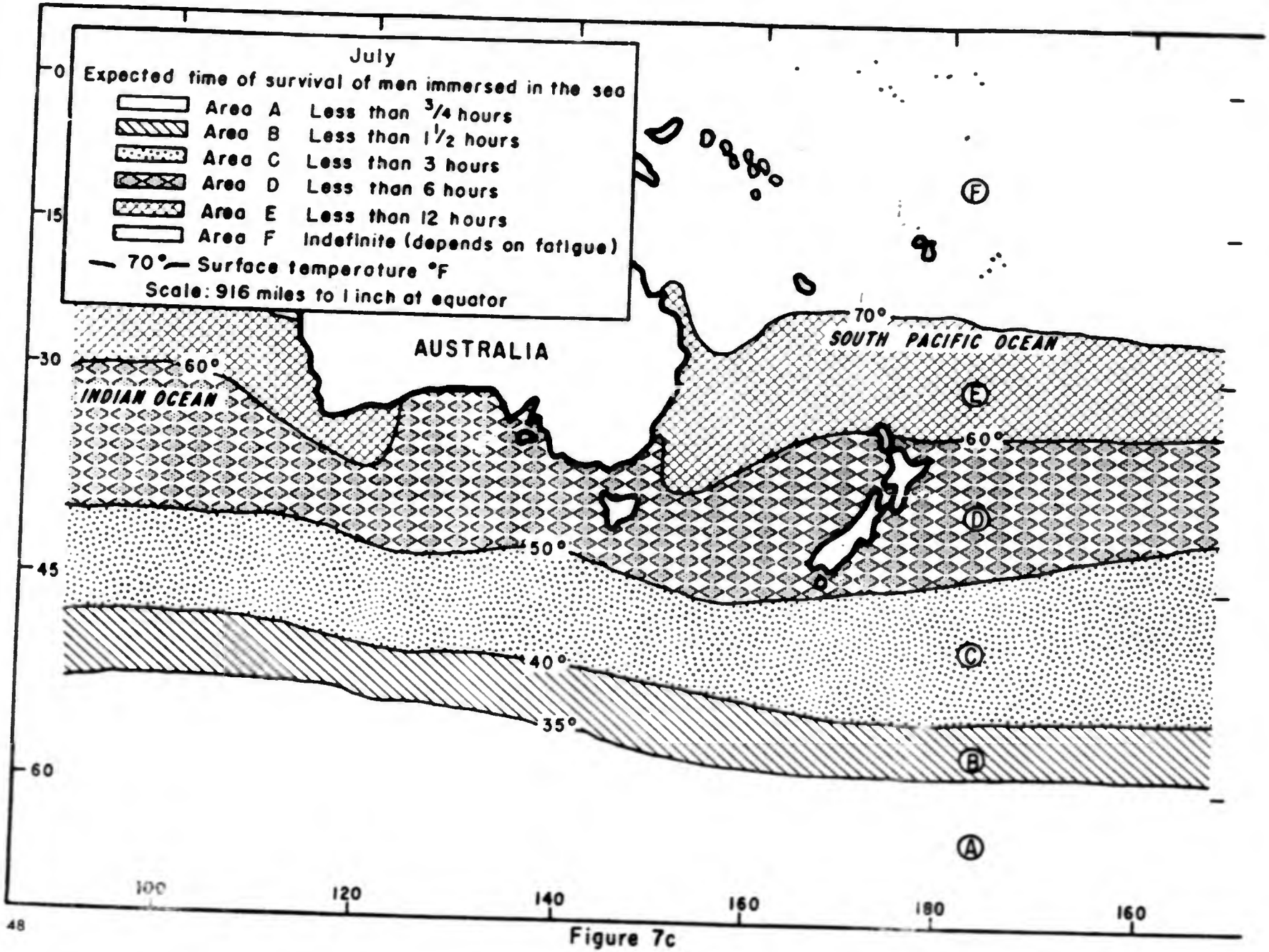

July
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
100
120
140
160
180
160

Figure 7c

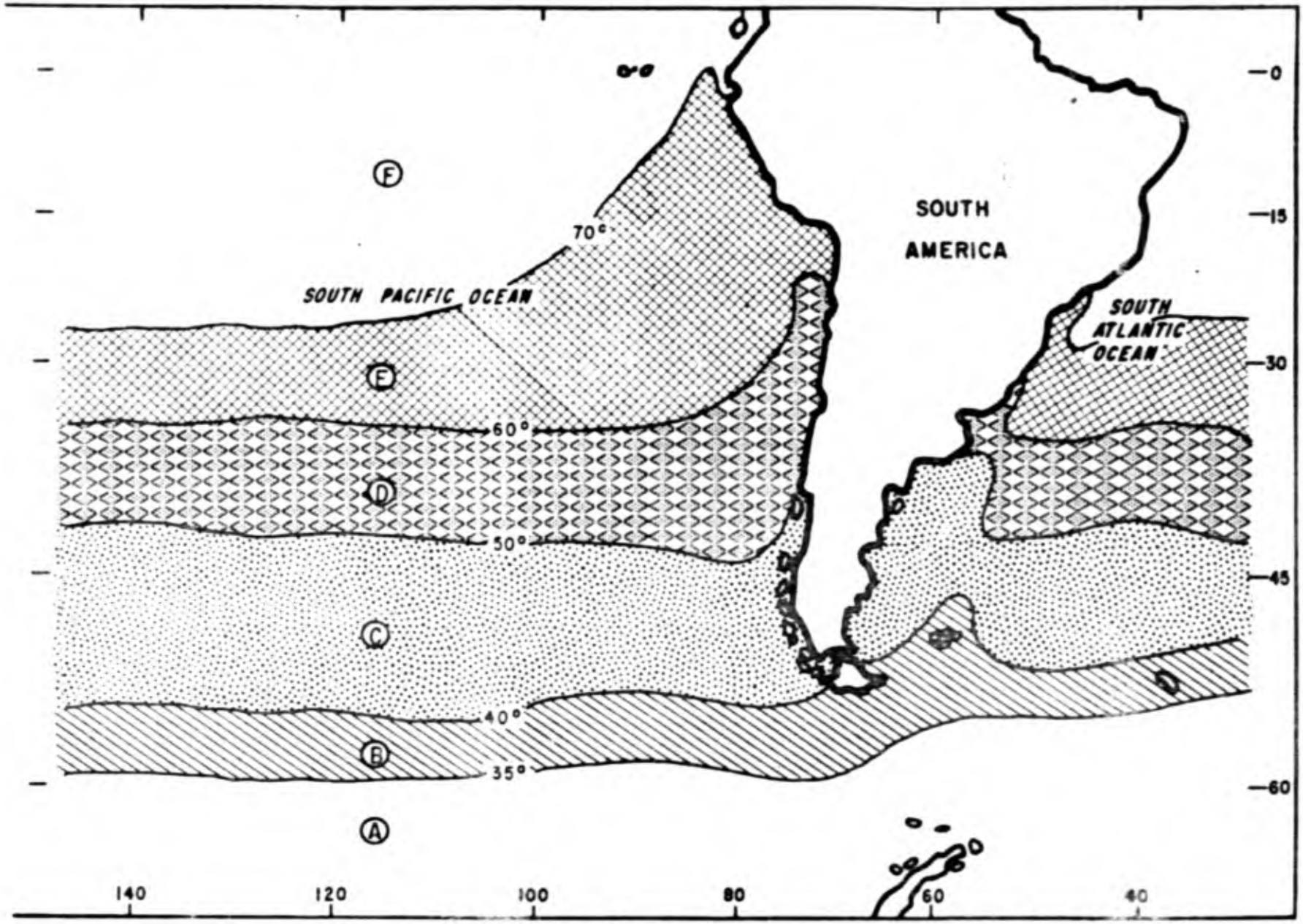

SOUTH
AMERICA
SOUTH PACIFIC OCEAN
SOUTH
ATLANTIC
OCEAN
70°
60°
50°
40°
35°
F
F
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 7d

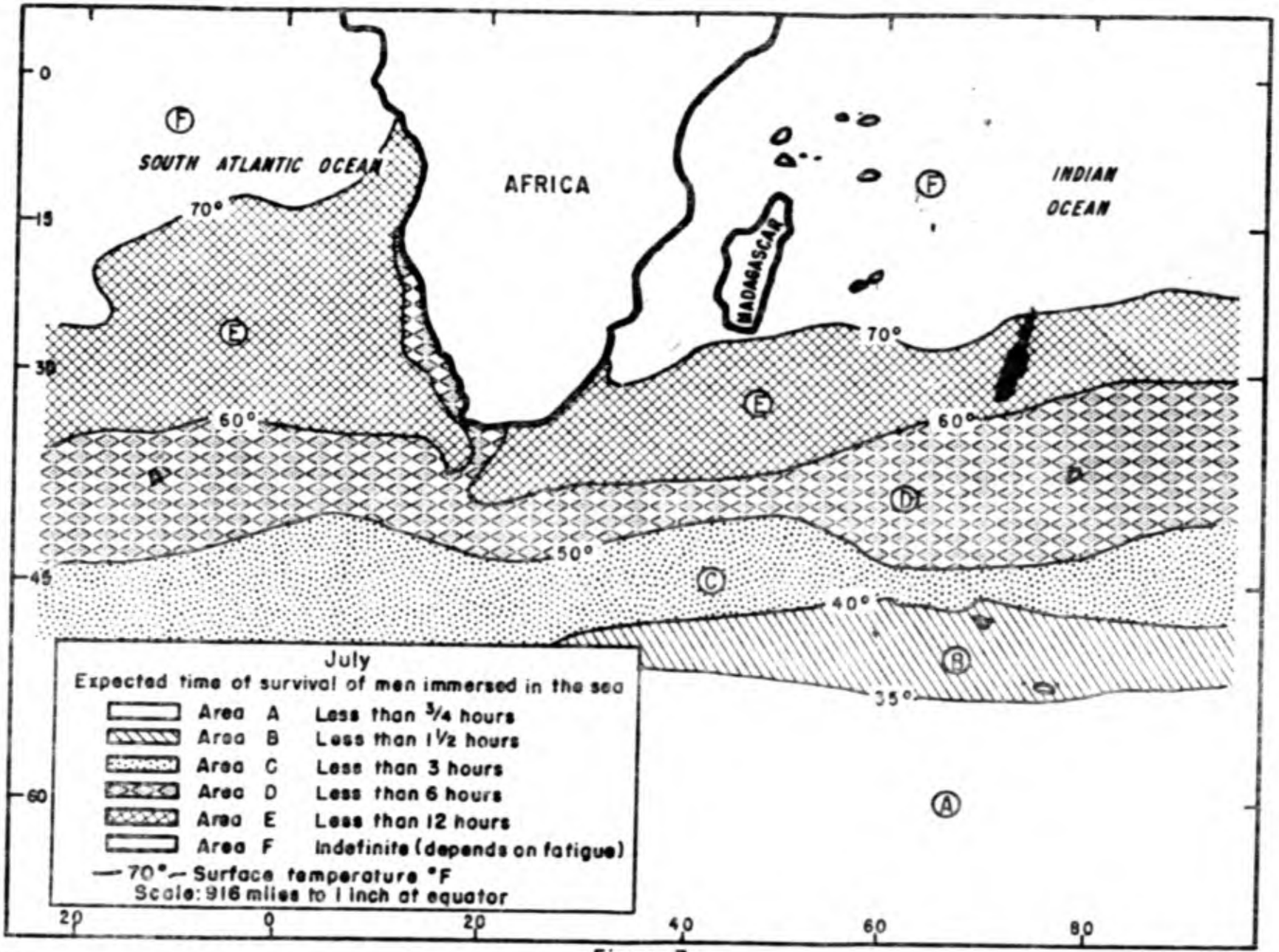

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
70°
60°
50°
40°
35°
0
15
30
45
60
July
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 7e

