

March 1983

CHAPTER NINE
DEPLETION AND UPDATE

SECTION 9.3

DISTURBANCE UPDATE USING 70 mm PHOTOGRAPHY

1981

SECTION 9.3
DISTURBANCE UPDATE USING 70 mm PHOTOGRAPHY

TABLE OF CONTENTS

9.31	PRE-FLIGHT PLAN PREPARATION
9.311	Maps
9.312	Photographs
9.313	Obtaining Disturbance Information
9.32	FLIGHT PLAN PREPARATION
9.321	Maps
9.322	Photographs
9.323	Flight Plan Record Book
9.33	OTHER CONSIDERATIONS
9.34	SEVENTY-MILLIMETRE PHOTOGRAPHY VERSUS CONVENTIONAL PHOTOGRAPHY

LIST OF TABLES

9-5	Sources of forest depletion
9-6	Geometry of 70 mm air photos
9-7	Time interval in seconds for 60% end overlap

LIST OF APPENDICES

9-1	Standards of measurement
9-7	Minimum type sizes for updating district forest cover maps
9-8	Area covered by 70 mm photographs - format for templates
9-9	Flight plan record sheet
9-10	Forest cover mapping - disturbance boundaries

9.3 DISTURBANCE UPDATE USING 70 mm PHOTOGRAPHY

Seventy-millimetre photography, when used in conjunction with a zoom transfer scope, can be an accurate and relatively inexpensive method of updating forest cover maps for disturbed areas. Detailed pre-flight planning is required and certain conditions must be adhered to during the actual flight plan to ensure successful photographic results. In the following section, procedures to follow during the preparation and flying of an operational 70 mm update flight plan are recommended. Minimum type sizes for updating forest cover maps are shown in Appendix 9-7.

9.31 PRE-FLIGHT PLAN PREPARATION

9.311 Maps

Obtain the following maps covering the project area:

- A. The most recent photo key map,
- B. National topographic series maps, at various scales,
- C. Existing forest cover maps with latest photo centers.

9.312 Photographs

Obtain the most recent conventional air photographs covering the project area. Smaller scale photography (e.g. 1:40 000) is useful for plotting flight plans and for flight plan navigation, but larger scale photography is preferable for transferring information from the 70 mm prints. Remember, at higher ground elevations the flying height required to obtain small-scale 70 mm photos may exceed the limitations of the helicopter.

9.313 Obtaining Disturbance Information

Openings and disturbed areas to be photographed are those which have occurred since the latest conventional air photos were taken. Most history information is available from the district and field offices having jurisdiction over the project area. The main sources of forest depletion are listed in Table 9-5. Recorded history information may be obtained from one or more of the following sources:

- A. Management work charts and files,
- B. History maps,
- C. History cards,
- D. Progress reports and annual reports.

9.32 FLIGHT PLAN PREPARATION

For detailed instructions on flight plan preparation, organization and assembly, see Section 3.52, Air Classification, of Chapter 3.

9.321 Maps

In point form the following steps should be taken:

- A. Locate the approximate boundaries of the disturbance to be photographed on a contour map, preferably at a scale of 1:50 000 in order to estimate ground elevation accurately.
- B. Using ground elevation estimation, determine the flying height which will yield the desired photo scale on 70 mm photographs (see Table 9-6). The scale of 70 mm photos should match as closely as possible that of the most recent conventional air photos, or that of the forest cover maps.
- C. For navigational purposes, mark the outline of each disturbance or opening on topographic maps at scales of 1:125 000 or 1:250 000. After a flight plan sequence has been determined, indicate those flight paths between disturbances which must be navigated without air photo coverage by different coloured lines (e.g. red pencil) than flight paths which will be navigated using air photos (e.g. black pencil).
- D. Determine the approximate distance of the flight plan by following the flight path on the small-scale topographic map with a wheeled map measurer, or a ruler. Multiply the number of centimetres read from the map measurer by the map scale and divide by 100 000 (number of centimetres per kilometre).

$$\text{Example: } \frac{99 \text{ cm} \times 125\,000}{100\,000 \text{ cm/km}} = 124 \text{ km}$$

- E. Estimate the approximate helicopter air time needed to complete the flight plan by assuming helicopter air speed during ferry routes as 175 km/hr (110 m.p.h.) and air speed while photographing air calls as 130 km/hr (80 m.p.h.).

