Managing Chinese Tallow in Forests – An Integrated Approach

Lauren S. Pile, Ph.D.

CLEMSON FORESTRY AND ENVIRONMENTAL CONSERVATION

SEL

Southeastern coastal plain

Great place for distribution maps: EDDmapS https://www.eddmaps.org/

Chinese tallow

High reproductive potential

Persistent seed bank

Tolerant to abiotic stressors

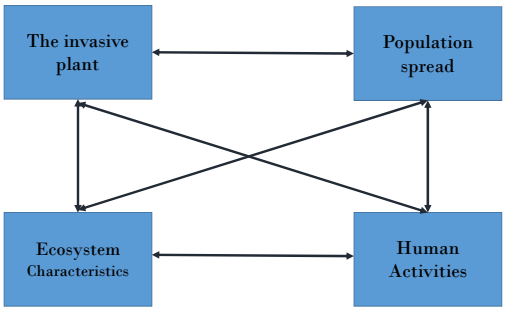
No natural enemies

Bird dispersed

Fire suppressor

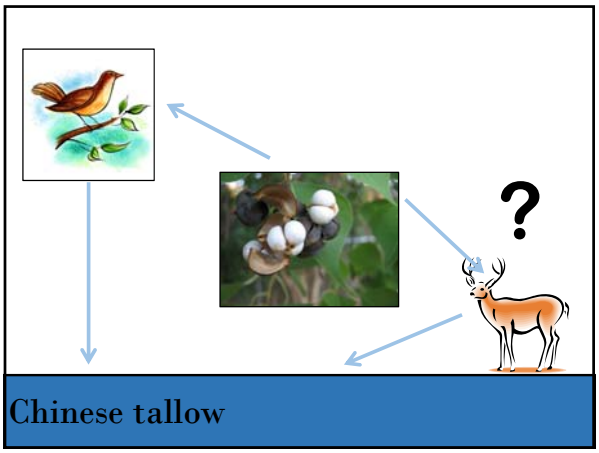
Chinese tallow

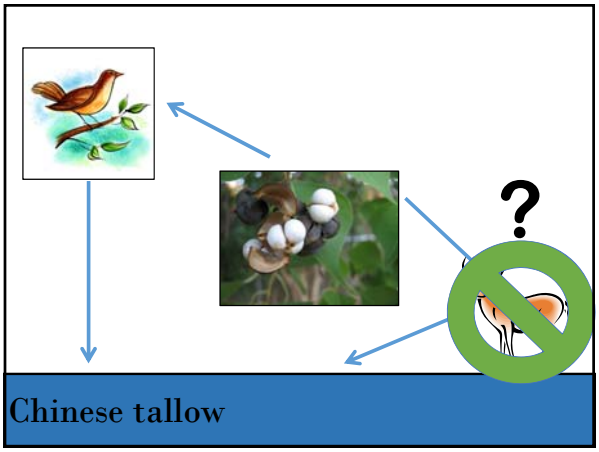
Parris Island



From Hobbs and Humphries (1995)

Seed Dispersal


?
Chinese tallow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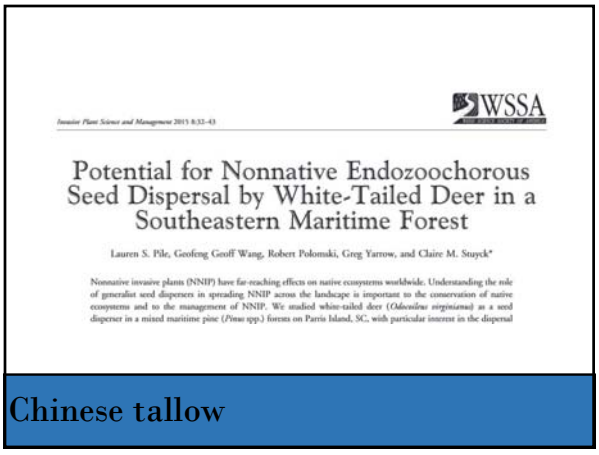
Chinese tallow


WSSA
Potential for Nonnative Endozoochorous Seed Dispersal by White-Tailed Deer in a Southeastern Maritime Forest
Lauren S. Pile, Geofeng Geoff Wang, Robert Polomski, Greg Yarrow, and Claire M. Stuyck*
Chinese tallow

Disturbance and Establishment

Chinese tallow

Chinese tallow

Chinese tallow

Chinese tallow

Remnant stands → + woody species richness

greater diversity between forest stands

Disturbed stands → + shrub density

dominated by few species (pine, yaupon, waxmyrtle)

+ Chinese tallow

Forest thinning → + Chinese tallow (forest management issue!)

