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Pacific Landforms and Vegetation: OPNAV-16-VP 107, May 1945 -- [Part 2, Vegetation]

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Pacific Landforms and Vegetation
OPNAV-16-VP 107, May 1945

by
Air Intelligence Group
Division of Naval Intelligence
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[United States Naval Photographic Intelligence Center
Navy Yard, Washington 25, DC]

Robert L. Bolin, Depositor, University of Nebraska-Lincoln, Libraries

Abstract

On the cover this report is listed as Photographic Intelligence Center Report 7, May 1945.

Note: The title page was torn out.

The purpose of this report is to acquaint photo interpreters with the military geology and vegetation of eastern Asia and the western Pacific areas where World War II was fought. It contains detailed descriptions along with numerous illustrations and photographs of various types.

The forward was signed by Marine Lieutenant Colonel Charles H. Cox as the Officer-in-Charge, Photographic Intelligence Center.

The report contains a list of 39 publications available and in preparation at the US Naval Photographic Intelligence Center.

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INTRODUCTION

The natural vegetative cover is classified into a limited number of broad groups or types that can be readily identified on aerial photographs by the interpreter. Technical ecology and botanical classification using scientific terminology is purposely avoided, as such detail is of little significance to the interpreter. Descriptive type names such as Short or Tall Grass, and Moss or Conifer Forest are generally used avoiding many local names that usually apply to only one region.

For military information, interest regarding vegetation is usually confined to the collective features of ground cover comprising types. The term, type, applies to an area of land supporting a particular kind or group of plants forming vegetative cover with certain characteristics. These require separate consideration consistent for the area affecting military operations; such as, movement of forces, concealment from the air or the ground, ease of clearing, and uses of the resource.

Some types are large and extensive. As an example, Rain Forest may cover hundreds of square miles, while other types may be clearly confined to an area of less than one square mile, such as Mangrove Swamp, which occupies a small tidal flat.

Landform characteristics, treated in Part One, are not included in this consideration of military operations in vegetative types. However, the combination of plant cover, topography, and moisture influences the movement of forces, especially motorized equipment. Occurrence of tree species shown on aerial photographs frequently indicate certain existing landforms. Often features of topography give reason to expect that they afford sites for particular vegetative types.

In addition to natural types of vegetation, the kinds of crops grown on cultivated lands justify analysis by the photo interpreter for the height and density of the crop on the ground, or moisture requirements in various stages of cultivation can influence military operations.

A key is contained in each section as an aid to the identification of natural vegetation types and cultivated crops shown on aerial photographs. Keys have certain limitations as they require careful study of each step to obtain the correct answer.

Types are not always definite in extent, and there are border cases that contain the mixed composition of several types. Variation may exist due to change in climate, soil, water, altitude, or disturbance by man.
NATIVE TROPICAL VEGETATION
CHARACTER OF TYPE

Vertical and oblique photographs provide the best means of delineating vegetation types of military significance. The broad classifications needed are easily determined from good black and white photographs.

Fig. 8.01 Rain Forest that is partly cleared. The large tree in the right background is Banyan; portion of a Papaya tree right foreground; Cocoa trees left foreground; red flowered trees are commonly called Flame of the Forest.

Fig. 8.02 Rain Forest with undergrowth showing a low Bamboo clump in right foreground.

Fig. 8.03 Rain Forest that has been partly cleared for cultivation; the largest trees are Banyans; Taro at lower right; and Cocoa trees in center background to left and right of road.

Fig. 8.04 Typical buttressed tree common in Rain Forest.

Fig. 8.05 Cultivated land. A coconut plantation free of undergrowth. Spacing of trees allows good visibility on the ground. Note fern epiphytes on tree trunks.

Fig. 8.06 Nipa Palm forming a fringe type on opposite river bank. Coconut palms are in the background.

Fig. 8.07 Nipa Palm on left bank of river, showing uniform height and absence of stems. Brackish water floods the area at high tide. Coconut trees and undergrowth on the right bank.

Fig. 8.08 Rain Forest extending to high water level on banks of river; note vine covered stumps in foreground and undergrowth beneath the Coconut trees. Hill in the background has short grass type cover.

Identical areas shown in figures 8.01 through 8.08 are also shown in vertical and oblique photographs on pages 8.03 and 8.04
The purpose of presenting close up ground photographs of vegetation types with accompanying vertical and oblique aerial photographs of the same areas shown on this page, is to give the interpreter a better understanding of how various trees and herbs with certain characteristics go together forming vegetative types that can be recognized on aerial photos.

Areas included in photograph sets on page 8.02 can be located on the vertical and oblique aerial photos on this page and the next.

By close study of stereo pairs individual trees shown in Figs. 8.01, 8.02, 8.03, and 8.04 on page 8.02 can be observed in respective fields of view shown on corresponding aerial photographs of Rain Forest on this page. The location being shown at the point formed by the lines bounding the field of vision.

The areas in photograph Figs. 8.05, 8.06, 8.07 and 8.08 correspond with the vertical and oblique photos taken along the Matanikau River showing Nipa Palm, Rain Forest, and Short Grass types. Note the Nipa Palms at the bridge shown in Fig. 8.06 for comparison with vertical and oblique photographs of the same area on this page and the next. The Short Grass in the background of Fig. 8.08 is visible in the vertical and oblique with the field of vision designated.
NATIVE TROPICAL VEGETATION
CHARACTER OF TYPE

FIG. 8.11 MATANIKAU RIVER, GUADALCANAL

FIG. 8.11
Rain Forest follows along the drainage system, lower dividing hills are covered with Short Grass type. Note to the right a Nipa Palm type at the bridge across the Matanikau River, Point Cruz area, Guadalcanal.

FIG. 8.12
Several types of vegetation are usually associated on dissected plateaus. Rain Forest follows the lateral drainages. Short Grass occurs on steep, well drained slopes, while land subject to flood along a braided stream is suitable for Tall Grass or Wild Cane.

FIG. 8.13
Field of vision designated is for area shown in stereo ground view Fig. 8.08. Note slope of ridge covered with Short Grass at upper right that is prominent in background.

8.04
FIG. 8.14 PACIFIC TROPICAL VEGETATION

Above oblique view contains representatives of all major natural vegetation types except Sago Palm. Vertical aerial photographs of similar types occur elsewhere in this part.

LEGEND VEGETATION TYPES
1---MOSS FOREST
2---RAINFOREST
3---SHORT GRASS
4---SAVANNAH
5---TALL GRASS
6---SWAMPFOREST
7---WILDCANE
8---NIPAPALM
9---MANGROVE
10---CASUARINA
NATIVE TROPICAL VEGETATION
IDENTIFICATION OF TYPE

KEY FOR THE IDENTIFICATION OF VEGETATIVE TYPES IN THE PACIFIC TROPICS

A Plants not cultivated; no man-made pattern discernible. Reference C
B Plants in rows; man-made cultivation pattern discernible. Ref. Section X
C Plants growing in swampy or poorly drained soil, subject to flooding. Ref. D
D Plants growing in well drained sites; rarely or never subject to flooding. Ref. H

E Leaves light in tone; rarely in distinct rosettes; all plants in clump are of uniform height (about 10 feet) without distinct flower stalks; usually grow in pure compact stands along stream banks near coast with roots submerged in brackish water. Ref. G
F Grass of uniformly grey tone and with "velvety" texture resembling sugar cane; usually confined to stream banks. Ref. I

G Trees usually dark in tone, with uniform height of 20 to 40 feet, confined to muddy coastal fringes and stream banks inland to the limits of brackish water. Ref. J
H Trees of mottled tone and variable heights up to 150 feet, usually bounded on the seaward side by mangrove and on the landward side by rainforest. Ref. K

I Grass from 4 to 12 feet high; coarse texture. Moist level sites. Ref. L
J Grass from 1 to 4 feet high; fine texture, well drained, rolling to steep terrain. Ref. M