AUGUST

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

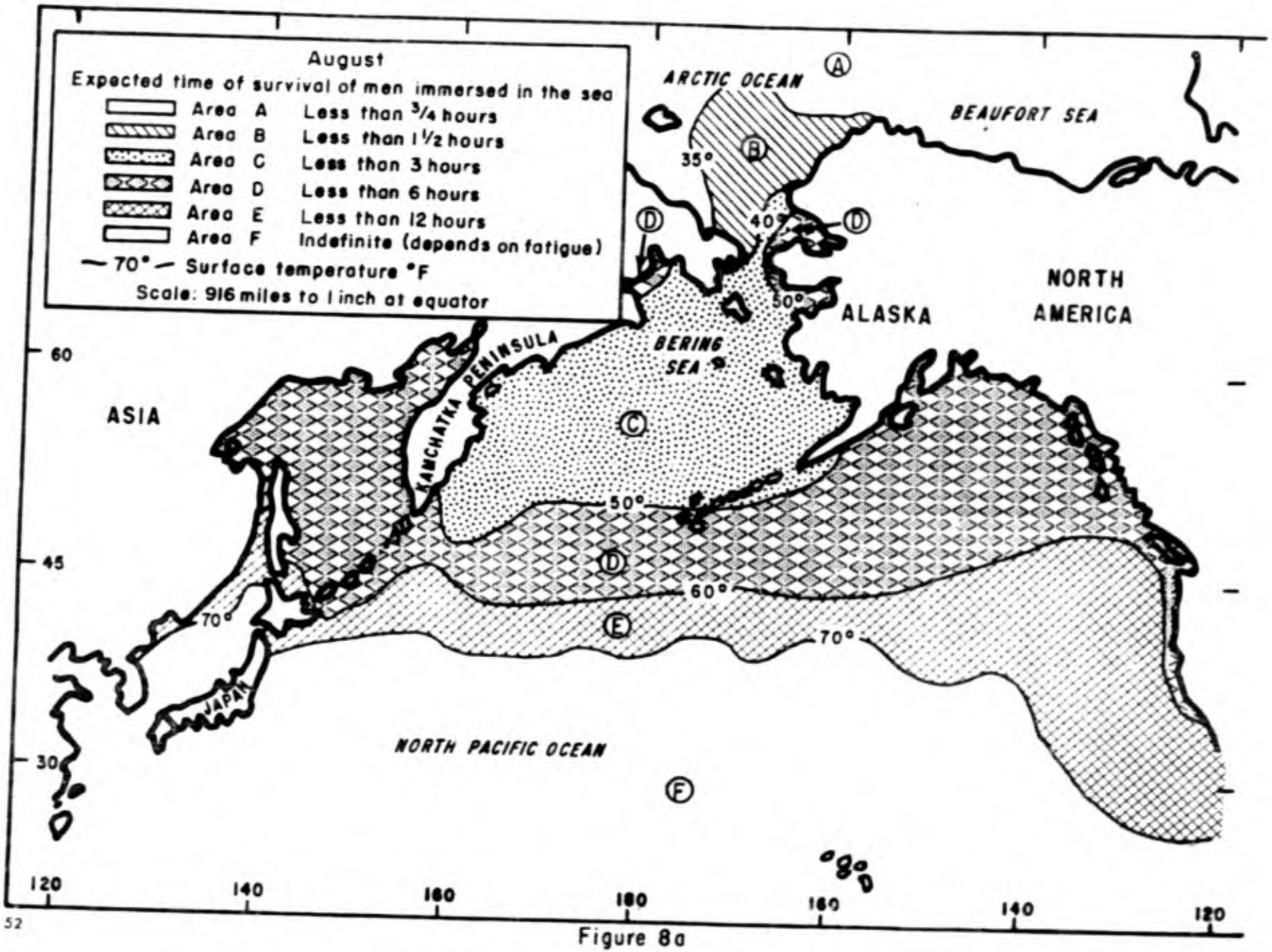

August
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
70°
60
45
30
120
140
160
180
160
140
120

Figure 8a

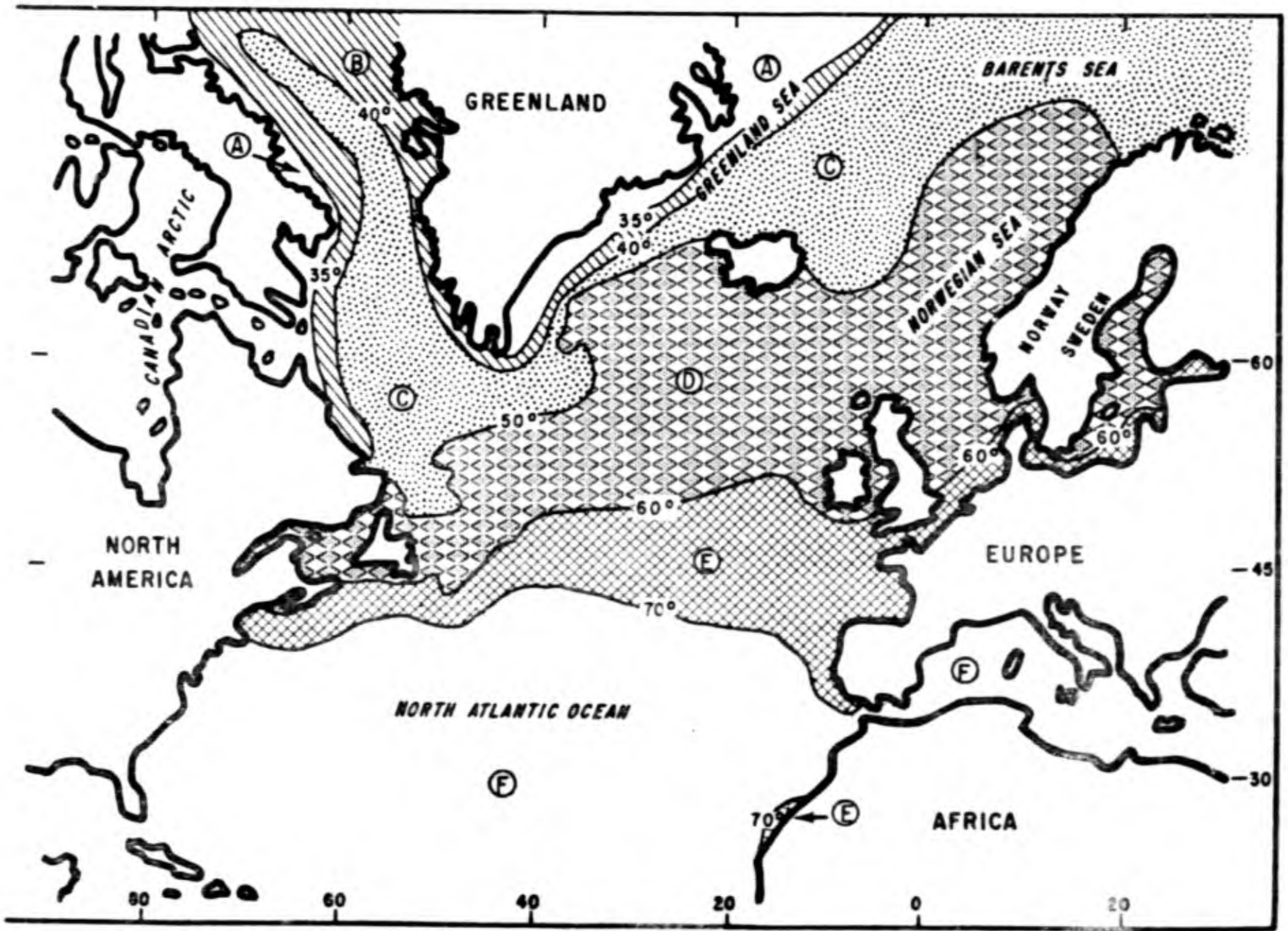

GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
CANADIAN ARCTIC
NORTH AMERICA
EUROPE
NORWAY
SWEDEN
NORTH ATLANTIC OCEAN
AFRICA
A
B
C
D
E
F
40°
35°
50°
60°
70°
80
60
40
20
0
20
60
45
30

Figure 8b

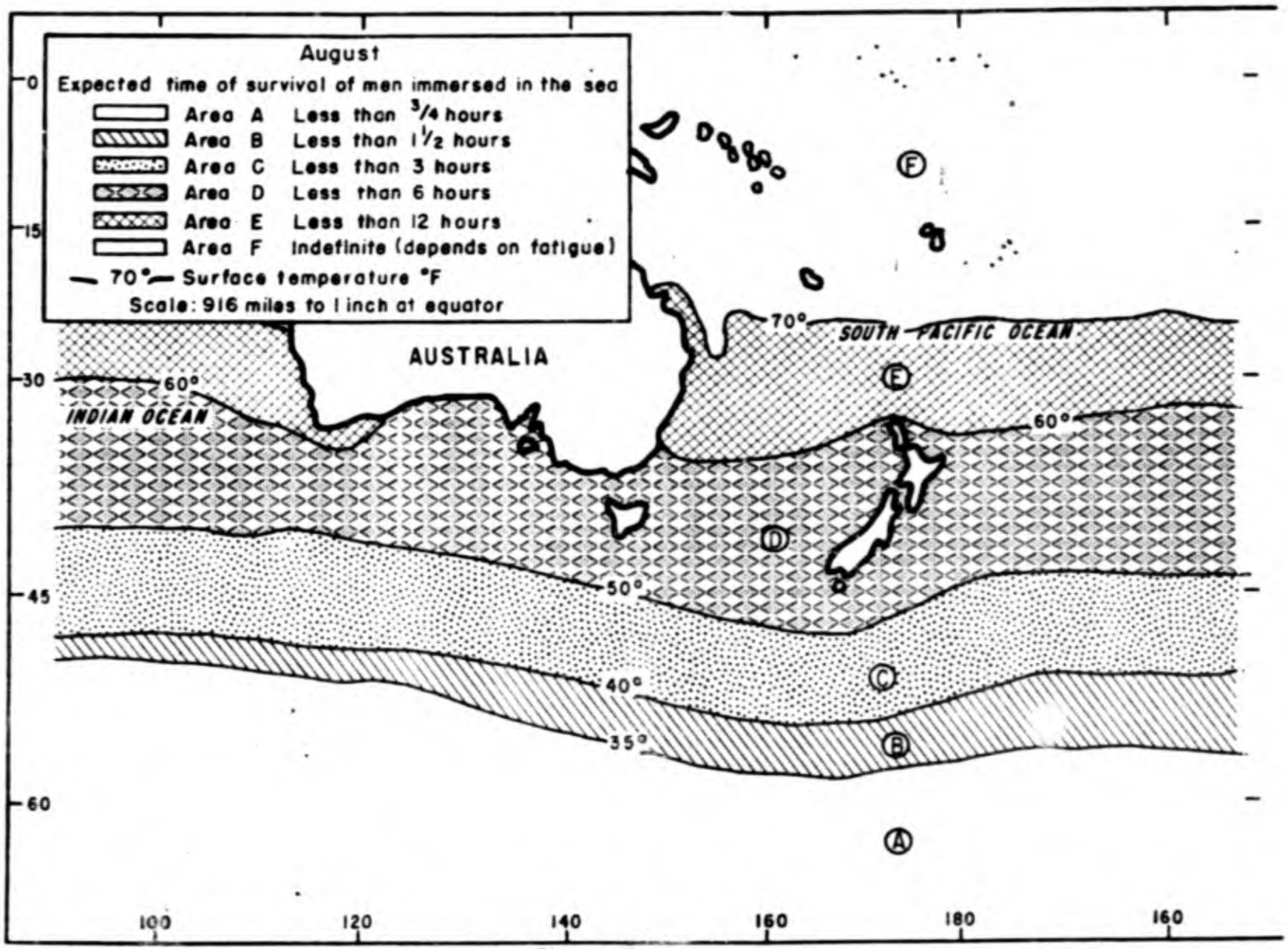

August
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
100
120
140
160
180
160

