Floodplain Forest Enhancement

Andy MeierLeadBen VandermydeLeadRobert CosgriffLead

Lead Forester Lead Forester Lead Forester

St. Paul District Rock Island District St. Louis District

> Mississippi River, Navigation Pools 2 to 27 Mississippi River Miles 0 to 816 Illinois River Miles 0 to 32 28 September 2016



US Army Corps of Engineers BUILDING STRONG_®



Tree Plantings Successes, Limitations, and Techniques

- Planting stock types
- Location: limitations and access
- Significant causes to mortality
- Lessons from past plantings
- Contributors to high success



Direct Seeding



BUILDING STRONG_ ${\mathbb{R}}$

Cuttings



Bare Root





Containerized Trees



Location and Site Conditions

- Elevation
- Site drainage
- Stock type and species selection
- Wildlife pressure
- High water flow versus stagnant water
- Existing forest canopy conditions
- Access for maintenance



BUILDING STRONG®



BUILDING STRONG_®

ĬH





BUILDING STRONG_®

ĨH





BUILDING STRONG_®

Hri















BUILDING STRONG_®

Ϊ¥.







Significant Causes to Mortality

Drought

- Duration and height of high water
- High water flow versus stagnant water
- Herbaceous and woody competition
- Ice and wildlife damage
- Neglect



BUILDING STRONG®



BUILDING STRONG_®

Ĩ.×i



































 $\textbf{BUILDING STRONG}_{\texttt{R}}$

Lessons to Success



















BUILDING STRONG_®

Ĩ.




Tree Planting



Tree Planting



Forest Inventory Analysis of Floodplain Forest Conditions





Phase I: 1990s-2000s

- First comprehensive survey of COE owned forest in the UMR
- Emphasis on defining management units (stands)
- Data largely stand based





Forest Inventory Data Collection



Plot data

- Canopy openness
- Canopy height
- Regeneration, size and species
- Herbaceous species
- Stand age
- Tree Data
 - Species
 - Diameter
 - Position in canopy
 - Health

- 1 variable radius plot per 2.5 ac
- All trees >5" diameter measured
- General summaries of smaller trees



Pool 4

Pool 15

Pool 16 Pool 17 Pool 18 Pool 19 Pool 20

Pool 5

Pool 7

Pool 8

Pool 9

Pool 10

Pool 12 Pool 13

Pool 14

707

Pool 1

Missouri

Minnesota

Iowa

Pool 2

Pool 3

Pool 5a

Pool

Pool 11

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Source: Esri, DigitalClobe, GeoEye, Earthstar Geographics, CNES/Airbus DS USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS 707 User Communit











Forest Inventory Analysis of Floodplain Forest Conditions





Phase I: 1990s-2000s

- First comprehensive survey of COE owned forest in the UMR
- Emphasis on defining management units (stands)
- Data largely stand based

Phase II: ~2007 - Present

- Resurvey of Phase I stands
- Emphasis on defining trends in forest growth and health and developing management prescriptions
- Data are tree based, with summaries available at higher levels