Integrated Management

Study Background

Developing Integrated Management for the Control of Chinese Tallow

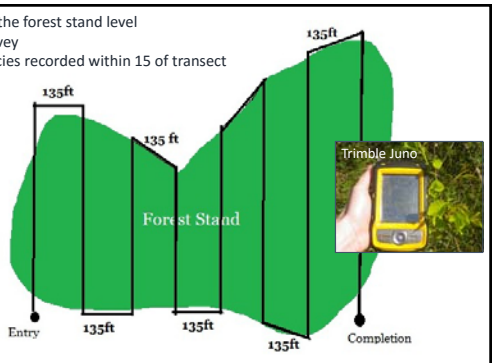
Impacts of Management Options on Chinese tallow

Impacts of Management Options on the Native Community

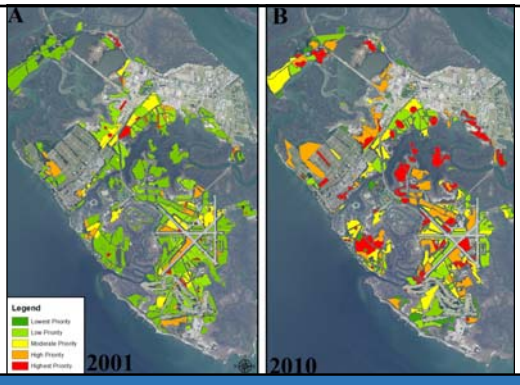
Other Options

Overview

Stratified at the forest stand level
Transect survey
Invasive species recorded within 15 of transect



Survey Methods



Study Background

Invasive species management

- Critical need for a practical and effective framework that links ecological theory to invasive species management
- Most weed management approaches developed from agriculture that do not account for the complexity of natural systems

Study Background

Objectives:

1. Determine the most effective management option to reduce Chinese tallow abundance and establishment
2. Determine treatment effect on native species abundance and diversity
   (really important!!)
3. Promote native species diversity, open forest structure, and ecosystem function (frequent prescribed burning)
   (management and military objective)

Study Background

integrated management

- System
- Combines multiple treatment techniques to reduce infestation size
- One treatment may aid in the application of following treatments
- Each subsequent treatment is designed to further diminish the infestation size

Study Background

ecologically-based management

- Considers the biology and ecology of the species (Chinese tallow)

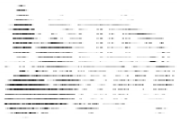
&

- Considers the ecology of the community
  Current and desired structure, composition, and process

Study Background

Target Species

Native Community

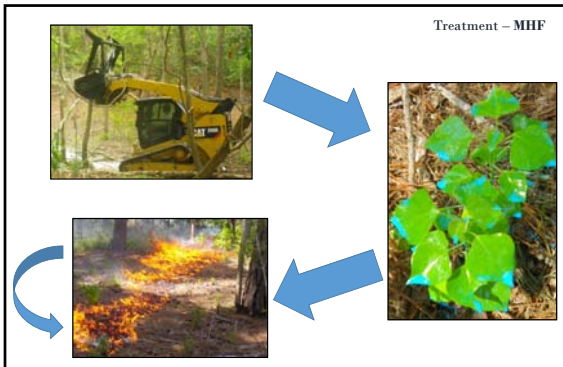


Tools

Developing Integrated Methods

Developing Integrated Methods

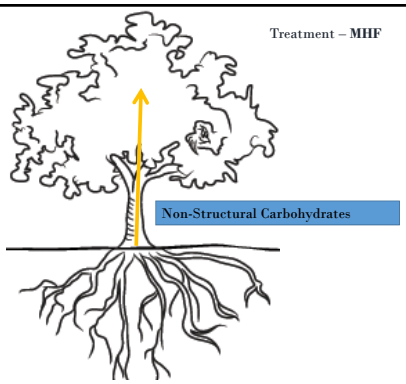
Treatment – **MHF**



Integrated Management

Treatment – **MHF**

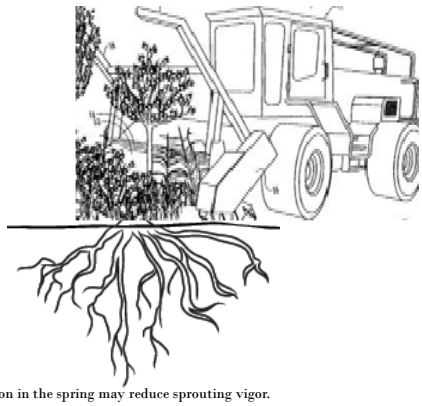
Spring



Non-structural carbohydrates are stored in the roots in the winter, and are used as energy for producing leaves and flowers in the spring.