Figure 8c

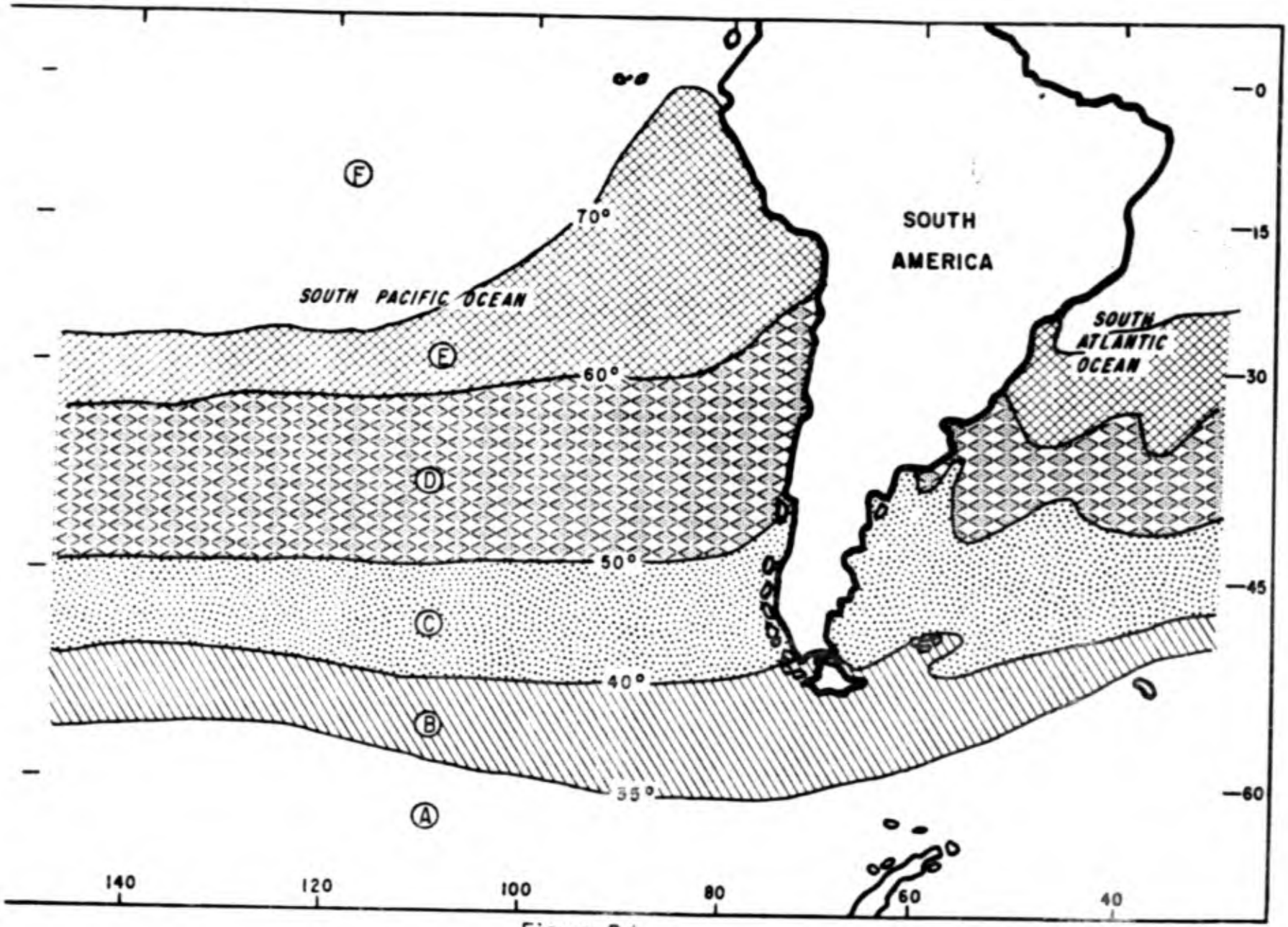

SOUTH PACIFIC OCEAN
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 8d

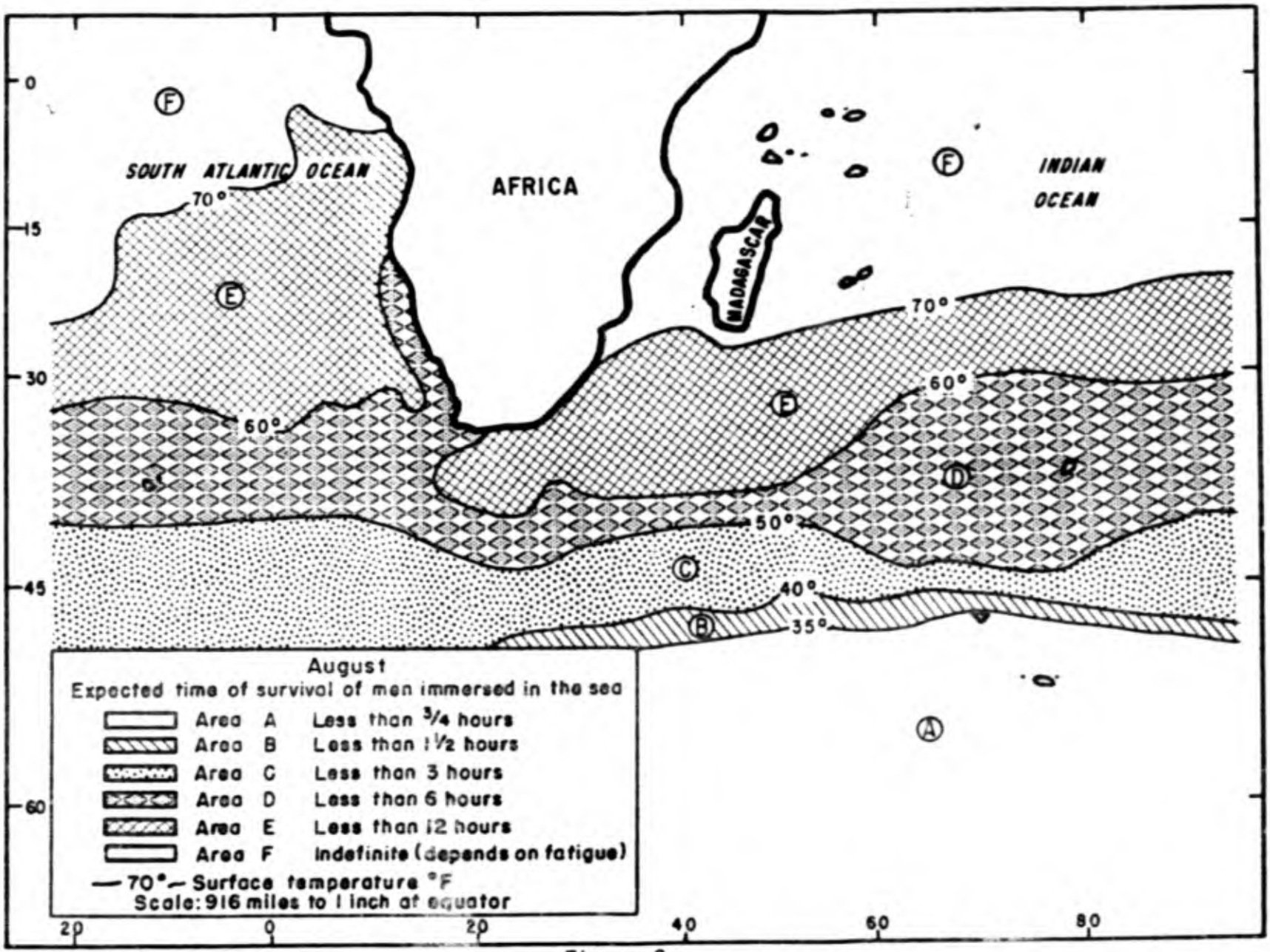

SOUTH ATLANTIC OCEAN
AFRICA
MADAGASCAR
INDIAN OCEAN
70°
60°
50°
40°
35°
0
15
30
45
60
20
0
20
40
60
80
August
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale: 916 miles to 1 inch at equator

Figure 8e

SEPTEMBER

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

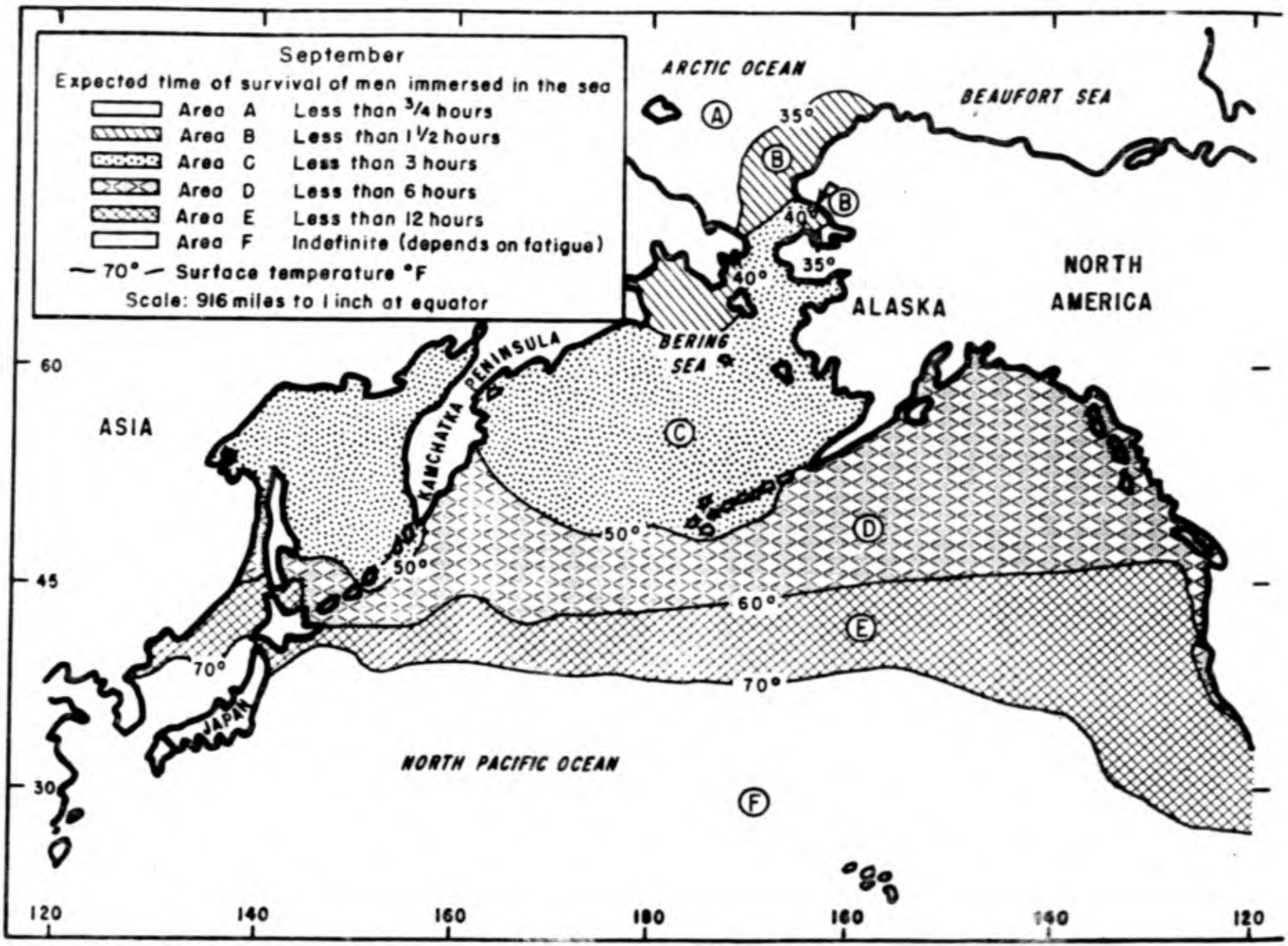

September
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
A
B
C
D
E
F
35°
40°
50°
60°
70°
60
45
30
120
140
160
180
160
140
120

Figure 9 a

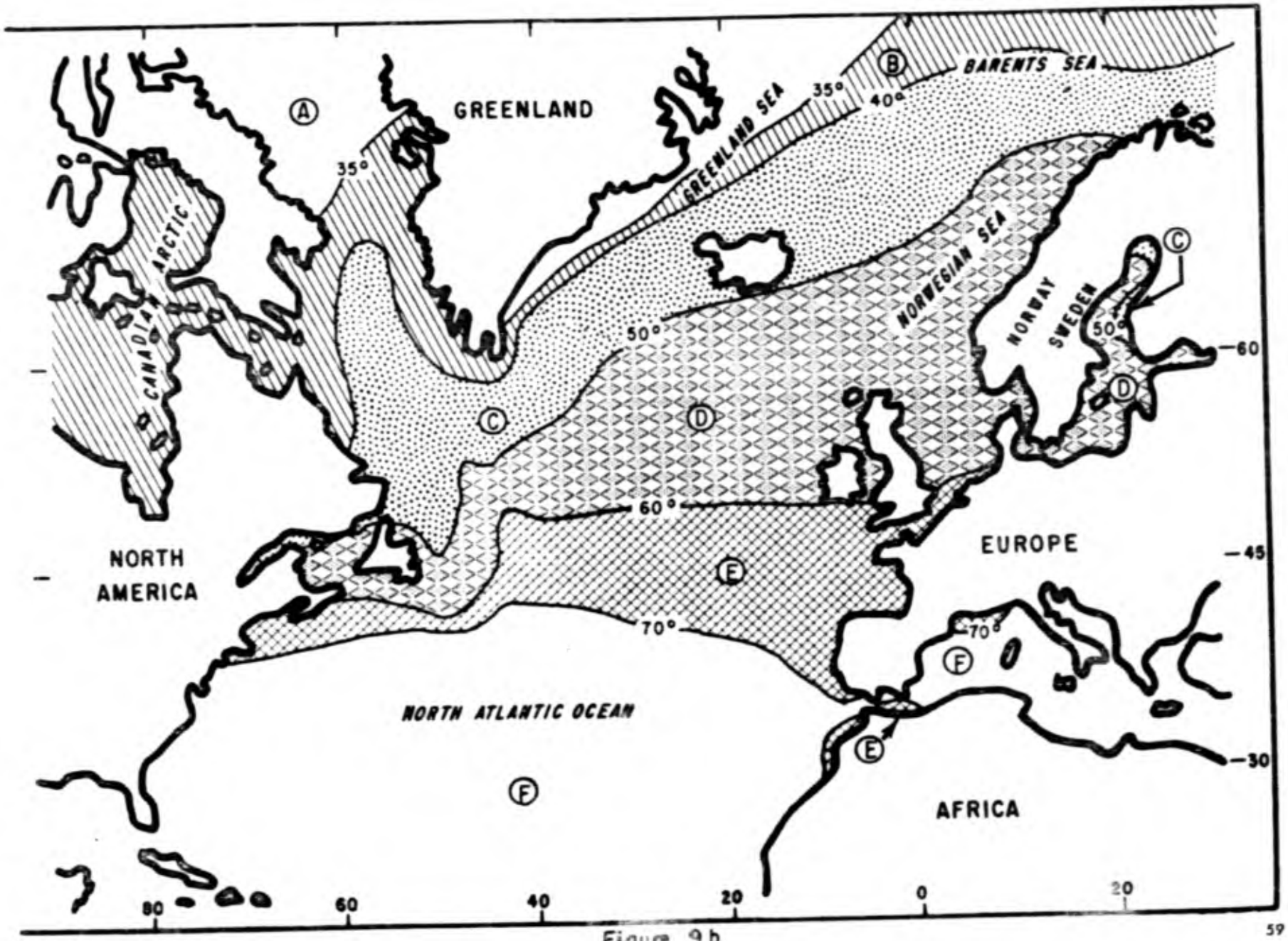

GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
NORWAY
SWEDEN
CANADIAN ARCTIC
NORTH AMERICA
EUROPE
NORTH ATLANTIC OCEAN
AFRICA
A
B
C
D
E
F
35°
40°
50°
60°
70°
80
60
40
20
0
20
60
45
30

