INVENTORY & PLANNING
SOUTHERN REGION

ESTIMATING KARRI SEED CROPS

ESTIMATING KARRI SEED CROPS ON COUPES

CUT TO SEED TREES

1. EQUIPMENT NEEDED

1.1. Telescope and binoculars
1.2. Rifle, ammunition, ear-muffs
1.3. Crown area grid
1.4. Calico bags, or tins, and lables, for capsule samples.
1.5. Form III and Table X + (APPENDIX 5 4)
1.6. Coupe Plans.
1.7. Booking Board and Pencils
1.8. Field Plans
1.9. Copy of Procedures.

1.1 TELESCOPE can be obtained from the Research Store.
BINOCULARS can be obtained from the Divisional Store.

1.2 Anyone who uses a firearm should become familar with the legal requirements. Refer to H.O letter dated 15/12/75. REGULATIONS COVERING USE OF DEPARTMENTAL FIREARMS. (APPENDIX 1)

1.2.1 RIFLE .222. Draw riffle from Research Store, fill in Register (APPENDIX 2) Register is kept in Research Front Office. Return riffle at the end of each day .

1.2.2 BOLT FOR RIFLE Obtain this from Divisional Office (locked in safe) return the same each day.

1.2.3 AMMUNITION Purchase ammo from "McCays Sports Goods" Store in Brockman Street Manjimup. Use Form (APPENDIX 3). The Department is exempt from Sales Tax therefore only use this Form. The Form must be signed by the D.F.O. Ammo must be kept in locked box provided and this box to be kept in Research Store with rifle. Use card for receipt and issue of ammo. Bring back all empty and misfired shells.

1.2.4 EAR - MUFFS Kept in Research Store with rifle. USE IS ESSENTIAL.

1.2.5 FIREARMS SAFETY

1. KNOW YOUR RIFLE (APPENDIX 7)

Be sure rifle and ammunition are in a clean condition.
Be sure barrel is clear of obstructions and that you have ammunition only of the proper size for the rifle you carry.
Always know and apprecaite the muzzle velocity and the distance a bullet from your rifle could travel and inflect injuries.

HANDLE YOUR RIFLE PROPERLY

2. TREAT EVERY RIFLE AS IF IT WERE LOADED

Watch that muzzle. Carry your rifle safely; keep on safety until ready to shoot.
Be sure of the target before you pull the trigger.
Never shoot at a target which you have not clearly identified.
Study the background so that if your bullet misses the target it will not travel on and cause injury.
Never point a rifle at anything you do not want to shoot.
Never skylark or engage in horse-play when you have a rifle in your hands.
Never shoot a bullet at a flat hard surface or water; at target practice be sure your backstop is adequate.
Firing a rifle across water is dangerous - a ricochet may occur and injure an innocent person.

3. SHOWING

Open the action, remove the magazine, don't trust the safety-point in a safe direction.

4. CLEANING

Open the action, remove the magazine, check mechanically, check bore. Clean rifle regularly after use.

5. TRANSPORTING

Unloaded - uncocked - carry cased or wrapped - watch that muzzle
Carry only empty rifles, taken down with action open.
Never lean a loaded rifle against fence or tree where it may fall.
Never climb a fence with a loaded firearm. Seek the assistance of a companion or place the weapon on the ground, through the fence with the action open.

6. STORING

Unloaded - uncocked - ammo elsewhere - clean and locked out of reach. Bolt stored seperately.

7. REPAIRS

When you have a rifle which is in need of repair - if you have any doubt about how to repair it - Don't experiment and hope for the best - seek the services of a gun-smith who will competently repair it - this course will probably be cheaper in the long run.

DRAFT

SEED FORECASTING - SAMPLING AND RELIABILITY

The following revised sampling technique provides a measure of reliability on a seed forecast as well as a time.

1. Standards

1.1 Sampling level is a compromise to achieve a reasonable level of reliability while not expending excessive effort in sampling. The proposed system allows the early rejection of coupes where variability of capsule crops between trees is high and excessive sampling effort would ne needed to reach the required level of reliability.

1.2 A reliability level has been chosen with the standard error within 12.5 percent of the mean. At this level the estimated mean of capsules per twig will be within ±25 percent (= 2 standard errors) of the true mean, with a probability of 5 percent.

1.3 Minimum capsule per twig numbers for a satisfactory seed crop are shown below in section 2.6. These capsule numbers were calculated from the numbers of seeds needed for satisfactory regeneration. These data are shown in 1.4 below. They represent some departure from past practice in that the ease of regeneration on different sites is taken into account, and a larger seed crop is assumed to be needed for the more difficult sites.

1.4 Minimum Seed Levels (at 4 seed trees/ha some flexibility is possible in No. of Seed Trees/ha).

Site Type	Seeds/Hectare		Seeds/Tree	
	Spring *	Autumn	Spring	Autumn
Red Loams	150 000	100 000	37 500	25 000
Northern Podsols (Gen. mixed type)	225 000	150 000	56 300	37 500
Southern Podsols (Walpole Area)	300 000	200 000	75 000	50 000

* Denotes anticipated season of regeneration burn.

2. Sampling Procedure

2.1 Sampling will be subjective in that only potential seed trees will be assessed.

2.2 Sampling will aim to cover roughly 5% of the potential seed trees. This amounts to assessing approximately 20 trees per 100 hectares of coupe area.

2.3 Sampling will cease temporarily after a rate of 10 trees per 100 hectares has been reached, and the calculations shown in Sections 3 and 4 ~~will~~ will be followed.

2.4 Depending on the results of these calculations, the following alternatives will be performed.

2.4.1 If the standard ~~cover~~ ERROR of the mean number of capsules per twig falls within 12.5% of the mean, sampling will cease. (the sample is adequate)

2.4.2 If the standard error of the mean number of capsules per twig exceeds 12.5% of the mean, then calculate the number of trees to be sampled to achieve the 12.5% level.

2.4.3 If the number of trees required is equivalent to 20# per 100 hectares or less, continue sampling to the requisite number.

2.4.4 If the number of trees required is greater than 20# per 100 hectares cease sampling and abandon the coupe as a seed tree proposition.

2.5 On return to the office, the mean capsule per twig figure will be compared with the minimum for an adequate seed supply shown in 2.6.

2.6 Minimum capsules per twig for an adequate seed supply (at 4 seed trees/ hectare) (assumes an average of 1.1 seeds/capsule).

Mean C.A.G. for Sample	Red Loams		Northern Podsols		Southern Podsols	
	Spring *	Autumn	Spring	Autumn	Spring	Autumn
35+	2.4	1.7	3.8	2.4	5.0	3.4
25 - 34	3.8	2.5	5.6	3.8	7.8	5.0
15 - 24	7.5	5.0	11.1	7.5	15.0	10.0

* Denotes anticipated season of regeneration burn.

3. Calculation of Standard Error

3.1 Calculate standard deviation as follows :-

3.1.1 Subtract the lowest capsule per twig figure from the highest. This will give a range.

3.1.2 Refer to the range/standard deviation ratio table given below and read off the ratio applicable to the number of trees you have sampled.

3.1.3 Divide the range figure by the ratio figure read off the table. The result is a fairly accurate estimate of the standard deviation.

3.2 Divide the standard deviation by the square root of the number of trees in the sample. The result is the standard error.

Ratio of Range/Standard Deviation

Number of trees in example.	Ratio Of range/SD
10	3.08
15	3.47
20	3.73
25	3.92
30	4.09
35	4.20

40	_____	4.32
45	_____	4.41
50	_____	4.50

eg:

Assume 10 trees sampled and the 10 capsules per twig figures range from the lowest of 2 to the highest of 8.

