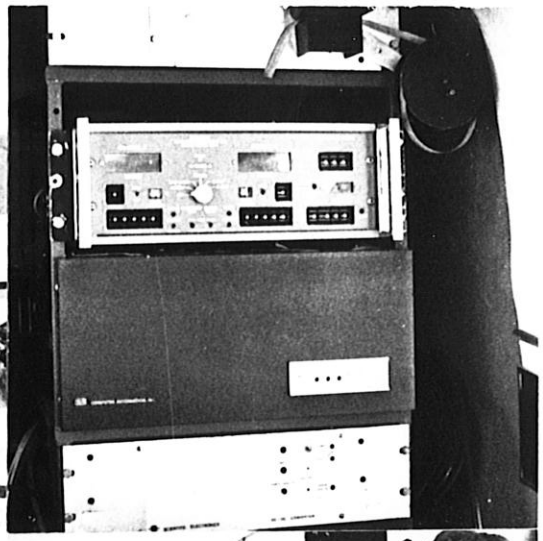
70 mm SYSTEM FOR DIEBACK PHOTOGRAPHY

VH – ISA

BN / 2A

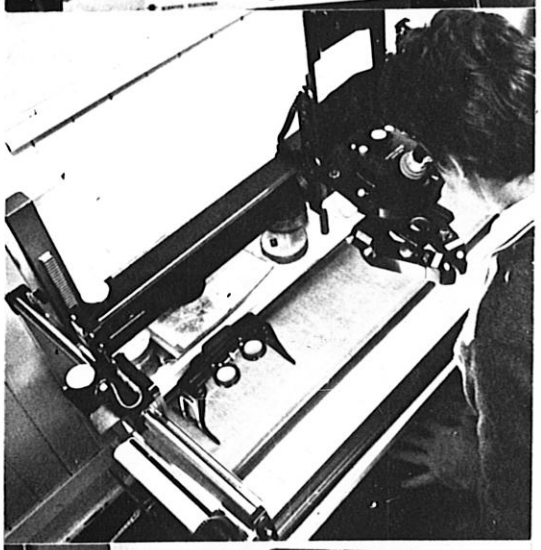


RANGER

COMPUTER

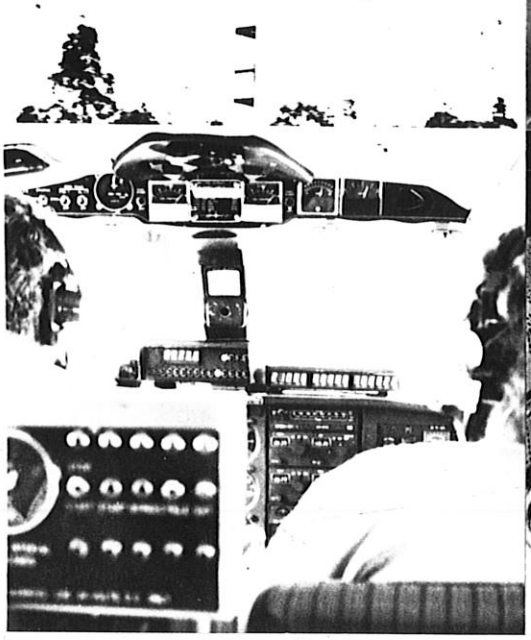
TRANSPONDER

STATION



FILM

INTERPRETATION

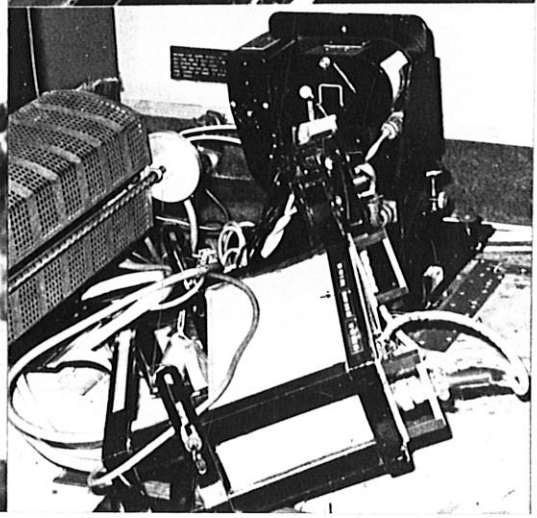


PILOT'S and

NAVIGATOR'S

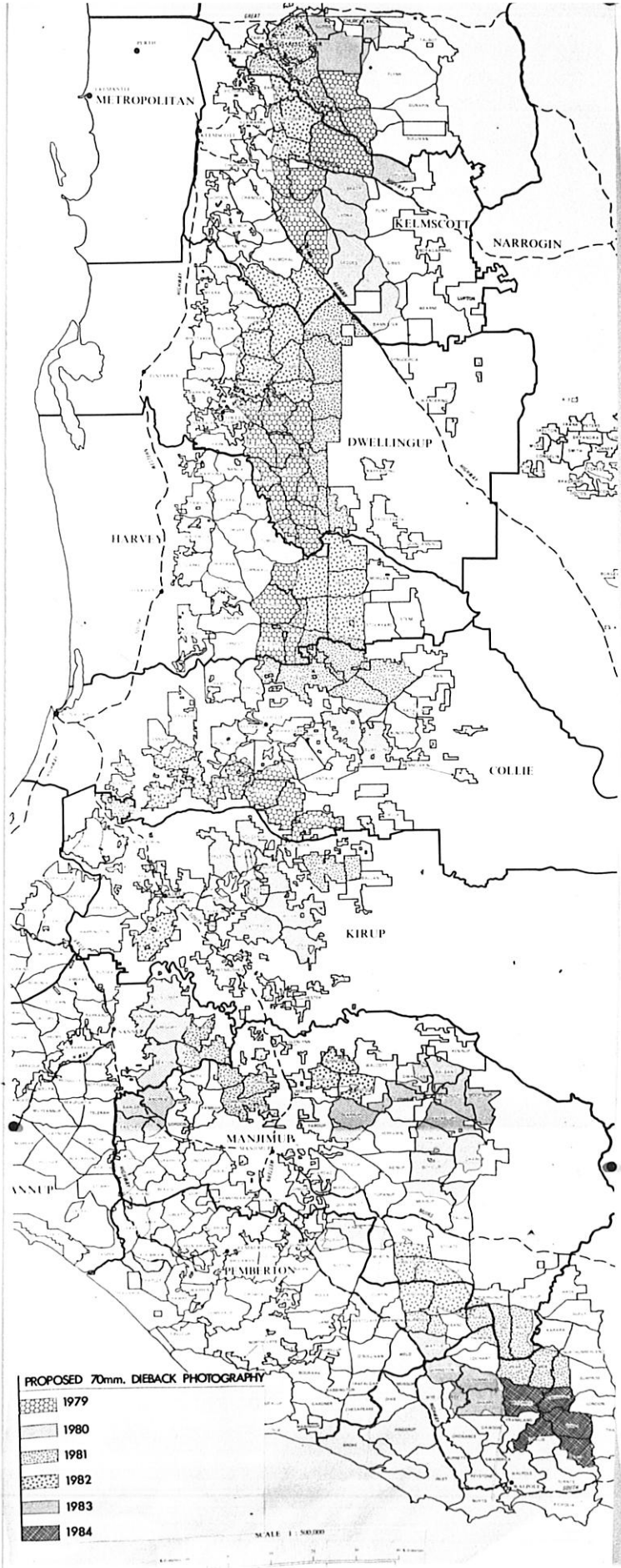
GUIDANCE

DISPLAY



CAMERA and

INTERVALOMETER


METROPOLITAN
KELMSCOTT
NARROGIN
DWELLINGUP
HARVEY
COLLIE
KIRUP
MANJIMUP
PEMBERTON
PROPOSED 70mm. DIEBACK PHOTOGRAPHY
1979
1980
1981
1982
1983
1984

DIEBACK MAPPING

INTRODUCTION

From inception in 1967 investigations have continued into techniques of large scale detection and interpretation of dieback symptoms with aerial photographic systems.

Methods and equipment are now considered capable of substantially contributing to our knowledge of the location and nature of spread of the disease.

REASONS FOR THE INVESTIGATIONS

One of the most significant declared aims of forest quarantine is the location and positive identification of all diseased areas. **This must be a logical prerequisite for effective hygiene measures.** It has been suggested that the continued artificial spread of dieback prior to quarantine was partly due to either unmanifested or unrecognised symptoms. The quarantine period was to arrest any further unnatural spread and allow the latest infections to appear. The consequence of this committment is an urgency for the Department to develop a means of detecting every infection prior to lifting quarantine.

This is a rather tall order.

However, given the potential destructive ability of a single small upland infection in relatively healthy forest, one can put this ambition into its correct perspective.

TECHNIQUES

Previous Methods:

1. Road Surveys

   These are cost effective for broad mapping of the disease as the bulk of infections commence from roads and are then transmitted down waterways or into the bush by machinery. Off road infections from cross-country agents (e.g. mining drilling) are not detected.

2. Ground Surveys on Foot

   Systematic ground surveys at first appearance may seem the best method of finding dieback, but there are substantial drawbacks. A large number of people are required to get the job done in a reasonable time so it is very costly and the standard of interpretation very unreliable.

