



SCENARIO PLANNING FOR SKID TRAIL IMPLEMENTATION AND LONG TERM TRAFFICABILITY

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Content

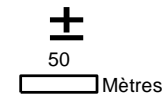
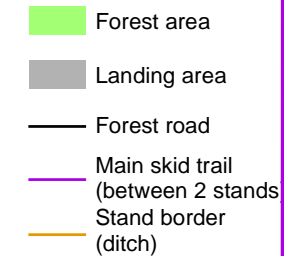
- ✓ **Context**
- ✓ **National recommendations for skid trail implementation in France**
- ✓ **Most efficient skid trail implementation for haulage activity**
- ✓ **Cumulated tonnage on skid trails over a 150-year rotation**

Context

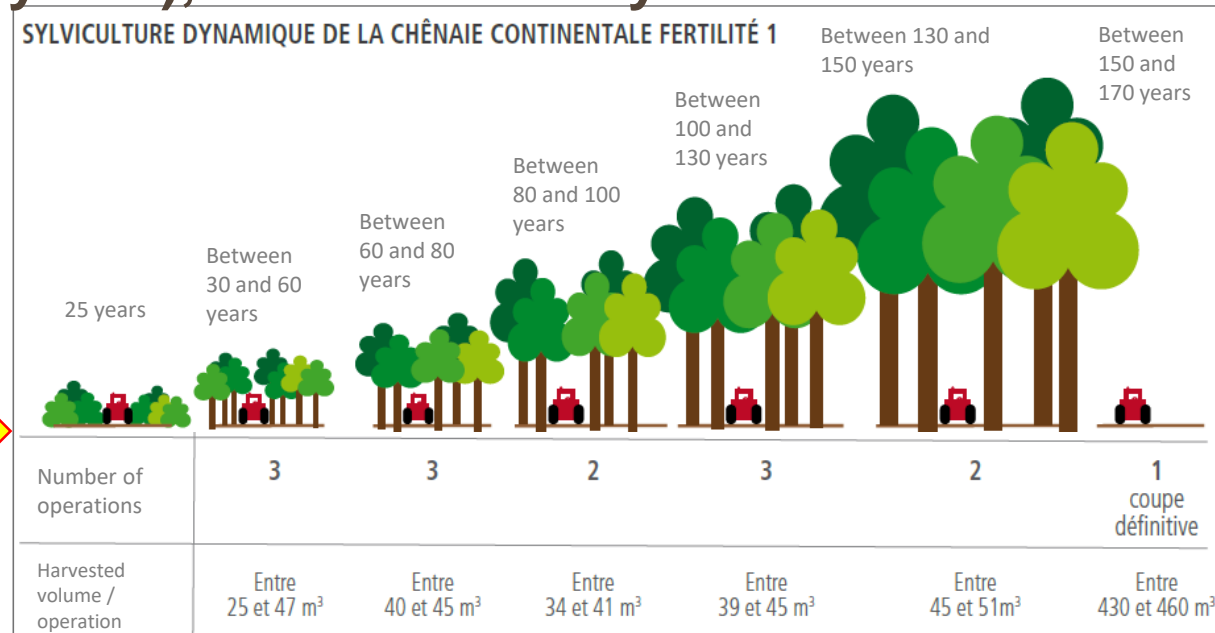
- ✓ A request from a French workgroup made up of a Forest Cooperative (Forêt & Bois de l'Est) and public Forest (ONF) in SIMWOOD project
- ✓ How to implement skid trails in a hardwood stand on sensitive soils in the plains?
 - ⇒ Which orientation ?
 - ⇒ And for which consequences according to haulage productivity and long term trafficability ?
- A geo-based comparison of skid trail implementation scenarios

Context

- ✓ A typical rectangular stand of 8,7 ha in the lowlands
- ✓ Private forest
- ✓ Oak high forest with hornbeam coppice
- ✓ Forest soils are heterogeneous and agriculture left us with the most sensitive situations to deal with: Silt, clay, hydromorphy...
- ✓ Traffic is frequent (every 5-10 years), so soil recovery is limited