Range = 2 to 8 = 6 (3.1.1 above)

Range: Standard Deviation ratio = 3.08 (3.1.2 above)

Standard Deviation = $\frac{6}{3.08}$ = 1.95 (3.1.3 above)

Standard error = $\frac{1.95}{\sqrt{10}}$ = 0.62 (3.2 above)

4. Calculation of number of trees required in sample to give a standard error within 12.5% of the mean.

The formular for this calculation is

$$n = \left(\frac{\text{Standard Deviation}}{\text{Standard Error}} \right)^2$$

where n - is the number of trees which need to be sampled.

Standard Deviation - is the one you have calculated already for your sample.

Standard Error - is the one you wish to work to and calculated from the mean capsules per twig from your sample divided by 8 (=12.5%)

eg: Standard deviation = 1.95 (See example 1)

Standard error = 0.25 (Say mean caps/twig = 2, St.error required = $\frac{2}{8}$ = .25)

Number of trees to be sampled to give a standard error of ± 12.5%

$$= \left(\frac{\text{standard deviation}}{\text{standard error}} \right)^2 = \frac{1.95}{0.25}^2 = 61$$

i.e. 61 trees will give a reliable estimate in this example.

5. Calculate standard error for all samples and assign a reliability to the estimate as follows.

RELIABILITY	STANDARD ERROR
GOOD	± 12.5% of mean capsules/twig
FAIR	± 25% " " " "
POOR	± 25% " " " "

eg: Mean capsules/twig = 4.3
Standard error of sample = 0.87
i.e. Standard error = $\frac{0.87}{4.3} \times \frac{100}{1}$ % = 20.23% of mean.

Reliability of the estimate is fair.

i.e. Estimated mean capsules/twig is within ±40.46% of the true mean, with a probability of 5%.

APPENDIX 4

1.3 CROWN AREA GRID - (APPENDIX 4)

1.4 BAGS AND LABELS - take into field for capsule camples. Labels inside and outside. Complete capsule count at the end of each day.

1.5 FORM III and TABLE 'X' - Detailed Recording Sheet. Clip Forms to Booking Board and use in field. Forms should be completed at the end of each day. (APPENDIX 5) + APPENDIX 5a.

1.6 COUPE PLANS List of coupes for Forecast will be provided together with list of priorities within cutting years. Photocopy coupe sheets required for each Forecast and Take them with you to the field.

1.7 BOOKING BOARD & PENCILS - as required.

1.8 FIELD PLANS - F.D. 80's to locate Blocks and other roads etc..

1.9 PROCEDURES - Take to the field for reference.

2. PROCEDURE

Drive through the coupe looking at selected trees with binoculars, to get an idea of the uniformity of the capsule crop. Note any particular differences between hilltop and valley crop, or if any pronounced falling off in crop from one end of the coupe to the other. Plot any major differences on the Large Plan.

Pick small groups of trees throughout the coupe for measurement with the grid. Each group should be about 5 to 8 trees, fairly representative of the area. Each tree in the group must be far enough away to allow accurate grid assessment, but also within reasonable range of the telescope. The exact number of trees in the group, and number and location of groups assessed, will depend mainly on the distribution and number of seed trees present and the variability of the coupe conditions. However, the total number of trees assessed should be at least 5% of the total number of seed trees present. It is usually unnecessary to assess more than 10% of those present, unless it is a very small coupe or there is very large variation in individual trees. Formerly coupes have been around the 50 hectare range, and a 10% count of this size coupe means there will be 20 trees to count (assuming and average 4 trees per hectare). With much larger coupes, up to 200 ha, a 10% count will mean 80 trees have to be assessed, so it would be desirable to reduce the count to the minimum 5% i.e. 40 trees.

Each tree chosen should be measured by the grid. the grid is held up in front of the assessor, and moved backwards and forwards until the entire tree comes exactly within the area of the perspex window, i.e. the base of the bole (ground level) should just cut the bottom scribed line, and the highest branch be level with the top scribed line. Holding the grid steady, the assessor then counts the number of squares occupied by the crown of the tree - the bole area below the crown being ignored. Some squares on the edge of the crown will be partially occupied, and these can be included at the assessors discretion two or more partially occupied squares can be counted as one complete one; or squares more than half occupied included, those less than half occupied ignored.

Each tree assessed with the grid must then be examined by telescope and the capsules per twig counted. The grid assessment and capsule per twig number is then noted on Form III, and each individual tree score worked out from Table X on Form III.

The actual assessment of capsule per twig by telescope is the most difficult step, and the one most subject to error. Heavy foliage, weather conditions, poor light, etc., often make counting difficult. The line between immature capsules (late Region 3 to early Region 4), mature capsules, and over-mature capsules (Region 5) is sometimes hard to distinguish. (APPENDIX 6) KARRI 5 YEAR FLORAL CYCLE.

Even when only one of these regions is present, it is not always easy to tell whether this comes in the under mature, mature,or over mature category. One of the main sources of error in assesssing areas for seed is assuming that if many capsules are apparent, there must be some seed. Often capsules hang on till the 6th or 7th year, and all seed is already cast.

To overcome this problem, one or two branches should be shot down at the commencement of the actual assessment. These branches can be examined closely and the regions present worked out, with the actual components per twig counted (these actual figures can, of course, be used for that particular tree count included in the Table on Form III).

It is helpful if the assessor first makes an estimate of the particular tree from which the branch is shot down. He can then check his estimate from the shot branch. This, and perhaps a further visual examination of the tree after obtaining the figures from the shot branch, will give a good guide to the remaining trees in that group.

Even if it is impossible to count the exact number of capsules per twig for any of the trees examined, it is usually obvious whether the number of capsules present fall into the 'Heavy','Medium', or 'Light' range as laid out in Table X. In this case, a'heavy' crop can be given the average figure i.e. 9 capsules/twig, a 'medium' crop 6 capsules/twig and a 'light' crop 3 capsules/ twig. The size of the tree is then applied in each case to this average figure to abtain seed per tree.

As well as the actual groups of trees chosen for grid assessment, it is advisable to examine some of the intervening trees with telescope or binoculars - this gives a good overall impression of the Coupe and should confirm your actual grid and capsule assessment of the groups of trees.

3. SHOOTING

It would be ideal to shoot down a branch from each tree examined, but this would be too expensive and time-consuming. In practice, a minimum of 3 branches are shot down in each coupe examined, and more if the coupe is large, or the trees very variable or difficult to assess visually. A good guide would be, in an average, fairly assessable coupe, to shoot down one branch in every 8 trees examined. This would give the minimum 3 branches for a 50 hectare coupe (with a 10% assessment rate), and 5 branches in a 200 ha coupe (with a 5% assessment rate).

The choosing of which branches to shoot down will become easier with experience, but the following points should be noted:

a) The number and siting of branches shot will depend on both the size of, and variation within, the coupe, but should be numerous and diverse enough to reflect any variation.

b) A reasonably 'average' branch should be chosen in each case, but the branch must offer a good target, contain enough' crown' to give a good sample, and have a free fall i.e. in practice, branches must be near the edge of the tree crown.

c) The target area of the branch stem should not be too thick from 4cm to 8cm is a reasonable size.

d) Branches often hang after breaking. In this case, it is futile firing off a dozen or so shots in an attempt to free it. It is better to try another branch. However it pays, particularly on a windy day, to check every area where branches are hanging before leaving the coupe. Often a branch will have freed itself by then, and is useful for a confirmatory check and another capsule sample.

e) Branches rising straight up, or at an acute angle, should be chosen for preference. This cuts down the number of 'hang-ups'.

f) Shooting range is up to the individual. However a distance of about 60 - 80 metres from the tree is about right. The most efficient way of obtaining the branch is to fire the first shot into the lower edge, second shot into the upper edge, then one or more shots into the centre. Precision comes with practice, and it is often possible to get a branch down with two shots - occasionally with one. But if a branch breaks with the first shot, more often than not it will hang. About 5 to 8 shots is the most frequent number to bring down a branch.