K Trees resembling pine with narrow crown and long slender stem extending nearly to top of tree. These features frequently discernible from shadow case on light-toned sandy beach to which tree is usually confined; crown has a light grey tone in aerial photos. Ref. N

L Trees densely spaced, with bushes and vines, instead of grass constituting the understory; confined to humid areas. Ref. O
M Trees confined in tropics to altitudes of 4000 to 11,000 feet. Light in tone because of light reflected from dense growth of moss and lichen on branches and ground. Tallest trees usually less than 100 feet high. Ref. P
N Trees ranging from sea level to about 3000 feet. Mottled in tone because of the many species of trees which almost invariably grow in mixed stands - tallest trees 150 feet high or more. Ref. Q

O Dense undergrowth beneath trees. Crown canopy of trees usually of variable height with frequent small openings where direct sunlight can strike ground. Common in rolling country on steep slopes along stream banks and at edge of swamps. Ref. R
P Very little undergrowth beneath trees; largest trees form almost continuous crown canopy. Ref. S

8.06
FIG. 8.15 (E) NIPA PALM

FIG. 8.16 (E) SAGO PALM

FIG. 8.17 (F) WILD CANE

FIG. 8.18 (G) MANGROVE

FIG. 8.19 (A-G) SWAMP FOREST BETWEEN CULTIVATED AREAS

FIG. 8.20 (I) TALL GRASS

FIG. 8.21 (I) SHORT GRASS

FIG. 8.22 (J-N) SECONDARY GROWTH

FIG. 8.23 (K) CASUARINA

FIG. 8.24 (L) SAVANNAH

FIG. 8.25 (M) MOSS FOREST

FIG. 8.26 (N) RAIN FOREST

NATIVE TROPICAL VEGETATION
IDEN TIFICATION OF TYPE
NATIVE TROPICAL VEGETATION
NIPA PALM

NIPA PALM

I. OCCURRENCE
Nipa, or Nipah Palm, is distributed at sea level throughout the tropics on sites that are usually submerged at high tide. It is often found as a fringe along tidal streams. It is less tolerant to salt water than Mangrove, but in general is limited to brackish waters, often upstream and adjacent to Mangrove.

II. DESCRIPTION
This palm is not in tree form. The leaves are 10 to 15 feet long and form a uniform stand with a height about the same as the length of the leaves, which originate from the mud or ground surface. They usually grow in such dense stands that few, if any, other plants can grow in association with them.

III. OBSTRUCTION TO MILITARY OPERATIONS
(1) Visibility from the Air
Complete cover prevents observation from the air, except for large objects; however, these can easily be camouflaged or concealed by cut Nipa leaves.

(2) Visibility from the Ground
Troops or objects surrounded by Nipa are well hidden. Visibility is limited to ten feet or less in most stands. As a habit, the leaves extend out over the water along streams, and if the water is deep enough to accommodate boats they are easily concealed.

(3) Movement on Foot
Ordinarily very difficult because of soft, muddy ground, and dense growth. Troops usually sink in over their ankles in mud, making movement slow and laborious.

(4) Movement of Motorized Equipment
Movement through the dense growth is almost impossible for amphibious craft or boats even at high tide. Along rivers fringed by Nipa palms, the deepest part of the channel is normally found in close to the overhanging edge of the type.

IV. METHOD OF CLEARING
Nipa Palms are easily cut by hand labor using the Bolo knife or Malay Parang. Due to wet conditions, bulldozers would be ineffective, and burning impossible.

V. USES
Nipa is useless as building material, except for thatch construction. Dried leaves have some value for fuel.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS
Nipa is recognizable on vertical and oblique aerial photographs by its feathery appearance, light tone, uniform height, and swampy location.
Coastal deflected streams in the tropics are optimum habitats for Nipa Palm types. Extent of tidal influence can be readily traced along rivers lined with Nipa.

Nipa Palm along stream navigable for small river craft. Oblique photograph shows comparison for height of overhanging palm leaves above the water, with height of small boats in foreground. This illustrates how boats could be concealed from air observation.

Along river banks Nipa Palm type stands out in contrast to adjoining swamp and Rain Forest. Scale 1:15,000

FIG. 8.30 EMPRESS AUGUSTA BAY, BOUGAINVILLE I.
NATIVE TROPICAL VEGETATION
SAGO PALM

SAGO PALM

I. OCCURRENCE

Sago Palms, or Sac Sac, generally grow in swampy areas inland beyond the extent of brackish water. They are frequently found along the coastal deltas, but the largest stands exist along alluvial flood plains within 10° of the equator.

II. DESCRIPTION

Some forms of Sago are smooth, while others are very spiny. Sago palms are usually more uneven in height than Nipa because the Sago Palm matures at various heights, often reaching heights of 30 feet or more, whereas Nipa palms rarely exceed 15' in height. Pure stands of Sago Palm are less common than Nipa palm, as Sago usually grows in association with other palms and hardwoods. The Sago Palm has a horizontal stem, which lies on the top of the mud and produces many clusters of leaves. An erect trunk 20 to 30 feet tall extends upwards from the end of this horizontal stem.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air

Cover is usually complete.

(2) Visibility from the Ground

The dense tangled growth provides good cover. Visibility is limited to a few yards.

(3) Movement on Foot

Movement is usually difficult because of the horizontal stems, crooked trunks, and an undergrowth of bushes. The soil is always soft and muddy, and often under fresh water.

(4) Movement of Motorized Equipment

If the soil is dry enough, tracked vehicles should be able to make their way through the entanglement.

IV. METHOD OF CLEARING

Because of the undergrowth, Sago swamps are generally more difficult to clear than Nipa swamps. If the ground is firm most of the trees can be removed by bulldozers. Living stalks are hard to burn because of their high moisture content.

V. USES

Sago Palms are soft and of little value for construction purposes. They are sometimes used by the natives for firewood. The erect trunk has great quantities of starch, which is the commercial sago and also a basic food in some areas. In such areas sago palms are sometimes planted in rows and cultivated. The starch is obtained from those trunks which are almost ready to flower. The trunk is split and the soft inner parts are removed, crushed, washed, and allowed to settle forming cakes of starch.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Sago Palm appears darker in tone than Nipa Palm and more uneven in height. This dark tone is broken only by the flowers which extend higher than the general level and appear as light dots on the photograph. The leaves of each palm radiate from the top of the stalk to form a distinct rosette, often star-shaped. Such a pattern is rarely seen in other palms.
Sago Palm showing flower stalk which gives the type an irregular height. Note undergrowth in foreground which is typical in association.

The different trees in association with Sago Palm give the type various tones in aerial photographs.

Oblique view of Sago Palm type on flood plain.

Sago Palm type in center of stereo pair. White dots are flower rosettes that distinguish Sago. The Nipa Palm along the stream, and Coconut trees in lower foreground show comparison with Sago Palm.
NATIVE TROPICAL VEGETATION
WILD CANE

I. OCCURRENCE

Wild Cane, or Pit Pit, occurs in swampy, low-lying coastal plains, lake plains, or river plains. It is often found along stream banks, or overflow areas, and is usually limited to small sites which may be covered with several feet of fresh water.

II. DESCRIPTION

It is a wild species of sugar cane and individual plants rather closely resemble the domestic species. It is a tall grass plant, sometimes attaining a height of 12 feet, and is light green in color. It produces a white tassel of flowers.

III. OBSTRUCTION TO MILITARY OPERATIONS

1. Visibility from the Air
   Cover from the air is complete in tall Wild Cane. However, trampling or other disturbance of the grass by troops will leave signs which might lead to their detection from the air.

2. Visibility from the Ground
   Concealment from ground observation is good. Visibility is limited to a very few feet.

3. Movement on Foot
   Travel on foot is difficult, as Wild Cane often grows in water or on muddy ground and forms a stand of coarse canes.

4. Movement of Motorized Equipment
   Tracked vehicles can maneuver through the grass if the site is dry enough for traction.

IV. METHOD OF CLEARING

Clearing is easy if the area is not covered by water and the ground is not soft or muddy. Stands of Wild Cane are sometimes dry enough to burn.