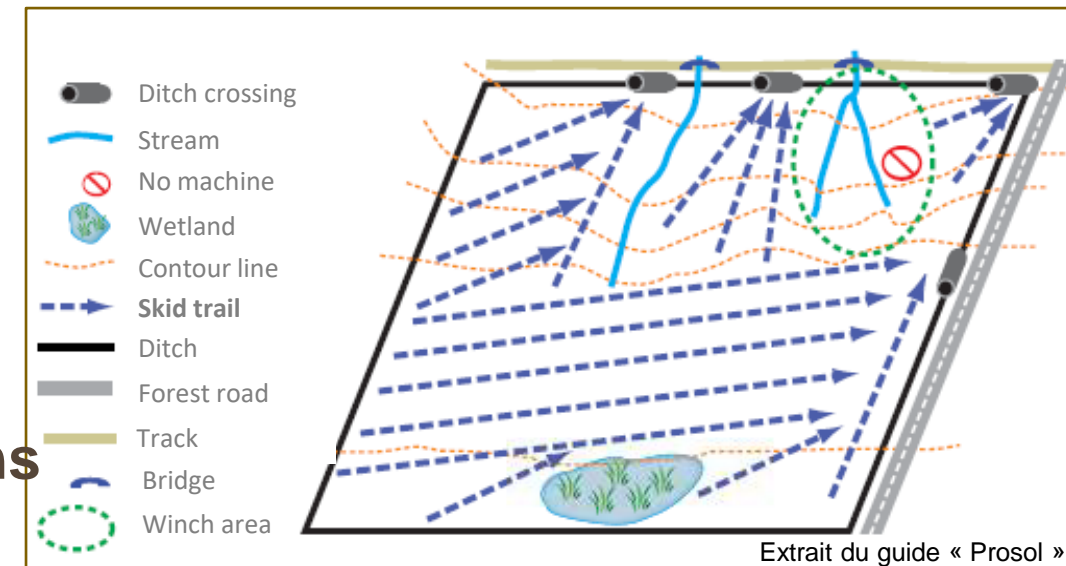


14 →
Operations / 150y



National recommendations for skid trail implementation in France

- ✓ A network of permanent corridors in order to preserve productive area from compaction and rutting
- ✓ Implementation of skid trails requires analysis and consequences over the whole forest rotation need to be taken into account
- ✓ Characteristics of optimal skid trails
 - width of 4 m
 - 18 m interspace
 - Straight as possible
 - Obliquely to exits
 - Following the slope
- ✓ Characteristics to be adapted to field conditions (wetland, stream, existing trails, slope break ...)
- ✓ Conditioned by forest roads and location of landing areas



Extrait du guide « Prosol »