2/....

Estimated example :

Crew capacity 10,000 metres of survey line per day.
Lines 100m apart assuming 50m visibility either side.
100 hectares covered per day.
25,000 hectares covered in 246 day year per crew.
Crews can be 1 man - poor locational accuracy.
" " " 2 man - 3 times more costly.

To do the entire quarantine area in one year would require 29 crews at absolute efficiency.

Apparent dieback symptoms are notorious for the kaleidescope of opinion they evoke amongst field observers.

Maintaining standards between interpreters would be impossible.

In many instances field assessors have to virtually walk on top of individual indicators to be aware of them. At the other end of the scale dieback disease pattern is difficult to discern on foot.

3. Conventional Small Scale (1:40,000) Black & White A.P.I.

This method has produced a reliable and cheap means of locating and mapping the preponderance of area affected by the disease. Used in conjunction with road reconnaissance and limited off road checking it has served to define the bulk of the diseased area.

Without this aid even the most elementary hygiene approach would have been in vain.

The limitation of this scale of photography is its inability to detect the early stages of an infection.

It seems reasonable to presume that in the relatively healthy quarantine areas, small latent or new infections will assume a greater significance than those in the Western sector of the Jarrah forest.

It is the small infection detection deficiency of 1:40,000 A.P.I. coupled with the cogency of our quarantine undertakings which has prompted the enquiry into other methods.

3/....

The New Aerial System

A large scale (1:4,000) colour approach to dieback detection.

The system proposed employs the following mechanisms :-

Camera 2 x Vinten 492 Reconnaissance Cameras

Remote control 101 mm lens f 2.0
Shutter 1/500 sec.
Film Capacity 100', 500 frames.
Cycling - custom-built intervalometer.

Film Ektachrome - Colour transparency
- Reversal processing to positive.

Push Processed 2 stops.
Exposure - external meter.

Aircraft Norman Brittain Islander.

High Wing Twin. 5-seat minimum.
6 hour endurance.
Slow, stable speed (100 knots).