V. APPEARANCE ON AERIAL PHOTOGRAPHS

Wild Cane appears light in tone and even in height resembling Kunai grass, but with a coarse, felt-like texture that is more characteristic of domestic sugar cane. It can be distinguished from the latter because domestic sugar cane is grown in uniformly rectangular fields.

VI. USES

Wild Cane has little or no military value, though the stalks may have a high sugar content.
FIG. 8.41 NEW GUINEA
Wild Cane type adhering to meandering stream course. Tall Grass types occupy slightly higher portion of flood plain, while Short Grass types are found on intermediate stream ridges.

FIG. 8.42
Light velvety-toned type along meandering river is Wild Cane.

FIG. 8.43
Wild Cane along braided river. Tall Grass occupies the site higher on flood plain. Note burned over portion of Tall Grass and Wild Cane types are darker in tone and small topographic detail is visible. Scale 1:9000.
NATIVE TROPICAL VEGETATION
MANGROVE SWAMPS

MANGROVE SWAMPS

I. OCCURRENCE

Along muddy coast lines between the limits of tide and along stream banks as far inland as the limits of brackish water.

II. DESCRIPTION

Mangrove trees usually grow to a height of about 40 feet, although occasionally they reach heights up to 150 feet. They have thick, dark green leaves and air roots. The roots often extend from the trunk at a height of ten or more feet above the ground and develop at right angles to the trunk. Since the trees grow close together the roots and trunks form a dense tangle. A smaller tree known as "Api-Api" (Avicennias) is often found at the outer fringe of the mangrove swamp. On the inner edge of the swamp larger trees, including "Bruguiera Sp.", are often found merging into the normal Rain or Swamp Forest. At low tide the ground is often thick mud, varying in depth from a few inches to several feet. Numerous small, but often deep, water courses meander within the general swamp.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
Cover is generally complete.

(2) Visibility from the Ground
Concealment is usually good.

(3) Movement on Foot
Movement is difficult and usually requires much cutting. The ground is muddy and slippery at low tide, and under water at high tide. Deep, muddy streams are common throughout the swamps. Travel on foot is made difficult not only by the soft mud, but also by numerous air roots and large tree trunks with knees, the underwater portion of which often are covered with oyster shells that are sharp and may inflict serious cuts upon the traveler.

(4) Movement of Motorized Equipment
If there are sufficiently deep channels it is often easier to traverse the swamp by boat than on foot, especially at high tide. Mangrove swamps usually are barriers to all amphibious craft and tracked vehicles.

IV. METHOD OF CLEARING

Clearing must be done by hand labor. This is difficult to do because of the slippery ground and the density and toughness of the stems and aerial roots.

V. USES

Large mangrove trees have very heavy, hard wood which makes excellent fuel. The straight portions of the trees can be used for a very durable piling.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Mangrove swamps can usually be recognized on aerial photographs by their position along brackish, muddy stream banks; by their uniform, dark tone; and by their fine-textured, even canopy.
FIG. 8.46
Uplifted coral heads entirely covered with Mangrove.

FIG. 8.47
Mangrove Swamp, high tide.

FIG. 8.48
Mangrove Swamp, low tide; note aerial root system.

FIG. 8.49
Mangrove Swamp shown in relation to other associated types. Casuarina and Swamp Forest can not tolerate salt water, while Mangrove requires sites that are submerged part time by tide.
NATIVE TROPICAL VEGETATION
SWAMP FOREST

I. OCCURRENCE
On low, swampy land which, though subject to flooding during the rainy season, may often be comparatively dry at other times of the year. Frequently found in association with scattered Sago Palm and adjacent to Rain Forest occupying higher ground.

II. DESCRIPTION
Consists of a dense growth of trees, shrubs, and vines with occasional thin stands of Sago Palm. A distinctive feature of swamp forest is the large buttressed tree trunks. The crowns of the trees often are flat-topped.

III. OBSTRUCTION TO MILITARY OPERATIONS
1. Visibility from the Air
Cover for troops is complete.

2. Visibility from the Ground
Within the forest concealment is good. Due to heavy undergrowth and the large, buttressed trees, visibility is limited to a few yards.

3. Movement on Foot
Movement is difficult because of the large, buttressed tree trunks, the heavy growth of tangled vines and swamp palms, and the boggy condition of the soil. During the wet season the whole area may be covered with several feet of water.

4. Movement of Motorized Equipment
Movement of motor vehicles is generally impossible because of the mud and water throughout most of the forest.

IV. METHOD OF CLEARING
Clearing is usually done by hand labor, but is difficult because of the large, buttressed trees, the tangled undergrowth and swampy ground conditions.

V. USES
Some of the large species of trees found in Swamp Forest have hard wood and make excellent firewood, lumber and structural timber.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS
The trees are usually of uneven height and frequently have flat tops. Water may be visible through gaps in the crown canopy. The presence of Sago or Nipa Palms, the low altitude of terrain, and the proximity of open bodies of water offer further indications. Often the tree tops are engulfed by vines, giving a mottled appearance from the air.

FIG. 8.50
Low, swampy terrain supporting typical Swamp Forest.

FIG. 8.51
Swamp Forest trees growing in flooded area which is dry part of the year. Swamp Forest cannot tolerate salt water.
FIG. 8.52
Swamp Forest on site slightly above water level of river.

FIG. 8.53
Swamp Forest occupies low, flat, flood plain too wet for support of Rain Forest.

FIG. 8.54 NEW GUINEA
Swamp Forest inhabiting flood plain above extent of brackish water. Looking down through openings in the canopy, water can be seen standing in areas remote from main streams. Scale 1:6,000.
NATIVE TROPICAL VEGETATION
TALL GRASS

I. OCCURRENCE
A common type of the tropical and semi-tropical plains, plateaus, or sometimes undulating terrain. Often considered as swamp grass, but not to be confused with wild cane which is a distinct separate type occurring along streams near the coast. Tall Grass types may exist from sea level to an altitude of several thousand feet.

II. DESCRIPTION
The type, also known as Lalang, Alang Alang, Kogon or Cogon depending on the locality, is a tall, coarse, rapidly growing grass. It grows in great profusion and stands from 4 to 12 feet high and springs up quickly after a fire. The blades of grass are about ½ inch wide with usual longitudinal fold and sharp, serrated edge.

III. OBSTRUCTION TO MILITARY OPERATIONS
(1) Visibility from the Air
There is no concealment unless the grass is extremely high. Disturbed grass usually accentuates track activity.

(2) Visibility from the Ground
The grass is usually taller than a man, causing visibility to be very limited.

(3) Movement on Foot
In Tall Grass travel is difficult but not impossible. The type is disagreeable to troops because a fine dust arises from the grass. There is very little movement of air. Blades are sharp enough to cut through light clothing.

(4) Movement of Motorized Equipment
The grass is not a serious obstacle to wheeled vehicles; tracked equipment readily traverses it without resistance.

IV. METHOD OF CLEARING
The grass is easily trampled down. When dry it can be burned; however, the fire often spreads out of control.

V. USES
It has no military value and most of the species are too coarse for livestock forage.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS
In general, grass lands are the easiest types of vegetation to recognize on vertical or oblique aerial photographs. They usually cover extensive areas and have a very light, uniform tone. Although it may be desirable for military purposes to know the height of the grass, this usually can only be roughly estimated on aerial photographs. Considering probable soil, moisture content and level terrain, Tall Grass types can be distinguished from short grass on the hills. If some of the grass has been trampled, the height of adjacent grass is indicated by the length of the shadow on the trampled area.

FIG. 8.55
Typical Tall Grass type composed of several species all requiring wet soil. Coarse rush, sedge, and wiregrass species are common in the type.