9.322 Photographs

- A. Outline the configuration of each disturbance on the most recent air photographs; later, these disturbances are linked into an operational flight plan. See Appendix 9-7 for minimum sizes.
- B. Mark identifiable topographic features on the photographs to determine the line of flight over an air call. An important prerequisite in transferring openings on the zoom transfer scope is that some topographic details, for purposes of control, are recognizable on both the 70 mm photographs and the conventional air photo.

- C. Mark the line of flight over an air call and indicate in omnichrom pencil the approximate locations at which to begin and to stop taking pictures. Using a clear plastic overlay (see Appendix 9-8), determine the number of 70 mm exposures needed to completely cover the disturbance boundaries, with 60% front overlap, at the given scale of photography. If more than one pass or photographic strip is required for complete 70 mm photo coverage, mark the flight path(s) of additional strip(s) and determine the number of 70 mm exposures needed for coverage.
- D. Beside each air call, mark:
 1. Air call number (e.g. A/C 3).
 2. Pass number (if needed).
 3. Flying height above sea level (determined from contour maps).
 4. Approximate number of exposures required.
- E. Mark ferry routes between air calls and indicate the direction of flight with arrows.
- F. After each air call, indicate on the photo the flying height for the next air call so that the pilot can make necessary changes in elevation before reaching the air call.
- G. After determining the sequence of the flight plan, number the northwest corner of each photograph consecutively from start to finish of the flight plan, including ferry photos.
- H. If a photograph is required more than once over the course of a flight plan, a cardboard tab taped to the top of the photo, showing the corresponding flight plan photo number, is useful for immediate recovery of that photograph.

9.323

Flight Plan Record Book

- A. Prepare a permanent flight plan record before flying and then fill it out as the flight progresses. Refer to the flight plan record form in Appendix 9-9.
- B. Make a carbon copy of each page to serve as a back-up for film and flight plan documentation. Exposed film becomes worthless if the written record is lost or destroyed.
- C. Briefly summarize the flight plan. Enter in the flight plan record book the following:
 1. Approximate distance of flight plan.
 2. Approximate helicopter air time needed to complete the flight plan.
 3. Approximate number of 70 mm frames required to photograph all air calls.

OTHER CONSIDERATIONS

- A. In order to obtain satisfactory results, it is imperative that minimum light requirements for photography are met.
- B. For safety and/or emergency purposes, a copy or overlay of each flight plan must be left on the ground with responsible personnel. A list of photos used in the flight plan, and/or a topographic or photo key map with the flight plan drawn on it, should suffice.
- C. Black-and-white film (Kodak Tri-X or Kodak Plus-X) is suitable for most man-made disturbances. Colour or colour infrared film may be more appropriate for updating disturbance caused by fire, wind, insect infestations, disease, industrial fumes, or floods.
- D. For updating disturbances, a 60 mm Biogon lens is used. Along the flight path only one camera is operational. This is set to give approximately 60 percent forward overlap. In Table 9-7, time intervals in seconds for 60 percent overlap at a given height are listed.
- E. Owing to the relatively small format of a 70 mm frame, side overlap should be avoided whenever possible. Accordingly, the flight path should be predetermined in such a way that a disturbance is covered by forward overlap only, if possible.
- F. Image enlargement of a 70 mm print on a zoom transfer scope is much easier than image reduction. Therefore, photographing from heights lower than those estimated from the contour maps is undesirable, as the resulting scale of the 70 mm prints will be larger than that of the conventional photos.
- G. Imperial units might still be used to express such functions as helicopter air speed (miles per hour) and contour intervals (e.g. contour interval 100 feet). For practical purposes, it may prove more desirable to express such functions in imperial units rather than in metric units when preparing an update flight plan.
- H. To facilitate plotting on the zoom transfer scope, the area to be transferred can be outlined in either mono or stereo on the 70 mm photographs. The method selected for transferring the new openings to existing forest cover maps depends upon the distortion of scale due to local relief and also on the number of topographic ground control points available. The possibilities are:
 1. Mono transfer direct to the map.
 2. Stereo mode transfer direct to the map.
 3. Stereo transfer to existing photographs and thence via a Kail-plotter to the forest cover map.
 4. Epidiascope.

