The Future of Sitka spruce

Presentation · January 2019

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The Future of Sitka spruce

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AFBI wood plant research seminar, Armagh, 15 January 2019

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Background

- Early State expansion in forestry in 1920s was limited to sub-marginal and marginal agricultural land.
- Sitka spruce - highly adaptable species which grows well on a range of soil/site types, tolerant of wind exposure, salt spray and wet soils growing successfully at elevations up to 550 m.
- Has a central straight clean stem capable of producing roundwood with good strength to weight properties producing structural timber (I.S. EN 14081-1)
- Better quality land afforested more recently since 1980's; very high production recorded. Height growth can be 20 to 25 m in 30 years with yield classes in excess of 24 m^3 ha^{-1} yr^{-1} frequently recorded
- State afforestation schemes use baseline of yield class 14 for Sitka spruce as basis for grant aid.

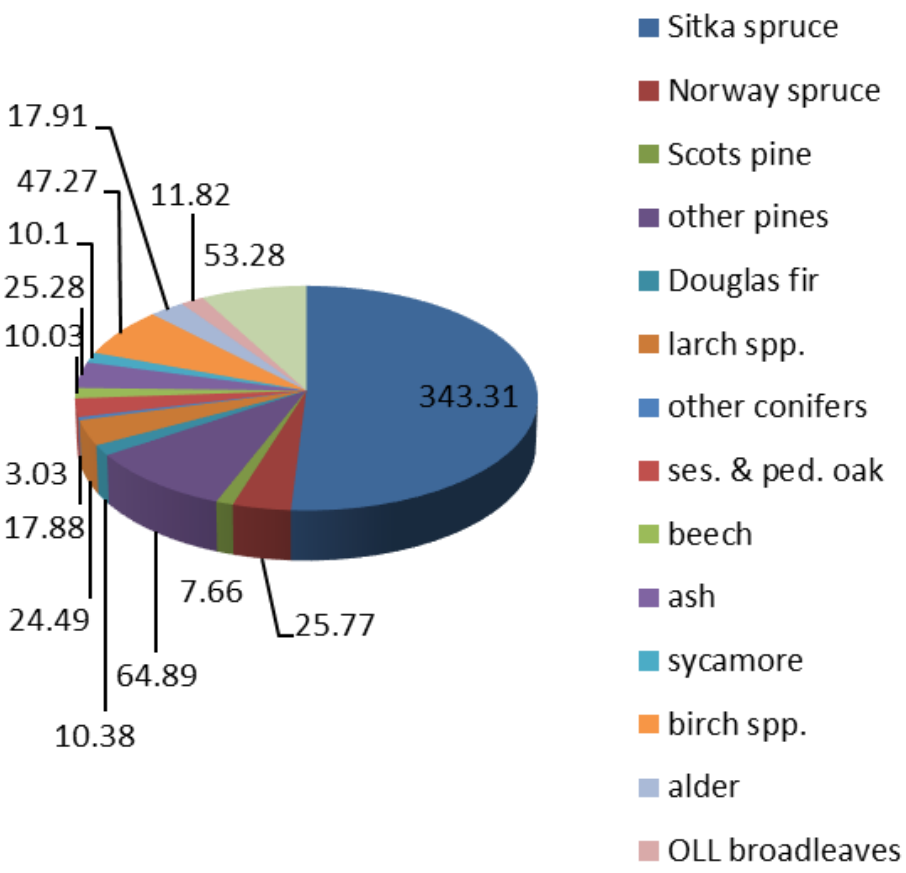
Sitka spruce – % gain/loss compared to other conifers on a range of sites