FIG. 8.56 DUTCH EAST INDIES
Tall Grass type in the foreground. Plants estimated to be about eight feet high judging by comparison of height of associated shrubs. Dutch East Indies.
FIG. 8.57

FIG. 8.58 KIARI AREA, NEW GUINEA

FIG. 8.59 CAPE GLOUCESTER, NEW BRITAIN

FIG. 8.57
Oblique shows Tall Grass type on lower plain extending back to foothills; Short Grass type occupies higher, rough terrain that is well drained. Rain Forest follows courses of streams.

FIG. 8.58
Tall Grass type occupying flat coastal plain and adjacent foothills.

FIG. 8.59
Extensive Tall Grass type interspersed with Rain Forest. Darker toned grassland has been burned. Trails are most conspicuous in burned area, but can be traced through the Tall Grass. Height of grass is indicated by shadow of grass along trail and margin of burn. Scale 1:10,325
NATIVE TROPICAL VEGETATION
SHORT GRASS

SHORT GRASS

I. OCCURRENCE

The short, fine grasses of the tropics and temperate zone occur on rolling to steep hills that are
well drained, where soils are of poorer quality than found in the Tall Grass plains. For Short Grass
types there is a wide range in altitude of habitat, extending from a few feet above sea level to over
5000 feet in some localities.

II. DESCRIPTION

Short Grass types have numerous local names; Kangaroo grass is a common term used in the South
Pacific. Short Grass resembles Tall Grass on aerial photographs, but does not grow as coarse and
with slightly less density. The grass is from 1 to 4 feet in height, and is usually associated with an
occasional tree or shrub, frequently adjacent to Savannah and Rain Forest types.

III. OBSTRUCTION TO MILITARY OPERATIONS

(i) Visibility from the Air
There is no natural concealment possible.

(ii) Visibility from the Ground
The grass is never tall enough to obscure the vision of a man.

(iii) Movement on Foot
Not considering terrain, this type has the least impediment for ground troops. Native trails
follow the grassy ridges. Although there is no concealment, military forces often choose routes
through Short Grass types in preference to travel through bordering Rain Forest types that offer
concealment.

(iv) Movement of Motorized Equipment
The type itself is not an obstacle to any wheeled or tracked vehicles.

IV. METHOD OF CLEARING

Clearing is not necessary. When the grass is mature, fire sometimes rapidly spreads through the
type.

V. USES

No military use, unless forage is needed for horses and mules; in such cases, green Short Grass makes
a fair supplementary food.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

As previously mentioned, Short and Tall Grass types are easy to recognize and separate from other
types, but the height of grass is difficult to determine from aerial photographs. Considering other
features, Short Grass can be distinguished from Tall Grass types with ease on most photographs when
using site as a basis for identification. Part of the year Short Grass types are yellow in color which
makes light gray tone on black and white photographs, with a uniform fine smooth texture.

Short Grass is not tall enough to cast a shadow along trails or edge of burn. Burned areas are
dark toned, and trails through the burn are more evident, although track activity in any Short Grass
type is easily detected.
FIG. 8.62  Short Grass type on sharp divides that are not suitable to support Rain Forest or Tall Grass types, which require greater soil moisture. Spur ridges would provide easy route of travel, but without concealment. Small area has been burned near the coastal drainage the third from the right.

FIG. 8.63  Dissected plateau covered with Short Grass type. The site assures good drainage. Shrubs growing in association is characteristic of the type.

FIG. 8.64  BLUCHER AREA, NEW GUINEA  Level terrain in foreground covered by Short Grass type. Comparing height of grass with palms make it obvious that the grass is less than four feet tall.
NATIVE TROPICAL VEGETATION
SECONDARY GROWTH

SECONDARY GROWTH

I. OCCURRENCE

Type is commonly found in vicinity of native villages or towns, where Rain Forest or Rain Forest with Undergrowth has been cleared for native gardens or plantations, which in turn have been abandoned. The soil supporting the original Rain Forest is usually of poor quality. After clearing it is not suitable for gardens after one or two years of use. Consequently, extensive areas have been cleared, gardens planted, and then abandoned. As a result, Secondary Growth invades the areas following cultivation as a stage of succession, in time returning to the original climax Rain Forest. Disturbance of Rain Forest by factors such as fire or land slides will be followed by Secondary Growth covering the area.

II. DESCRIPTION

Composition of the type consists of a variety of quick-growing, broadleaf, softwood trees and shrubs. The height depends upon age, but Secondary Growth types are generally composed of low trees and shrubs not exceeding 20 feet in height. The type is dense and often supports entangled vines that form an almost impenetrable jungle from the ground up to about 10 feet in height. In the first several years the type may consist only of a dense growth of vines, herbs and tree seedlings or sprouts.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
Cover is usually complete for troops, but motor vehicles and larger objects are usually visible.

(2) Visibility from the Ground
Concealment is normally very good with visibility limited to a few feet.

(3) Movement on Foot
Much cutting is required to allow penetration of troops because of the dense, tangled growth.

(4) Movement of Motorized Equipment
Motor transport is generally impossible; heavy tracked vehicles and tanks could break through most secondary types.

IV. METHOD OF CLEARING

Trails can best be cut with a heavy knife or axe. Bulldozers may be employed successfully for pushing large areas free of vegetation, especially when the trees are less than six inches in diameter. Under favorable conditions fire will burn the type if there is a mixture of dry weeds and grass present.

V. USES

Most of the trees are soft wood, and too small to be of timber value, except for poles.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Usually appears as small mottled patches less in height and lighter in tone than surrounding forest. A sharp artificial line demarking limits of the former cleared area usually can be distinguished. Remnants of previous rows of crops can often be observed.

FIG. 8.65
Secondary Growth composed of young broadleaf trees and palms. Difficulty of travel on foot is indicated by density of the type.

FIG. 8.66
New Secondary Growth type consisting of a variety of trees and shrubs. Understory of grass present could cause fire to rapidly spread during dry period.

FIG. 8.67
Oblique stereo pair showing Secondary Growth type back of Coconut plantation straight lines bound the type.
FIG. 8.68 Mixture of palm plantations, gardens and secondary growth types. Abandoned garden plots are turning to Secondary Growth type in first stage of succession toward climax Rain Forest.

FIG. 8.69 Secondary Growth type lines are distinct due to previous clearing.

FIG. 8.70 Mangrove Swamp along coast line; Secondary Growth covering upland. Scale 1:13,000.

FIG. 8.71 Extensive Secondary Growth types in vicinity of village. Scale 1:13,000.
NATIVE TROPICAL VEGETATION
CASUARINA

I. OCCURRENCE

Casuarina is widely distributed in the Pacific tropical islands. It generally grows in narrow stands along elevated sandy beaches, and usually indicates an area above high tide level that is well suited for mechanized landing equipment. On Java and certain other islands, another kind of Casuarina forms forests inland up to an altitude of 9000 feet.

II. DESCRIPTION

The word Casuarina is both the scientific and common name for the tree that is also locally known as Agaho and Ironwood. This tree has a gray-green foliage, resembling Pine, although they are not Conifers. Mature trees are medium sized, growing to approximately 100 feet in height and 8 to 36 inches in diameter. They form open stands, but the canopy overhead is fairly continuous. As the sandy beach builds up, Casuarina seedlings and sprouts encroach upon the newly formed elevated strip of sand which gives the trees the appearance of being in rows. There is little undergrowth in Casuarina stands except reproduction. The ground surface is usually covered with duff consisting of leaves, twigs and numerous seeds.

III. OBSTRUCTIONS TO MILITARY OPERATIONS

1. Visibility from the Air
   Cover is good under the complete canopy, though the stands are often very narrow.

2. Visibility from the Ground
   Concealment from ground observation is fair to poor since there is little or no dense undergrowth. Visibility from within is generally good.

3. Movement on Foot
   Travel through Casuarina groves is usually easy. Trees are spaced irregularly, allowing troops to pick a way through the type.

4. Movement of Motorized Equipment
   In many cases lanes are wide enough to let vehicles through. The ground is usually firm, well drained, and there are small quantities of undergrowth to impede tracked or wheeled vehicles.