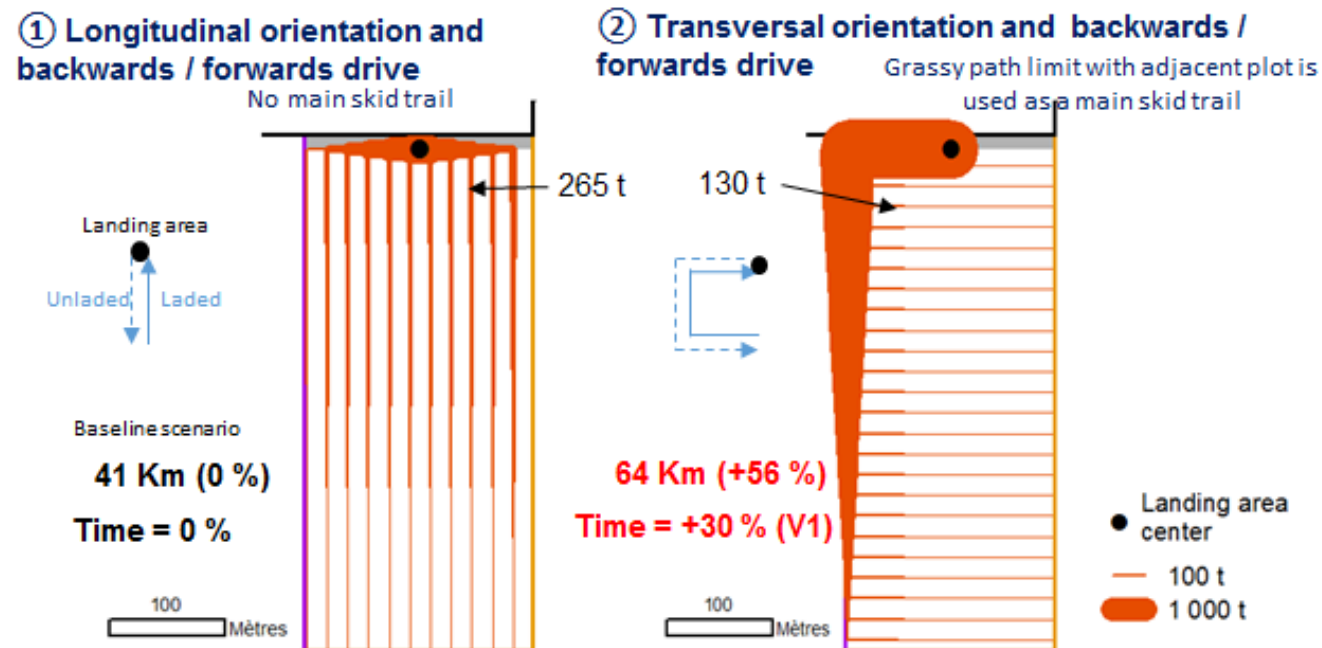
What is the most efficient skid trail implementation for haulage operation ?

- ✓ **Focus on a single operation : forwarding of tree crowns (80 m³/ha) after the final cut and after the skidding of logs**
- ✓ **Seven scenarios were compared (scenarios ① to ⑦) in terms of driving distance and productive time, depending on the combination of four conditions :**
 - **Number of landing areas : one or two**
 - **Skid trail orientation : longitudinal or transversal**
 - **Driving direction : one-way drive or loop drive**
 - **Forwarder speed : same speed on every skid trails or variable speed depending on skid trail status (main skid trail or not)**

Skid trail status	Load status	Speed (km/h) by scenario		
		V 1	V 2	V 3
First main skid trail (to east border with other stand)	Empty	9	9	6
	Loaded	8	8	5
Second main skid trail (inside stand, near west border)	Empty	9	6	6
	Loaded	8	5	5
Other skid trails	Empty	6	6	6
	Loaded	5	5	5

→ One-way drive and one landing area

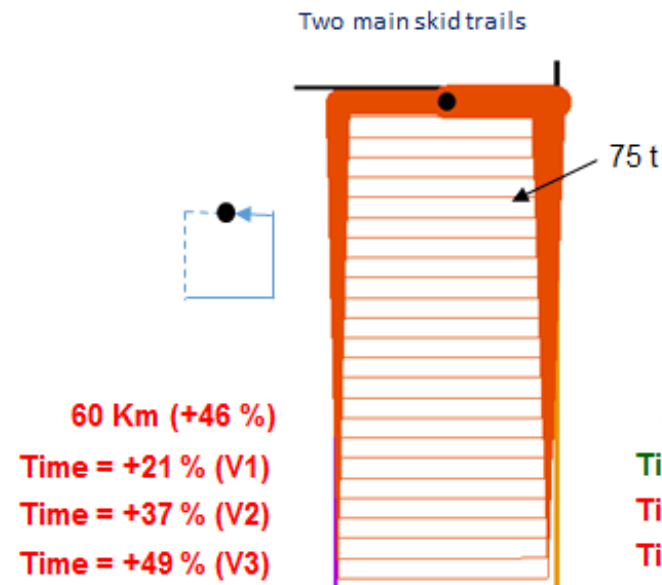
- ✓ Shortest driving distance (41 km) is obtained with longitudinal orientation
 - ① = reference scenario
- ✓ Transversal orientation increases
 - driving distance by 56%
 - driving time by 30%
- ✓ Cumulated weight at the entry of a skid trail is 265 tons for longitudinal orientation against 130 tons in the scenario with transversal orientation (-51%)