Soil Type	Acid Brown Earth	Brown Podzolic	Grey Brown Podzolic	Shallow Brown Earth	Rendzina /Rock	Podzol	Peaty Podzol	Lithosols /Rock	Gley	Peaty Gley	Blanket Peat	Basin Peat
NF	81%	78%	74%	77%	109%	82%	77%	91%	73%	63%	80%	66%
GF	116%	96%	100%	94%	80%	133%	115%	115%	103%	91%	106%	99%
SF	76%	69%	64%	83%	0%	70%	69%	65%	87%	0%	0%	108%
LC	69%	62%	55%	62%	57%	68%	56%	69%	65%	55%	61%	57%
MC	109%	130%	0%	0%	0%	0%	0%	74%	0%	0%	0%	72%
JL	56%	56%	56%	50%	58%	58%	60%	57%	56%	56%	62%	67%
HL	64%	62%	59%	65%	0%	64%	65%	61%	60%	62%	73%	56%
EL	39%	39%	40%	36%	43%	43%	44%	36%	41%	39%	51%	41%
NS	88%	87%	85%	85%	88%	86%	93%	90%	91%	87%	99%	90%
LP	53%	46%	48%	57%	53%	46%	47%	50%	47%	44%	52%	54%
SP	53%	52%	52%	47%	50%	53%	54%	54%	52%	48%	60%	58%
CP	51%	56%	62%	41%	42%	55%	59%	65%	56%	0%	49%	57%
MP	74%	84%	78%	67%	77%	88%	84%	96%	76%	0%	86%	103%
DF	83%	82%	76%	68%	68%	81%	94%	76%	80%	70%	91%	82%
WH	98%	93%	73%	68%	89%	91%	99%	79%	90%	98%	97%	90%
WRC	107%	90%	74%	78%	0%	124%	90%	71%	78%	0%	86%	77%
SS	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

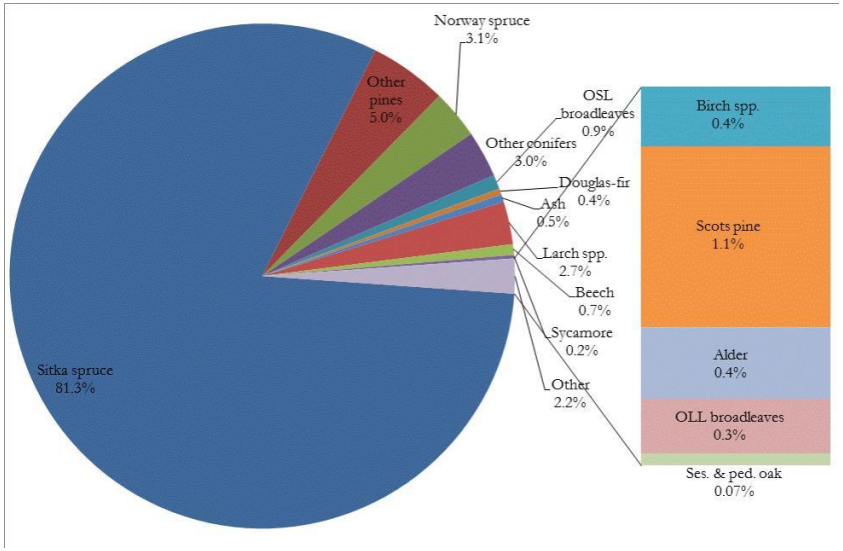
Agriculture and Food Development Authority

Sitka spruce – outperforms many other conifers

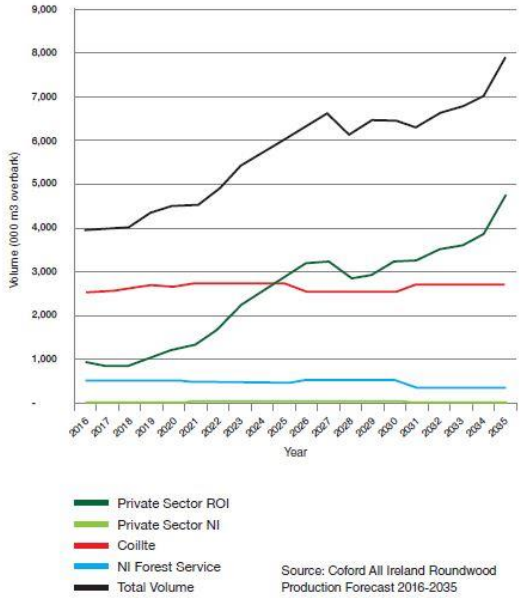
Ireland – 770,000 ha in 2017; Sitka spruce 51%



National Fell volume (82%) Sitka spruce - Roundwood supply increasing



Source: Ireland's National Forest Inventory 2017 – Main Findings



All Ireland roundwood forecast (Phillips et al. 2016)

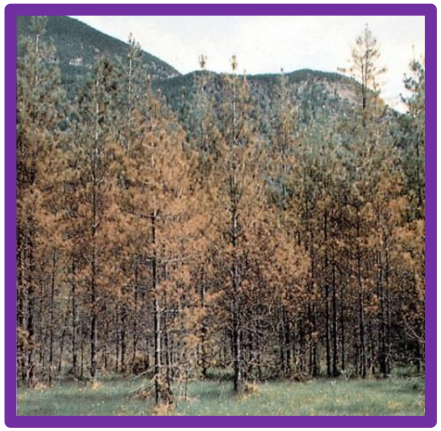
- Majority of roundwood harvested from Irish Forests is SS (2.63 M m^3)
- 83% of forest products are exported to the UK – preference for white deal
- Forest products valued at 423 million
- Forest industry is making a €2.3 billion contribution – SS (1.86 billion) to the national economy

Threats to Existing Forest Resource

- Drought-induced damage/ yield restriction.
- Existing pest and disease issues
- Introduction of a novel insect pest.
- Mutation/ arrival of a fungal pathogen.