SEVENTY-MILLIMETRE PHOTOGRAPHY VERSUS CONVENTIONAL PHOTOGRAPHY

A high-flying helicopter equipped with 70 mm cameras provides a useful technique for achieving immediate and/or continuous updating of disturbances for mapping purposes. The credibility of the system is lessened if it is used as a means of supplanting, rather than supplementing, conventional air photography. In active areas where conventional photography has not been obtained for a relatively long period of time, flying 70 mm flight plans may prove less feasible than having the area reflown by conventional methods. Also, for mapping the perimeter of large disturbances, for example, a complex-shaped 1 500 hectare wildfire requiring more than two photographic passes, 70 mm photography is generally unsatisfactory. On the positive side, updating recent conventional photography on a yearly basis using 70 mm photography should provide accurate and comparatively inexpensive results.

Table 9-5
Sources of forest depletion

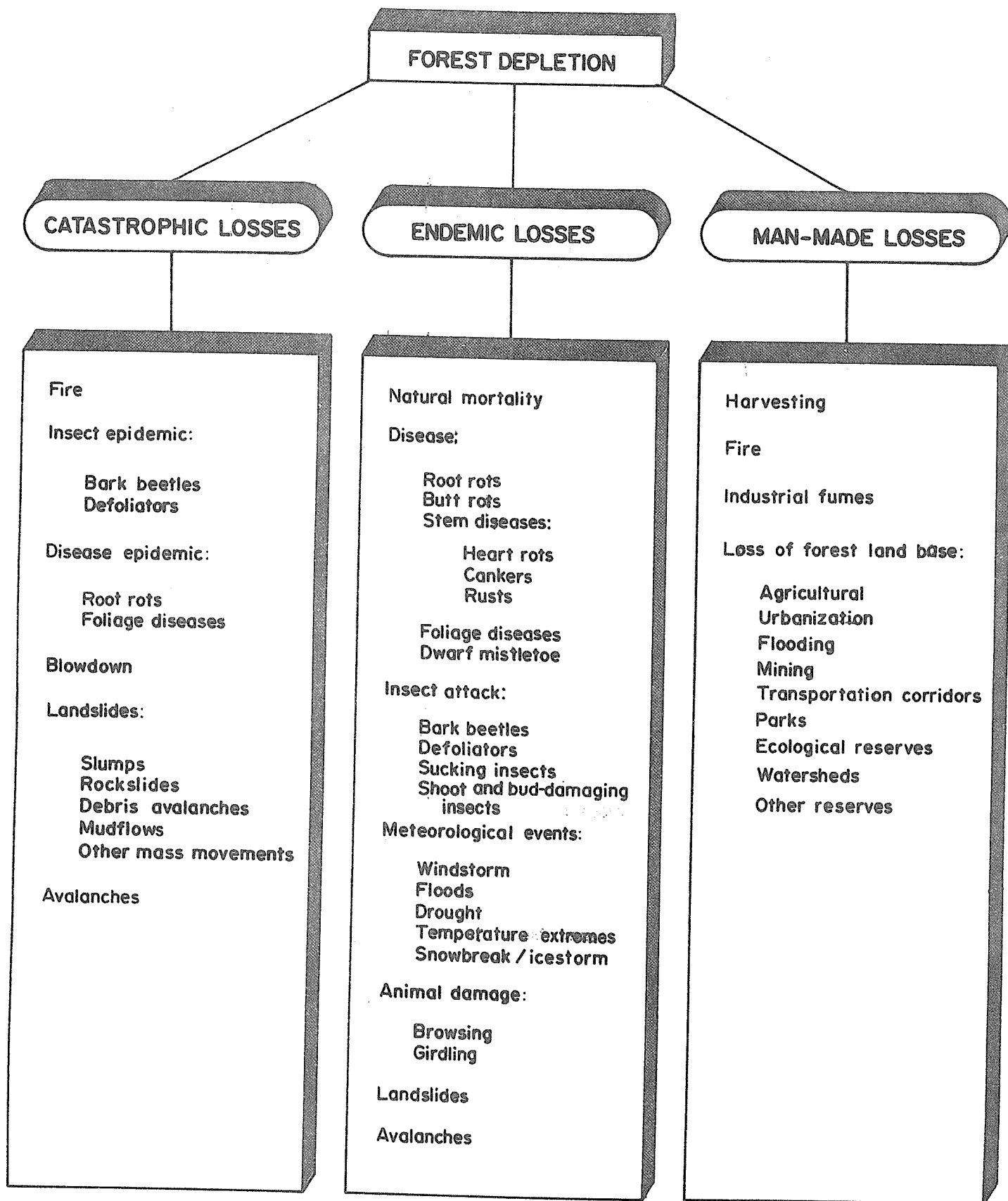


Table 9-6
Geometry of 70 mm air photos

LENS - BIOGON

SHUTTER SPEED 1/500 SEC.

FOCAL LENGTH - 61.2 mm

HEIGHT ABOVE GROUND (m/ft.)	WIDTH (m)	LENGTH (m)	AREA (ha)	Stereo Model ACTUAL AREA OF STEREO PAIR (ha)	PHOTO SCALE
50/164	43.3	43.3	0.19	0.14	1:817
100/328	86.6	86.6	0.75	0.65	1:1634
150/492	129.9	129.9	1.69	1.53	1:2451
200/656	173.2	173.2	2.99	2.79	1:3268
300/984	259.8	259.8	6.75	6.44	1:4902
400/1312	346.4	346.4	11.99	11.58	1:6536
600/1968	519.6	519.6	26.99	26.37	1:9804
612/2007	529.9	529.9	28.08	27.44	1:10 000
800/2624	692.8	692.8	47.99	47.16	1:13 072
969/3178	839.2	839.2	70.43	69.41	1:15 840
1000/3280	866.0	866.0	74.99	73.94	1:16 340