IV. METHOD OF CLEARING

The wood is hard and tough and mature trees must be felled with an axe or saw. Trails through occasional undergrowth can be cut with bolos or taken out with bulldozers.

V. USES

Large trees make good post and pole material for construction purposes, as the wood is strong, heavy and durable. It also makes good firewood. Cities in tropics and semi-tropics often use Casuarina for wind breaks and shade along streets.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Casuarina appears light in tone on aerial photographs. It is often recognizable by the shadow cast on the light, sandy beach which reveals an excurrently branched stem similar to that of Pine. On large scale photographs a slight feathery appearance is noticeable. Heights are not uniform, but the type stands out in constrast to bordering vegetation.
FIG. 8.75
Casuarina on high, well drained sandy beach. Mangrove along back channel grows on site submerged part time by tidewater.

FIG. 8.76
Planted Casuarina along a city street.

FIG. 8.77
Casuarina type along high, well drained sandy beach. A row of reproduction is noticeable between the mature trees and the high water line. Good traction for vehicles is evident by presence of tracks.

FIG. 8.78
Street lined with two rows of planted Casuarina trees which are mature and larger than most of those found in natural stands.
NA T IV E T R O P I C A L V E G E T A T I O N
SA V A N N A H F O R E S T

SA V A N N A H F O R E S T

1. OCCURRENCE

Confined to areas of less rainfall, especially on plains to the leeward of high mountain ranges, in tropic and temperate zones, usually from sea level up to medium altitudes. Soils supporting the type are usually porous, well drained, and of poor quality consisting of sandy clay.

II. DESCRIPTION

Trees in a Savannah type are drought resisting, most nearly resembling desert vegetation of any trees in the tropical zone. They are widely spaced, from approximately 20 yards to over 100 yards apart. Oblique views often appear as an open orchard. Wide spacing allows the growth of dense ground cover of grass as an understory that is usually from 1 to 4 feet high extending through the entire type area.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
Cover is poor to fair depending upon the density of trees and height of the grass. Concealment is usually limited to small spots beneath the scattered trees. Vehicle track activity, in general, is clearly visible in the trampled grass.

(2) Visibility from the Ground
Concealment of troops or motor transport is usually difficult and visibility is normally good because the grass is less than head high in the open woodland.

(3) Movement on Foot
Troops can move freely through the type as there are no vegetation obstacles.

(4) Movement of Motorized Equipment
Wheeled and tracked vehicles can operate without difficulty. The type is always well drained and the soil is dry and solid except during wet weather. It quickly dries following rain storms.

IV. METHOD OF CLEARING

Clearing is obviously easy and not necessary for troop movement. Bulldozers can remove the shrubs and smaller trees. Blasting is practical for trees over six inches in diameter.

V. USES

Trees of the Savannah type have little value except for firewood. The grass provides seasonal range for livestock.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

The trees are of medium height, widely but uniformly scattered and having a gray tone in contrast with existing light toned cover of grass.

8.26

FIG. 8.79
Arid site inhabited by small trees and shrubs composing a Savannah type.

FIG. 8.80
Typical site occupied by Savannah has rolling terrain, dry soil with frequent outcropping of rock.
FIG. 8.81 NEW GUINEA

Level plain supporting Savannah and dry crop plots. Note the distinct type line at base of mountain which is covered with Short Grass.

FIG. 8.82 NEW GUINEA

Rolling plains covered by Savannah type. Fringe of Rain Forest exists along permanent streams. Roads and buildings in woodland are conspicuous. Trails are made by livestock. Scale is 1:3,800.

FIG. 8.83 NEW GUINEA

Roads, trails and structures clearly defined in extensive Savannah woodland.
NATIVE TROPICAL VEGETATION
MOSS FOREST

MOSS FOREST

I. OCCURRENCE

Widely distributed in the eastern tropics where mountains are saturated by an almost continuous cloud belt. Most commonly found on steep mountain slopes between altitudes of 3,000 and 10,000 feet or slightly lower on north windward exposures.

II. DESCRIPTION

The site is wet resulting from long periods of rain and fog which completely saturates the soil and deep humus. The soil is generally clay, or sandy clay that supports this type of forest. The stand consists of a dense growth of small trees, often less than 30 feet high, with branches close to the ground dripping with moisture. The tree trunks, tangled branches and ground surface are covered with mosses, ferns, epiphytes, and other herbaceous plants. Moss Forest is sometimes referred to as an "Elfin Forest" because of the curiously dwarfed grotesque form of the trees.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
   Cover from the air for troops is complete.

(2) Visibility from the Ground
   Concealment is good with visibility restricted to a few yards because of the dense growth of branches close to the ground. Moss and epiphytes on the trees and ferns on the ground also limit vision.

(3) Movement on Foot
   Extremely difficult and hazardous. The low branches of the trees form a dense network close to the ground and footing is hidden by thick layer of moss and humus. In limestone formations moss often covers deep chasms, and a false step may cause a fall of many feet. Natives and military forces usually avoid Moss Forest.

(4) Movement of Motorized Equipment
   Travel of all vehicles is practically impossible. Wet conditions associated with usually steep terrain makes Moss Forest a barrier to traction equipment.

IV. METHOD OF CLEARING

Clearing is usually difficult, axes or blasting is necessary to remove vegetation of the type.

V. USES

The trees are usually small and crooked in shape with very little clear bole, making them inferior for timber, and normally too wet for firewood.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Similar to Rain Forest but generally lighter in tone due to the reflected light from the moss and ferns. Crowns of individual trees present a slightly distinct round or conical appearance that are smaller and lower than those of a Rain Forest. Identifying the type on aerial photographs, the interpreter should keep in mind the occurrence is limited to altitude and wet climate prevailing within the cloud belt. Due to consistent cloud coverage, it is often difficult to obtain high vertical aerial photographs of the type.
Unusually tall trees in Moss Forest at altitude over 9000 feet.

Trees of tropical Moss Forest supporting variety of plants attached to trunks and branches. Altitude is over 3,000 feet.

Leaning trees of Moss Forest suggest direction of prevailing wind; herbaceous vegetation includes many species of ferns.
NATIVE TROPICAL VEGETATION
RAIN FOREST AND UNDERGROWTH

RAIN FOREST AND UNDERGROWTH

I. OCCURRENCE

Varities of this type are the most prominent and widely spread forms of vegetation cover in the Pacific tropics. Rain Forests with Undergrowth occur along high banks of watercourses, at the edge of clearings, or on slopes of most mountains. After abandoned clearings have been occupied by Secondary Growth, these types gradually evolve into Rain Forest with Undergrowth followed by Rain Forest without undergrowth which is the climax or permanent growth.

II. DESCRIPTION

Rain Forest with Undergrowth has the forest floor covered with a dense understory of tangled shrubs, creepers, vines, palms and other plants ranging up to 20 feet or more in height. The stand is not uniform in age or height until the mature Rain Forest type develops with a dense canopy.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
Complete concealment usually is provided by the combined effect of the overhead canopy and undergrowth.

(2) Visibility from the Ground
Concealment within the forest is very good when there is dense undergrowth. Visibility is usually better after the undergrowth has been shaded out.

(3) Movement on Foot
When undergrowth exists troop movement is extremely difficult, slow, and laborious, requiring a great amount of work to open trails. Rain Forest without undergrowth allows easy travel.

(4) Movement of Motorized Equipment
Large trees are barriers; heavy tracked vehicles can slowly break way through most of the undergrowth.

IV. METHOD OF CLEARING

Knife work or bulldozers are practical to remove undergrowth. Large trees must be felled by axe and saw, or sometimes blasting is effective. Large trees in camp areas are often cut to avoid danger of wind fall.