Navigation Microwave Ranging System (Transponder)

2 Ground stations.
Line of sight high frequency transmission.
Airbourne ranger, computer, pilots tracking system.
Ultimate accuracy.

Season Autumn : March - May.

OTHER SYSTEMS WHICH HAVE BEEN INVESTIGATED

Cameras Standard Survey Cameras f 5.6 6"
f 4.0 12"

Other small format Cameras.

4/....

Film	Types - B & W Panchromatic - B & W Infra-red - Colour negative - prints - Colour positive - Colour Infra-red
	Large format and small.
Aircraft	Fast Twins. Low wing.
Navigation	Visual only Periscope A.D.F. Beacons Decca Doppler Transponder

The present technique evolved in response to the following basic aspects of the target to be detected :

1. Understorey dieback indicator species mortality most prominent during autumn.

   Therefore :- Aircraft contract March - May.

2. Symptoms distinguished by colour discrimination.
   Light Yellow ——— Orange/Brown.

   Therefore :- Use colour aerial film.

3. Indicator species are relatively small targets to detect.

   Therefore :- Employ very large scale of 1:4,000

4. Significant Proportion of symptoms obscured by tree crowns of crown shadow.

   Therefore :- Fly under full cloud.

5/....

The most important of these constraints is aerial photography under cloud.

As suitable cloud (we are very particular) is usually 1500' - 2000' above the forest the camera must have a 100 m.m. focal length lens to produce the 1:4,000 scale required for symptom detection. The camera must also have a fast lens as light levels are low under cloud. All cameras studied do not have sufficient exposure ability so we push process the colour film 2 stops to compensate. There is no option of a slower shutter speed as image motion intrudes after an exposure of 1/500 second at f2.0.

Previously aerial survey cameras with a film format of 9"x9" would not do the job as their lenses were too slow. There is now a relatively new camera available with a faster lens which when combined with a different faster film just makes the exposure we require.

The catch is that the new camera has a focal lengths of 12" so we would not be able to operate the 8-9 low cloud days, but would have to use the cloud above 4,000' which is estimated to have a frequency of only 3-4 days over Autumn.

The apparent gross advantage of the larger format is partly illusory as radial displacement of trees obscures the understorey for all but narrow angled lenses. This is why one cannot get any advantage from a standard 6" focal length survey camera even if it could produce sufficient exposure.

It is because the 12" survey lens closely approximates the 70mm lens geometry that one can consider it.

The problem with all aerial photography at very large scale is aircraft navigation, particularly for extensive coverage such as the quarantine area.

The solving of the camera problem was of no consequence until a means of contiguous large area coverage was achieved.

This is now possible with a microwave transponder system recently developed in Perth of all places.

This system gives us the ultimate accuracy we require for 70 mm photography. The device employs two groundstations per photography area cell (i.e. 15km x 30km).

6/....

How Effective are Large Scale Photos?

Numerous large scale colour trials have demonstrated a remarkable ability to detect symptoms. The identification of symptoms down to a diameter of 15cm is routine.

With the exception of photogaps, there is little fear of failing to detect the range of dieback symptoms especially at their earliest stages.

The film gives the interpreter the ability to field check any specific individual Macrozamia, Xanthorrhoea or Banksia.

The Photo Acquisition Programme

The basic logistics of large scale 70mm coverage are as follows :

- The average number of suitably clouded days per autumn season is approximately 12.
- On an ideal day we could do 6 hours photography.
- We would cover 16,000 hectares on such a day.
- Given a few failures we hope to get 150,000 ha done per annum commencing in Autumn 1979.

This ambitious target is a result of :-

- Extending the endurance of the aircraft with extra fuel tanks.
- Flying efficient paterns, that is, maximum flight line length to reduce the proportion of time lost on turns. Protection Branch has extended itself in rearranging the burning programme so 3 year old burns (symptoms) are aggregated into suitable elongated blocks.
- Using two cameras to avoid disrupting flight lines with magazine changes.
- Ensuring an adequate number of transponder stations to allow a complete choice of any target.

7/....

- Establish a Divisional weather watch to alert the aircrew of suitable conditions. Also special Bureau of Meteorology reports.

- Co-ordination with daily burning to avoid being smoked out.

- Double precautions on all mechanical components with rapid repair ability.

- Fifteen week, seven day a week, aircrew standby.

- Efficient preflight planning.

- Maximum assistance from Divisions.

- Portable Potty.

The rate of lifting quarantine is regulated by the photographic coverage potential. Consequently Spring burning and some milling operations are following closely behind. There is little scope for failing to get the ground covered and mapped.

Once the areas are burnt or logged there is no going back for several years.

Because the quarantine release is geared to the theoretical target, there is little leeway, especially in a poorly clouded Autumn.

One insurance policy is to double the capacity with two aircraft. This is $2 the present cost.

The other possibility is to combine the large & small format cameras in the one aircraft and use the few high altitude days to get more coverage with the survey camera. We are currently investigating this potential.

Conversely a good year will put us ahead if there are additional areas we can do which have adequate symptoms (old burns).

Small isolated quarantined areas unsuited to efficient aerial coverage will have to be done by ground survey.

8/....

Film Interpretation

Detection of symptoms is relatively straightforward, interpretating their significance is not!

The interpreter faces at least six classes of forest scene from which he must make a decision about dieback.

1. Green line active symptoms.

2. Graveyard with no active symptoms.

3. Absence of susceptible understorey.

4. Isolated indicator species deaths.

5. Crown death with healthy understorey.

6. Drought deaths.

Interpreting symptoms on film has some advantages compared with ground survey :-

- The overview gives a better impression of symptom pattern and site association.

- Highly specialised interpreters can consider large areas in minute detail, so more reliable and consistant standards can be maintained.