Once a branch is down, the components should be counted, each region separately. It is also helpful to count the bud stages also - though these will not be needed for that particular coupe, they will be useful record for the future seed years in that locality, and will supplement the normal annual seed forecast by Research Branch.

Region 4 capsules can be noted on Form III, and if Region 5, and/or immature 4 are also present they can be noted on separate forms and taken into account in the final assessment report.

The assessor must fill out Form III in the field.

A sample of at least 200 capsules from each stage should be collected from each branch. Thus there may be from 1 to 3 separate samples from each i.e. there could be 9 samples if 3 branches are shot down. Normally there is only one sample from each branch. Late Region 3 capsules, even if they appear green, should be sampled as they will sometimes open under heat, and will give a good guide as to when the next burn may be possible if the first one is delayed for any reason.

Each sample should have a label, inside the bag, giving the Coupe No., Region of capsules, Sample No. and date. (eg Iffley Block, Coupe 2 Region 4(early), Sample No.1 23/2/77). The rough area where each sample branch is shot should be marked on the coupe plan, or at least described on the report, e.g. "Sample No. 3 shot in north west corner of coupe, from junction of black and Smith Roads". Thus if there are any marked changes in seed per capsule from one area to another, this can be picked up, and if thought necessary can be checked on later by further sampling.

At this stage, the samples should be sent to Research Branch for seed extraction. This entails 2 or more days oven treatment so cannot be done in local offices yet. Research Branch will send the results back to Divisional H.Q.

Sometimes branches are shot down which contain less than 200 capsules needed for checking seed/capsule. In this case, collect all the capsules available, but note the actual number on the label. A total of 200 capsules give an accurate assessment, but as few as 50 will give a reasonable figure.

When all the information has been collected and seed/capsule figures obtained from Research Branch, Form III is easy to fill in. A copy of the form should be sent to Research Branch, as well as the Divisional requirements. A note of other regions present, from pin buds (Region 1) to flowering buds (Region 3) should also be sent.

4. GENERAL NOTES

Seed crop assessment is not a simple job, and if we can get our prediction to within 10 - 15% of the actual figure, we are pleased. The above procedure, 'mechanical' as it might appear, should give an estimate to within 20 - 25% of the true figure, which is quite acceptable considering the variability of any crop, and the several sources of error in the procedure. As the assessor does more seed prediction work, it becomes easier, and it may be possible to cut down on the use of the grid. However, it takes several seasons to get the 'Feel' of Karri seed prediction, and no short cuts should be attempted until some proficiency is reached. Particularly as wrong or insufficient forecasts can be very costly.

When shooting in any coupe; Divn Office, Bunnings, or nearby farmers should be informed if they are working in or near the coupe. Also ensure that the direction of shooting is away from any such working. All safety precautions with the rifle should, of course, be strictly adhered to. The wearing of ear-muffs is strongly recommended both for the shooter and any helpers.

FURTHER REFERENCES

Circular Karri Reproduction and Seed Cycle.

APPENDIX 8

APPENDIX 1

FORESTS DEPARTMENT
54 BARRACK STREET
PERTH. W.A. 6000.

319/74
Mr. C. Chambers

OFFICER IN CHARGE
FOREST DEPARTMENT
RESEARCH

REGULATIONS COVERING USE OF DEPARTMENTAL FIREARMS

The Forests Department holds a corporate licence under the Firearms Act 1973 and Regulations 1974. This licence covers all firearms held by the Department.

The Department is required to advise Police of any change in firearms (e.g. purchases) and provide a list of personnel authorised by the Department to use these firearms.

At present, divisions are required to provide fire control with a list of officers and employees using verey pistols. The List is revised annually on September 15th.

With increasing numbers of firearms held by the Department (e.g. incendiary launchers) it is necessary to maintain more complete records. In addition, Police have advised the Regulations and more specific records must be kept at the local office.

1. Please ensure the following information is forwarded to Protection Section before September 15th each year (see example below)

1975/76 SEASON

Firearm Type	Personnel Authorised to use the Firearms	
	Name	Address
Verey pistol	JONES, John	Brain Street, Manjimup
	SMITH, Edward	Brain Street, Manjimup
	BROWN, Peter	Brain Street, Manjimup
Incendiary Launcher	GREEN, Peter	Forests Dept., Wheatley
	BLACK, Noel	Forests Dept., Nyamup

2. At each divisional office it is necessary to maintain a register showing name and address of personnel using a particular firearm on any date. Any police officer may demand to see this register at any time.

   Your register should show details as shown in the example below and must be signed by the O.I.C.

2...

Date	Firearm		Firearms Issued to:		Signature of O.I.C.
	Type	Serial No.	Name	Address	
1.12.75	V.P.	123456	BROWN, Bill	Rose St, Manjimup	
2.12.75	Incend. launcher	65421	JONES, John	Glew St, Pemberton	

A/CONSERVATOR OF FORESTS

15th December, 1975
CC:AP

DISTRIBUTION:

DISTRICT AND DIVISIONAL OFFICES
INSPECTORS
SUPERINTENDENTS

APPENDIX 2

Date	Firearms		Firearm issued to:		Signature ~~of O.I.C.~~
	Type	Serial No	Name	Address	

CERTIFICATE "A"

(APPENDIX 3)
INVENTORY AND PLANNING
SOUTHERN REGION

SALES TAX (EXEMPTIONS AND CLASSIFICATIONS) ACT

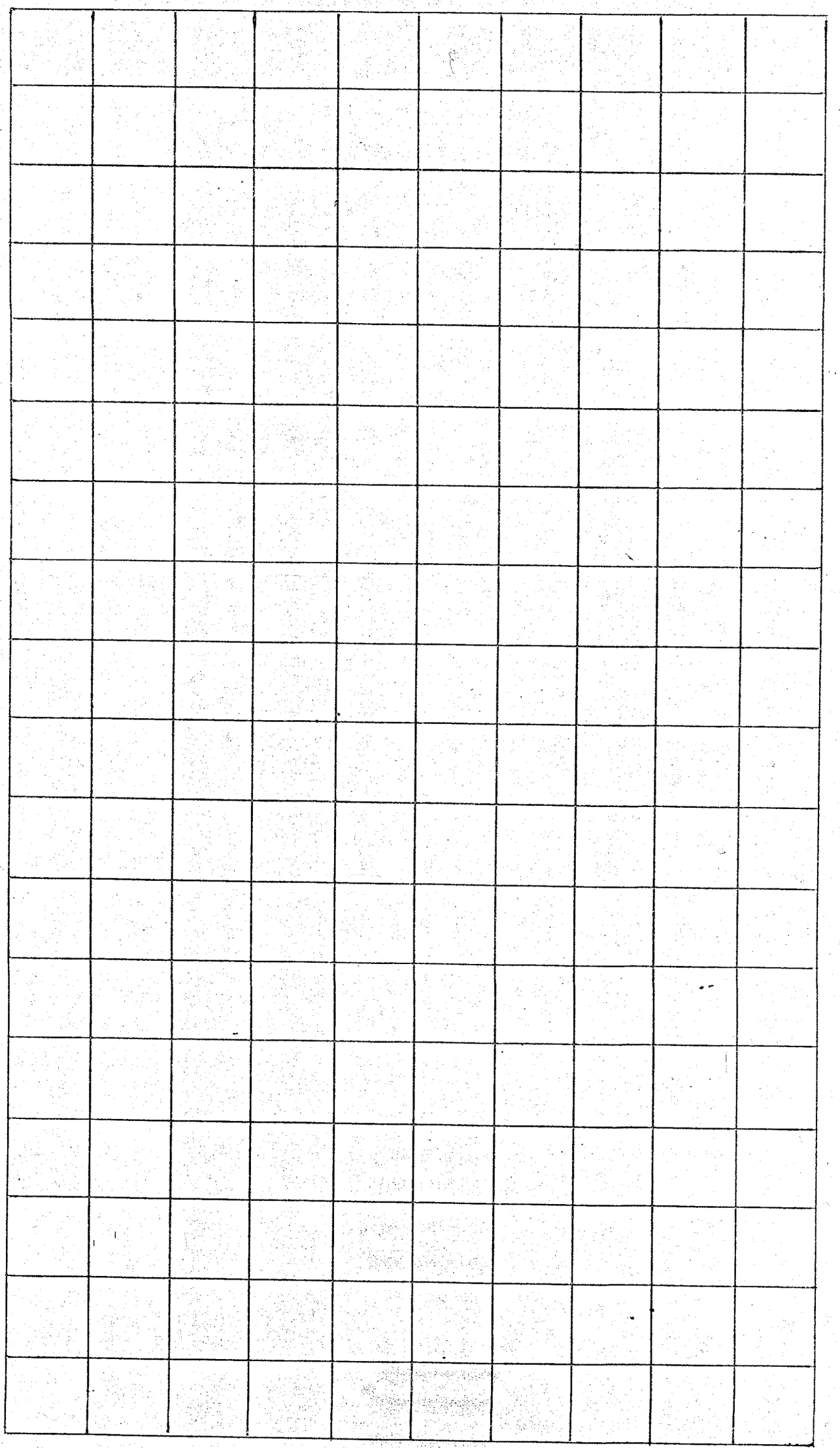
To:- The Commissioner of Taxation; and
The Commonwealth of Australia.