V. USES

Rain Forest contains various species of hardwoods that are suitable for saw timber. Bridge timber, sills, shoring, and plank for decking are the principal uses for timber sawed into lumber for military purposes. This does not require so much selection of species as the choice of tall trees having clear, sound boles of three to four log lengths. Tall saw timber can usually be found by examination of aerial photographs; also other important features, such as density of the stand, accessibility for a logging operation, and extent of the desired type can be determined.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

This type has a mottled appearance as the mixed stands contain species with leaves lighter in tone than other associated species. A few dead, or partially deciduous trees scattered in the forest canopy add to the mottled effect. The general tone is lighter than Mangrove but darker than that of Moss Forest. The texture is rough, or irregular due to variation in size and height of the trees.
Rain Forest with small amount of Undergrowth. Tree boles are tall and straight indicating dense shade that excludes undergrowth.

Cleared area supporting grass, shrubs and small trees in Rain Forest with Undergrowth type.

Oblique view of Rain Forest with Undergrowth. Note the variation in tree heights and density of understory.

Rain Forest almost free of Undergrowth. Movement of troops on foot would be easy through this type. Large trees are too close together for vehicles to travel.
NATIVE TEMPERATE ZONE VEGETATION
NATIVE TEMPERATE ZONE VEGETATION
IDENTIFICATION OF TYPE

FIG. 9.01  (B-D) SEMI-TROPICAL FOREST AND CULTIVATED LAND

FIG. 9.02  (D) TRANSITION FOREST AND BARREN LAVA

FIG. 9.03  (D) CONIFER TIMBER AND SECOND GROWTH

FIG. 9.04  (E) ALPINE TYPE OF NORTHERN MEDIUM ALTITUDE SITE

KEY FOR THE IDENTIFICATION OF VEGETATIVE TYPES IN THE PACIFIC TEMPERATE ZONE NORTH OF 22°

A  Plants uncultivated; no man-made pattern discernable.

B  Plants cultivated; geometric, man-made pattern.

C  Forest types; area densely covered with trees.

C  Scrub trees and brush widely scattered with areas of herbaceous plants or tundra readily apparent in open spaces between trees.

C  No trees present; grass 1 to 4 feet high.

D  Hardwoods 30 to 60 feet high; altitude 100 to 1000 feet above sea level; uniform dark tone.

D  Mixture of evergreen and deciduous hardwoods including Mulberry thickets; some conifers present. Trees 40 to 100 feet high, altitude 1000 to 4000 feet above sea level; lack of uniformity gives mottled tone.

D  Evergreen conifer timber 60 to 150 feet high; altitude 4000 to 10,000 feet above sea level; conical shape with uniform grey tone.

E  Trees low to medium height; widely spaced with ground covered by grass readily apparent between the trees; confined to dry sites with altitude 300 to 1000 feet.

E  Dwarfed trees and low, flat brush scattered among moist herbaceous plant cover including Tundra. Altitude over 10,000 feet above sea level.*

* Altitude range for Conifer Forest and Alpine types occur at lower elevations farther North so that the types extend to sea level near the Arctic Zone.

For identification of Savannah and Grassland types, the photographic interpreter can make reference to the Tropical Vegetation section, as the characteristics of these types occurring in the Temperate Zone are similar to those of the Tropics.

The description and significance regarding military operations in Semi-Tropical types is comparable to that given Rain Forest in the Tropical section and should be referred to for detail.

The Transition type is an unstable mixture of natural types and often the result of abandoned cultivated lands or areas denuded that are in stages of succession toward original natural types. Characteristic details can best be determined by reference to natural or cultivated lands the Transition most nearly resembles, which might be varieties or mixtures of Conifer Forests and hardwood types. Climate may cause the type character to range from Semi-Desert scrub to the Secondary Growth as described in the Tropical Section.
CONIFER FOREST

I. OCCURRENCE

Widely distributed in mountainous areas between altitudes of 4,000 and 10,000 feet above sea level in most of the Temperate Zone, except near the Arctic Zone the type extends down almost to sea level. Usually found on sites where the temperature is moderate and soils are well drained.

II. DESCRIPTION

In general, the trees are evergreen and cone bearing. They grow straight and tall, often reaching a height of 150 feet. Branches are arranged in whorls from a main trunk that is continuous to the extreme top. Species include cypress, pine, spruce, larch, cedar and fir.

Except in very remote areas most of the virgin forest has been cut, and trees remaining are scattered or second growth.

III. OBSTRUCTION TO MILITARY OPERATIONS

1. Visibility from the Air
   Dense canopy composed of mature trees and undergrowth conceals troops and large objects on the ground.

2. Visibility from the Ground
   Vision is obstructed in proportion to the density of the reproduction. Visibility is good if the stand is mature and has a canopy that shades out undergrowth.

3. Movement on Foot
   Usually easy to select a route through the type.

4. Movement of Motorized Equipment
   Tree trunks with diameters over 8 inches are barriers to all types of vehicles; tracked equipment can go through most young reproduction.

IV. METHOD OF CLEARING

Cutting by axe or bulldozers will clear reproduction. Larger trees require felling with saws. Stumps are blasted or burned.

V. USES

Mature trees make excellent softwood lumber and fuel. Reproduction is useful for posts and poles.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Uniform light gray tone and casts shadows similar to Casuarina. Tall slender trees are conical in shape.

Fig. 9.05
Small Conifer Trees, mountains of North Philippine Islands.

Fig. 9.06
Conifer timber and mixture of Transition types with second growth. Scale 1:4,000.

Fig. 9.07
Vertical photograph of pure Conifer Forest. Small opening at upper edge was caused by fire.
NATIVE TEMPERATE ZONE VEGETATION
FORESTS OF JAPAN

FIG. 9.08 JAPAN
Transition Forest of evergreen oak and camphor. Japan.

FIG. 9.09 KURILE ISLANDS
Fir, pine and hardwoods. Note flat crowns due to wind action. Kurile Is.

FIG. 9.10 JAPAN
Natural stand Kashiwa Oak in Southern Hokkaido, Japan.

FIG. 9.11 JAPAN
Spruce Forest. Central Hokkaido, Japan.
FIG. 9.12 JAPAN
Land depleted of forest has been terraced and planted with conifers to hold the soil. This area could appear on aerial photographs as terraced hill crop land.

FIG. 9.13
Scattered low shrub successional of deforestation.

FIG. 9.14
Terrain denuded of forests, causing desert aspect.
FIG. 9.15
Bamboo rafts float to destination where commonly used for light construction.

FIG. 9.16
Rain Forest logs are towed in rafts to sawmills shown along waterfront. The rough lumber is piled in yards to supply nearby woodworking shops that are constructing small wooden boats.

FIG. 9.17
Lumbering operation in Japan

FIG. 9.18
Coastal fish trap made of native poles; similar shaped traps are sometimes constructed of coral.

FIG. 9.19
Logs are transported by railroad from tropical forests to yard and adjacent sawmill to the right.
ALPINE FOREST

I. OCCURRENCE

On mountains over 10,000 feet high, or above timber line in Formosa, with the type gradually dropping down to lower altitudes farther north, as it occurs at sea level near the Artic Zone. Alpine grows in climates having low temperatures where there is considerable precipitation and a very short frost-free period.

II. DESCRIPTION

Vegetation is low, rarely higher than 4 feet. In areas exposed to strong winds woody plants are uniformly prostrate and dense. In sheltered slopes or canyons some of the dwarfed trees may grow higher. Vegetation is composed of numerous herbaceous plants, shrubs, small trees belonging to the alder and willow families, and tundra consisting of moss, grass and other cold resisting plants.

III. OBSTRUCTION TO MILITARY OPERATIONS

1. Visibility from the Air
   No concealment possible except that material such as tundra is used as a natural camouflage to cover military objects. Track activity and trails are clearly defined on good aerial photographs.

2. Visibility from the Ground
   Generally there is no obstruction to vision.

3. Movement on Foot
   Travel is easy except on wet, soft tundra. Trails are sometimes cut through shrub thickets. Snow is often a greater obstacle than the vegetation.

4. Movement of Motorized Equipment
   The vegetation itself is not an important barrier, but tundra prevents drainage and a wet, spongy condition exists that will cause all but the lightest vehicles to mire down.