- A permanent record is available of the exact forest condition for referral.

- Any doubtful situations can be precisely traced and checked. Test cases can be monitored if necessary.

- Accurate mapping of dieback sites can be done automatically.

Ground assessors are subject to much the same quandaries as film interpreters, especially where limited samples are involved and do not have their special advantages.

A disadvantage of film interpretation is that you see too many individual indicator species deaths. It is the frequent isolated death or deaths which are the most problematic, closely followed by areas which do no possess any symptoms because there is a "natural" dearth of indicator species.

9/....

Interpreters cannot divorce themselves from field checking their doubts. Their advantage is that they can spend all their field time checking only those areas causing problems.

At least four interpreters will have to be drawn from Department ranks. We require individuals very familiar with dieback in the field and also possessing many other attributes essential for this specialised and demanding job.

Mapping

A magnetic tape recorder attached to the ranger/computer navigation system in the aircraft will record the flight path and photo locations for later automatic mapping.

Maps at 1:25,000 scale displaying the flight lines and any other relevant dieback information will form the recording base for interpreters.

Dieback symptoms can be located with pinpoint accuracy from the film if desired.

Dieback mapping categories are yet to be determined, the classes chosen will reflect the degree of assurance the map user demands.

Mapping every symptom is possible (although not within the present time scale) but may only serve to shift the burden of decision from the film interpreter to the operational map user.

Suggestion from the Operations sector on the confidence limits of map categories are required.

Post Mapping Period

How will the maps be used?

A General Word on Costs of 70mm System with One Aircraft

Looking only at the first three years after quarantine: i.e. 450,000 ha

Allup Cost to map stage	$300,000
Capital costs (Cameras, etc)	$40,000
Running costs	$260,000.

10/....

Some cost rates :

Film processing	12 cents per hectare
Aircraft	19 cents per hectare
Interpretation, field checking, mapping	20 cents per ha.

Total average cost rate $0.60 per hectare.

A ground survey approximating 70 mm system accuracy would cost approximately $1.30 per hectare.

11/....

This has necessarily been a sketchy and somewhat superficial treatment of this subject.

Any further detail required may be obtained from the following :

C.O.D. F. Campbell	-	Policy
Inspector Williamson	-	Programmes - cutting & burning.
S.D.F.O. Bradshaw	-	Operation priorities and system evaluations.
A.D.F.O. Chandler	-	Technical detail and methods.

Involvement by way of querry, suggestion or objection is welcomed.

R.J. CHANDLER,
A.D.F.O.

RJC:JT

PRESENT DIEBACK PHOTOGRAPHY SYSTEM

CAMERA

2 x VINTEN 492 RECONNAISSANCE CAMERAS

REMOTE CONTROL 101mm lens f2·0.
SHUTTER 1/500 sec.
FILM CAPACITY 100', 500 frames.
CYCLING - custom-built intervalometer.

FILM

EKTACHROME - COLOUR TRANSPARENCY
- REVERSAL PROCESSING TO POSITIVE.

PUSH PROCESSED 2 STOPS.

EXPOSURE - EXTERNAL METER.

AIRCRAFT

NORMAN BRITTAIN ISLANDER

HIGH WING TWIN. 5-SEAT MINIMUM.
6 HOUR ENDURANCE.
SLOW, STABLE SPEED (100) knots

NAVIGATION

MICROWAVE RANGING SYSTEM (TRANSPONDER)

2 GROUND STATIONS.
LINE OF SIGHT HIGH FREQUENCY TRANSMISSION.
AIRBOURNE RANGER, COMPUTER, PILOTS TRACKING SYSTEM.
ULTIMATE ACCURACY.