I hereby certify that the .....
purchased from .....
on .....is/are for the official use and not for resale by a Government Department, viz .....
and exemption is accordingly claimed under item 74 in the First Schedule to the Sales Tax (Exemptions and Classification) Act.

Signature .....
Address .....
.....
Date .....

KARRI CROWN GRID

(APPENDIX 4)



FORM III (APPENDIX 5)

KARRI SEED CROP ESTIMATE INVENTORY & PLANNING

DIVISION _____ BLOCK _____

COUPE _____ MAP REF _____

DATE _____ FORECASTER _____

TREE	SIZE	STAGE	CAP PER TW	SCORE

SAMPLE No (shot down)	1	2	3	4
PIN BUDS				
STAGE 2				
STAGE 3				
STAGE 4				
STAGE 5				

CALCULATION OF SEED CROP

	Stage 3	Stage 4
(a) Capsule per TREE		
(b) Seed per Capsule		
(c) Tree per Hectare		

Seed per Hectare = (a) X (b) X (c)

=

Stage 3	Stage 4

NB Seed Per Capsule (b) and Trees Per Ha (c) are obtained From Office after field work is completed

Caps Per Twig		Crown Size L	Crown Size M	Crown Size S	
Heavy	10	150	100	50	SEED PER TREE IN THOUSANDS
	9	135	90	45	
	8	120	80	40	
Medium	7	105	70	35	
	6	90	60	30	
	5	75	50	25	
Light	4	60	40	20	
	3	45	30	15	
	2	30	20	10	
	1	15	10	5	

FINAL FORECAST

Spring Burn 300 000 Seeds Per Ha

	1979	1980	1981
STAGE 3			
STAGE 4			
Recommend.			

Autumn Burn 200,000 seeds Per Ha

	1979	1980	1981
STAGE 3			
STAGE 4			
Recommend.			

TOTAL SCORE x 1000 / No of Trees = Caps PER TREE (a)

KARRI SEED FORECASTING - SAMPLING RELIABILITY (APPENDIX 5a)

DIVISION _____ DATE _____
BLOCK _____ FORECASTER _____
COUPE _____ RECENT BURN. _____

1. Calculation of Standard Deviation and Standard Error. (See procedure note 3.1 & 3.2)

RANGE = ____ to ____ = _____
RANGE: STD. DEV. RATIO = RATIO OF RANGE/ST. DEV.
(10 trees assessed) = 3.08 NB See procedure for more than
(15 " ") = 3.47 25 trees per coupe.
(20 " ") = 3.73

Standard Deviation = $\frac{\text{RANGE}}{\text{RATIO}}$ = _____ = _____

Standard Error = $\frac{\text{ST. DEVIATION}}{\sqrt{\text{NO. TREES ASSESS.}}}$ = _____ = _____

STANDARD DEVIATION = _____
STANDARD ERROR = _____

2. Calculation of number of trees required in sample to give a standard error within 12.5% of the mean. (See Procedure note 4.1)

NUMBER OF TREES = $\left(\frac{\text{STANDARD DEVIATION}}{\text{STANDARD ERROR}}\right)^2$

NB Standard error is the one you wish to work to and calculated from the mean capsules per twig from your sample divided by 8 (=12.5%)

NUMBER OF TREES = $\left(\frac{\quad}{\quad}\right)^2$ = _____

3. Calculate standard error for all samples and assign a reliability to the estimate as follows. (See procedure note 5.1)

RELIABILITY	STANDARD ERROR
GOOD	$\pm$ 12.5% of mean capsules/twig
FAIR	$\pm$ 25% of mean capsules/twig
POOR	$>\pm$ 25% of mean capsules/twig

MEAN CAPSULES/TWIG = _____
STANDARD ERROR OF SAMPLE= _____
ie STANDARD ERROR = ___ x $\frac{100\%}{1}$ = _____% of mean

RELIABILITY (from above chart) is GOOD/FAIR/POOR.

4. Minimum seed levels (at 4 seed tress/ha some flexibility is possible in number of seed trees/ha.) (See procedure note 1.4)

SITE TYPE	SEEDS/HA SPRING *	SEEDS/HA AUTUMN	SEEDS/TREE SPRING	SEEDS/TREE AUTUMN
RED LOAMS	150000	100000	37500	25000
NORTH.PODSOLS (Gen. mixed type)	225000	150000	56300	37500
SOUTH.PODSOLS (Walpole area)	300000	200000	75000	50000

*Denotes anticipated season of regeneration burn.

5. Minimum capsule per twig for adequate seed supply (at 4 seed trees per hectare). NB Assumes an average of 1.1 seeds per capsule. (See procedure note 2.6)

MEAN C.A.G. FOR SAMPLE	RED LOAMS SPRING *	RED LOAMS AUTUMN	NORTH.PODS. SPRING	NORTH.PODS. AUTUMN	SOUTH.PODS. SPRING	SOUTH.PODS. AUTUMN
35+ Large	2.4	1.7	3.8	2.4	5.0	3.4
25-34 Med.	3.8	2.5	5.6	3.8	7.8	5.0
15-24 Sml.	7.5	5.0	11.1	7.5	15.0	10.0

*Denotes anticipated season of regeneration burn.