Forest Inventory Phase II: Forest Management Geodatabase

입···瑄··· 暄 앱 모 관 ※ Conway Foriny Fixed Plots ×															
	POOL	COMP	UNIT	SITE	SID	PID	OV_CLSR	OV_HT	UND_COV	UND_HT	UND_HT2	UND_SP1	UND_SP2	UND_SP3	GRD S .
1	p09	c10	1	CNWY	ns09	p766	40	60	1	2-5	0	Green Ash			SOLID
1	p09	c10		CNWY	ns09	p767	60	65	2	2-5	0	Green Ash			LYTH2
	p09	c11		CNWY	ns09	p768	40	60	0	0	0	No Regen			URDI
I.	p09	c11		CNWY	ns09	p769	80	60	1	5-10	0	Silver Maple			POPE
	p09	c11	1.22	CNWY	ns09	p770	70	70	2	5-10	0	American Elm			POPE
	p09	c10	u017	CNWY	s444	p771	60	51	2	2-5	0	Green Ash			CALU4
	p09	c10	u017	CNWY	s444	p772	70	93	2	2-5	0	Green Ash			URDI
ł.	p09	c10	u017	CNWY	s444	p773	70	75	4	2-5	0	Green Ash			URDI
	p09	c10		CNWY	ns09	p774	70	57	2	2-5	0	Black Willow	American Elm		CALU4
	p09	c10	u017	CNWY	s444	p775	40	60	3	2-5	0	Green Ash			URDI
	p09	c10	u017	CNWY	s444	p776	40	75	3	10-15	0	Green Ash			LEOR
	p09	c10	u017	CNWY	s444	p777	90	75	1	2-5	0	Green Ash			URDI
	p09	c10	£	CNWY	ns09	p778	70	55	3	2-5	0	Green Ash			LYTH2
	p09	c10		CNWY	ns09	p779	60	60	1	2-5	0	Black Willow			BOFL3
1	p09	c10		CNWY	ns09	p780	80	78	0	0	0	No Regen			
	p09	c10		CNWY	ns09	p781	70	52	0	0	0	No Regen			POHY
	p09	c10	1	CNWY	ns09	p782	80	47	3	10-15	0	Black Willow	Green Ash		CALU4
	p09	c10	u017	CNWY	s444	p783	70	70	5	2-5	0	Green Ash			URDI
	p09	c10	u017	CNWY	s444	p784	40	63	1	5-10	0	Black Willow			BOFL3
	p09	c10	u057	CNWY	s438	p785	50	63	0	0	0	No Regen			POPE =
	p09	c10	u057	CNWY	s438	p786	30	63	3	5-10	0	Green Ash			LEOR
	p09	c10	u057	CNWY	s438	p787	60	50	2	5-10	0	River Birch	Green Ash		CALU4
	p09	c10	u057	CNWY	s438	p788	70	54	0	0	0	No Regen			POPE
	p09	c10	u057	CNWY	s438	p790	80	50	0	0	0	No Regen			POHY
1	p09	c10	u057	CNWY	s438	p791	50	50	0	0	0	No Regen			POPE
	p09	c10		CNWY	ns09	p792	60	64	0	0	0	No Regen			POHY
	p09	c10		CNWY	ns09	p793	50	46	0	0	0	No Regen			BOFL3 *
		-		III											*

Identify fro	n: <ton-most laver=""></ton-most>	
E-Stands	1 trop most by cr-	-
Ē-027	c1u01ABRA003	
	Age Plots	
+	Fixed Plots	
	ES_StandNotes	
	Prism Plots	
ė-	ES_StandSpp	
	- QUMA2 IV:55.762894	
	- ACSA2 IV:20.082788	
	FRPE IV: 30. 554059	
	ULAM IV:40.298924	
	CEOC IV:69.306832	
	PODE3 IV: 19.438279	
	- DIVI5 IV:64.556224	
		lê.
Location:	750,377.643 4,297,246.056 Meters	
Field	Value	-
OBJECTID	59	
SHAPE	Polygon	
SID	p27c1u01ABRA003	8
INV_DATE	2009-2012	
ACRES	10.742377	
AV_BA	50	-
AV_TPA	73.351729	
SAP_TPA	0	
POL_TPA	63.306091	
SAW_TPA	3.183189	
MAT_TPA	5.368998	
OVM_TPA	1.493452	
SNAG	0	
HRD_M	4.751123	
SFT_M	51.560124	-
٠	m	E.
dentified 1	feature	







~ 60%









Forest Inventory Metrics: Basal Area



Basal Area (BA): The surface area of a cross-section of a tree trunk at 4.5 feet above ground level $BA_{tree} = \pi r^2 = \pi (\frac{1}{2}d)^2$, where r = radius and d = diameter $BA_{acre} = sum of the basal area of all trees in one acre$

UMR Target Basal Area

90 ft²/ac (0.21%) - 160 ft²/ac (0.37%)





Forest Inventory Metrics: Basal Area



Forest Inventory Metrics: Basal Area



Forest Inventory Analysis of Floodplain Forest Conditions





Phase I: 1990s-2000s Phase II: ~2007 - Present

Permanent Plots: 2003 - present

- Established to track long-term trends in tree growth and forest succession
- Utilized for the development of relationships between tree species distributions and site characteristics such as hydrology
- Individual trees remeasured at roughly 10 year intervals
- Higher intensity measurement within plots
- Much lower intensity distribution of sampling points (1 per 500 ac.)