Figure 9b

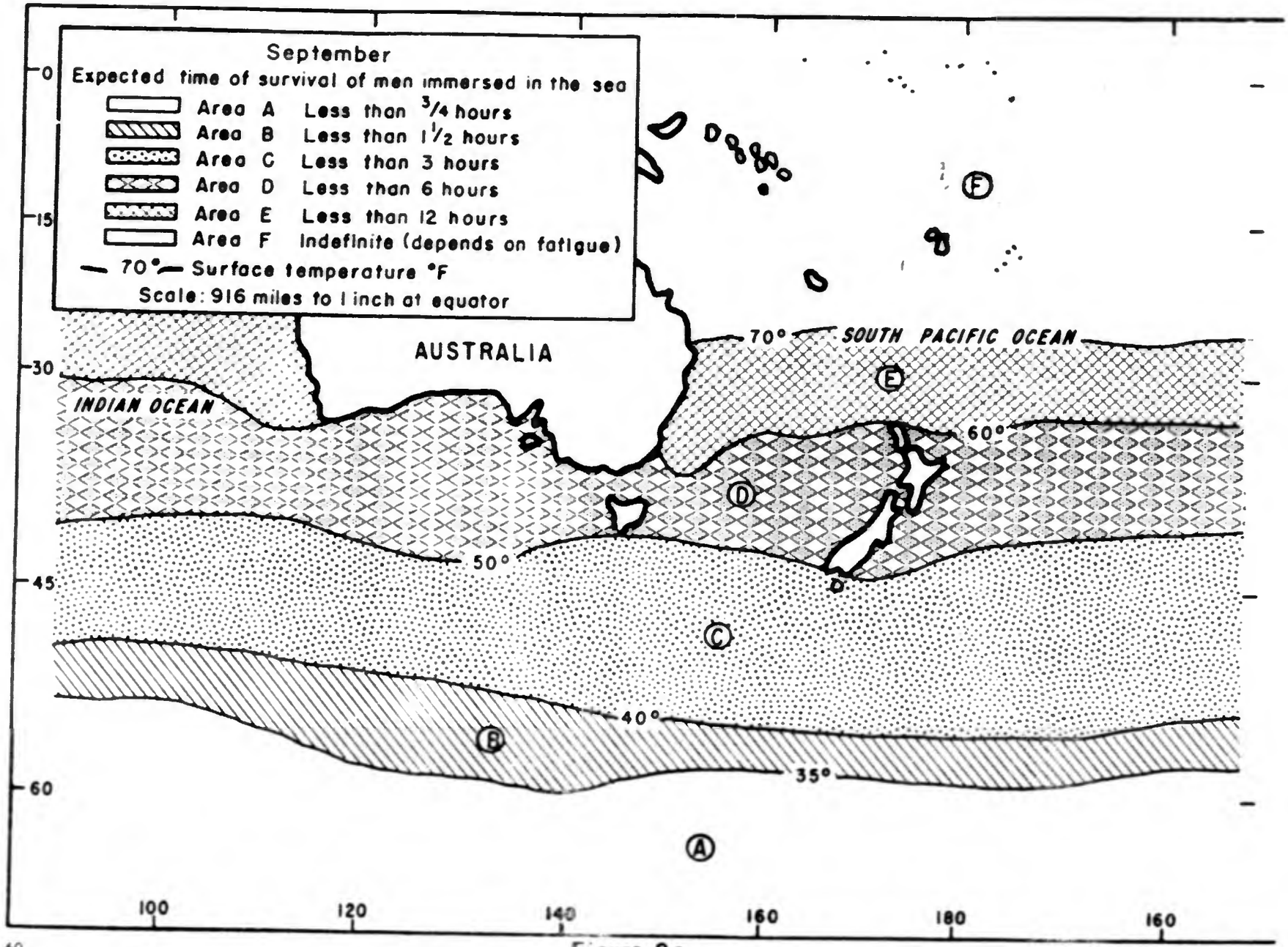

September
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
A
B
C
D
E
F
0
15
30
45
60
100
120
140
160
180
160

Figure 9c

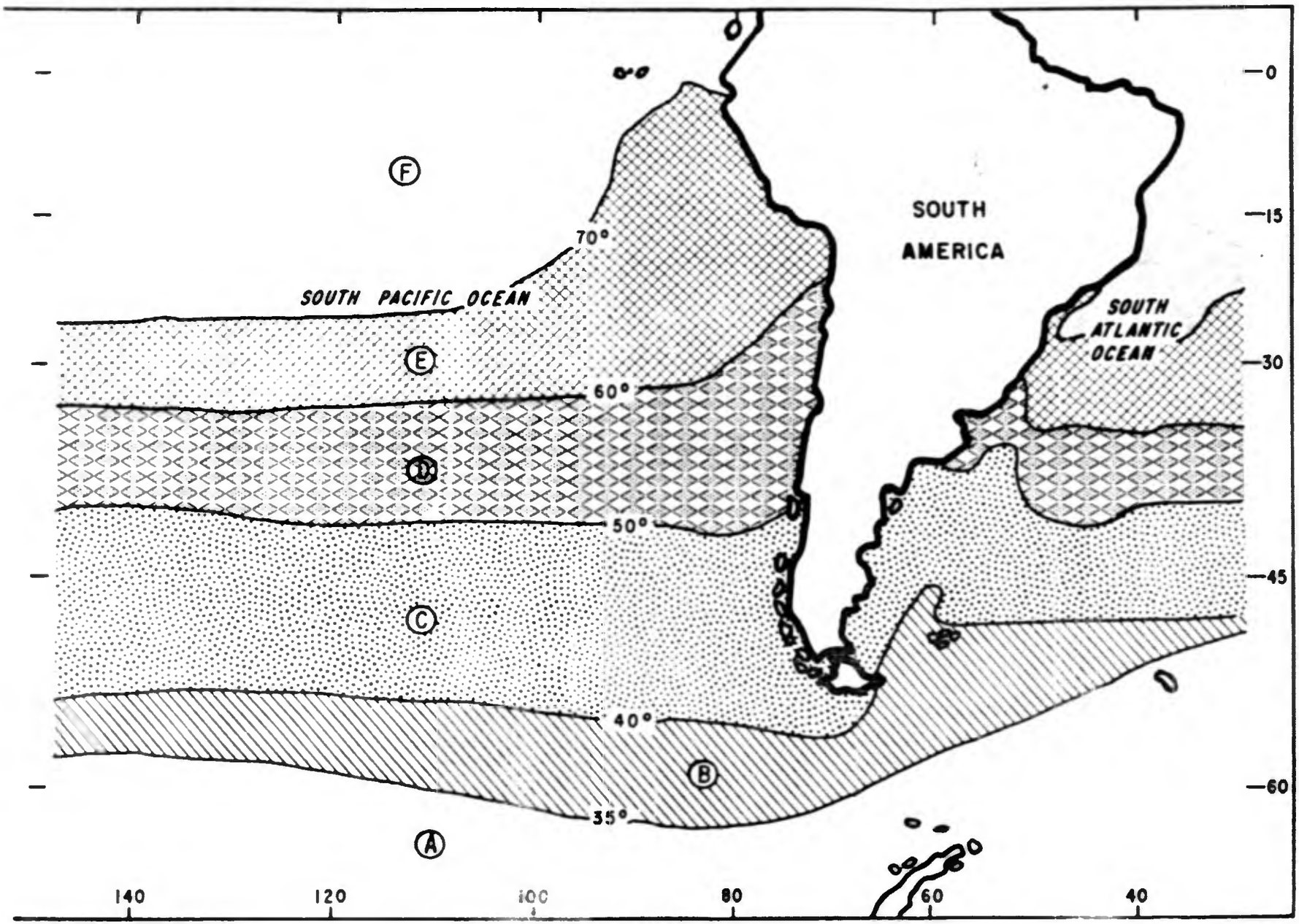

SOUTH
AMERICA
SOUTH PACIFIC OCEAN
SOUTH
ATLANTIC
OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
140
120
100
80
60
40

Figure 9d

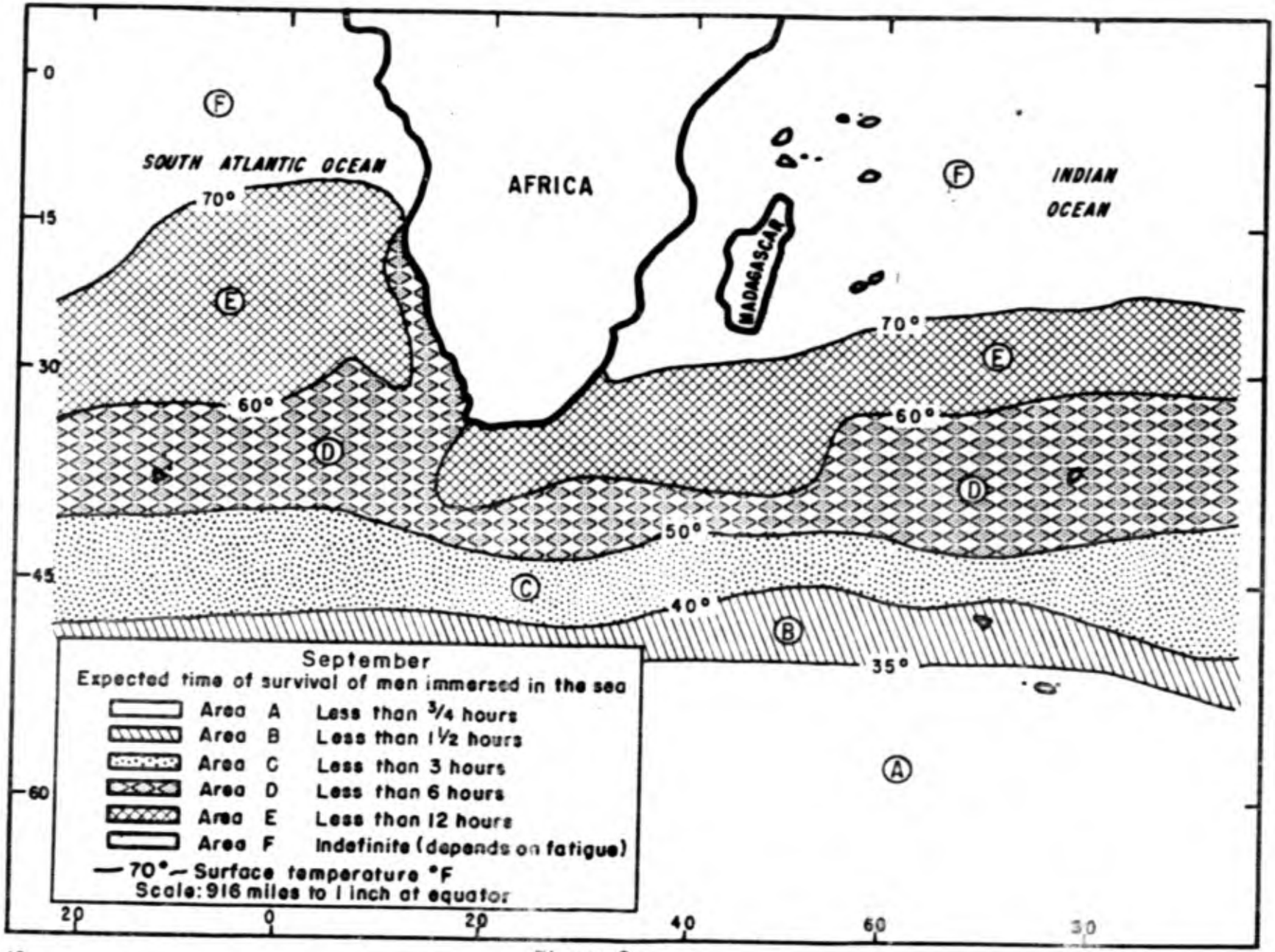

SOUTH ATLANTIC OCEAN
AFRICA
MADAGASCAR
INDIAN OCEAN
70°
60°
50°
40°
35°
0
15
30
45
60
September
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 9e

OCTOBER

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

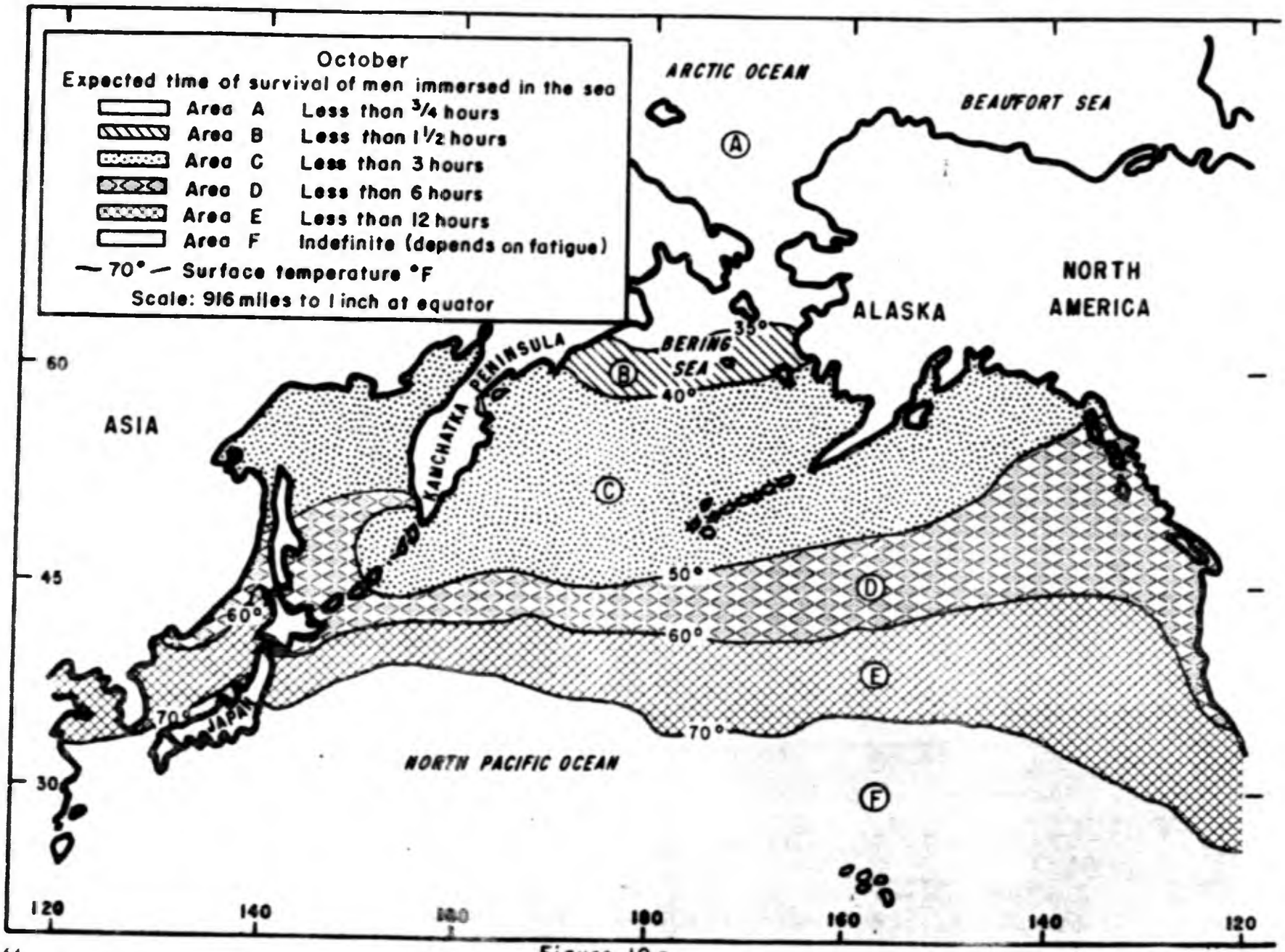

October
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
A
B
C
D
E
F
35°
40°
50°
60°
70°
60
45
30
120
140
160
180
160
140
120