Phytophthora ramorum

Phytophthora lateralis



Dothistroma septosporum

Dendroctonus rufipennis

Forest Resource - threats of P. Ramorum, P. lateralis and Dothostroma.

Genus/Species	Species	Private (ha)	State (ha)	Total (ha)	%
Abies	Noble fir	108	1,229	1,336	0.2%
	Grand fir	11	277	289	0.1%
	Silver fir	1	59	60	0.0%
Chamaecyparis lawsoniana	Lawson cypress	356	120	476	0.1%
Cupressus macrocarpa	Monterrey cypress	47	8	55	0.0%
Larix	Japanese larch	14,268	13,591	27,859	4.9%
	Hybrid larch	1,607	1,145	2,752	0.5%
	European larch	881	565	1,446	0.3%
Picea	Sitka spruce	144,018	243,477	387,495	68.4%
	Norway spruce	16,758	13,785	30,543	5.4%
	Serbian spruce	116		116	0.0%
Pinus	Lodgepole pine	14,018	45,868	59,886	0.11
	Scots pine	3,892	4,499	8,390	1.5%
	Corsican pine	72	490	563	0.1%
	Monterrey Pine	17	241	258	0.0%
Pseudotsuga menziesii	Douglas fir	1,376	8,014	9,390	1.7%
Thuja plicata	western red cedar	114	573	687	0.1%
Tsuga heterophylla	western hemlock	103	535	637	0.1%
	Larch/Pine/Spruce	32,830	1,187	34,017	6.0%
Total		230,592	335,663	566,255	100.0%

Species Threat Matrix*–

Species	Biotic- Risk*	Primary and (secondary) biotic agents	Drought tolerance
CP	**Medium**	Dothistroma septosporum, (Heterobasidion annosum)	High
DF	**Low**	Phaeocryptopus gaeumannii (Adelges cooleyi)	High
EL	**High**	Phytophthora ramorum*, (Phytophthora pseudosyringae)	Somewhat
GF	**Low**	Heterobasidion annosum , (Adelges piceae)	Less to somewhat
HL	**High**	Phytophthora ramorum*, (Phytophthora pseudosyringae)	Less
JL	**High**	Phytophthora ramorum*, (Phytophthora pseudosyringae)	Less
LC	**High**	Phytophthora lateralis*, (Phytophthora cinnamomi)	Less
LP	**Medium**	Dothistroma septosporum, (Heterobasidion annosum)	High
MC	**Low**	Coryneum cardinale, (Cinara cupressivora)	Somewhat
MP	**Medium**	Dothistroma septosporum, (Cyclaneusma minus)	High
NF	**Low**	Heterobasidion annosum , (Phytophthora ramorum)**	Less
NS	**Low**	Heterobasidion annosum , (Elatobium abietinum)	Less to Somewhat
SERBS	**Low**	Elatobium abietinum	Somewhat
SF	**Low**	Heterobasidion annosum , (Adelges piceae)	Less
SP	**Medium**	Dothistroma septosporum, (Heterobasidion annosum)	High
SS	**Low**	Heterobasidion annosum , (Elatobium abietinum), Hylobious abietinum	Less
WH	**Low**	Heterobasidion annosum	Somewhat to High
WRC	**Low**	Heterobasidion annosum , (Cinara cupressivora)	Less to Somewhat

***From R Walsh, PhD**

SS currently low threat for biotic – drought less a problem

Future –Resilience strategies for Sitka spruce (some examples)

- First step - Right tree in the Right place
- Avoid putting the species out of it's comfort range - on nutrient deficient, water deficient, heaths, water saturated or frost prone sites, etc.
- Choose alternative species – Douglas fir, Scots pine western hemlock, Norway spruce, which are more suited to certain sites
- Windblow - consider windblow mitigation strategies early in management cycle– pre-commercial thinning/repspacing or wider spacing at planting and avoid brown edges.
- Management to maintain maximum productivity/vigour throughout rotation in the face of biotic challenges the role of shorter rotations, etc.
- Increase monitoring and aggressive removal of underperforming stands - remove breeding grounds or bark beetles – cleanup of windblow
- Mixtures – nursing mixtures with SS, or mixtures for diversification – structural diversity
- Consider tree breeding strategies linked to climate and biotic resiliance (GENESIS, etc.)