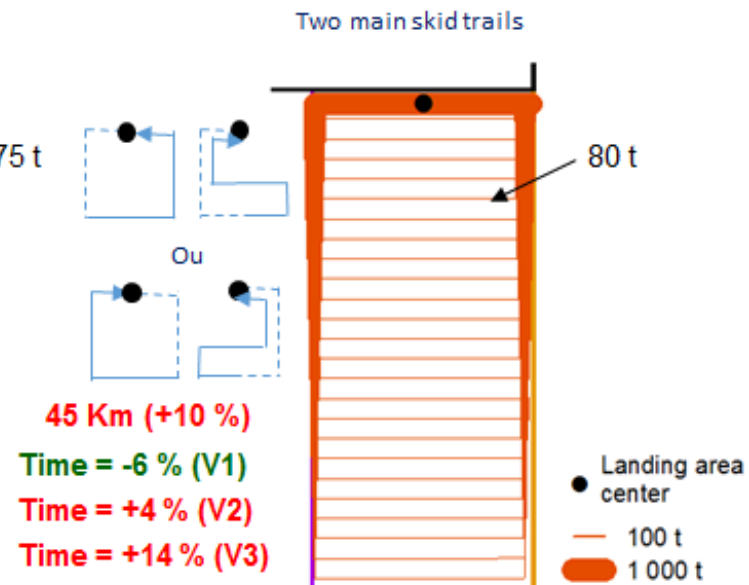
→ Loop drive and one landing area

- ✓ Drive as a loop by using a second main skid trail
- ✓ Driving distance increases by 46% or 10% depending if the driver returns to landing area with the last load of a skid trail partially filled or not
- ✓ Driving time decreases by 6% in scenario ④ with full loads and higher speed in the 2 main skid trails
- ✓ In all other cases, driving time increases compared to reference scenario (①)
- ✓ Cumulative weight at the exit of a skid trail is 75 tons against from 62 tons to 80 tons in case where last load of a skid trail is fulfilled

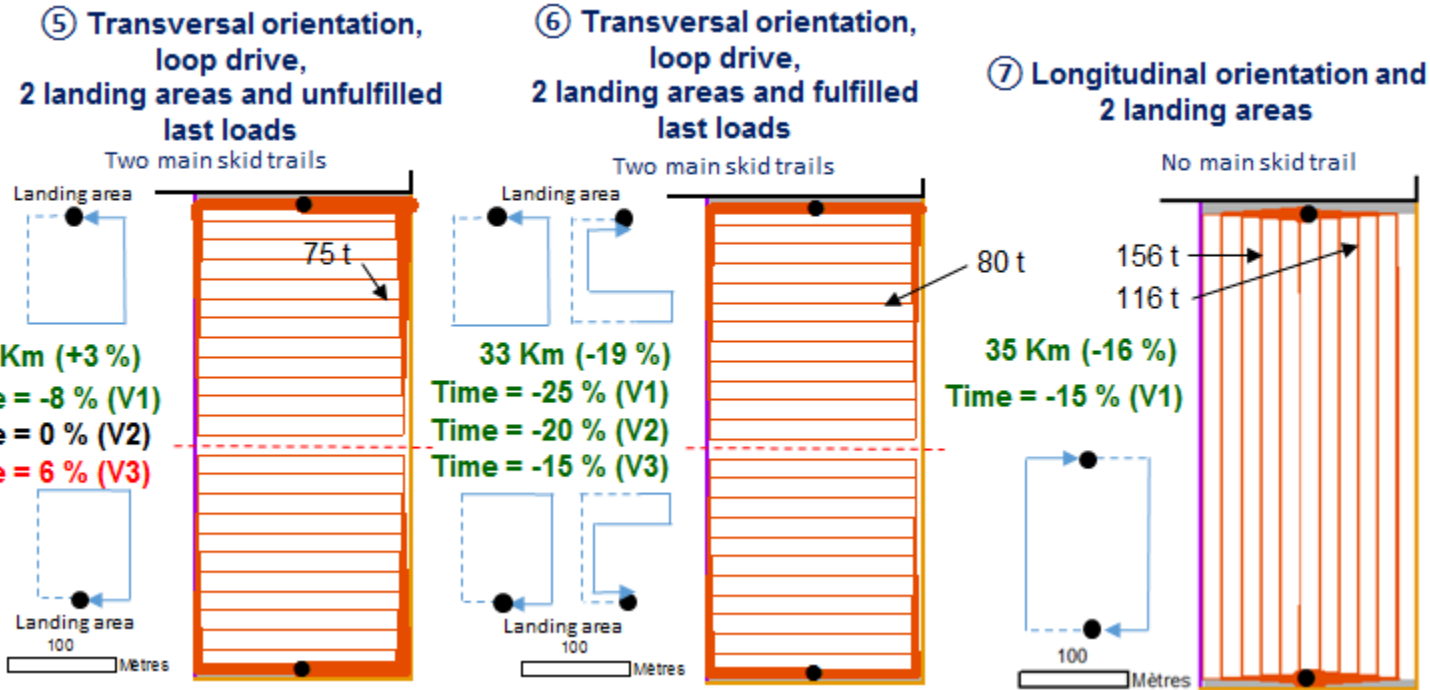
③ Transversal orientation, loop drive and unfulfilled last loads



④ Transversal orientation, loop drive and fulfilled last loads



→ Two landing areas



- ✓ Same weight at the exit of a skid trail in ⑤ and ⑥ than in ③ and ④.

But cumulated weight decreases in the 2 main skid trails

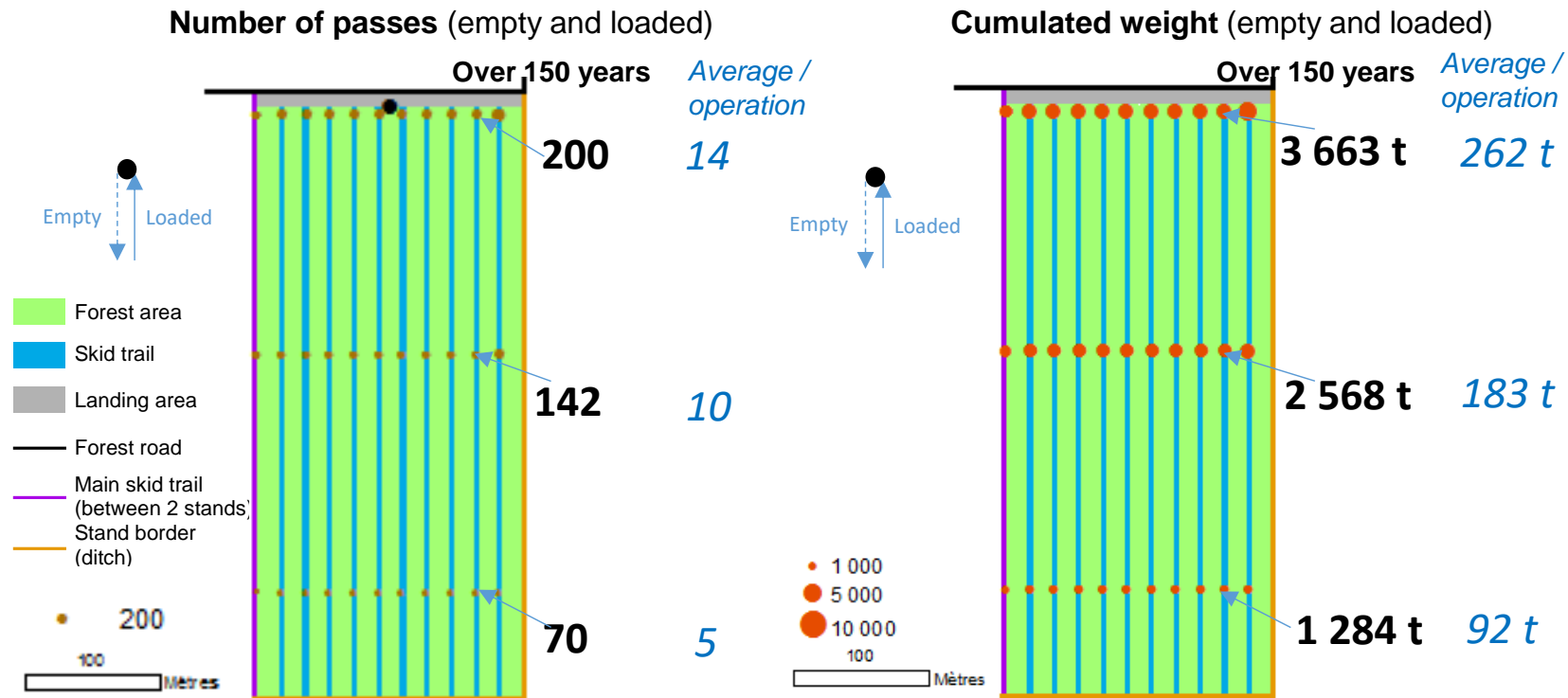
- ✓ Transversal orientation with full last loads is always the most efficient organization (scenario ⑥)
 - total driving distance decreases by 19% and productive time by 15% (V3) or by 25% (V1)
- ✓ Longitudinal orientation allows saving 16% on driving distance and 15% on productive time (scenario ⑦)
- ✓ With longitudinal orientation (⑦), cumulated weight at the entry of a skid trail is 116 tons and is 156 tons at the exit

What are the cumulated tonnages on skid trails over a 150-year forest rotation ?

- ✓ Forwarder (18 tons + 8 tons load)
- ✓ Skidder (11 tons + 7 tons load)
- ✓ Rules to complete last loads:
 - Load <20% : added to the previous forwarding load
 - $20\% \leq \text{Load} \leq 60\%$: completed in next skid trail
 - Load >60% : not completed
- ✓ 14 operations

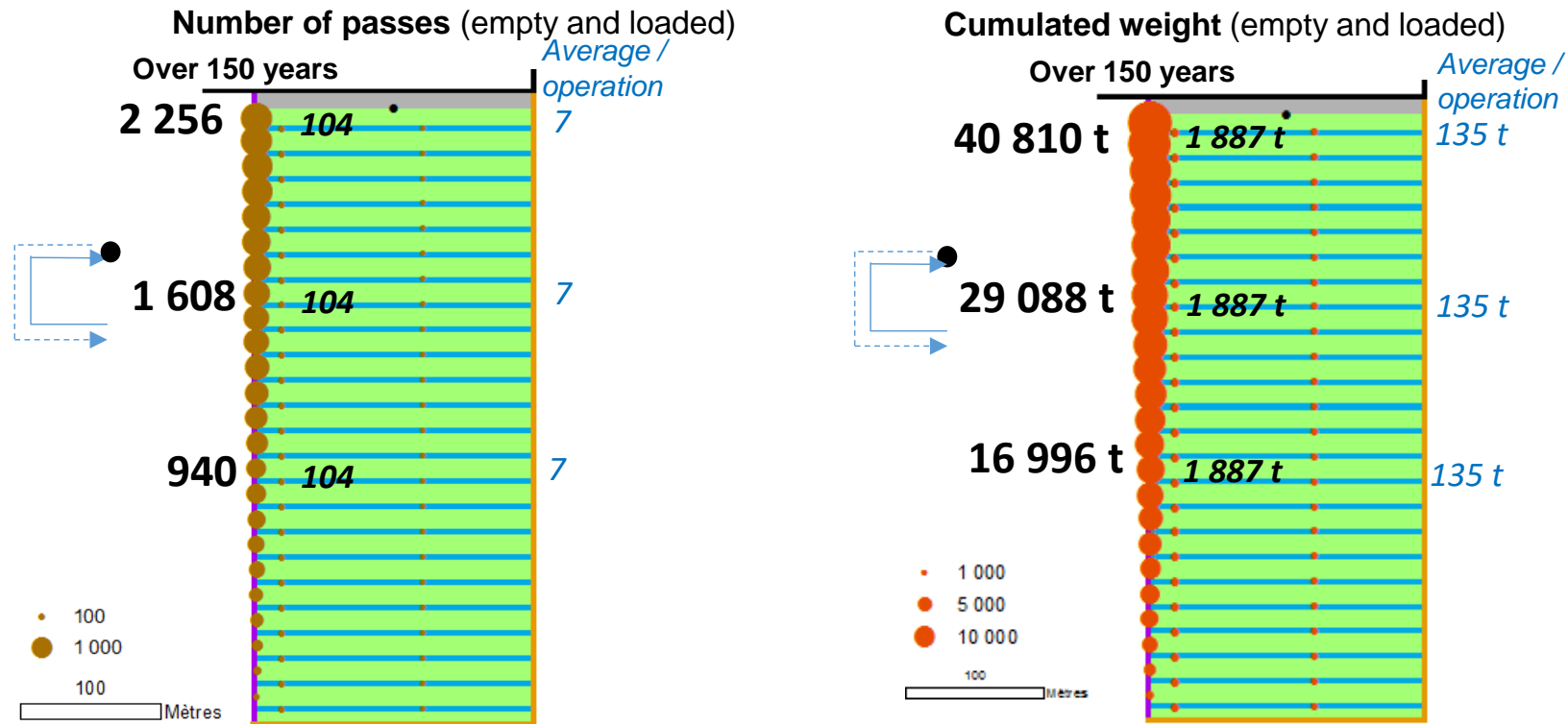
Stand age	Operation	Storey	Product	Haulage machine	Harvested volume (m³/ha)
25	Skid trail implementation		Wood energy	Forwarder	55
30	1 st thinning		Wood energy	Forwarder	30
50	2 nd thinning		Wood energy	Forwarder	30
60, 70, 80, 90, 100, 110, 120, 130	8 increment fellings	High forest	Logs	Skidder	25 / operation
			Wood energy	Forwarder	20 / operation
		Coppice	Wood energy	Forwarder	20 / operation
140	Regeneration felling	Coppice	Wood energy	Forwarder	10
		High forest	Logs	Skidder	120
			Wood energy	Forwarder	85
145	Regeneration felling	High forest	Logs	Skidder	120
			Wood energy	Forwarder	80
150	Final felling	High forest	Logs	Skidder	120
			Wood energy	Forwarder	80
14 operations in total					1 250

→ Longitudinal orientation



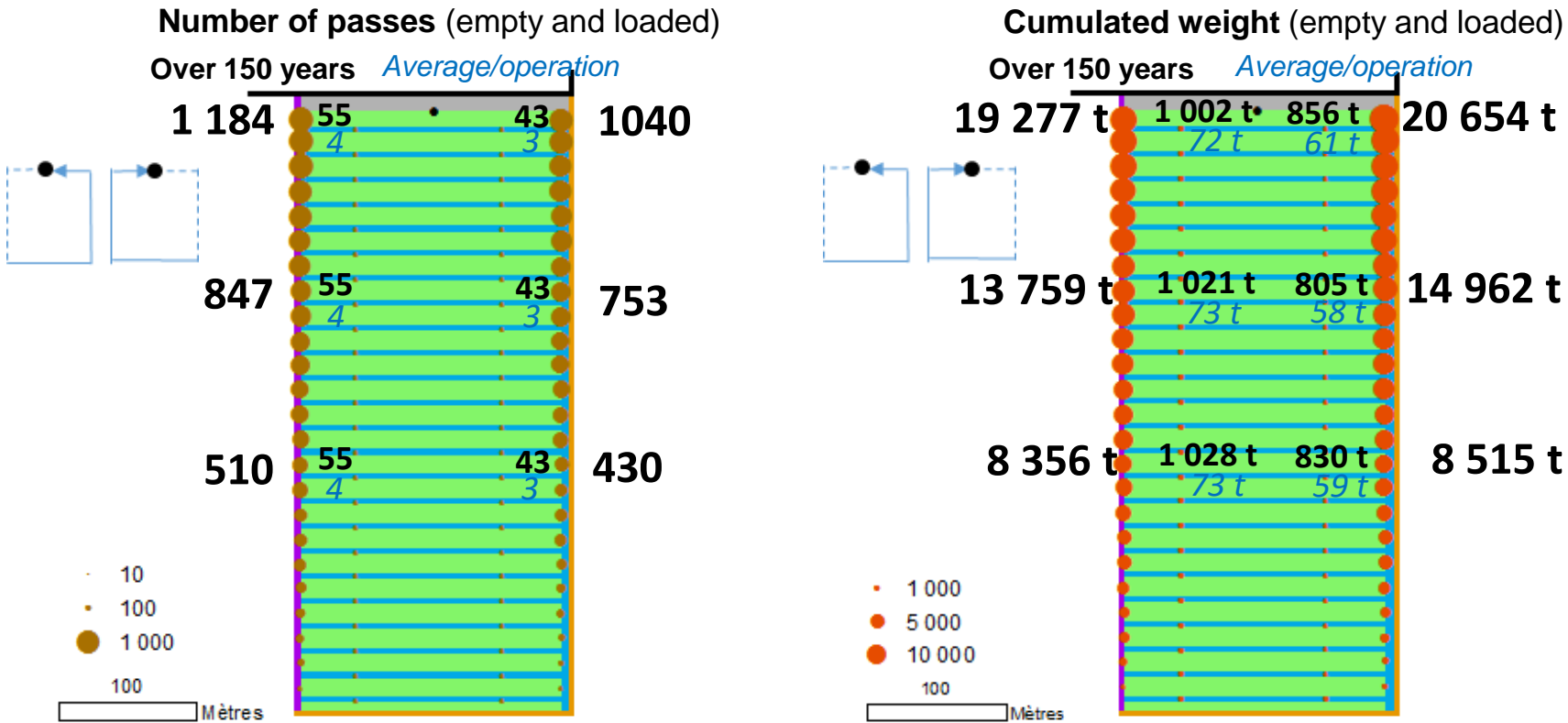
- ✓ 200 passes adding-up 3 663 tons at the end of a skid trail (for an average of 14 drives and 262 tons per operation and per skid trail)
- ✓ Cumulated weights are equally distributed from one skid trail to the next but not along a skid trail

→ Transversal orientation, one main skid trail



- ✓ At the end of a skid trail : 104 passes adding-up 1 887 tons (for an average of 7 drives and 135 tons per operation and per skid trail).
- ✓ Cumulated weights and numbers of passes are focused on the main skid trail
- ✓ Main skid trail must be capable to support heavy loads

→ Transversal orientation, two main skid trails



✓ Haulage as a loop for forwarding but not for skidding (logs and tree crowns obstruction)

- ✓ At the end (left) of a skid trail 55 passes adding-up from 1 002 to 1 028 tons (for an average of 4 passes and approximately 72 tons per operation and per skid trail)
- ✓ Cumulated weight on the ends of skid trails is divided by 2

Conclusion / lessons learnt from the scenario approach

- ✓ In studied conditions, all forest machineries must drive on permanent corridors to preserve soils from compaction and rutting
- ✓ With a typical rectangular hardwood stand of oak high forest with hornbeam coppice on sensitive soil, best implementation is :
 - two landing areas (one at each opposite side of the stand),
 - transversal orientation of skid trails
 - and loop-drive instructions
- ✓ If only one landing area is possible,
 - then longitudinal orientation of skid trails is better than a transversal one,
 - but the traffic is high at the entrance of each skid trail
- ✓ Nevertheless, transversal orientation is to be preferred despite its impact on productivity when considering the need to maintain the long term trafficability

Conclusion / lessons learnt from the scenario approach

- ✓ Forest cooperative changed skid trail orientation to transversal
- ✓ Results published in ONF's technical journal
- ✓ Traffic simulation is now used as a part of training session to increase professional know-how and to contributes to getting agreement of forest owner





Thank you for your attention

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