Treatment – **MHF**

Spring



Mastication in the spring may reduce sprouting vigor.

Treatment – **MHF**

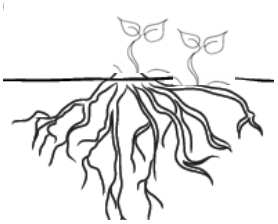
Mastication to reduce understory shrub density….

Treatment – **MHF**

Increase accessibility to apply herbicide and promote fire spread

Treatment – **MHF**

Summer

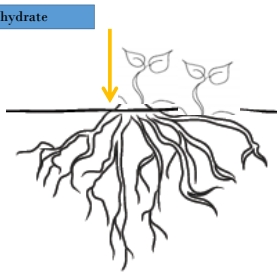


Regeneration from root sprouts (suckers) and soil seed bank (up to 7 years)

Treatment – **MHF**

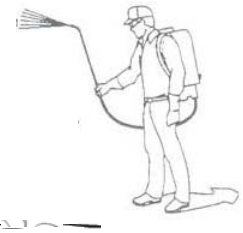
Fall

Non-Structural Carbohydrate



Treatment – **MHF**

Fall



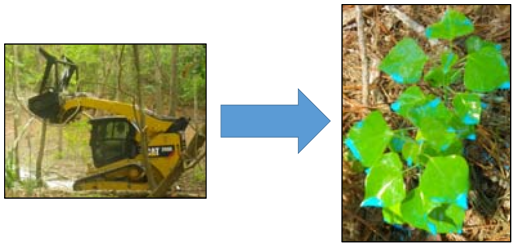
Herbicide application in the fall as translocation of carbohydrates move to the roots for dormancy may help to kill the residual rootstock

Treatment – **MHF**

2-years later…
Growing Season

Growing season prescribed fire can further reduce sprouting vigor and can promote native species adapted to frequent fire.

Treatment – **MH**



Foliar application: 5% v/v Garlon 4 Ultra ® with water & blue indicator dye

Integrated Management

Treatment – **HF**

Hack & Squirt/Basal Bark Application: 25% v/v Garlon 4 Ultra with MSO

Integrated Management

Compare to "typical" methods of control…

Integrated Management

Treatment – **H**

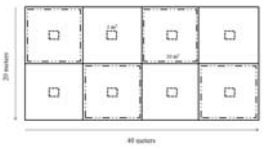
Hack & Squirt/Basal Bark Application: 25% v/v Garlon 4 Ultra with MSO

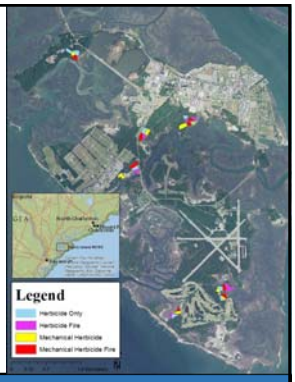
Integrated Management

Four treatment types

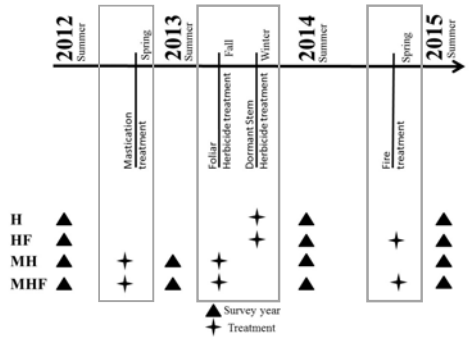
MHF – mastication, herbicide, & fire
MH – mastication and herbicide
HF – herbicide and fire
H – herbicide only