Diversification – Sitka spruce in conifer mixtures

Genus/Species	Species	Pure (ha)	Mixture (ha)	Common mixtures
Abies	Noble fir	475	861	SS,LPSC,JL
	Grand fir	49	239	SS,NS,DF
	Silver fir	8	52	SS,SP,JL
Chamaecyparis lawsoniana	Lawson cypress	46	429	JL,EL,WH
Cupressus macrocarpa	Monterrey cypress	4	51	LC,JL,WH
Larix	Japanese larch	7,386	20,473	SS,LPSC,LPNC
	Hybrid larch	662	2,090	SS,JL,SP
	European larch	261	1,185	SP,SS,JL
Picea	Sitka spruce	165,992	221,503	JL,LPSC,LPNC
	Norway spruce	8,363	22,180	SS,JL,SP
	Serbian spruce	5	110	JL,SS,NS
Pinus	Lodgepole pine	31,570	28,317	SS,NS,DF,JL,SP
	Scots pine	2,621	5,769	JL,NS,SS
	Corsican pine	210	353	SS,JL,SP
	Monterrey Pine	78	180	SS,JL,LPSC
Pseudotsuga menziesii	Douglas fir	2,756	6,634	SS,JL,NS
Thuja plicata	western red cedar	173	514	SS,JL,NS
Tsuga heterophylla	western hemlock	157	480	SS,DF,JL
	Larch/Pine/Spruce	33,382	635	SS,LPSC,JL
Total		**254,199**	**312,057**	

SS in compatible mixtures – need prior knowledge about performance of companion species in mixture on various site types

NS/ SS mixtures on mod. fertile sites

SS/DF mixtures suitable on drier sites

WH/SS mixtures (mimic natural range)

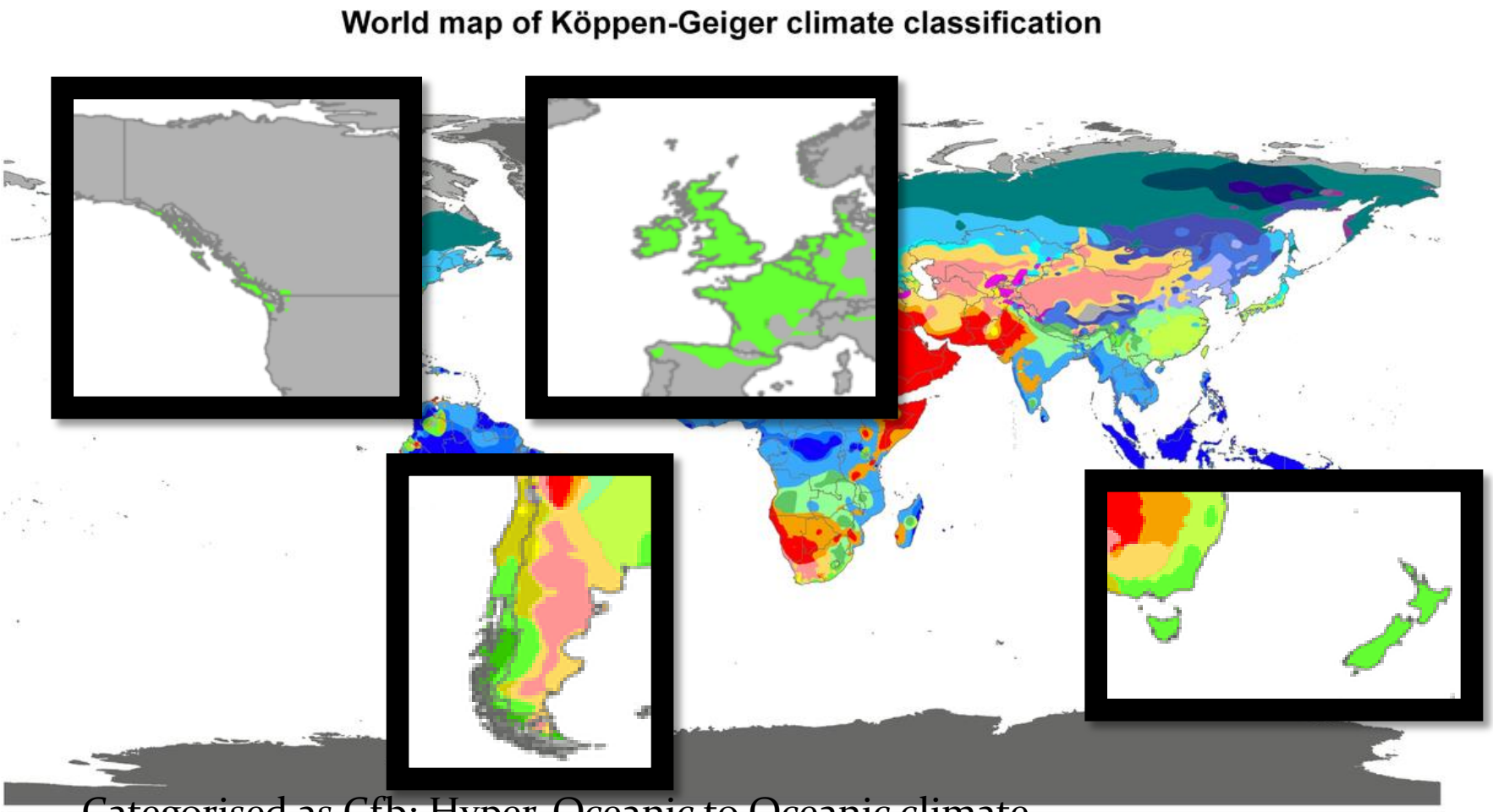
SS/GF mixtures (most fertile sites – over yielding)