1200/3936	1039.2	1039.2	107.99	106.73	1:19 608
1224/4015	1059.9	1059.9	112.34	111.05	1:20 000
1400/4592	1212.4	1212.4	146.99	145.52	1:22 876
1600/5248	1385.6	1385.6	191.99	190.30	1:26 144
1800/5904	1558.8	1558.8	242.99	241.09	1:29 412
2000/6560	1732.0	1732.0	300.00	297.89	1:32 680
2400/7872	2078.4	2078.4	431.97	429.44	1:39 216
2800/9184	2424.8	2424.8	587.97	585.01	1:45 752
3000/9840	2598.0	2598.0	674.96	671.79	1:49 020
4000/13120	3464.0	3464.0	1199.93	1195.71	1:65 359

Table 9-7

Time interval in seconds for 60% end overlap

FLYING HEIGHT ABOVE GROUND		GROUND SPEED						
		mph	20	40	50	60	80	100
Feet	Metres	km/h	32	64	80	97	129	161
		m/s	8.9	17.8	22.2	26.9	35.7	44.7
200	61		2.4					
250	76		2.9					
300	91		3.5	1.8	1.4			
350	107		4.1	2.1	1.7			
400	122		4.7	2.4	1.9			
500	152			2.9	2.4			
600	182			3.5	2.8			
700	213			4.1	3.3			
800	244			4.7	3.8	3.1		
900	274				4.2	3.5		
1000	305				4.7	3.9	2.9	
1100	335					4.3	3.2	
1200	366					4.7	3.5	
1300	396					5.1	3.8	
1400	427					5.5	4.1	
1500	457					5.9	4.4	3.5
1600	488					6.3	4.7	3.8
1700	518					6.7	5.0	4.0
1800	549					7.1	5.3	4.2
1900	579					7.5	5.6	4.5
2000	610					7.9	5.9	4.7
2100	640					8.3	6.2	5.0
2200	671					8.6	6.5	5.2
2300	701					9.0	6.8	5.4
2400	732					9.4	7.1	5.7
2500	762					9.8	7.4	5.9
2600	792						7.7	6.1
2700	823						8.0	6.4
2800	853						8.3	6.6
2900	884						8.5	6.8
3000	914						8.8	7.1
3500	1067						10.3	8.3
4000	1219						11.8	9.4
4500	1372						13.3	10.6
5000	1524						14.8	11.8
5500	1676						16.2	13.0
6000	1829						17.7	14.1
6500	1981						19.2	15.3
7000	2134						20.7	16.5
7500	2286						22.2	17.7
8000	2438						23.6	18.9
8500	2591						25.1	20.0
9000	2743						26.6	21.2

APPENDIX 9-1 cont.