SEASON

AUTUMN - MARCH - MAY

PRINCIPAL ASPECTS OF DIEBACK SYMPTOMS DETECTION

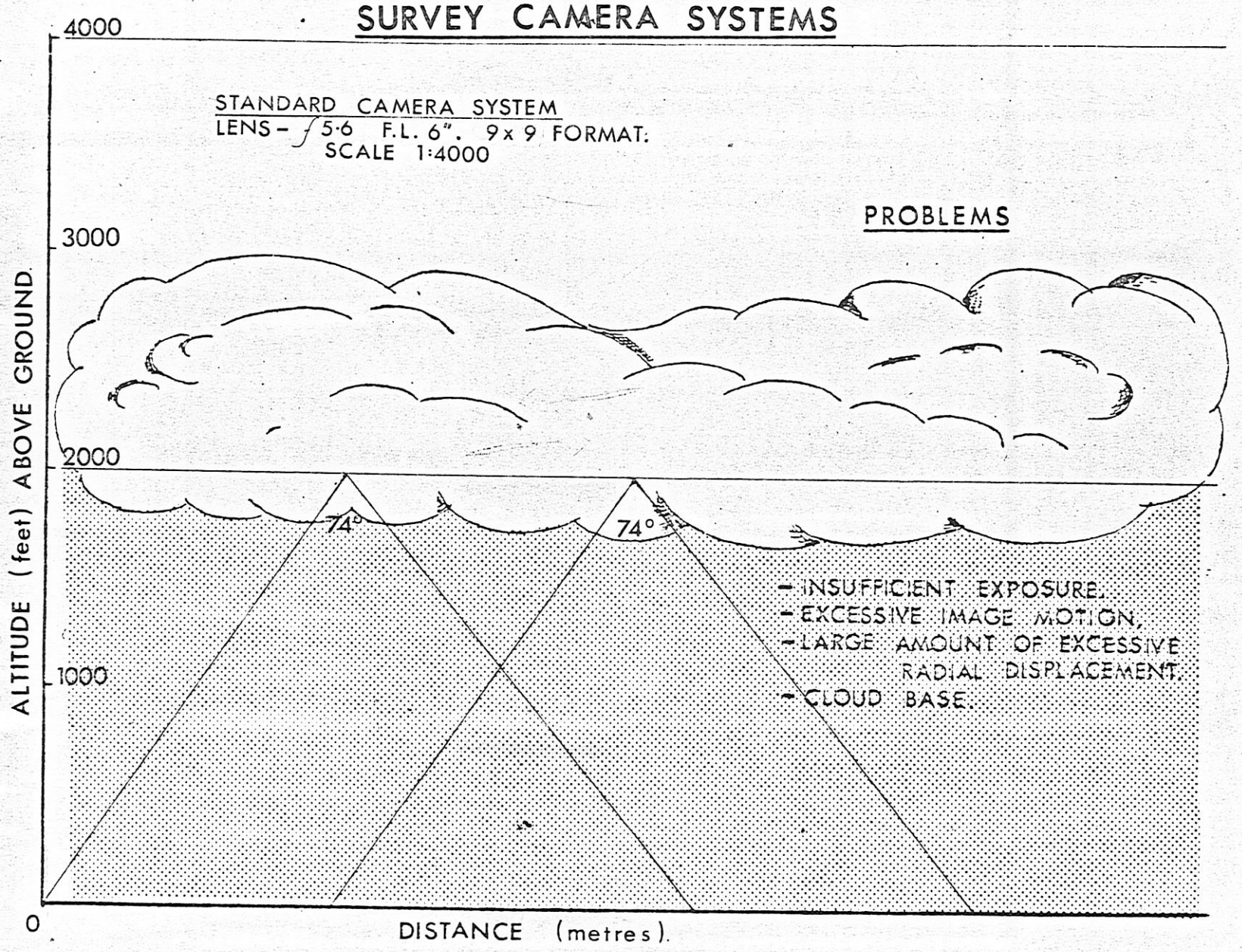
1. UNDERSTOREY DIEBACK INDICATOR SPECIES MORTALITY MOST PROMINENT DURING AUTUMN.

2. SYMPTOMS DISTINGUISHED BY COLOUR DISCRIMINATION.
   LIGHT YELLOW ⟶ ORANGE/BROWN.

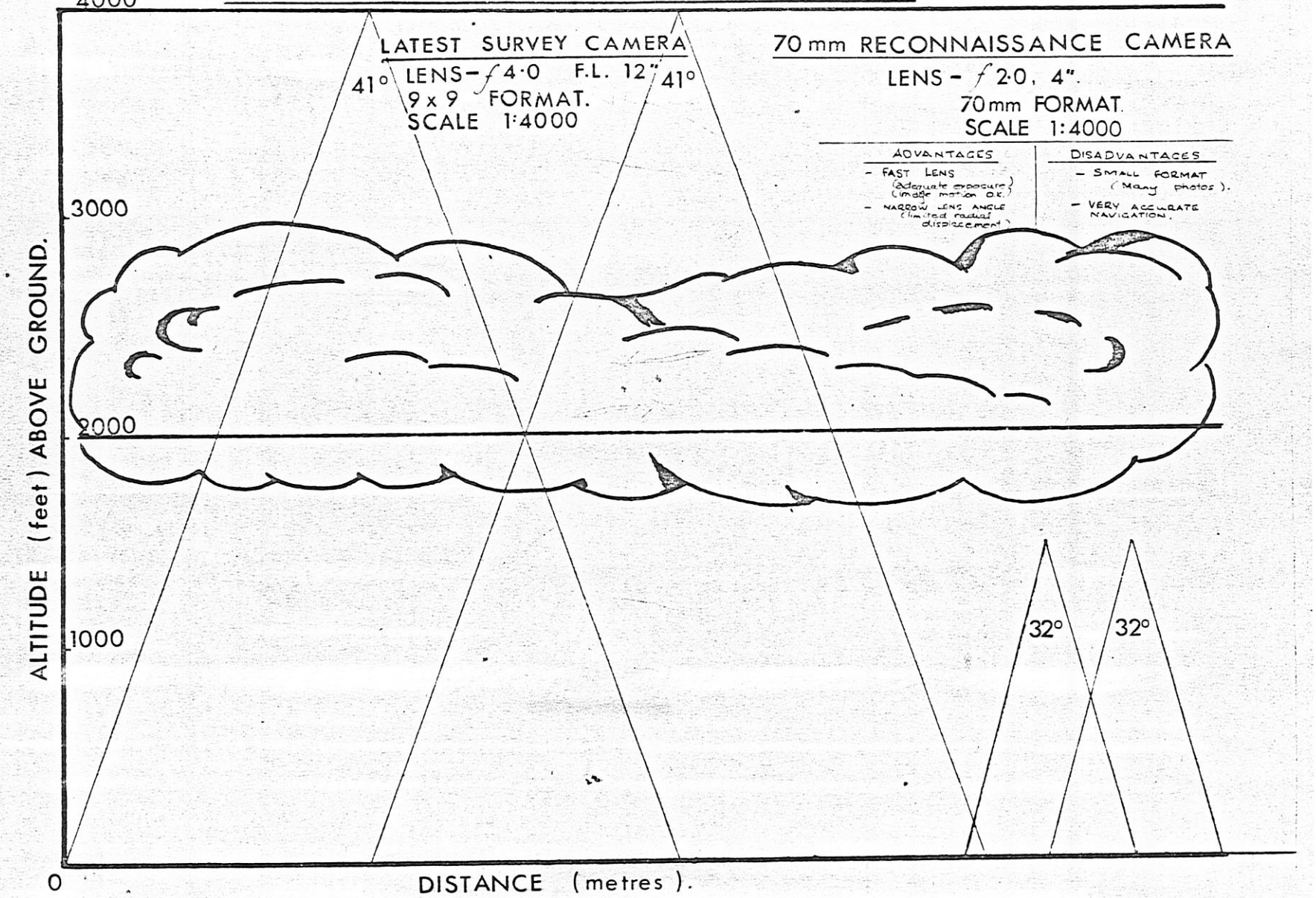
3. INDICATOR SPECIES ARE RELATIVELY SMALL TARGETS TO DETECT.