Forest Inventory Permanent Plots













Forest Inventory Application to HREPs: HSI

HABITAT SUITABILITY INDEX MODELS: GRAY SQUIRREL



h and Wildlife Service

51 154 3. Department of the Interior

HABITAT SUITABILITY INDEX MODELS: MINK



And Wildlife Service
 Department of the Interior



HSI Species	HSI Variable	Available in current summaries	Deriv- able	Analysis needed to derive data	Data not collected
Bald Eagle	Percent of potential nesting area covered by mature timber (tree height and density)		Х		
	Average height of overstory trees	X			
Black-Capped	Number of snags 10 to 25 cm dbh/0.4 ha		Х		
Chickadee	Percent tree canopy closure	Х			
Dabbling Duck	Tree canopy volume/area of ground surface Distance to bottomland hardwoods, species composition, and water availability		X	Х	
	Mean dbh	Х			
	Percent canopy cover	X			
Fox Squirrel	Percent shrub crown cover Proportion of total tree canopy that is hard mast producing >= 25 cm dbh		Х		Х
	Mean dbh	X			
	Number of hard mast tree species	X			
Gray Squirrei	Percent canopy cover	X			
	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh		Х		
Mink	Percent tree and/or shrub canopy closure within 100 m of water's or wetland's edge		Х		
	Number of potentially suitable tree cavities/0.4 ha				Х
Wood Duck	Percent of area providing equivalent optimum brood-rearing habitat (downfall and herbaceous emergent plants)				x
	Percent of area providing equivalent optimum nesting habitat (dist. to canopy openings and to water and dbh of trees)		X		

Forest Inventory Conway HREP Planning Example, Pool 9



Forest Inventory Conway HREP Planning Example, Pool 9



Forest Inventory Conway HREP Planning Example, Pool 9

nter Condition:	P09C10U904	Enter Year:	50
/ariable	Description	DATA	HSI
SIV ₁	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
	Number of hard mast tree species		
	1 = hard mast species absent		
SIV.	2 = one species present		
5102	3 = two species present		
	4 = three species present		
	5 = more than 4 species present	1	0.10
SIV ₃	Percent canopy cover of trees for food (%)	31.8%	0.79
SIV ₄	Percent canopy cover of trees for cover/reproduction (%)	31.8%	0.79
SIV ₅	Mean dbh of overstory trees (inches)	25.33	1.00
SI _{WF}	Winter Food Index		0.08
SI _{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.08
nter Condition:	P09C10U905	Enter Year:	50
ariable	Description	DATA	HSI
SIV ₁	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
	Number of hard mast tree species		
	1 = hard mast species absent		
CIV/	2 = one species present		
51v ₂	3 = two species present		
	4 = three species present		
	5 = more than 4 species present	1	0.10
SIV ₃	Percent canopy cover of trees for food (%)	63.3%	1.00
SIV ₄	Percent canopy cover of trees for cover/reproduction (%)	63.3%	1.00
SIV ₅	Mean dbh of overstory trees (inches)	26.91	1.00
SI _{WF}	Winter Food Index		0.10
SI _{CR}	Cover/Reproduction	-	1.00
	HSI		0.10



Forest Inventory



Development of Stand Prescriptions for Forest Management





Development of Stand Prescriptions for Forest Management

Robert Cosgriff

Forester

Rivers Project Office, St Louis District

Upper Mississippi River Restoration Program

Habitat Rehabilitation and Enhancement Projects Workshop

27-29 September, 2016





US Army Corps of Engineers
BUILDING STRONG®
Forest Stand – The basic unit of forest management; a group of trees that are more or less homogeneous with regard to species composition, density, size, and sometimes habitat.





Forest Structure



Young Forest Stand



Multi-Aged



Sapling Forest Stand



Old, Multi-Aged

Forest Stand Layer



 $\textbf{BUILDING STRONG}_{\texttt{R}}$

What is a stand prescription?