C. Disturbance Update

1. Frequency of disturbance update

Forest cover maps shall be updated annually for partial and complete disturbances (openings), particularly depletions arising from harvesting and forest fires.

2. Map medium, format and scale

Matte film (mylar), paper prints or sepia traces may be used for mapping disturbances.

Both the B.C. Geographic System of Mapping and the National Topographic System may be utilized as follows:

a) Reinventory surveys

- T.S.A.'s and unit surveys: 6' x 12' at a scale of 1:20 000.
- Sub-unit surveys: 3' x 6' at a scale of 1:10 000.

b) Update surveys

Map format and scale must agree with that used at the time of the original survey or be modified to the B.C. Geographic System.

3. Minimum size of openings and disturbances (see Appendix 9-7 for graphic representation).

	<u>Photo Scale</u>	<u>Size</u>
a) Forest	1:10 000	2 ha
	1:15 000	5 ha
	1:15 840	5 ha (existing photos only)
	1:20 000	8 ha
	1:31 680	20 ha (existing photos only)
b) Non-forest	1:10 000	1 ha
	1:15 000	2 ha
	1:15 840	2 ha (existing photos only)
	1:20 000	3 ha
	1:31 680	8 ha (existing photos only)

Note: These standards apply to forest classification and photo typing only, not to detailed history maps or precise records of silvicultural treatments. Accordingly, the minimum type sizes do not preclude more detail at a lower level, if so desired. Some factors to consider are: site productivity, significance of forest type or treatment, shape of opening, size and complexity of descriptive label, and surrounding map clutter.

APPENDIX 9-1 cont.

4. Accuracy of disturbance update

a) Boundary delineation

One or more of the following methods may be used to obtain disturbance boundaries (see Appendix 9-10). Three distinct type lines accommodate the different levels of accuracy inherent in each method. Levels 1 and 2 are intended for short-term use only and should be upgraded to level 3 as soon as suitable imagery becomes available. Plotting standards do not apply to levels 1 and 2.

Level of Accuracy	Method	Type Line
1	Assumed boundary Planned boundary	— ··· —
2	Sketch mapped Closed traverse	— ··· —
3	Satellite image analysis 70 mm vertical photography Conventional air photography	— · —

b) Plotting

Disturbance boundaries obtained by remote sensing may be transferred to the forest cover map by epidiascope, by radial line plotter, or by zoom transfer instrument. The accuracy of plotting using conventional photography shall be ± 1 mm at compilation scale. Slightly greater tolerances, say ± 3 mm at map scale, are allowed where photo centres have been spotted, or when the quality of imagery is substandard or questionable. Plotting standards at 1:20 000 may be summarized as follows:


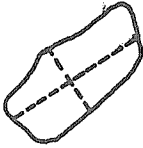

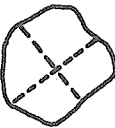



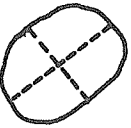
Satellite image analysis	- ± 5 mm
70 mm vertical photography	- ± 4 mm
Conventional photography	- ± 1 mm (± 3 mm)