(Photos: Scott McG Wilson)

Benefits over monocultures – Questions about timber quality?

On poorer sites – Nursing effect, better sites - underyielding

Future climate – review current provenances selection



Categorised as Cfb: Hyper-Oceanic to Oceanic climate

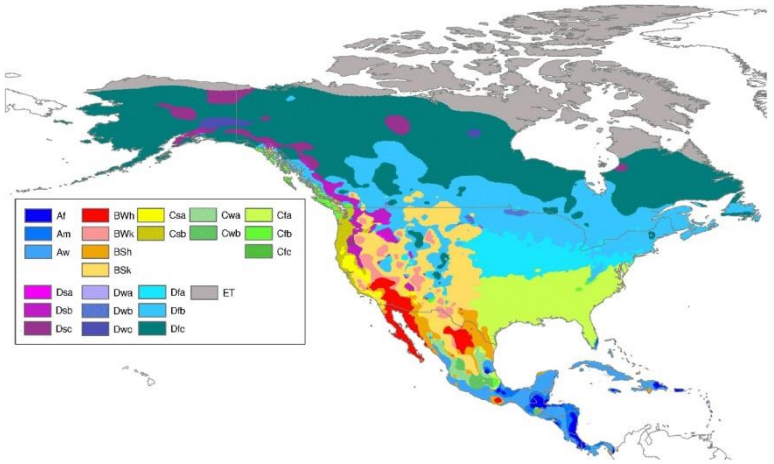
Choose SS provenances from warmer regions – assisted migration

Cs - **DRY SUMMER**

Subtypes

Csa – **Hot**

Csb - **Warm**



Cf –WITHOUT DRY SEASON

Subtypes:

Cfa - ***humid subtropical*** (Hot Summer), southeastern USA

Cfb – ***marine*** (Warm Summer), Ireland

Cfc – **cold summer**

Therefore species/provenances from Cfa, Cfb

and possibly increased warmth

CSa, CSb are likely to prove suitable in future

Sitka spruce - Future of Tree Breeding

- Get more for less – Limited land – produce more sustainably - close the supply – demand gap:
- The selection of faster growing trees with desirable traits has the potential to increase productivity and increase the output of sawn timber for the forestry sector in Ireland. (Co2 benefits in storage and HWP)
- However it is a long term process taking many years to test and produce improved material.
- Genomic selection offers potential to speed thing up
- New resilience traits should be incorporated into breeding populations
- Timber quality – structural timber – value added

GENESIS - Genomic evaluation for the sustainable Improvement of Sitka spruce

- A new research programme called GENESIS - *Genomic evaluation for the sustainable Improvement of Sitka spruce"*