- A site specific plan that describes forest management objectives for a specific area.
 - To improve growth rates of 25 year old pin and swamp white oak within Red's Landing Reforestation Site
- Identifies what management tools will be utilized to change a current condition to a desired condition.
 - Undesirable tree species will be removed around 3 of 4 canopy sides of desired retained stock
 - Trees less than 4 inches in diameter will be felled and herbicide applied to cut stump
 - Trees greater than 4 inches in diameter will be girdled with herbicide applied to girdle
- The prescription must be consistent with a higher-level plan.
 - Improve the quantity and biodiversity of floodplain oak-hickory forest communities within the UMRS



Conceptual Model of RPO Forest Program Dynamics



Steps in Stand Prescription Process

- Identify Current Conditions (Current Forest Community Type and Stand Structure)
 - Forest Inventory
 - Data Analysis
 - Forest Management Geo-Database
- Identify Potential Conditions (Potential Natural Communities)
 - Stand Walks
 - Soil Analysis
 - LiDAR Elevation and Flood Potential





- Identify Desired Conditions (Forest Community Type and Stand Structure)
 - Forest Community Composition
 - Forest Structure
 - Desired Benefit to Wildlife Species
- Identify a Means to Achieve Desired Conditions
 - Treatments to be Utilized
 - Treatment Time Frame
 - Quantifiable Desired Outcome
 - Monitoring Program
 - Adaptive Management
 - Funds Resourcing
 - NEPA Compliance

PA D rest N	ecision Do	cument		Construction of the							
rest N	Ananama				The	Treatment 151/Reforest Resdua/BA/Acre			G-Factor: Traversed Arres		
	nanageme	nt		السنا	Tre	atment Spec	fications:				
Sec. 1		~~~		US Arm	Cerps	shiet TSLOP 2	7 acres of THE are shown	otion they will in stand. The			
CI NAME	Mile 215 Isrand St. Louis District					Lon-meeting	es. Creitell gaps will er tran 2º clamater al	be no imper than 0.25 acres m	Sec. Sec.	120	
		STAND	INFORMATION		Tra	as less that 4 is will be retain	diameter will be faile med. All dead trees w	d. All hard-and soft-main If be retained for cently	A		
1	Peol	26	Stand Armage	15.4	i hai tak	e piece during	est and site preparation of her winter COSET-OI	n Activity is recommended to APRO & 100 fort buffer will be	Reine .	ALC: NOT OF	
1	Compartment	8	Trained Acres		est.	inferted betw iting will be a	neer harrist site and i it appresimately 130 r	herinte sturnal. Fail tran			
1	theit	x	Ferent Community Type	8	off	beincolocra	tell into maimetarica	program and receive annual			
	Subunit/Stand	1	Sol Tree		100	iversity of p	arted mode	Cruid 2 New Garment 52-6			
	Promiting Thins	28%49/2014	Frescription Ran (D)						Intege Field Inlicks	nace above to load image, maph, etc.)	
- 7	It of Isventory Flats.		E of Field Notes			_		DECICH CHITTENA AND			
-			1	£	Co.	etecl page (v)	De no larger than 0.2	S acres in size. Trees greater the	a discripter will be grd	led and left standing. Trees less than 6"	
		STAND	DESCRIPTION Stand Condition		ipe pe	paration activ	ity is narozymanical t	of mail tract will be referred. An o trial place during the winter [2	EERIOTATE: A 100 form	action could be antibilished bary san harvest	
1.1	New Base Age 417					The the dis	0.04				
	Adman Transiddea	12.4	A Made Street	110.00							
	PLANTE (5.11 PM)	178	Doubles (Incor	28							
- 19	Sea TFA (12 (7:50)	107	Doment Harder	0							
- 1	also up The res 21.00		the families in the second	10.0							
	Composition TEA (m.24)	3	Maan Van Otor	1020	_				-		
1.13	Shari TPA	las	Statuton Details IN					POST HARVEST TREA	TMENT/MONITOP	ING	
	ColiTune		Manutamentes Com								
	Ferencer	423	DND / DEH	140	YEA	R 7	Treatment:	Conduct TSI. Plant trans in	canoba Daba		
		P. Later Breed Con	And	12		_	_				
enny - LASA, CAUL 2018 AJ faiseling Casieri - ULAMA ACDAZ, FARE 2016 : Saerling Caberi - 1795, CODC, ACDAZ Margar I Low your / Low your House						R 1	Treatment	Monitoriste, Mantain Ste.			
DISUED CONTINUE								Bacher and Malazar Eng			
Mirad, Mit	d-Successional transitioner	INMAE			118	1	The and the	NUMBER OF THE PROPERTY OF			
							7				
SHORT & LONG TERM OBJECTIVES						° [`	Treatment	(wonitoriginal Maintain Side			
carvpy gaps	a					_	-	-			
saural regim	MININGIN WATH MAK				YEA	2	Treatments	Monitorate Maintain Site			
		ADDIT	CHAL REMARKS			L		-	_	10.0	
And the second sec						Theretly	Cosgrill, Robert	Tabe Fr	vester	100e 28MAV2014	
						Annual	1	798			