c) Type lines

Final type lines shall be shown in black ink only

Clarity, completeness and map joins between adjacent

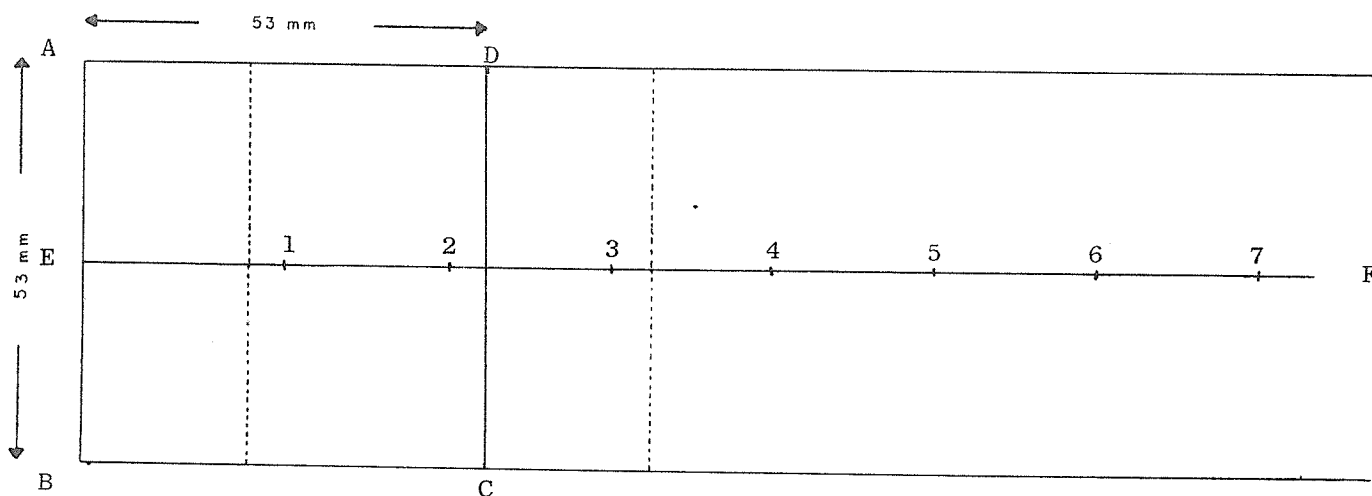
MINIMUM TYPE SIZES FOR UPDATING DISTRICT FOREST COVER MAPS

Photo Scale	Non-Forest	Forest
<p>1:10 000</p>  <p>200 m x 50 m = 1.00 ha</p>  <p>100 m x 200 m = 20 000 m² = 2.00 ha</p>	1 to 2 ha	
<p>1:15 000</p> <p>Also 1:15840</p>  <p>100 m x 200 m = 2.00 ha</p>  <p>225 m x 200 m = 45 000 m² = 4.50 ha</p>	2 to 5 ha	
<p>1:20 000</p>  <p>180 m x 170 m = 3.06 ha</p>  <p>400 m x 175 m = 70 000 m² = 7.00 ha</p>	3 to 8 ha	
<p>1:31 680</p> <p>For existing photos only</p>  <p>400 m x 225 m = 9.00 ha</p>  <p>500 m x 400 m = 200 000 m² = 20.00 ha</p>	8 to 20 ha	

1. These guidelines apply to forest classification and photo typing only, not detailed history maps or precise records of silvicultural treatments. Accordingly, the minimum type sizes shown do not preclude more detail at a lower level, if so desired.

APPENDIX 9-8

AREA COVERED BY 70 mm PHOTOGRAPHS - FORMAT FOR TEMPLATES



ABCD - area covered by one 70 mm frame (53 mm by 53 mm format)

E - F - line of flight

Note: 70 mm photographs will cover the outlined area shown above, with 60% end overlap, when flown at the height above ground which will yield desired scale, with appropriate time intervals between exposures.