Figure 10 a

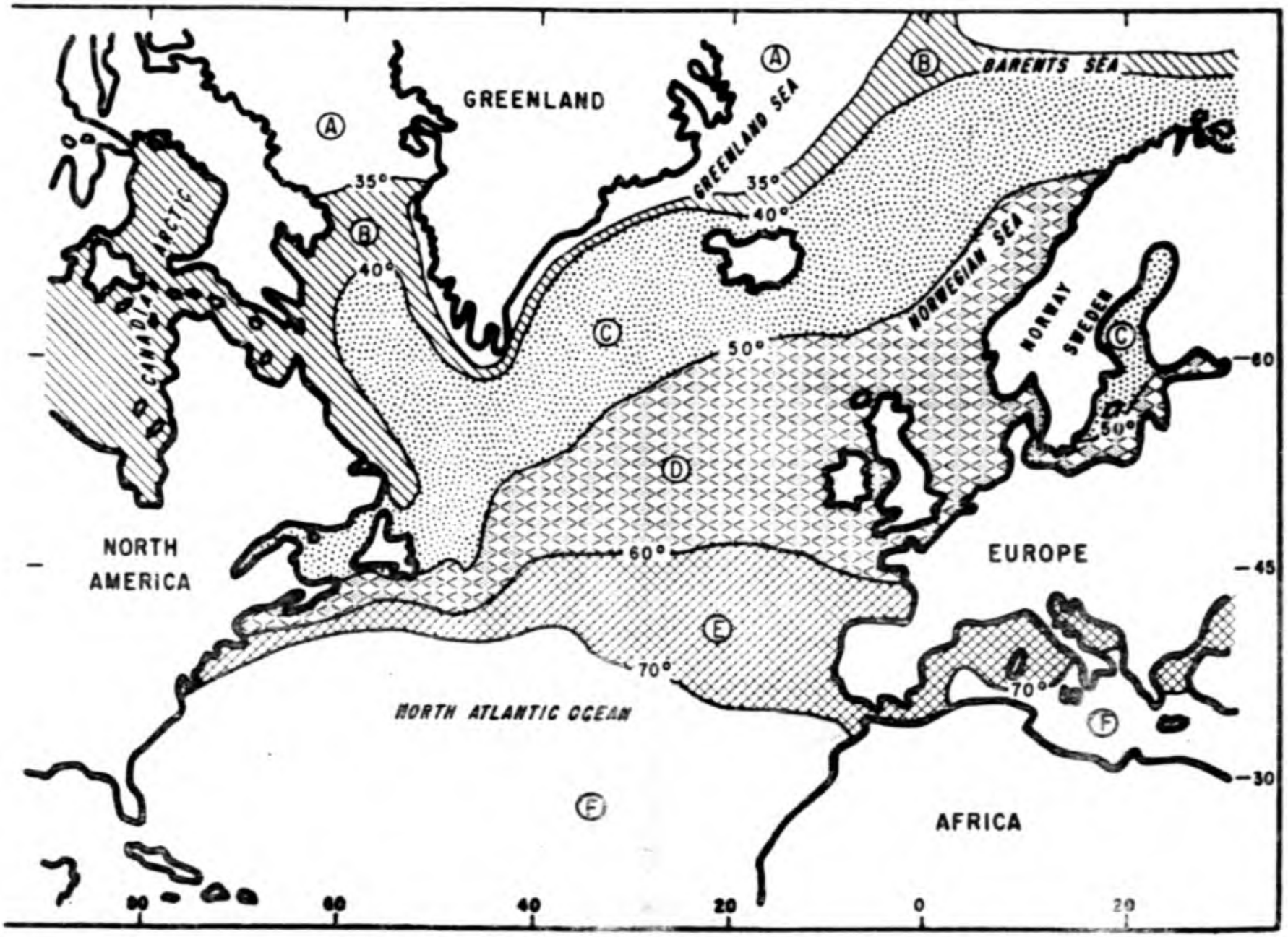

GREENLAND
GREENLAND SEA
BARENTS SEA
NORWEGIAN SEA
NORWAY
SWEDEN
CANADIAN ARCTIC
NORTH AMERICA
EUROPE
AFRICA
NORTH ATLANTIC OCEAN
A
B
C
D
E
F
35°
40°
50°
60°
70°
80
60
40
20
0
20
60
45
30

Figure 10 b

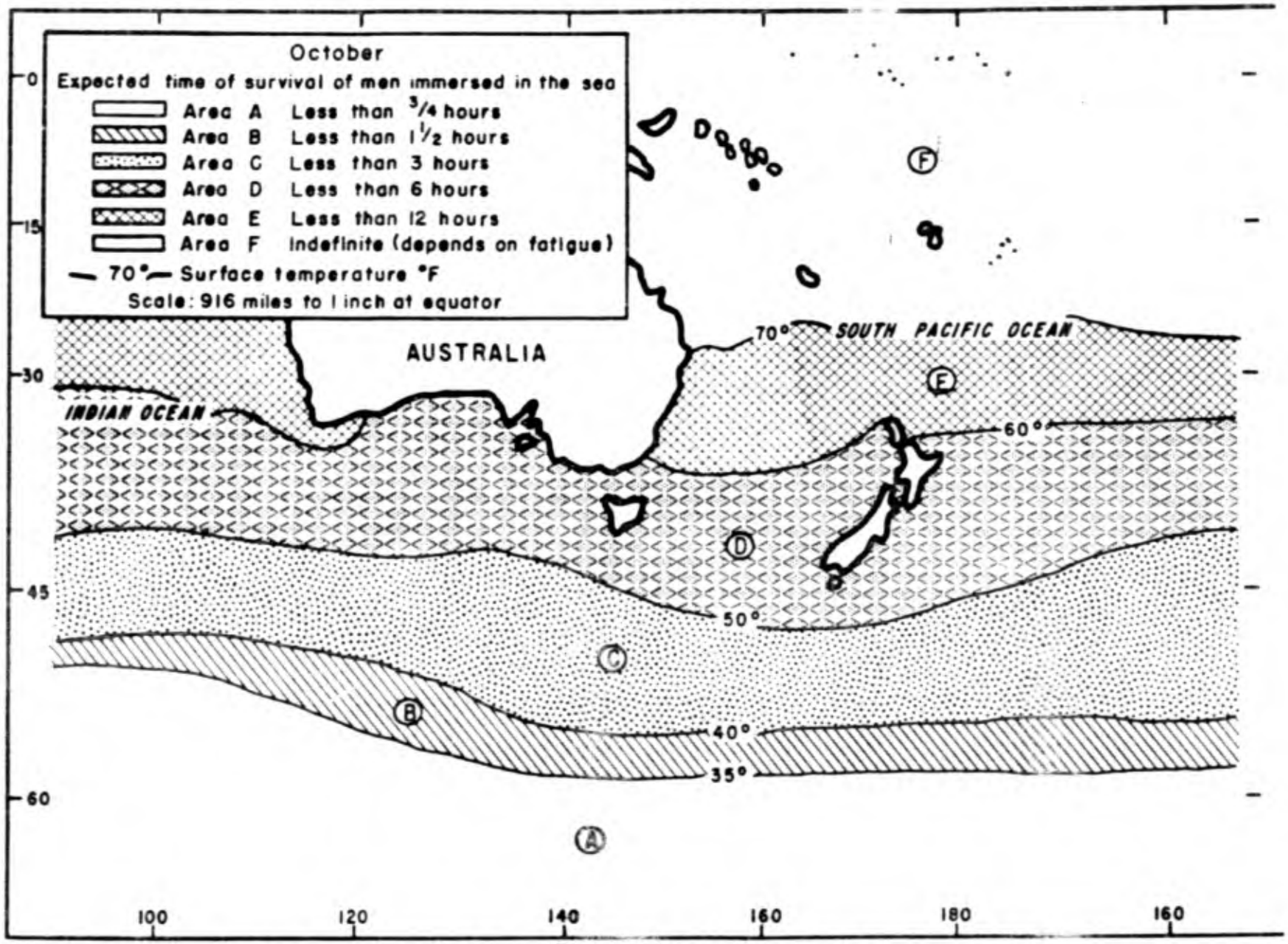

October
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
30
45
60
100
120
140
160
180
160

Figure 10c

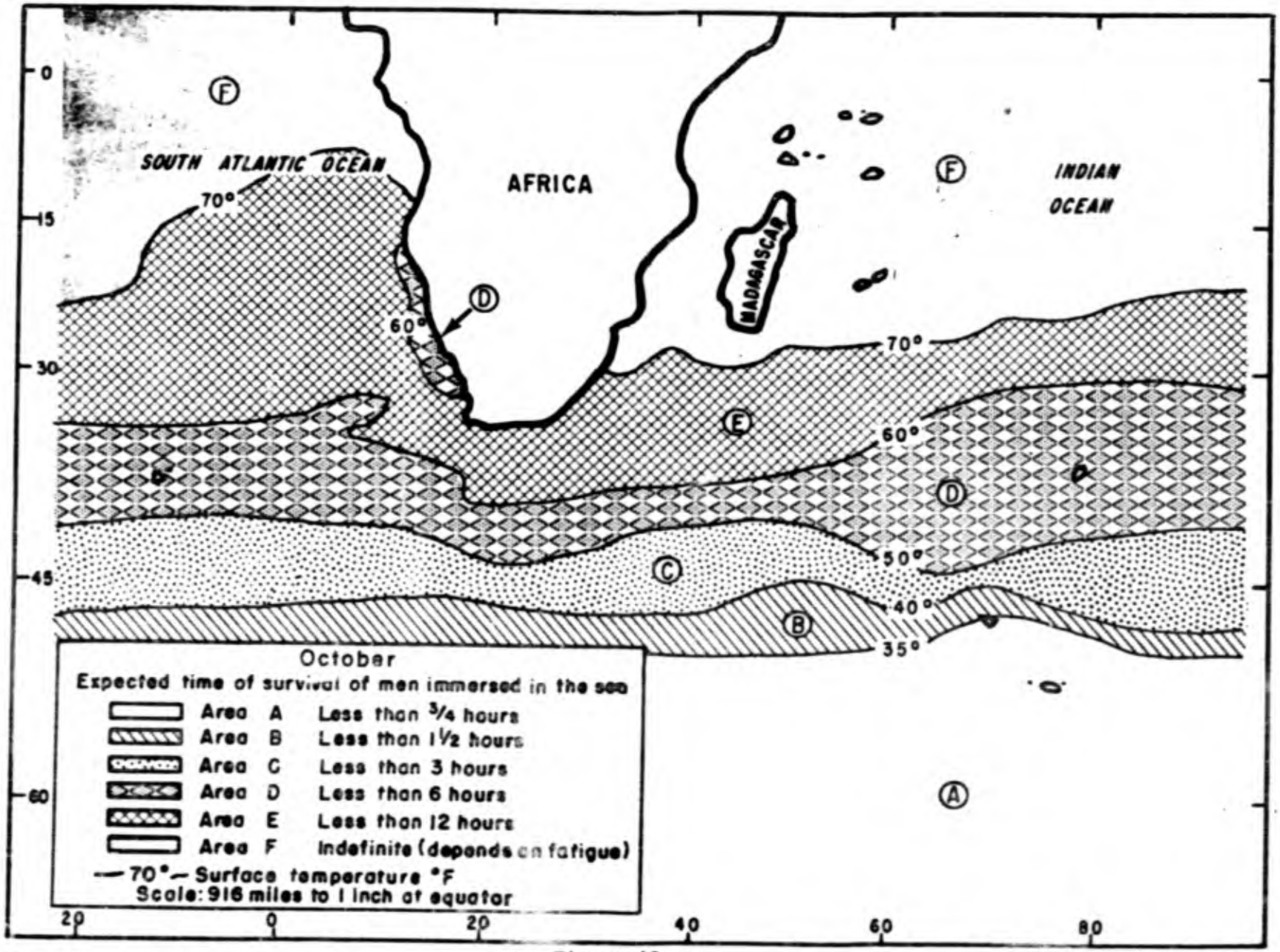

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
70°
60°
70°
60°
50°
40°
35°
F
D
E
D
C
B
A
F
0
15
30
45
60
October
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 10e

NOVEMBER

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.