4. SIGNIFICANT PROPORTION OF SYMPTOMS OBSCURED BY TREE CROWNS OR CROWN SHADOW.

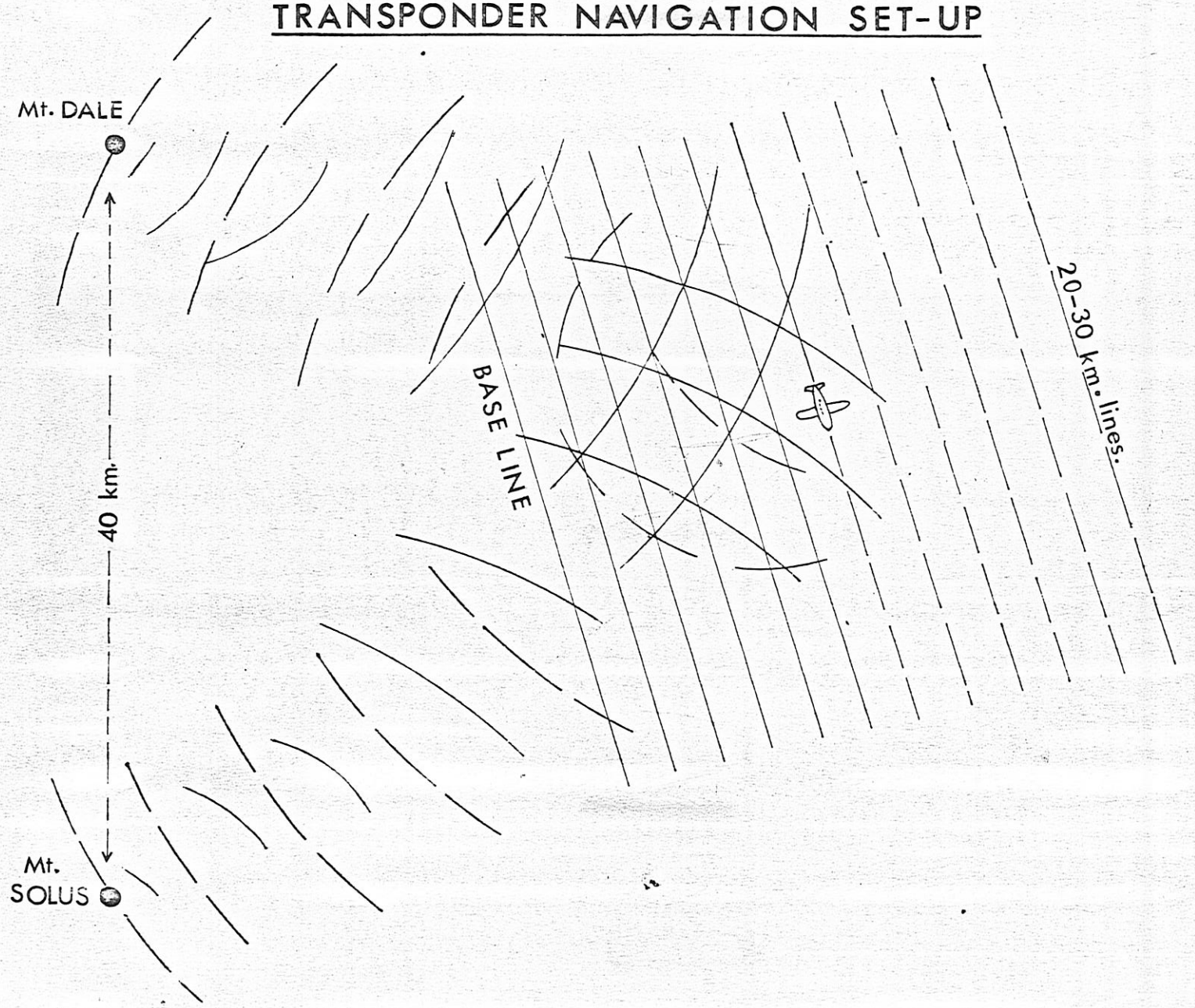
SURVEY CAMERA SYSTEMS



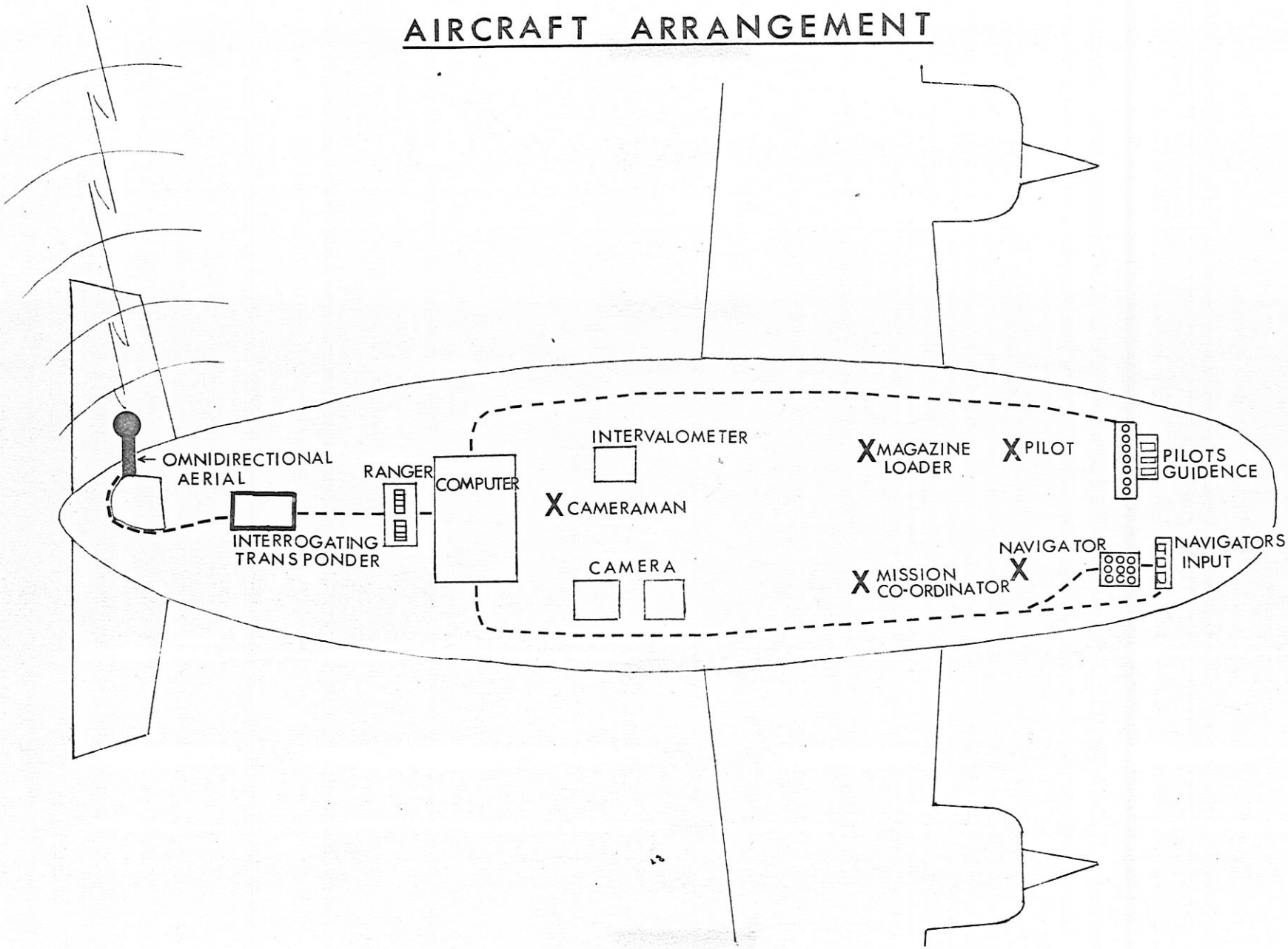
NARROW ANGLE CAMERA SYSTEMS



TRANSPONDER NAVIGATION SET-UP

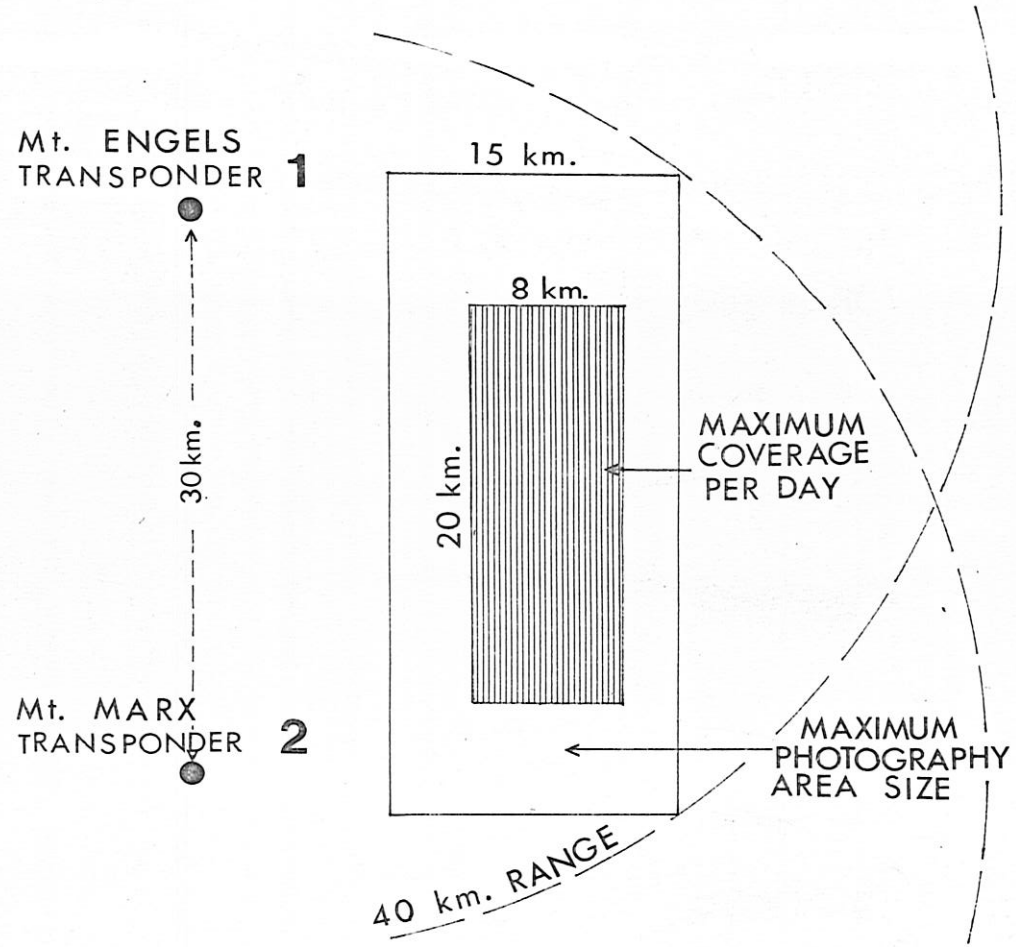


AIRCRAFT ARRANGEMENT



TRANSPONDER RANGE 70 mm PHOTOGRAPHY COVERAGE