APPENDIX 9-9

FLIGHT PLAN RECORD SHEET



Province of British Columbia Ministry of Forests

1 OF 3

FLIGHT PLAN RECORD

PROJECT NO.: PRINCE GEORGE SSA FLIGHT PLAN NO.: 2 (UPDATE) DATE: AUGUST 20TH, 1979

FILM TYPE: TRI-X MAG NO.: FRONT 51, REAR 4 TIME: 12:15 TO 14:45

ASA: 400 f/STOP & SPEED: 16.5/250 LENS: 60mm FILTER: 1.5 X YELLOW

NAVIGATOR: / PHOTOGRAPHER: / * ROLL NO.: 81 FRAMES: 471 to 526

A/C	B.C. PHOTO NO.	NO. OF FRAMES	COUNTER NUMBER	*FINAL FRAME NO.	E. (deg.)	Δ p (mm)	REMARKS
START F.P. — MAP NAVIGATION TO WHERE B.C. RAIL CROSSES CALE CREEK							
		2	0-1	472			TEST CAMERA
	77096:82	FERRY					FLYING Ht #FRAMES
1	77096:80	4	2-5	476			6,300 5
2	77096:100	6	6-11	482			6,600 6
3	77090:165	3	12-14	485			6,600 4 one corner missing
etc.			↓				
20	77004:91		54-56	526			5,500 4
END OF FLIGHT PLAN — RETURN TO BASE							
TOTAL DISTANCE OF F.P. —————→					180 miles		
DISTANCE @ 80 mph —————→					48 miles	————→	0.6 hours
DISTANCE @ 110 mph —————→					132 miles	————→	1.2 hours
APPROX. TIME OF FLYING —————→					1.8 hours	=	1 hour 50 minutes
NUMBER OF OPENINGS =					20		
NUMBER OF FRAMES NEEDED —————→					75 FRAMES		

FS. 811 INV. 81/3

* VICTORIA OFFICE USE ONLY.



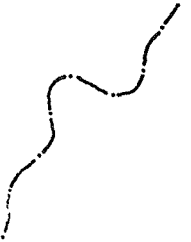
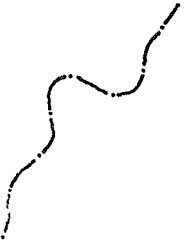
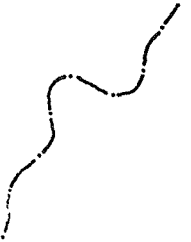
APPENDIX 9-9 cont.

INSTRUCTIONS FOR FILLING IN THE 'FLIGHT PLAN RECORD'

The flight plan record describes a length of film frame by frame and is filled in by the camera operator during actual flight. The form is also used in flight plan preparation to show the project name or number, the flight plan number, the air call number (opening or disturbance) and the B.C. photo number. At the same time, list in the "Remarks" column for each air call the approximate flying height above sea level and the estimated number of frames required for complete photo coverage. Record air calls on every second line and as the flight plan progresses fill in only the two columns headed "No. of Frames" (per A/C) and "Counter Number". Read the counter number from the command board. Do not fill in "Final Frame No." in the field. If extra air calls are required during flight, record them either between the scheduled air calls on every other line or on the back of the form.

APPENDIX 9-10

FOREST COVER MAPPING - DISTURBANCE BOUNDARIES

Level of Accuracy	Type Line
<p>1. <u>Assumed Boundary; Planned Boundary</u></p> <p>These boundaries are usually the result of logging activity and are based on planned cutting permit limits. In effect, this is an office function only whereby the pencilled pre-logging boundary is merely inked-in on the history map once harvesting has been completed.</p>	
<p>2. <u>Sketch Mapping; Closed Traverse</u></p> <p>Sketch-mapped openings are the result of photo sketching, rarely map sketching, according to post-logging examination and subsequent radial line plotting. Examination may be made on the ground, either by tie-in measurements or observation from a vantage point, or by aerial reconnaissance. Although the plotted boundaries are still inexact sketch mapping can be highly accurate depending on the number and nature of identifiable topographic features and the skill of the mapper. Small cameras (35 mm) can often be used to advantage.</p> <p>Locating the perimeter of openings by running a closed traverse has been a traditional means of updating history maps. However, the method is labour intensive for the benefits gained and, except for special situations, is being replaced more and more by remote sensing techniques. Accuracy tends to be variable.</p>	
<p>3. <u>Satellite Image Analysis</u></p> <p>This form of remote sensing is developing rapidly and may eventually replace conventional photography for certain forestry applications. Because of changing technology and high short-term costs, this technique has not been used in B.C. on an operational basis. Landsat-D, due for launching in 1983, will provide three times better resolution than existing satellite imagery.</p>	
<p>4. <u>70 mm Photography</u></p> <p>This method is relatively cheap, efficient, and fulfills a short-term need, say 5 to 10 years, consistent with accuracy, until such time as new planimetric bases become available.</p>	
<p>5. <u>Conventional Air Photography</u></p> <p>Vertical aerial photography is the technique most widely used in British Columbia for forest inventory mapping. Although the photos are the primary source of data in map construction they must still be supplemented by field survey work to provide ground control points, hence scale control of the base map and improved accuracy. Planimetric base maps are updated on a periodic basis, usually every 10 to 15 years.</p> <p>In the absence of revised base maps recent photography may be used for updating purposes by superimposing the new photo centres onto the existing bases and subsequently plotting any disturbances. Again, this is a short-term technique, more accurate than 70 mm updating, but fails to deny the eventual need for revised planimetric maps.</p>	