6. CONCLUSION _____

APPENDIX 6

REGION 1
YEAR 1

PIN BUDS

REGION 2
YEAR 2

CYLINDRICAL BUDS

REGION 3
YEAR 3

CLAVATE BUDS

BLOSSOM

HYPANTHIA

IMMATURE CAPSULES

REGION 4
YEAR 4

MATURE CAPSULES

REGION 5
YEAR 5

MATURE CAPSULES

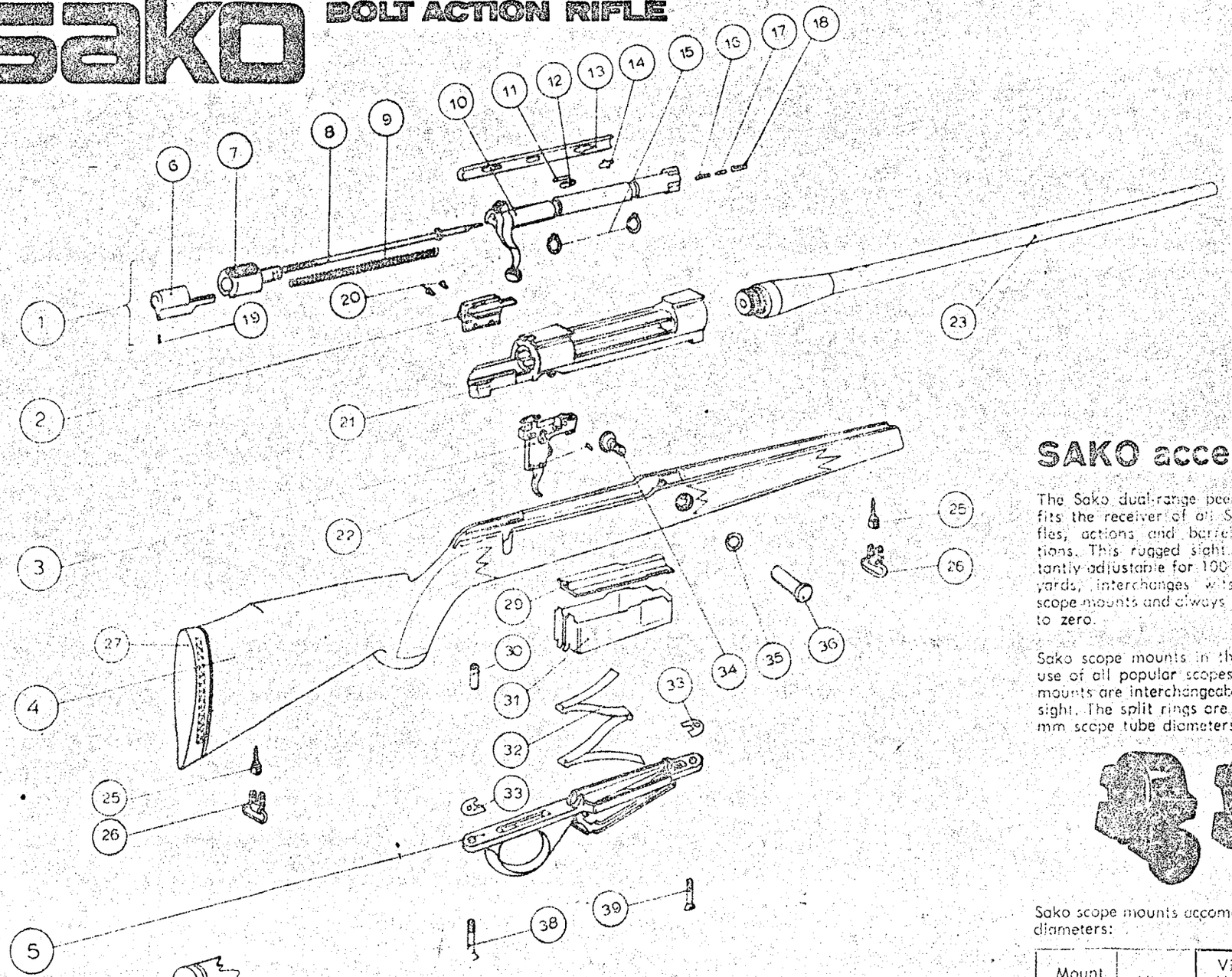
KARRI 5 YEAR FLORAL CYCLE

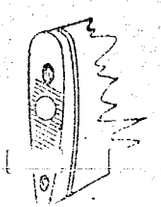
APPENDIX 7

FINLAND

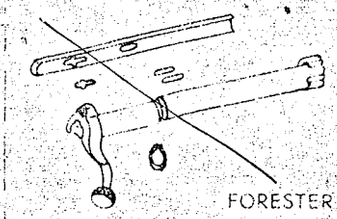
Sako

BOLT ACTION RIFLE

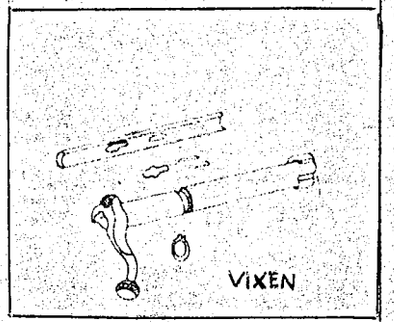




FINNBEAR



FORESTER

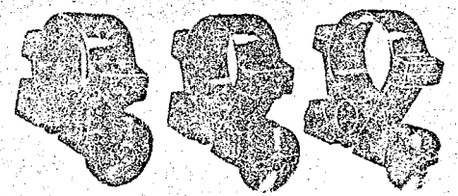


VIXEN

SAKO accessories

The Sako dual-range peep sight fits the receiver of all Sako rifles, actions and barreled actions. This rugged sight is instantly adjustable for 100 or 200 yards, interchanges with Sako scope mounts and always returns to zero.

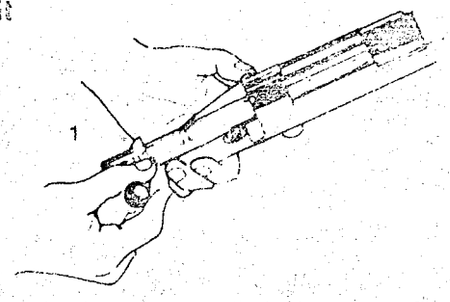
Sako scope mounts in three different heights permit the use of all popular scopes on Sako rifles. These two-piece mounts are interchangeable with the Sako dual range peep sight. The split rings are available for 22 mm, 1" and 26 mm scope tube diameters.



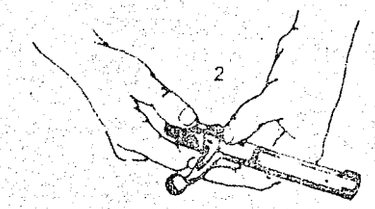
Sako scope mounts accomodate scopes with these objective diameters:

Mount type	Vixen	Vixen Heavy Barrel	Forester	Forester Heavy Barrel	Finnbear
Low	38 mm	30 mm	40 mm	33 mm	36 mm
edium	3 mm	2 mm	50 mm	45 mm	43 mm

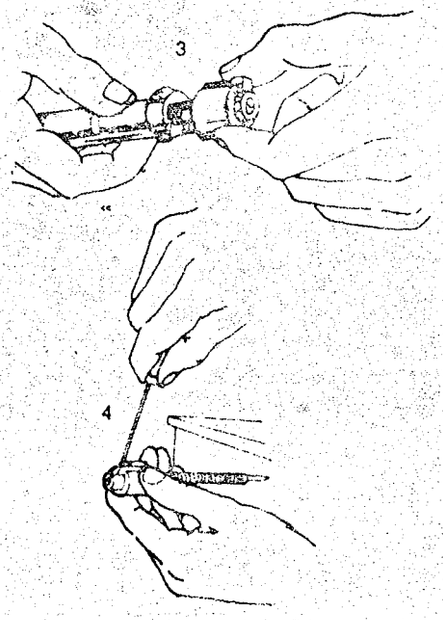
To Disassemble the Bolt



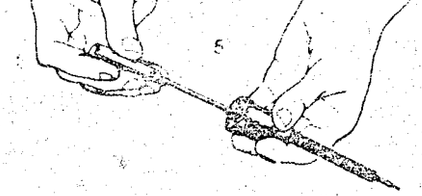
Depress the bolt release button with the left thumb (Fig. 1) and slide the bolt back and out of the receiver. Next, . . .