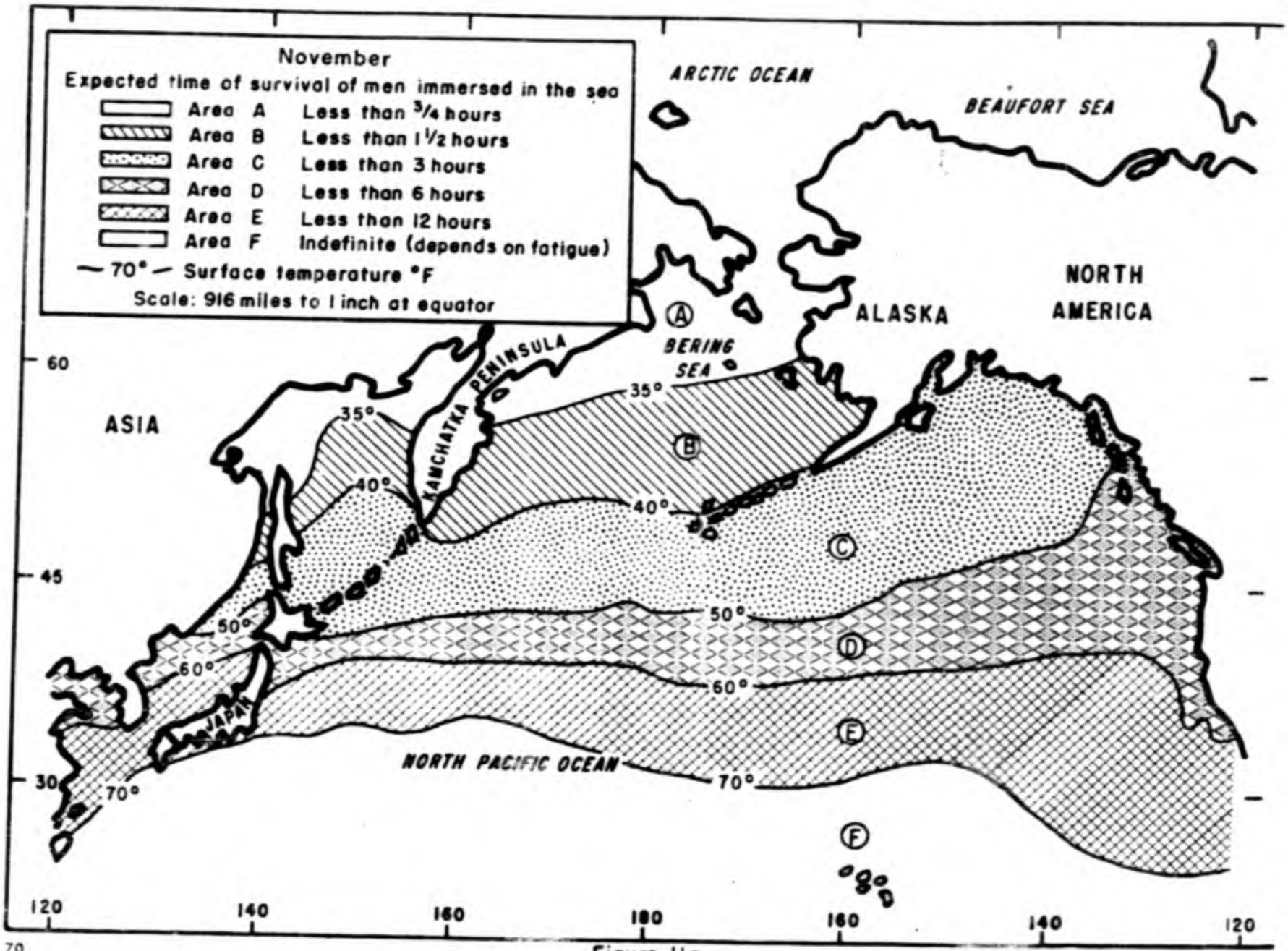
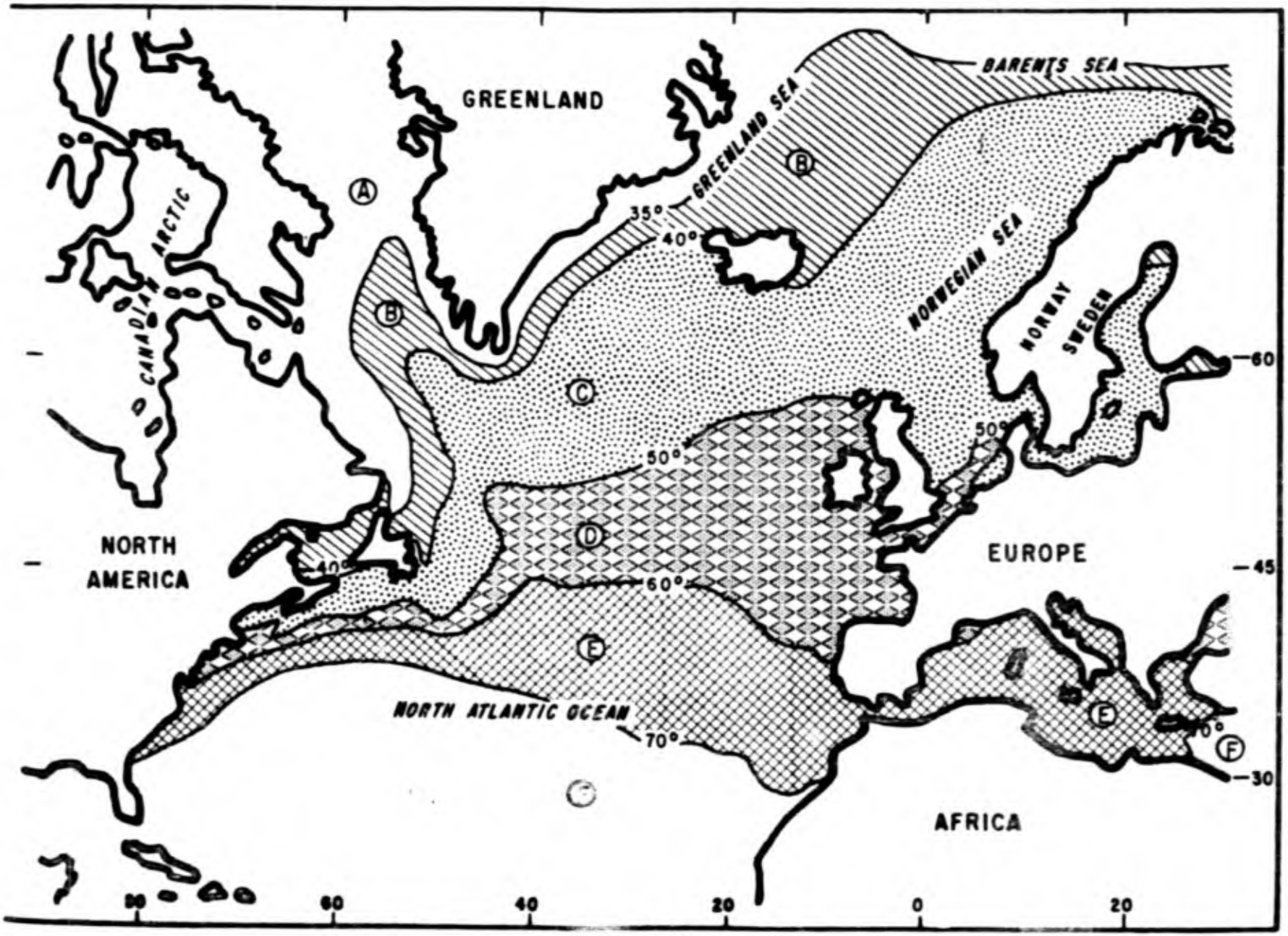

November
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
70°
A
B
C
D
E
F
60
45
30
120
140
160
180
160
140
120

Figure IIa


GREENLAND
BARENTS SEA
GREENLAND SEA
NORWEGIAN SEA
NORWAY
SWEDEN
CANADIAN ARCTIC
NORTH AMERICA
EUROPE
AFRICA
NORTH ATLANTIC OCEAN
A
B
C
D
E
F
35°
40°
50°
60°
70°
80°
60
45
30
80
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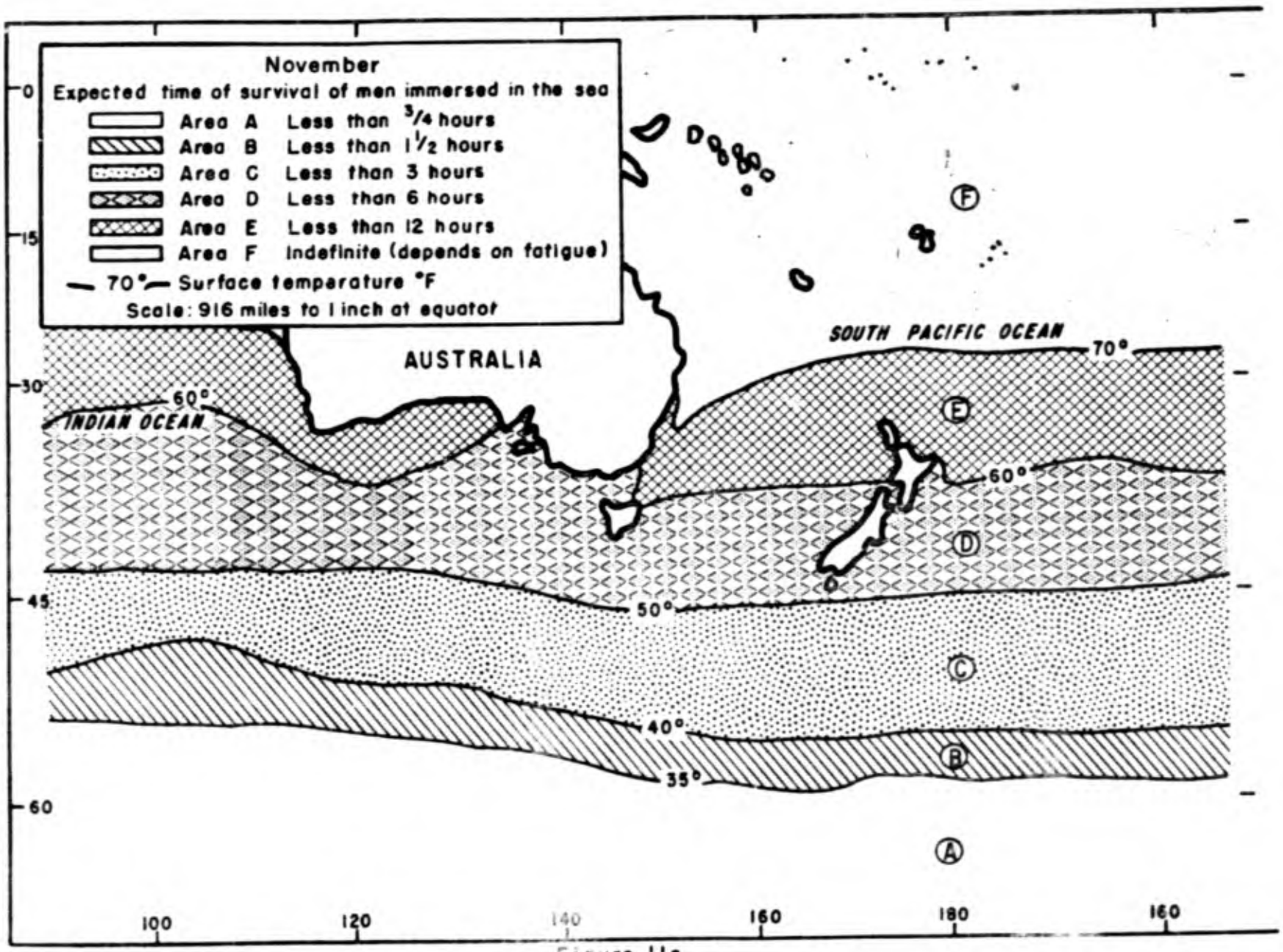
40
20
0
20