APPENDIX 9-11

DEFINITION OF INSECT DAMAGE

DEFINITION OF INSECT DAMAGE

NATURE OF DAMAGE BY INSECT GROUP	DEFINITION OF DAMAGE FOR PHOTOGRAPHS AND AERIAL SKETCH MAPPING	ATTRIBUTES COME OR ENTRY TO INDICATE DEGREE OF INFESTATION
<p><u>Defoliating Insects</u> Blackheaded budworm Douglas-fir tussock moth Greenstriped forest looper Larch casebearer Larch sawfly Western false hemlock looper Western hemlock looper Western spruce budworm Black army cutworm</p> <p><u>Not listed:</u> Forest tent caterpillar Gypsy moth</p>	<p><u>Light:</u> Defoliation barely visible from the air; barely discernible on 70 mm colour photos; needle loss confined to upper 1/3 of crown, or 1 to 30% over entire crown. No mortality. For black army cutworm, few seedlings defoliated, or 1 to 30 larvae /m² on the ground.</p> <p><u>Moderate:</u> Defoliation easily visible from the air and ground; readily apparent on 70 mm colour photos; needle loss mostly in upper 1/2 of crown, or 31 to 60% over entire crown. Some scattered mortality, depending on the number of years of successive defoliation. For black army cutworm, 40-50% of all seedlings defoliated, or 31-120 larvae /m² on the ground.</p> <p><u>Heavy:</u> More than 60% of entire crown defoliated. Mortality variable, ranging from scattered individuals to complete death of the stand (pure types) or susceptible species within the stand (mixed types). For black army cutworm, most seedlings defoliated, or 121 + larvae /m² on the ground.</p> <p><u>Past Occurrence</u></p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p>

APPENDIX 9-11 cont.

DEFINITION OF INSECT DAMAGE

NATURE OF DAMAGE BY INSECT GROUP	DEFINITION OF DAMAGE FOR POLYGON ATTRIBUTES AND AERIAL SKETCH MAPPING	ATTRIBUTE CODE OR ENTRY TO INDICATE DEGREE OF INFESTATION
<p><u>Bark Insects</u> Douglas-fir beetle Mountain pine beetle Spruce beetle</p>	<p><u>Polygon Attributes</u> Stem count of number of dead and dying trees per hectare either measured (actual: ground; 70 mm photo count) or estimated (observed: air; sketch-mapping count) up to a maximum of 9. For a count of 10 or more stems per hectare report as heavy. Green-attacked trees are not included. Assume a random damage distribution pattern.</p> <p><u>Sketch Mapping</u> Classification of bark beetle damage intensity as L - light, M - moderate and H - heavy applies to the entire stand, not simply the host component within the stand.</p> <p><u>Light:</u> 1 - 5% of trees affected <u>Moderate:</u> 6 - 30% of trees affected <u>Heavy:</u> 31% + of trees affected</p>	<p>Enter absolute value to a maximum of 9. For 10+ record as H. P = Past occurrence.</p> <p>No entry. Definition used for aerial sketch mapping only.</p>
<p><u>Sucking Insects</u> Balsam woolly aphid Cooley spruce gall aphid</p>	<p>Under investigation</p>	
<p><u>Shoot and Bud-damaging insects</u> Spruce weevil</p>	<p><u>Light:</u> 1 - 2 % of spruce leaders infested <u>Moderate:</u> 3 - 10% of spruce leaders infested <u>Heavy:</u> 11%+ of spruce leaders infested <u>Past occurrence</u></p>	<p>1 2 3 4</p>

APPENDIX 9-12

LIST OF FORMS

F.S. 803	Volume Analysis Tree Record
F.S. 811	Flight Plan Record
F.S. 811A	Decay Sample Plot Record
F.S. 814	Decay Tree Record Main Stem
F.S. 814A	Abnormality Record
F.S. 815	Decay Tree Record Secondary Leader
F.S. 842	Butt Taper Measurement