IV. METHOD OF CLEARING

In general, no clearing is necessary.

V. USES

Tundra and sod is used in construction of small huts and for the insulation of larger structures; some woody plants and peat provide limited fuel.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Low vegetative cover that follows ground or rock form. Sometimes thin tundra is confused with snow or barren rock surfaces. Woody plants are darker in tone, and in thickets individual bushes are difficult to distinguish from the large, irregular shaped mass of shrub patches.
### Key for the Identification of Cultivated Lands in the Pacific Tropic and Temperate Zones

<table>
<thead>
<tr>
<th>Man-made pattern discernable by regular lines forming perimeter or rows.</th>
<th>Ref C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Tree crops; Canopy supported above the terrain, crowns visible with height effect.</td>
<td>Ref D</td>
</tr>
<tr>
<td>B Ground crops; Homogeneous texture and composition that appears flat on the ground within each field or plot. Outline of an individual plant is rare.</td>
<td>Ref E</td>
</tr>
<tr>
<td>C Trees with long palm-like leaves having rosette appearance without branches; plantations on level land.</td>
<td>Ref F</td>
</tr>
<tr>
<td>D Trees planted in straight lines; rows that radiate in two or more directions with spacing of 25 to 30 feet apart. Crowns almost join; rosettes are compact.</td>
<td>Ref G</td>
</tr>
<tr>
<td>D Trees usually irregularly spaced in small tracts. Often some distance between loose, extended rosette crowns.</td>
<td>Ref H</td>
</tr>
<tr>
<td>D Trees in close rows that are sometimes irregular and non-distinctive. Rosettes are crowded. Less uniform in height. (Confined largely to Philippines).</td>
<td>COCONUT PALM</td>
</tr>
<tr>
<td>D Trees planted close together, individual crowns not always distinct. Blended rows apparent. Light tone that is almost silver for portion that is free of shade from adjoining forest trees.</td>
<td>BANANA</td>
</tr>
<tr>
<td>E Trees with dense, uniform high canopy; dark tone individual crowns or rows rarely discernable, rectangular.</td>
<td>MANILA HEMP</td>
</tr>
<tr>
<td>E Trees with dense, uniform high canopy; dark tone individual crowns or rows rarely discernable, rectangular.</td>
<td>RUBBER</td>
</tr>
<tr>
<td>E Trees widely spaced; each individual crown clearly distinct in round form that is dark toned.</td>
<td>COFFEE</td>
</tr>
<tr>
<td>F Occurs on rolling, well-drained terrain often in rows with other plants that provide shade for the crop that appears as cultivated undergrowth. Usually over 2000' above sea level.</td>
<td>COCOA</td>
</tr>
<tr>
<td>G Trees uniform; carefully spaced to avoid crowding on level sites; intensively cultivated; regulation of soil moisture usually visible by existing drainage or irrigation system.</td>
<td>FRUIT ORCHARD</td>
</tr>
<tr>
<td>G Most frequently occurs on rolling to steep slopes often requiring terrace; common in rice paddy region; has dense dark foliage, usually a shrub.</td>
<td>TEA</td>
</tr>
</tbody>
</table>

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**Figures:**
- **Fig. 10.01:**
  - (D) Coconut plantation many trees missing from rows.
  - (E) Rubber in dark rectangle blocks.

- **Fig. 10.02:**
  - (D) Coconut plantation below
  - (J) Cotton in square field above.

- **Fig. 10.03:**
  - (F) Coffee in fine rows ending at edge of rain forest.
  - (F) Cocos mixed with low trees at left of coffee.

- **Fig. 10.04:**
  - (G) Tea on terraced slopes.
  - (G) Fruit orchard on flat land lower left.

---

**References:**
- Ref C
- Ref D
- Ref E
- Ref F
- Ref G
- Ref H
- COCONUT PALM
- BANANA
- MANILA HEMP
- RUBBER
- COFFEE
- COCOA
- FRUIT ORCHARD
- TEA
AGRICULTURAL LANDS OF THE TROPICS AND TEMPERATE ZONE
IDENTIFICATION OF TYPE

H Fields of uniform composition; light tone when dry; no rows visible. Areas of intensive cultivation.

Ref I

I Plants distinctly in rows of dark tone, tilled soil between rows has lighter tone.

Ref J

H Plants partly in rows; entire area dark tone; level sites.

Ref K

I Fields with velvet texture; rank growth 12 to 18 feet high, which is sufficient to cast slight shadow along margin. Fields are extensive rectangular areas on level terrain that has a regular drainage pattern.

Sugar Cane

Ref L

I Fields with very fine texture, outline of each small plot distinct by surrounding dike or bund several feet high. Areas are not uniform in size or shape as they are arranged according to topography. Boundary appears as contour lines, especially terraced steps following the form of the watershed.

Rice Paddy

Ref M

I Rectangular fields that are level; good natural drainage and are not surrounded by ditches or bunds.

Dry Grain Crops

Ref N

J Margin of each row appears to be irregular and rough with considerable distance between rows. Rolling terrain that is well drained and intensively tilled.

Pineapple

Ref O

J Rows are even, straight lines with smooth margins; rows close together, usually large areas.

Cotton or Bush Crops

Ref P

K Rows not uniform in spacing, overall tone is dark; usually confined to small scattered plots in the vicinity of villages or town.

Vegetable Gardens

Ref Q

K Large leaves obscure some existing rows; site is open freshwater lowland.

Taro

Ref R

During the different stages of growth, cultivated land has various tone and appearance on aerial photographs. Tree plantations may have height ranging from several feet at time of planting to as much as 50 feet in height at full growth. Variety is even greater for ground crops as any condition might exist from a freshly tilled or flooded field to a ripe crop that may be in the process of harvest.

Most of the cultivated lands occur where the climate is favorable for a year-long growing period; as a result, there are some mature crop fields present in most areas at any given time. For identification, these should be considered for application of the above key or in the following descriptions.

Rotation or diversified crops in a field or paddy is not common so other stages of growth can usually be identified by comparison with nearby mature crop lands, giving consideration to shape, size, and drainage pattern of fields. Landform also suggests what type of cultivated land to expect.
AGRICULTURAL LANDS OF THE TROPICS AND TEMPERATE ZONE
CULTIVATED TREES

I. OCCURRENCE

Planted and cultivated areas are usually situated in the vicinity of the coast near settlements. In general, most plantations are of coconuts, with rubber, cocoa and coffee being next important crops. Other cultivated tree crops found in these areas include bananas, abaca, tea, cassava, quinine, citrus and oil palm. On some islands the area of cultivation is small in comparison with the total land area while other islands have extensive plantations covering most of the level land areas where the soil is suitable. Some crops are restricted to very limited regions while others have wide distribution.

II. DESCRIPTION

Cultivated areas are usually easily distinguished because of the regular lines of division, adjacent settlements or towns, and uniform height of trees. Coconuts in the natural state are more scattered while the cultivated plantations are in rows, usually 25-30 feet apart in each direction. Frequently, old abandoned plantations are visible with remnant partial rows existing among encroaching Second Growth types. Other cultivated tree plantations are often difficult to accurately classify without some ground information.

III. OBSTRUCTION TO MILITARY OPERATIONS

1) Visibility from the Air

Palm, rubber, cocoa and coffee trees all provide good concealment for men and small equipment. Rubber trees hide all military objects on the ground. The amount of cover afforded by other tree crops will depend upon the density and height.

2) Visibility from the Ground

Concealment would be poor to fair in well managed plantations, but in neglected areas young trees or brush encroach between the rows restricting visibility.

3) Movement on Foot

Usually easy by walking between the rows.

4) Movement of Motorized Equipment

Travel in well-kept plantations is easy if the area is comparatively level with few streams or canals present. In poorly maintained plantations, where young trees have come in, movement may be retarded for wheeled vehicles.

IV. METHOD OF CLEARING

Generally easy by blasting stumps or trees as sometimes the entire trees are uprooted.