Figure 11b


November
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
A
B
C
D
E
F
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15
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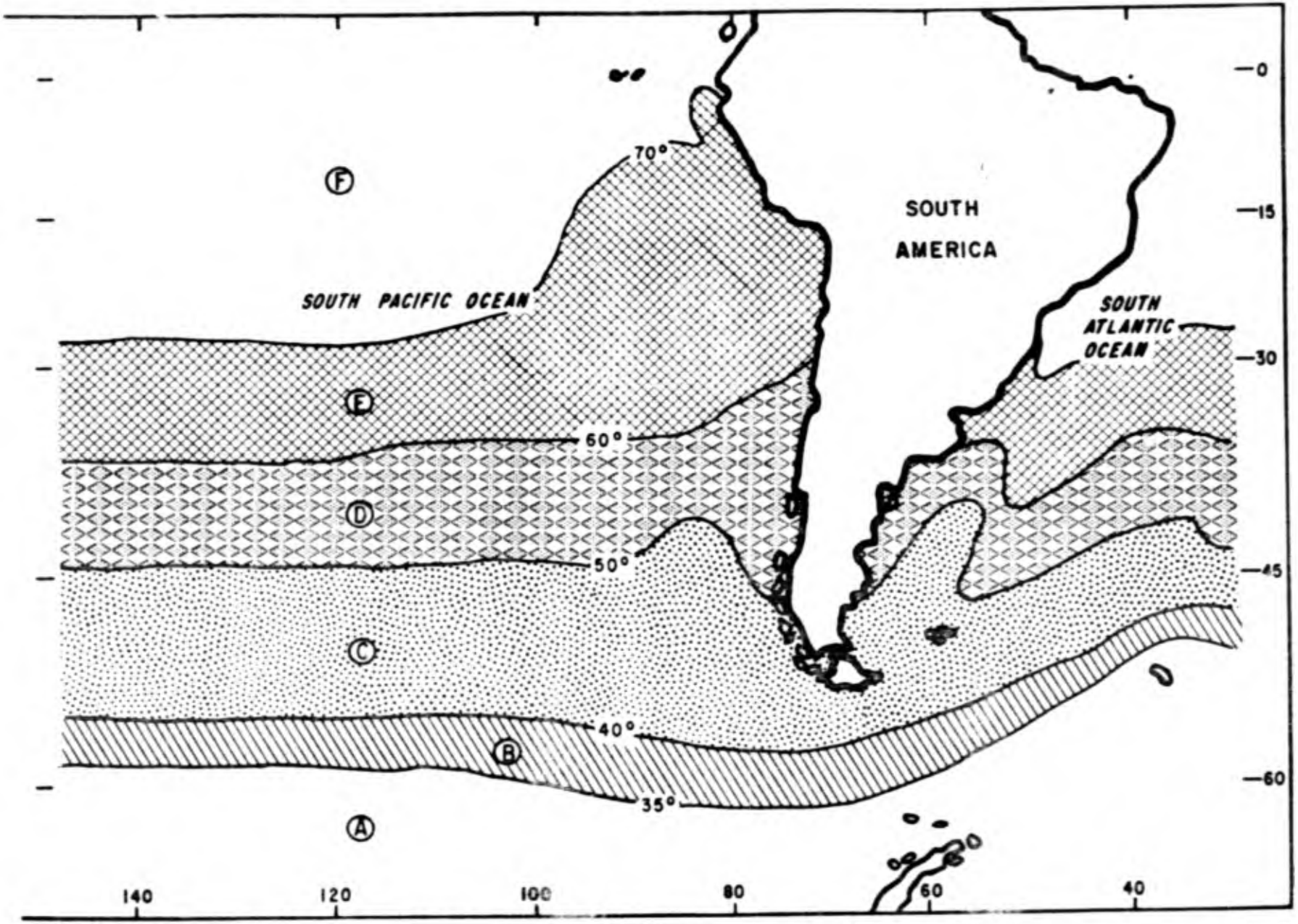
45
60
100
120
140
160
180
160

Figure IIc


SOUTH PACIFIC OCEAN
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
0
15
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45
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140
120
100
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60
40

Figure IId

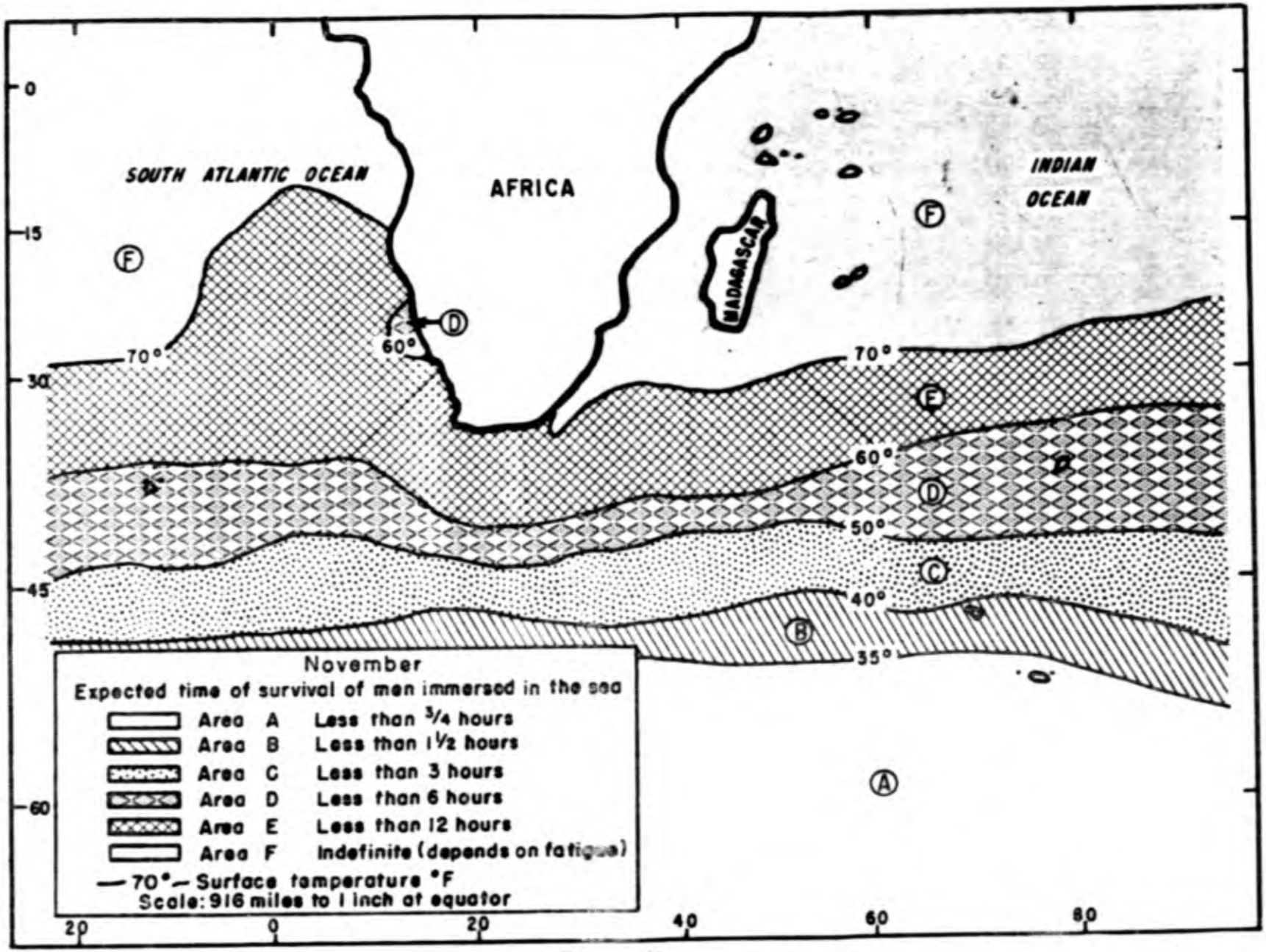
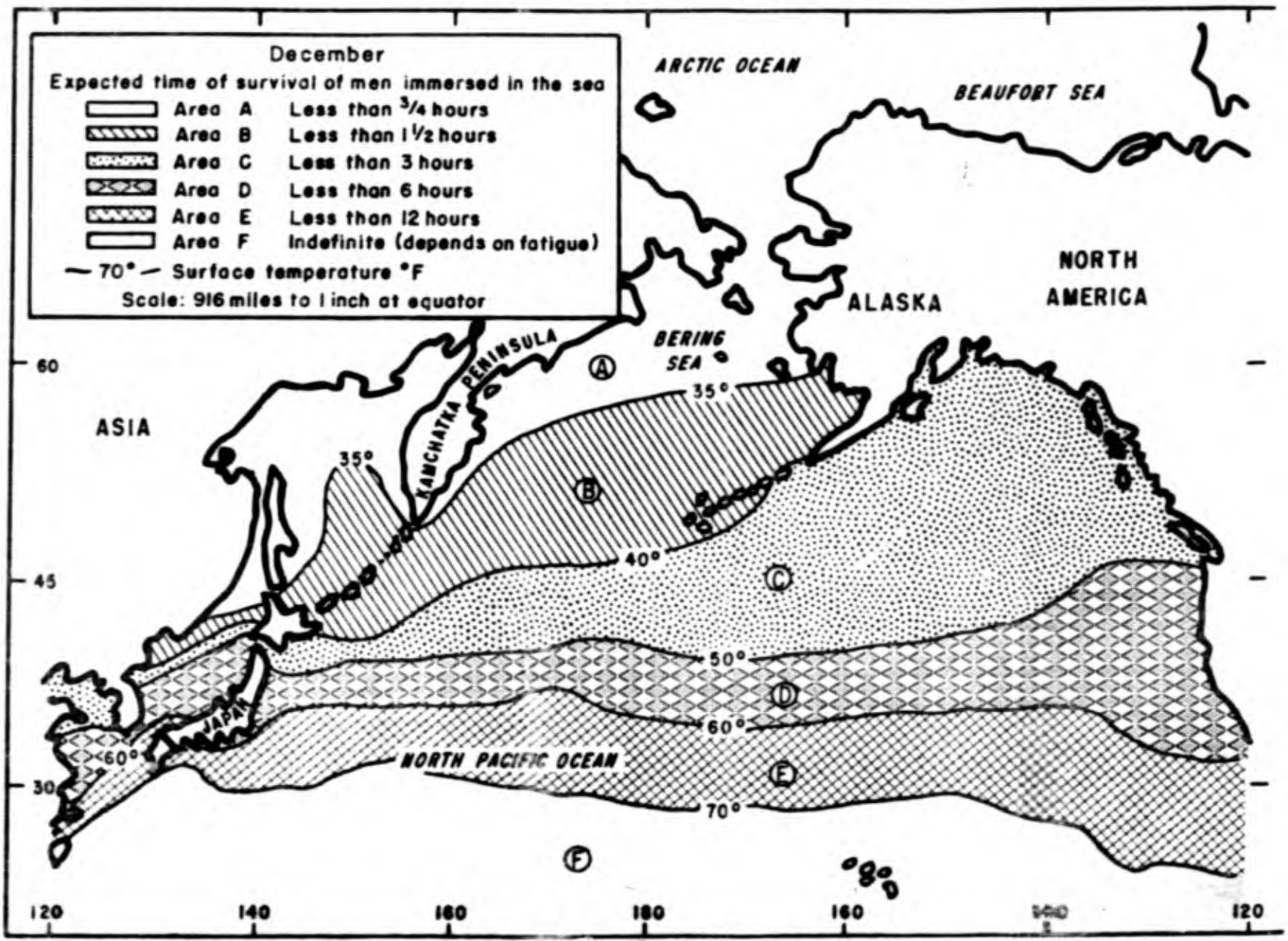

SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
0
15
30
45
60
70°
60°
70°
60°
50°
40°
35°
November
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70°— Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure IIe

DECEMBER

Approximate period of time a man in ordinary flying clothes or uniform with a life preserver can be expected to stand immersion without fatal effects.


December
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
ARCTIC OCEAN
BEAUFORT SEA
NORTH AMERICA
ALASKA
BERING SEA
KAMCHATKA PENINSULA
ASIA
JAPAN
NORTH PACIFIC OCEAN
35°
40°
50°
60°
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160
180
160
120

Figure 12a

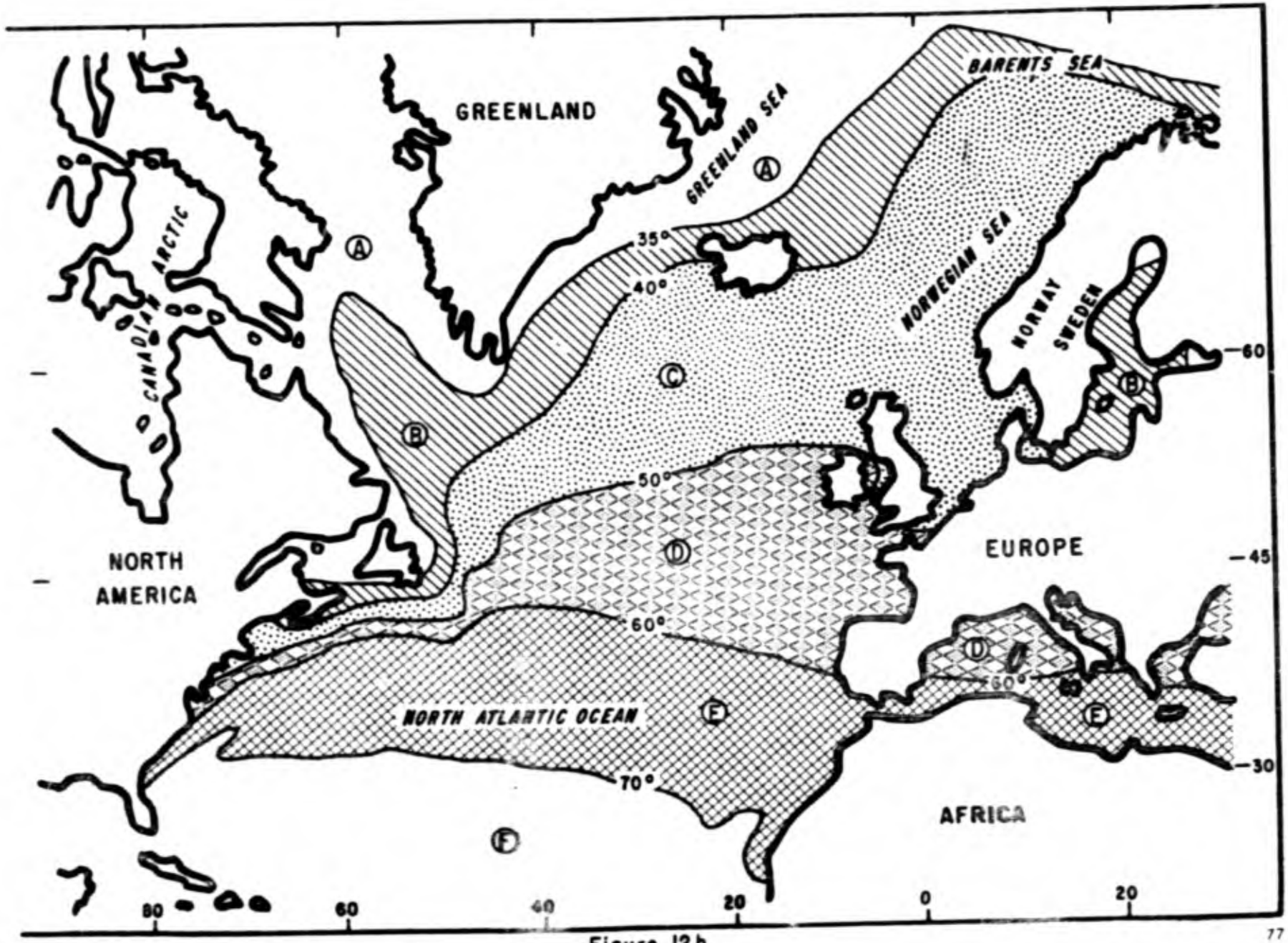

BARENTS SEA
GREENLAND
GREENLAND SEA
CANADIAN ARCTIC
NORWEGIAN SEA
NORWAY
SWEDEN
35°
40°
50°
60°
70°
NORTH AMERICA
EUROPE
NORTH ATLANTIC OCEAN
AFRICA
A
B
C
D
E
F
80
60
40
20
0
20
60
45
30