Hold the bolt in the left hand and with the rear of the bolt pointing up (Fig. 2) turn the bolt sleeve clockwise until it disengages from the bolt body (Fig. 3).



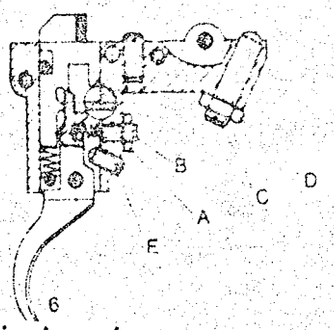
Loosen the firing pin stop screw with small screw driver (Fig. 4). Hold the firing pin assembly in the left hand with the point of the firing pin on a flat surface with the cocking piece and bolt sleeve unit held firmly in the hand.



This will prevent the components from flying apart due to the pressure of the firing pin spring. Using a screw driver, turn the threaded and slotted end of the firing pin downward out of the cocking piece. (Fig. 5).

To Reassemble

Simply reverse the foregoing procedure, making sure the firing pin protrusion is approximately .059" – 071". The protrusion has been fixed within these tolerances and it is not possible to alter this without special equipment.



Trigger Adjustment

The Sako triggers, as illustrated, as well as the identical triggers with integral thumb safety mechanism, are factory set for perfect sear engagement. The weight of pull and backlash can be adjusted simply and positively without the aid of a gunsmith. To lessen weight of pull, loosen lock nut "A" and back off screw "B" until desired weight is reached. Then tighten lock nut "A". To increase weight of pull, reverse above procedure. Backlash may be reduced, if necessary by turning in screw "E".

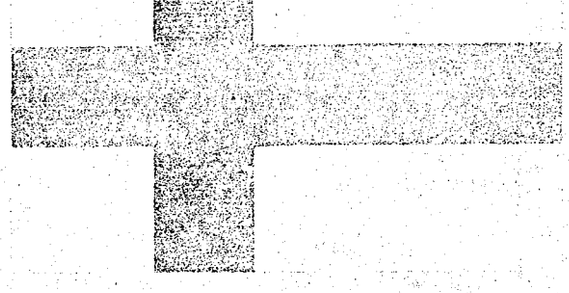
NOTE: Be sure screw "C" and lock nut "D" are tight before attempting adjustment.

To Operate Rifle

Lift the bolt handle and pull the bolt to the rear. Lay each cartridge on the magazine follower, pressing down until it is held in place in the magazine. Repeat this operation until cartridges have been loaded into the magazine. With magazine loaded, push the bolt forward and down. This will strip the top cartridge from the magazine and into the chamber. The rifle is now loaded and cocked.

To Operate Safety

With the rifle cocked, slide the safety to the rear. In this position the safety is on "SAFE" and the bolt is locked. The safety is pushed forward to place it in "FIRE" position while the red dot on the stock can be seen. The safety will operate only when the rifle is cocked.



FINLAND

SAKO

BOLT ACTION RIFLE

Type	
[X] VIXEN	Heavy Barrel
[ ] FORESTER	
[ ] FINNBEAR	

Calibre

[X] .222 [ ] 7x64

KARRI REPRODUCTION AND SEED CYCLE

Karri is a fire intolerant species and does not form lignotubers as does Jarrah and Marri. It reproduces naturally by seed, which germinates and grows directly into tree form. In its early stages, to at least 30 or 40 feet in height, it is very susceptible to fire and thus must be protected from fire for at least 15 years or so after germination. It will coppice after fire, saplings may sprout from ground level or higher up the stem, depending on the extent of the fire damage.

In its natural state the general pattern is of mature or over mature stands with scattered groups of younger trees - these apparently have developed in the natural gaps left after the deaths of older trees. However many karri stands appear to be even-aged, probably due to large fires occurring in the past during seed years, resulting in the deaths of all or most of the old trees.

Natural reproduction. The usual method of re-stocking areas cut over is by natural regeneration from seed. This is irrespective of the silvicultural method used. For successful regeneration the following requirements are necessary:

a) Seed supply. Seed must be in adequate supply at the time of burning and regeneration. On average sites 120,000 seeds per acre are required for a Spring regeneration burn, and 80,000 seeds per acre for an Autumn burn.

b) Seed bed. For successful germination karri requires a mineral soil free of both overhead canopy and ground competition. The ash bed left after a regeneration burn provides excellent conditions.

c) Germination. This follows either natural Summer seedfall, or Spring to Autumn seedfall induced by regeneration burning. Whatever the season of seedfall, the seed will not germinate until the onset of the first significant Autumn rains, which occur usually about mid-April. Most germination is complete by early July, though a few germinants appear as late as mid-August.

d) Survival and establishment. With optimum conditions, germination is very dense and can average as high as 50,000 per acre. The majority of germinants die in the early stages (i.e. cotyledon stage) and growth at first is slow. In Spring, growth accelerates and most germinants have reached the four-leaf stage by October. Deaths can occur through several causes. Insect attack is probably the largest single cause, followed by fungus (damping-off), frost and drought.

e) Tree per cent. This is briefly the percentage of seedlings which become established from the seedfall. It can vary from 0.6% to 2.8% depending on site conditions.

f) Fire and seedfall. Fire stimulates seedfall, the aim being to burn at the optimum time and induce the entire seed crop to fall over a short period. With a fire of sufficient intensity to scorch crowns, seed begins falling a few days after the burn, thus not getting damaged by the fire itself, and all seed is shed within a few weeks. A mild intensity fire will stimulate seedfall if the capsules are mature, but a fire of very low intensity may have little or no effect on seedfall.

Within a normal four-year seed cycle, seed matures in the fourth Spring and Summer. Half of this falls in Summer 4, and the remainder Summer 5.

Three opportunities therefore exist for regeneration burning - Spring and Autumn of year 4, and Spring of year 5. It is also possible that if maturity is sufficiently advanced, a successful seedfall can be induced in the Autumn of year 3, though a proportion of the capsules may fail to open at this stage. In more complex seed cycles with crops overlapping, the period of successful regeneration burning may be considerably increased.

g) Fire and seedbed. Under the present clear-falling with seed tree system, fire is used to remove scrub competition, provide an ash-bed, and induce seedfall. Burning is the standard site preparation for natural regeneration.

h) Regeneration and gap size. Both canopy and root competition of larger trees have an inhibiting effect on karri seedlings, restricting light and the availability of moisture. A gap of at least 2 chains between the edges of surrounding large crowns is considered necessary for vigorous regeneration. This problem does not of course, arise under the present clear-felling with seed-tree system.

i) Regeneration and scrub competition. Karri seeds falling into green scrub may germinate, but the majority quickly die through competition for light and available moisture. Any that do survive usually remain in a suppressed spindly condition for years before finally overtopping the scrub. Given an equal start with the scrub however - i.e. when it germinates in a scrub free ash-bed or disturbed soil, karri will quickly outstrip the scrub regrowth and dominate the community. It is thus most important to ensure that regeneration burns are of sufficient intensity both to promote seedfall and to clean out all existing scrub and slash.

To summarize the above points: - Karri regeneration in the field is mainly by natural reproduction from seed. Both seed, and young trees to at least 30' high, are susceptible to fire. The seed cycle, from first budding to mature seed in capsule, is usually of four-year duration, but may on occasion take only 3 years or up to 5 years. Seed cycles may overlap, or cycles initiated in 2 successive years may join up and mature at the same time. Under the present clear-falling with seed tree system, efficient regeneration relies on sufficient mature seed being available at the time of burning, and the burn being hot enough to bring down the seed and consume all ground litter and scrub and provide an ash bed. If these requirements are met, regeneration should be sufficient to restock the area without resorting to hand planting or seed sowing.