- *Coordinated by Teagasc including UCD, Trinity, NBG, NUI-Galway, Coillte.*

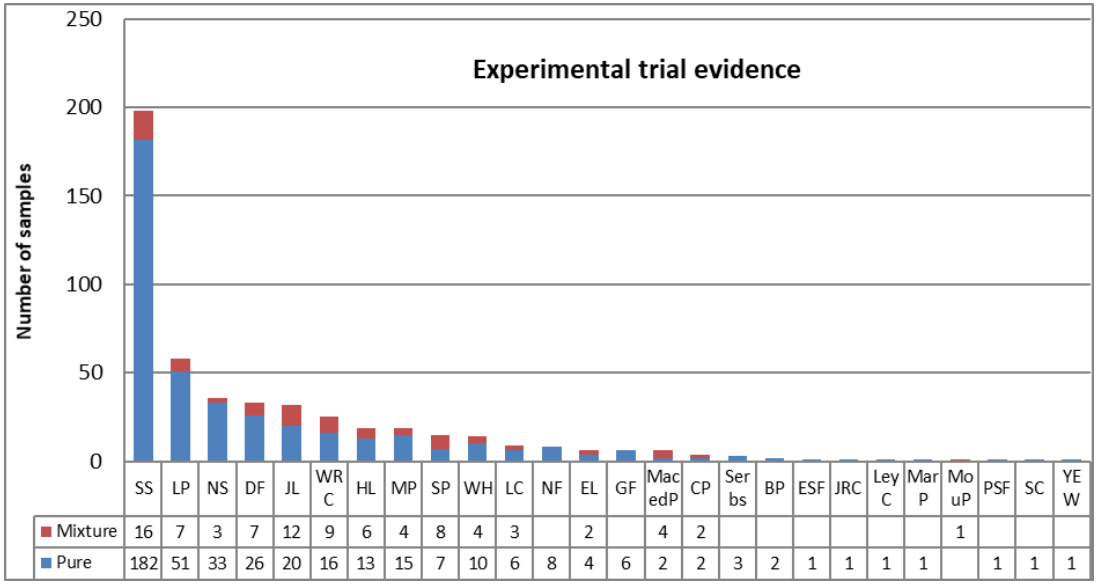
Proposes to :

(i) develop and evaluate a genomics platform to accelerate, improve decision making, and increase efficiencies in the Irish tree breeding programme, and

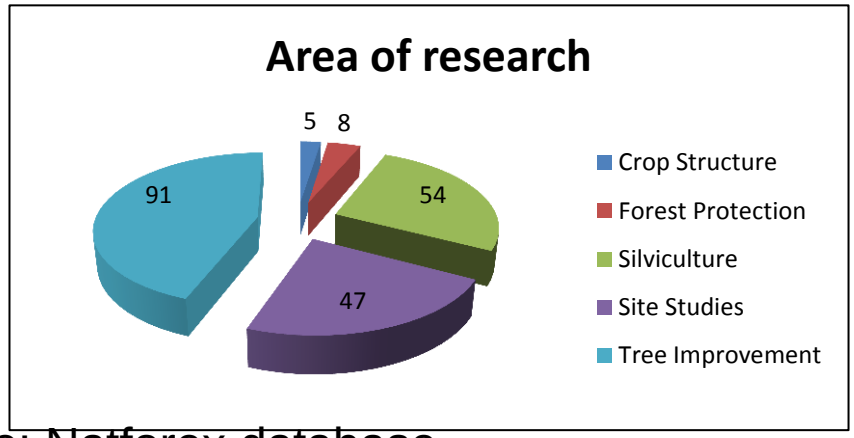
(ii) generate important phenotypes for traits not previously evaluated in the Irish tree breeding programme.

- Determine the genetic diversity of breeding population.
- Expand the range of phenotype data (tree form, wood quality, and acoustic properties) and combine it with the genotype data to assist cross selection
- Evaluate whether resilience traits are evident in Sitka spruce and can be included into the breeding programme (e.g. climate change and biotic risk - aphid, pine weevil. etc.)

Finally: future choices need to be informed by sound scientific evidence:



	SS	LP	NS	DF	JL	WRC	HL	MP	SP	WH	LC	NF	EL	GF	MacedP	CP	Serbs	BP	ESF	JRC	LeyC	MarP	MouP	PSF	SC	YEW
Mixture	16	7	3	7	12	9	6	4	8	4	3		2		4	2							1			
Pure	182	51	33	26	20	16	13	15	7	10	6	8	4	6	2	2	3	2	1	1	1	1		1	1	1



Evaluate state of play – and identify information gaps to address future challenges.

Source: Natforex database

Thank you for your attention

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