Figure 12b

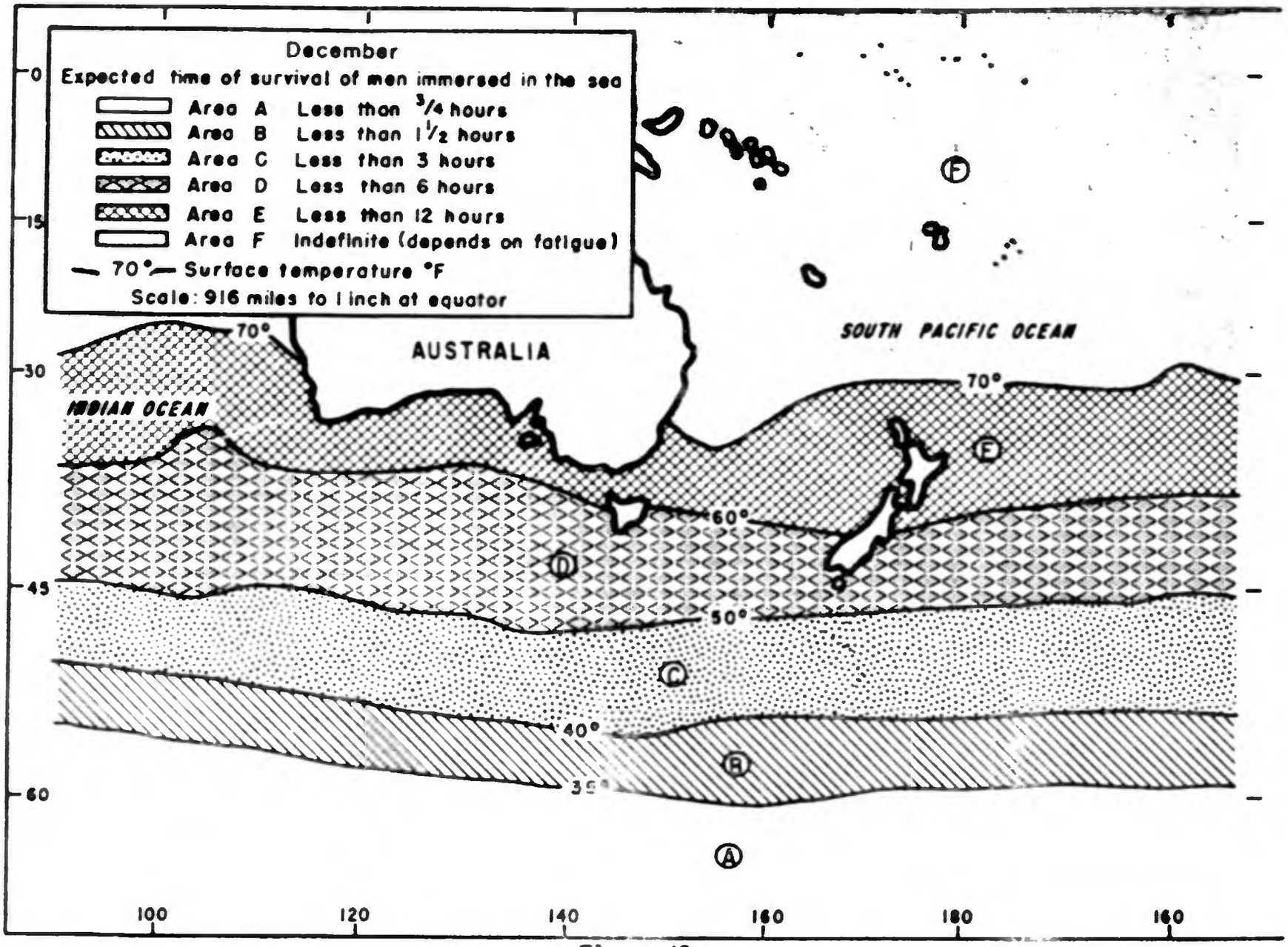
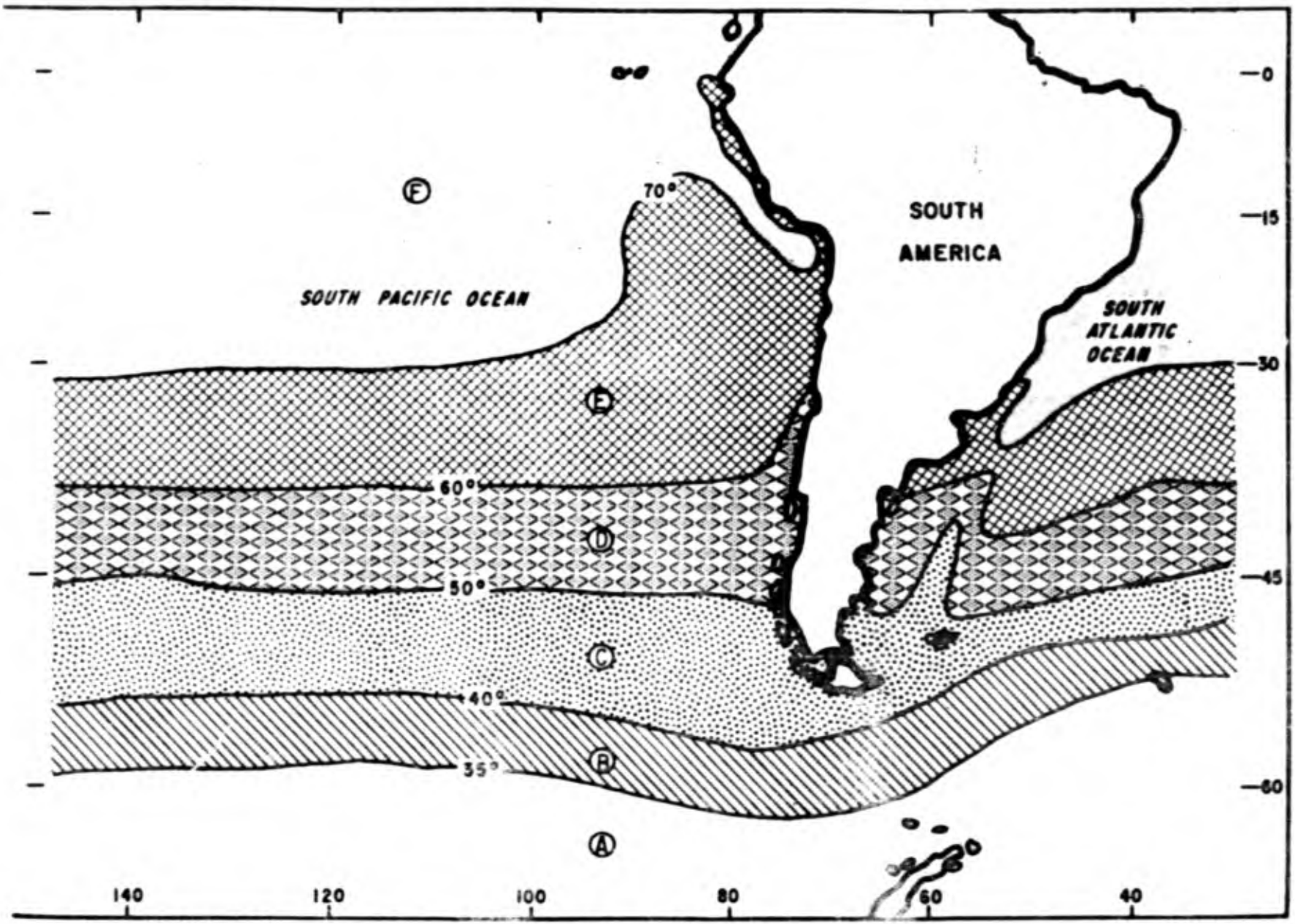

December
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
70° Surface temperature °F
Scale: 916 miles to 1 inch at equator
AUSTRALIA
INDIAN OCEAN
SOUTH PACIFIC OCEAN
70°
60°
50°
40°
35°
F
D
C
B
A
0
15
30
45
60
100
120
140
160
180
160

Figure 12c


SOUTH PACIFIC OCEAN
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
70°
60°
50°
40°
35°
F
E
D
C
B
A
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15
30
45
60
140
120
100
80
60
40

Figure 12d

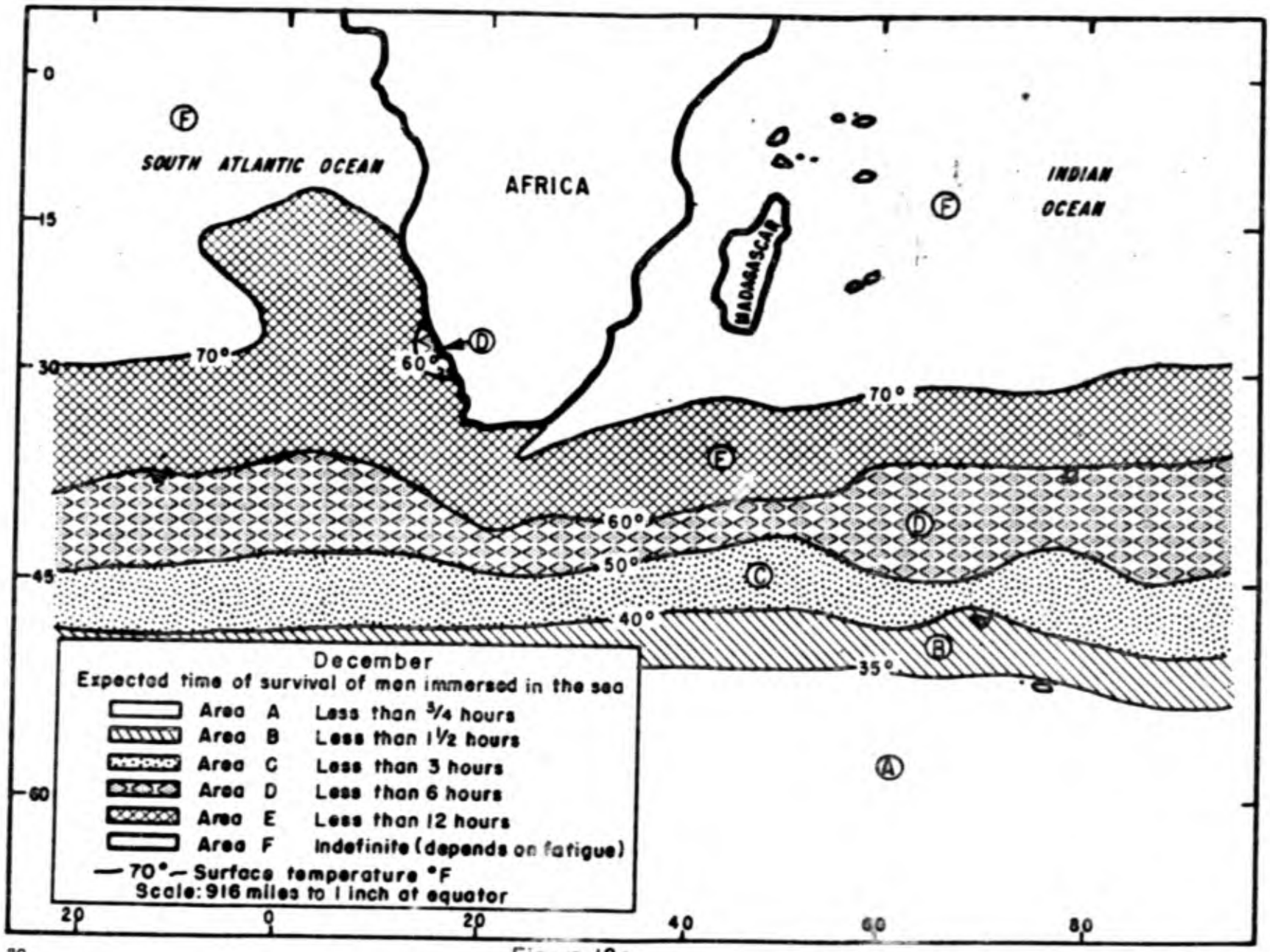
SOUTH ATLANTIC OCEAN
AFRICA
INDIAN OCEAN
MADAGASCAR
0
15
30
45
60
70°
60°
70°
60°
50°
40°
35°
December
Expected time of survival of men immersed in the sea
Area A Less than 3/4 hours
Area B Less than 1 1/2 hours
Area C Less than 3 hours
Area D Less than 6 hours
Area E Less than 12 hours
Area F Indefinite (depends on fatigue)
— 70° — Surface temperature °F
Scale: 916 miles to 1 inch at equator
20
0
20
40
60
80

Figure 12e

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For a more complete listing of water survival literature write: Director, Research Studies Institute, Attn: ADTIC, Maxwell AFB, Alabama.