There are several enemies of karri seed production and young seedlings:

Insects. The larval stage of a beetle of the Bruchidae family east seeds within the capsules, Research is going on to find out at what stage of the floral cycle the beetle lays its eggs in the bud or capsule, but the adult beetle merges when the bud is mature, in the 4th or 5th years. A small round hole in the capsule is evidence of their attack. Other beetles of the family Bruchidae and a curculionid beetle, are responsible for laying their eggs in the karri buds, then nipping off the bud which falls to the ground.

Ants are known to remove seed, and also nip off young seedlings in the cotyledon stage. In a recent experiment on karri seed sowing, the survival and germination of seed in areas treated with insecticide was found to be four times as great as that of seed in the control areas. It would appear therefore that a considerable amount of seed is destroyed by ants over the Summer months.

There are several gall-forming insects and defoliators which attack young karri, which may cause temporary setbacks but are not of major importance.

Fungi. The main danger to young germinants is the "damping-off" fungi, which appear to do considerable damage in some areas, and can be the cause of low stocking in spite of there having been a good seed supply initially.

Karri is not susceptible to Phytophthora cinnamomi (Dieback), though it seems possible that some damage may be caused to roots when the fungus is present in the area. In pot trials, root regeneration was shown to be rapid after attack by Phytophthora.

Frost. Karri are "frost-tender", and may have their tips damaged by hard frosts. However in general Karri areas are not prone to heavy frosts.

SEED FORECASTING

It is evident that a clear idea of what seed is available must be obtained as soon as possible to allow forward planning of cutting, site preparation and burning. For successful regeneration sufficient seed must be available, though because of site and other factors, sufficient seed does not automatically mean successful regeneration.

A technique has been developed to forecast seed supply up to 4 years ahead. To better understand this, we will first look at the floral cycle, taking the normal 4-year cycle as an example.

Year one. Inflorescence forms in the terminal axils of current flush leaves in January, and by March or April the bud initials can be recognized. During the Winter, these "pin-buds" develop.

Year 2. The pin-buds grow large and fatten out into "cylindrical buds" up to $\frac{3}{4}$" long. These appear lower in the leaves as a new leaf flush will have appeared above them.

Year 3. Buds grow much larger, into "fat-buds", change colour from green into yellow-green or brown, and the operculum becomes dome shaped. One week before flowering a white line appears between the operculum and hypanthium. The operculum falls off, exposing the stamens, which unfold to expose the anthers. Trees flower for up to 6 months. The flower heads dry up and immature capsules develop through the Winter.

Year 4. Capsules continue to ripen and seed is ripe for dissemination by Spring. Some seed is then cast over Spring and Summer, and the remainder is cast over the following Spring and Summer (Year 5).

This describes a straightforward 4 year cycle. However the cycle can sometimes be shortened to 3 years by early flowering of buds, and sometimes lengthened to 5 years by "fat-buds" delaying flowering (as is currently happening). On occasions, pin-buds may form in 2 consecutive years and give 2 seed crops consecutively, or the 2 crops merge and give one good seedfall. Some trees flower early, others late, and there may also be local areas of early or late flowering.

It appears also that some outlying karri areas have floral cycles "out of phase" with the main karri area. The eastern and southern fringes appear to have floral cycles a few months in advance of the main area, and at Boranup, on the west coast, the cycle is running a year ahead of the main area, i.e. where the main area would have a seed year in 1975/76, Boranup would have a seed year in 1974/75.

It is possible, knowing the above facts, to forecast approximately the next seed-year, and the amount of seed that may be expected. Much basic field work has been done on estimating future seed crops, using the fact that throughout the floral cycle, floral components are continually being shed. By placing seed trays (2'2" x 2'2" wire mesh trays, each representing one tenth of a mil-acre) beneath trees, this loss can be counted and potential seed crop worked out. This is done by counting the number of pin and cylindrical buds falling in each seed tray up to flowering time. Then counting the number of operculum shed and thus working out the number of potential capsules still held on the tree. Any further loss of capsules is then subtracted, and the balance remaining should represent the number of capsules that will seed.

The rate of loss of floral components, irrespective of the size of the initial seed crop, has been found to be similar, i.e. we can expect the loss of some 80% of floral components between the initial budding and mature capsule. A graph has been compiled to show this rate of loss (Graph 3). Using this graph, measurement of the floral cycle at any stage will enable a good prediction of the number of capsules expected at maturity.

The easiest way of measuring floral density is to measure floral components per twig - a twig being one seasons growth. The regions are usually fairly well defined, and a complete picture of the next 3 to 4 years seed supply can be established. From past work it has been found that a mature karri tree has some 8,450 twigs, but for convenience a constant figure of 10,000 is used.

The method used in the annual seed forecast is fairly simple. All areas in which karri is being logged are visited in the Autumn, and from 10 to 15 trees assessed. On each tree, a representative branch or branches is picked out, and 30 twigs examined in each annual region. All components are counted and an average obtained, and from these an average for the area is worked out of all stages of the floral components. The likely crop of mature capsules resulting from each floral stage present can then be worked out from our graph.

To take an example, say in one area the trees contain floral components in regions 4, 3 and 1. Region (or year) 4, being mature, can be expected to retain all the capsules until seedfall, i.e. if the capsules per twig average 6, the amount of capsules, in each tree will average 60,000 (6 x the 10,000 twigs per tree). Reading from the graph we see there will be some 70% of the region-3 buds remaining at the mature capsule stage, so we must reduce the figure here to 70% of the actual average figure counted. Likewise with region 1 (pin-buds), the graph shows that 80% of these will fall before reaching maturity, so we must reduce the average figure counted by this 80%.

We need at least 3 to 4 capsules per twig to give a reasonable crop, and twice this to give a good crop (assuming all other factors are favourable). Therefore in our tree of 6 mature capsules per twig, we can sssume a reasonable to good crop of seed can be expected if the area is burnt at the optimum time. As region 3 will lose 30% of its components before maturity, we look for at least 5 or 6 per twig to have enough remaining for a reasonable crop. And in region 1, which loses some 80% of its components before maturity, we must have at least 20 per twig to have a chance of a reasonable crop of seed.

As stated previously, the floral cycle may take 3, 4 or even 5 years to reach maturity, though 4 is the most common. It is impossible to tell at the region 1 stage (pin buds) how long the cycle will be, as the usual pattern of a 3 year cycle is for the buds to grow more quickly and flower during the 2nd year, instead of the third. Indications of a 3 year cycle can usually be picked up

during the 2nd year either by the advanced state of the buds at the annual seed forecast inspection, or subsequently by evidence of early flowering. With a 5 year cycle it is more difficult, for some reason the flowering due in the 3rd year is delayed, though the region 3 buds may appear ready for flowering at this time. This is currently the case, the buds which should have flowered in Autumn and Winter 1974 have, in the main, failed to do so, which means that the capsules will be a year later to mature (capsules always take a year to mature from the flowering stage). Even if the buds now flower in early Autumn 1975, the earliest we can expect mature capsules will be in Autumn 1976, and more likely in Spring 1977. Which will be a $4\frac{1}{2}$ to 5 year cycle. To complicate matters another moderate seed crop is coming along which was initiated one year later. As this will probably develop into the normal 4 year seed cycle, we may have a rather extended seedling period from Autumn 1976 to about Spring 1977 or Autumn 1978. A combination of a 4 and a 5 year seed cycle.