IDEAL NAVIGATION DISPOSITION



LOGISTICS

6 HOURS PHOTOGRAPHY PER DAY.
40 FLIGHT LINES 20 km. LONG 200m APART.
LONGITUDINAL FRAME DIMENSION 240 m.
" " GAIN 96 m.
NUMBER OF FRAMES PER DAY 8300.
" " ROLLS " " 19.
AREA COVERED PER FRAME 4·8 ha.
" GAIN " " 1·9 ha.
AREA COVERED PER DAY 16000 ha.

DIEBACK INTERPRETATION TYPES

1. GREEN LINE ACTIVE SYMPTOMS.

2. GRAVEYARD WITH NO ACTIVE SYMPTOMS.

3. ABSENCE OF SUSCEPTIBLE UNDERSTOREY.

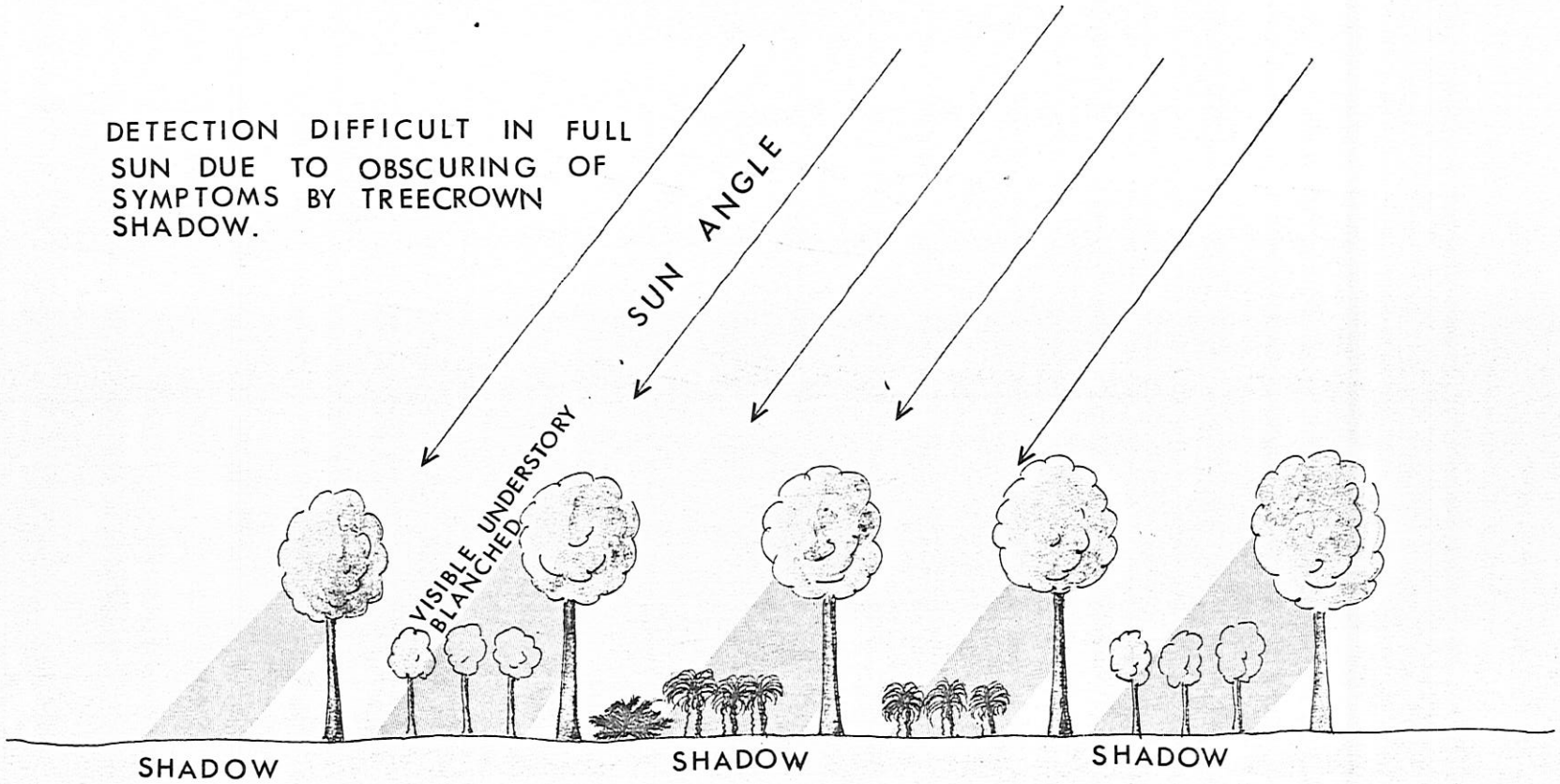
4. ISOLATED INDICATOR SPECIES DEATHS.

5. CROWN DEATH WITH HEALTHY UNDERSTOREY.

6. DROUGHT DEATHS.

PROBLEMS OF DETECTING DIEBACK SYMPTOMS

DETECTION DIFFICULT IN FULL SUN DUE TO OBSCURING OF SYMPTOMS BY TREECROWN SHADOW.



OVERCOME DETECTION PROBLEMS BY: