

Internal Project Information Note 34/08 - Extended summary
Woodfuel production from small diameter stems

Studies were undertaken on three methods of harvesting and extracting densely stocked, small diameter coppice stems in the Wyre Forest. Harvesting took place in a stand of predominantly oak and birch which was to be managed as open habitat. Average stocking was 12,400 stems/ha with a mean stem diameter of 3.3 cm.

Motor-manual felling using either chainsaw or clearing saw was studied with forwarder extraction. Fully mechanised felling and extraction by a Ponsse Caribou fitted with an accumulating Naarva 1500-25E felling head was also studied. Accumulated felled stems were loaded directly into the vehicle bunk for extraction. Extracted stems were stored at roadside and chipped with a Musmax Terminator 8 chipper into demountable lorry containers. The chipper was fitted with a 40 mm screen to produce woodchip of CEN 335 P45 specification or Austrian ONORM G30.



Ponsse Caribou and Naarva 1500-25E
Harwarder



Naarva 1500-25E



Musmax Terminator 8 and Valtra tractor.

Working in all methods was difficult due to cut material having a small mean stem diameter and low bulk density. Manual cutting and handling was physically demanding and mechanised handling was difficult and time consuming. The small diameter stems were also difficult to feed into the chipper and were not drawn in as easily as larger material, often requiring pushing from the loader. Consequently, productivity in all operations was low:

Operation	Output in area		Output in weight (odt/shr)	Output in volume (solid) (m ³ /shr)
Chainsaw felling	0.010	ha/std man hr	0.25	0.47
Clearing saw felling	0.014	ha/std man hr	0.35	0.63
Forwarder extraction	0.072	ha/shr per 100m extraction distance	1.81	3.30
Mechanical felling & extraction	0.018	ha/shr per 100m extraction distance	0.45	0.82
Chipping	0.106	ha/shr	2.67	4.84

Woodchip produced after the material was left to dry at roadside for 6 months still had high moisture content (MC) and did not qualify for CEN/TC 335 P45 classification due to containing a proportion of fines (particle size <1 mm) of 5.9% compared to the allowable 5.0%. Laboratory testing of the chip provided a property summary as:

Tested Property	Chip Sample Value	CEN/TS 335 Specification
Total moisture (wet basis) %	48.4	M55
Ash %	1.0	A1.5
Volatile matter %	43.4	
Sulphur %	0.02	
Gross calorific value kJ/kg	10,218	
Net calorific value kJ/kg	8,382	

Due to low productivity, the cost per hectare was found to be very high, mechanised harvesting costing £3,490/ha, chainsaw felling costing £3,167/ha and clearing saw costing £2,730/ha. The small diameter stems harvested, although at a high stocking density, did not produce a high volume per hectare and so chip yield was comparatively low and production cost high. Cost of total woodchip production (felling, extraction, chipping) was very high as a result; costs per oven dry tonne were calculated as £125.70 for chainsaw felling, £108.33 for clearing saw/chainsaw felling and £138.51 for mechanised felling with the Naarva head:

Operation	Hourly cost (£/hr)	Cost (£/ha)	Cost/m ³ woodchip (£/m ³)	Cost/m ³ solid timber (£/m ³)	Cost/t woodchip (48% MC) (£/t)	Cost/ odt woodchip (£/odt)
Chainsaw felling	18.63	1,791.81	15.70	39.24	36.68	71.10
Clearing saw felling	18.63	1,353.88	11.86	29.65	27.72	53.73
Forwarder extraction	48.20	667.81	5.85	14.63	13.67	26.50
Mechanical felling & extraction	50.16	2,782.26	24.37	60.93	56.96	110.41
Chipping	75.00	708.13	6.20	15.51	14.50	28.10
Total cost chainsaw felling + extraction		3,167.74	27.75	69.38	64.85	125.70
Total cost clearing saw felling + extraction		2,729.82	23.91	59.79	55.88	108.33
Total cost mechanised harvesting		3,490.39	30.58	76.44	71.45	138.51

All three working methods were shown to be technically feasible but are expensive due to the difficult crop characteristics. Economic exploitation of similar stands would require significantly higher chip prices than currently available. Future working would also require greater rest allowances for motor manual working and modification of all work methods to improve efficiency.

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Other related work

The work summarised here is part of an ongoing programme of research funded by the Forestry Commission aimed at improving the efficiency with which fuel is harvested from sustainably managed forests in the UK. Other reports related to mechanised woodfuel harvesting are IPIN 35/08 Woodfuel production from mixed Scots and Corsican pine, IPIN 31/08 Wyre Forest woodfuel production from pine thinnings, 30/07 Woodfuel production from a thinning operation (Sitka spruce), 07/07 Rumster Forest Northern Wood Heat woodfuel cutting trial (Sitka spruce and Lodgepole pine clear fell) and 15/06 Wood fuel trial Rivox, Ae Forest District (Sitka spruce clear fell).