When capsules mature, we can take samples and extract seed in the laboratory, to get an average figure of seed per capsule. This can vary, but is usually between 1 and 1.5. In the earlier floral component stages we assume a figure of 1 seed per capsule when working out forecasts.

The annual seed forecast is done routinely, and a graph maintained of expected seed years and the approximate amount of seed anticipated. This applies as an average throughout the main karri areas, and is a guide only for broad planning. Whenever specific areas are ready for burning, a confirmatory check is made to see how much seed is mature in that specific locality, and ascertain the best times for burning.

This check consists of visual examination of trees in that area and a count of mature capsules present using binoculars or telescope. Several branches are shot down and components counted to confirm the visual assessments, and capsule samples taken back to the laboratory to work out seed per capsule and the state of maturity (i.e. if capsules are slightly immature and do not open easily under heat treatment, if may be better to wait a further season before burning).

In assessing seed in each locality, the following factors must be considered:

a) Trees per acre. In clear falling with seed trees, an average of $1\frac{1}{2}$ trees per acre should be left, of as good form and vigour as possible, and distributed as evenly as possible throughout the area to be burnt. If trees are small or with poor crowns, or there are groups of trees with a below average seed crop, then the number per acre left for seed or their distribution may need to be altered.

b) Seed per capsule. Usually 1 to 1.5, figures as high as 5.6 per capsule are sometimes encountered. If the figure is very low, the some form of supplementary planting or sowing must be considered.

c) seed left from previous years crop (now region 5). Often if there had been a good seed year in the year previous, some seed will be left in those capsules to supplement the current crop. These older capsules quite often have considerable numbers of borer beetles and much of the seed may be destroyed. When assessing, a sample of these older capsules are also brought back to the laboratory to estimate seed per capsule, and seed per acre.

d) Local variations. Individual trees may differ considerably and not much can be done about this. However there may be variations in groups of trees within the crop, e.g. seed in trees growing in a gully may be double the amount of those growing on a hilltop. One corner of an area may contain little or no seed due to local site factors. It is therefore necessary to note any specific large patches where regeneration may fail, so steps can be taken to prepare plants to fill in these gaps.

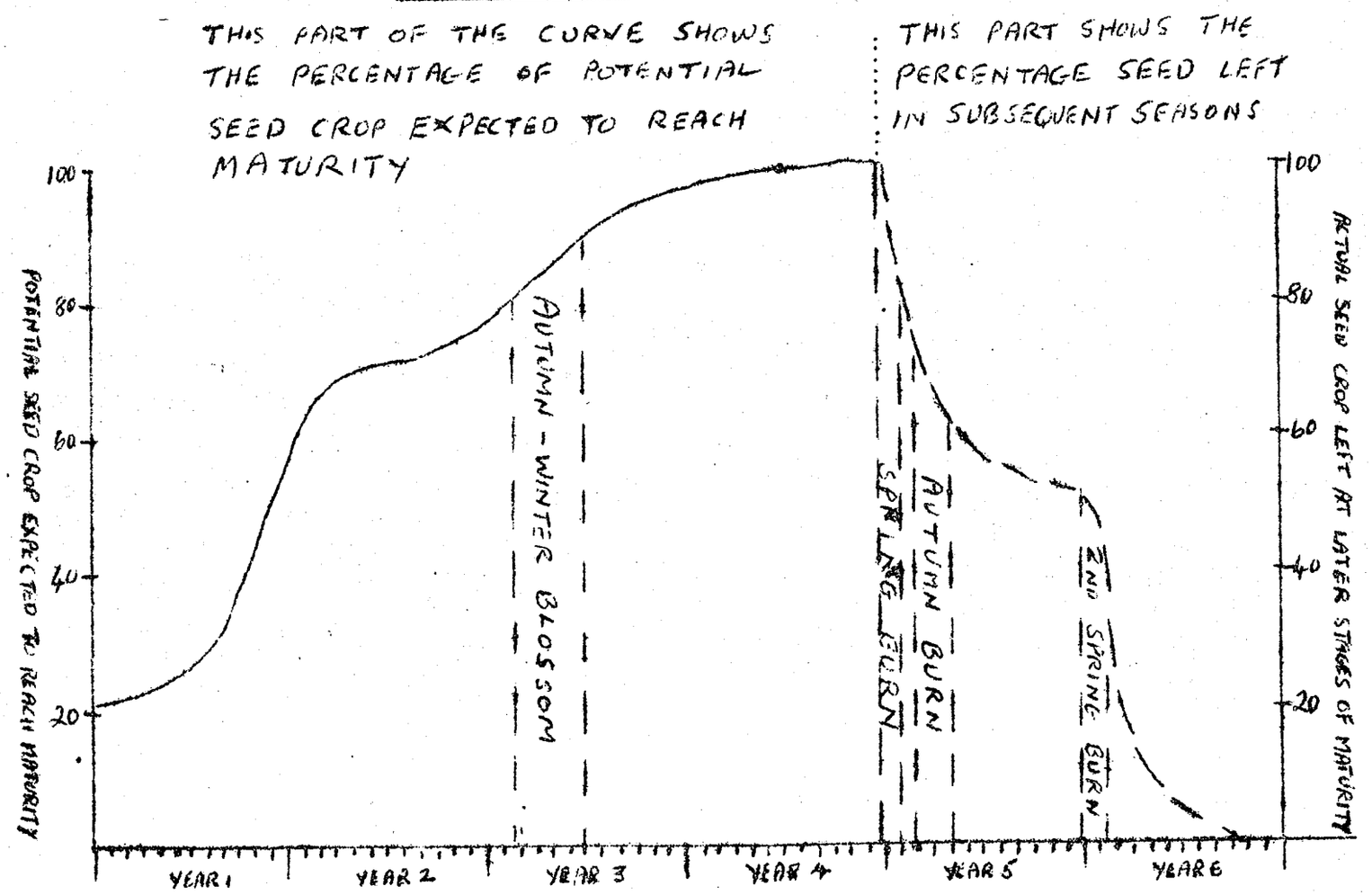
e) Sampling error. Owing to the steps in the sampling procedure any one of which may be a cause of error, it is impossible to be absolutely accurate in assessing seed supply. The procedure at present adopted has cut down the steps to the minimum possible, and is probably as accurate as we can get. It is usually obvious when a good to heavy seed crop may be expected and burning proceeds at the optimum time to induce seedfall. More caution is needed where a doubtful crop is indicated, burning must be timed more accurately and some fill-in planting anticipated. In areas of very poor or nil seed, the choices are either to leave the burning until the next good seed year - a policy which has several disadvantages - or to raise enough stock to plant the entire area during the first Winter following burning.

Spring or Autumn burning. Regeneration burning may be done in either Spring or Autumn - which season will depend on several factors. Though there are more seed available in the first Spring following maturity, loss of seed which falls over the Summer is high (due to insects, fungus etc). The higher germination of the Autumn cast seed more than compensates for the lower numbers of seed available i.e. though there is only about 50% of seed remaining in the first Autumn following maturity (assuming the area has not been burnt, and seed has fallen naturally), the germination of the seed induced to fall then will be about 180% higher than that of Spring and Summer cast seed.

With a large area to be burnt, it is usually safer to burn as soon as practicable, i.e. in Spring, to ensure that the burning programme may be curtailed by wet weather, and the greater risk of wildfires in this season may interrupt the regeneration burning programme.

Decisions as to the precise time of burning cannot be planned too far ahead, and all factors must be considered before such decisions are made.

GRAPH USED TO ILLUSTRATE THE PERCENTAGE SEED CROP EXPECTED TO REACH MATURITY



ANNUAL GROWTH REGION

Karri seed years since 1926

Strate of seed cycle

1 = Seed - none to rare

2 = Seed . local only

3 = Good seed years

4 = Main seed years