What are some of the desired forest conditions and why

- 1. Young Early Successional Forest
 - a) Nesting habitat for song birds
 - b) Erosion control sediment trapping
 - c) Necessary for mature early successional forest
- 2. Mature Early Successional Foresta) Nesting habitat for raptorsb) Nesting habitat for colonial water birds
- Over Mature Early Successional Forest

 a) Indiana bat
- 4. Oak-Hickory Forest

a) Hard- and soft-mast production for many species of wildlife





What are some of the desired forest conditions and why

- 5. Maple-Ash-Elm Foresta) Nesting habitat for song birdsb) What the forest naturally transition to without active management
- 6. Uneven Age Maple-Ash-Elm Foresta) Support multiple species of wildlife
- 7. Swamp shrublanda) Support multiple species of wildlifeb) Pollinator habitat







What are some of the treatment tools and when would we use?

- Establishment of early successional forest

 a) Seed Tree Harvest retain 4-5 trees / acre
 - i. Natural regeneration
 - b) Clear Cut Harvest small acreage
 - i. Natural regeneration
 - ii. Artificial regeneration
- 2) Oak-hickory forest
 - a) Seed Tree Harvest retain 8-10 trees / acre
 - b) Shelterwood Harvest
 - Retain more mature trees than seed tree harvest
 - ii. Allow establishment of seedlings
 - iii. Mature trees removed
 - c) Prescribed burns









What are some of the treatment tools and when would we use?

- 3) Maple-Ash-Elm Forest
 - a) Active management not necessary under current conditions
 b) Emerald Ash Borer Impact implications Reforestation
 c) Reforestation in areas where floodplain forest is desired
- 4) Uneven-Age Maple-Ash-Elm
 - a) Timber stand improvements
 - b) Natural and artificial reforestation
- 5) Swamp shrublanda) Alter hydrology or natural change to hydrology
 - b) Natural and artificial reforestation



Uneven-Age Management



Invasive species control

- 1) Most reforestation sites will require 5-7 years of active management
- 2) Native herbaceous mowing and herbicide application
- 3) Woody vines cut stem/herbicide treatment
- 4) Japanese hops mowing and herbicide application
- 5) Reed Canarygrass mowing and herbicide application
- 6) Bush honeysuckle cut stem/herbicide treatment
- 7) Native woody Timber stand improvement











Stand Prescription Process





Food for Thought: Selection of Forest Alternatives In HREPs



How can forest benefits be represented fairly in a cost analysis that encompasses only 50 years?

How can we most adequately represent desired forest conditions in an HSIbased framework?

Selection of Forest Alternatives HSI Models



HSI Model: Gray Squirrel Objective: Mast Trees







HSI Model: Gray Squirrel Objective: Mast Trees



HSI Model: Gray Squirrel Objective: Forest Canopy



HSI Model: Gray Squirrel Objective: Forest Canopy





HSI Model: Gray Squirrel Conway HREP Planning Example, Pool 9