V. USES

On many Pacific islands plantations are the only economic resource which is often important in world trade. Most of the developments such as port facilities, warehouses, and drying racks were constructed for the industry. Coconuts provide one of the principal foods for natives and is of military importance as a source of food for poorly supplied personnel. This is especially true regarding the enemy who has frequently been forced to subsist almost entirely on coconut meat for considerable time on isolated islands. Coconut logs make excellent temporary retaining walls, barricades, and revetments. Leaves are good source of natural camouflage.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Palm plantations are generally recognizable by their uniform spacing and systematic pattern. Often, removal of only one tree can be detected on aerial photographs of an area where coverage is repeated. Rubber trees appear very dark in tone with a fine texture similar to Mangrove, but is not confused if occurrence and site is considered. Cocoa, coffee and tea present an orchard-like appearance with regular spacing when cultivated. Most cultivated areas are conspicuous and clearly defined because of geometric patterns.

FIG 10.09

Variety of cultivated trees presents characteristic pattern. Cleared area is prepared for another crop.
FIG. 10.10
Dark toned trees are rubber; remnant rows are Coconut trees. Scale 1:12,000.

FIG. 10.11
Distant oblique view that includes areas shown to right.

FIG. 10.12 GARVOC ISLAND
Diverse plantation consisting of Coconut, Rubber, and Cocoa trees; the latter require protection from wind, which accounts for the unusual pattern of trees that serve as a windbreak.

FIG. 10.13
Annotated low altitude oblique view of the area included in Fig. 10.12.
Tea fields in the neighborhood of Fujiyama, Japan.

Young banana plantation. Trees are similar to Manila hemp, but space between banana trees is usually more than for hemp.

Tea growing on a terraced hill.

Low, sparse, orchard-like trees cultivated in rows are tea. Dark toned thickets include Mulberry.

Manila hemp grows in dense stands. Philippine Islands.
AGRICULTURAL LANDS OF THE TROPICS AND TEMPERATE ZONE
CULTIVATED GROUND CROPS

I. OCCURRENCE

In the tropics and warmer portion of the Temperate Zones sugar cane, cotton, rice paddies, native gardens and other ground crops are widely distributed where there are better soils that have regulated irrigation or drainage. Intensity of agriculture, especially on steep slopes, depends upon the demand of populated localities.

II. DESCRIPTION

Sugar Cane fields are generally large and rectangular in shape with dense cover. Dikes and canals are common around the fields. The cane is tall, often growing 12 to 18 feet high. Rows are not evident in mature stands.

Rice paddies are more irregular in shape with variation ranging from almost circular to square. The natural drainage system or slope often controls the size and shape. Leves, or berms, surrounding the paddies are slightly higher than the mature rice which grows seven feet high. Water standing in the furrows or over the entire fields is characteristic part of the year.

Cotton is planted close together in rows on dry sites. The plants are 3 to 4 feet high.

Pineapples are planted in wide spaced rows having irregular margins; soil between the rows. The soil is well drained and often light in color. The plants are several feet high and about as wide with sharp painted leaves extending in all directions from the center.

III. OBSTRUCTION TO MILITARY OPERATIONS

(1) Visibility from the Air
Sugar Cane conceals troops and small objects on the ground, but intensive track activity is clearly visible. Most other ground crops are too low to conceal objects from the air.

(2) Visibility from the Ground
Excellent in all cultivated ground crops except sugar cane, which limits vision to a few feet when the cane is higher than a man.

(3) Movement on Foot
Difficult for troops to travel through dense cane fields. Other cultivated ground crops are not serious obstacles, except flooded rice paddies which are difficult unless walking is confined to dikes or berms.

(4) Movement of Motorized Equipment
Tracked vehicles can usually operate in cane fields, and most wheeled equipment can travel through other crop lands when drained or dry. Rice paddies when flooded, are barriers to all vehicles because of the deep, muddy, fine silt. When dry, travel is easy, especially after the soil has baked.

IV. METHOD OF CLEARING

Sugar cane can be cleared by burning during dry periods, or it can be cut with knives as in harvest. Clearing is not a problem for other cultivated ground crops.

V. USES

The name of the crop suggests the use.

VI. APPEARANCE ON AERIAL PHOTOGRAPHS

Sugar Cane is similar to wild cane, with a light tone and fine, velvet texture. Fields are bounded by straight lines, but no rows are visible when mature.

Rice paddies are small, and bounded by geometrical straight or curved lines.

Cotton fields have medium-light texture and tone. Fine uniform rows are visible although plants appear to cover the entire area.

Pineapples are planted in long, straight, conspicuous, rows with space of darker toned, tilled soil between the rows. Tone is light with variegated texture.

FIG. 10.19 PHILIPPINE ISLANDS
Extensive fields of Sugar Cane, also included are Coconut plantations, and some grain crop land.
AGRICULTURAL LANDS OF THE TROPICS AND TEMPERATE ZONE
CULTIVATED GROUND CROPS

FIG. 10.20
Extensive Sugar Cane fields. Note the network drainage and irrigation system. Stereo pair scale 1:12,625.

FIG. 10.21
Intensive subsistence form of agriculture in densely populated area accounts for small, irregular-shaped Sugar Cane fields. Circular forms in center of photos are Sugar Cane grinders that might be confused with military installations.

FIG. 10.22
Sugar Cane grown by native cultivation. Note height compared with man.

FIG. 10.23
Clump of semi-domesticated Pineapple plants grown in Solomon Islands.

FIG. 10.24
Pineapple plantation with typical well-cultivated rows. Note the well-drained soil.

FIG. 10.25
Distant oblique shows group of rice paddies with distinct dike around each field.

FIG. 10.26
Rice paddy being prepared for planting. Note the wet condition and low dike.
FIG. 10.27 — FIG. 10.31
Paddies with rice in various stages of maturity are shown in the above series of oblique photos.

FIG. 10.32 FORMOSA
Intensively cultivated region in Formosa with rice paddies having typical shape and size, entirely utilizing area available.

FIG. 10.33 SAIGON
Large rice paddies on low flood plain. Dark toned fields are prepared for planting, lighter toned areas show the crop ready to cut or are in shock. Several crops a year is the usual practice. Rice is sometimes alternated with other grain in this region. Scale 1:10,000.
## Publications Prepared and Available

**At U.S. Naval Photographic Intelligence Center**

- **Japanese Pillboxes**: Feb. 1944
- **Japanese Aircraft Shelters**: May 1944
- **Japanese Supply Dumps**: June 1944
- **Japanese Landing Craft**: Oct. 1944
- **Determination of Ships' Speeds from Aerial Photographs**: Oct. 1944
- **Underwater Depth Determination**: Oct. 1944
- **Japanese Electronics**: Jan. 1945
- **Japanese Military Buildings**: Jan. 1945

### Publications in Preparation by Photographic Intelligence Center

- **Photographic Interpretation Handbook Supplements: Shadow Factor Tables**: PLOtting

### Publications Prepared Jointly by Photographic Intelligence Center and Hydrographic Office, Navy Department

- **Introduction to Oblique Photogrammetry**: Feb. 1945

### Publications Prepared Jointly by Photographic Intelligence Center and Office of Assistant Chief of Air Staff, Intelligence, U.S. A.A.F.

- **Photographic Interpretation Handbook**: Apr. 1944
- **The Petroleum Industry**: July 1944
- **The Coke, Iron, and Steel Industries**: Sept. 1944
- **The Aluminum Industry**: Nov. 1944
- **The Aircraft Industry**: Dec. 1944

### Publications Under Joint Preparation by Photographic Intelligence Center and Office of Assistant Chief of Air Staff, Intelligence, U.S. A.A.F.

- **The Copper, Lead, and Zinc Industries**: The Explosives Industry
- **Industrial Target Analysis**: The Shipbuilding Industry
- **The Magnesium Industry**: Photographic Interpretation Handbook Supplements
- **The Power and Gas Industries**: Standard Symbols
- **The Sugar and Alcohol Industries**: Industry

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*Pending revision*