8 replicates
32 Experimental Units





Study Design



Study Design

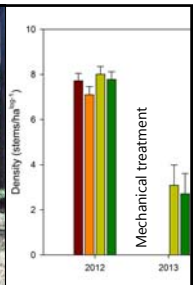
Impacts to Chinese Tallow

Treatment		2012
H		
	Density (trees/ac)	1002 ± 265
	Basal Area (ft2/ac)	15.3 ± 9.1
	regeneration (% cover)	0.98 ± 0.6
HF		
	Density (trees/ac)	391 ± 287
	Basal Area (ft2/ac)	9.6 ± 6.5
	regeneration (% cover)	1.08 ± 0.6
MH		
	Density (trees/ac)	841 ± 266
	Basal Area (ft2/ac)	18.7 ± 6.1
	regeneration (% cover)	2.19 ± 0.6
MHF		
	Density (trees/ac)	792 ± 266
	Basal Area (ft2/ac)	14.8 ± 6.1
	regeneration (% cover)	1.18 ± 0.6

Prior to Treatment…

Effect of mastication…

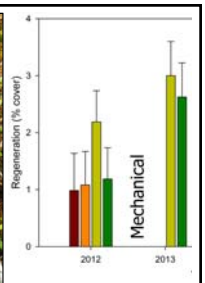
Impacts to Chinese Tallow



$F = 62.83$; $p < 0.01$

Significant reduction in Chinese tallow density following mastication

Impacts to Chinese Tallow



$F = 2.34$; $p = 0.15$

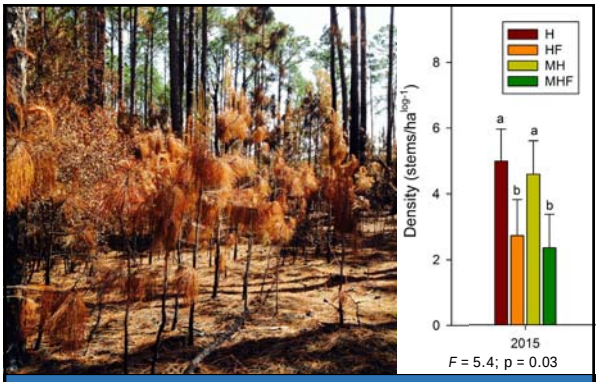
Increase in Chinese tallow regeneration following mastication, but not significant.

Impacts to Chinese Tallow

Effect of prescribed fire….

Impacts to Chinese Tallow

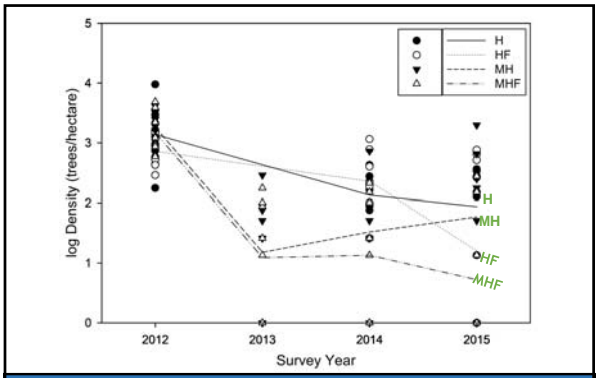
Impacts to Chinese Tallow



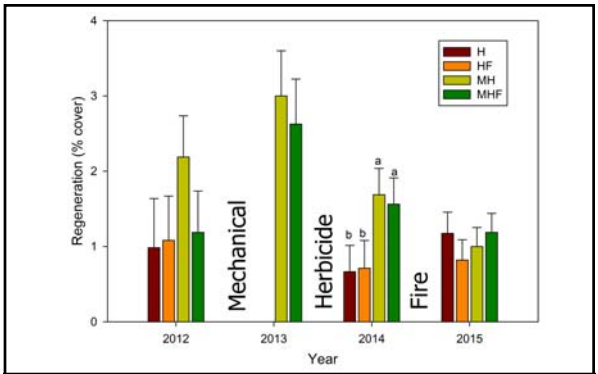
Impacts to Chinese Tallow

Effect of integrated treatments on Chinese tallow…

Results



Impacts to Chinese Tallow



Impacts to Chinese Tallow

Treatment	log Density (trees/ ha)	Regeneration (% cover)
H	2.43 ± 0.21	0.89 ± 0.21
HF	2.14 ± 0.23	0.85 ± 0.24
MH	2.18 ± 0.22	1.71 ± 0.23
MHF	1.67 ± 0.22	1.31 ± 0.23
T	p = 0.047	p = 0.009
Y	p < 0.001	p = 0.458
T*Y	p = 0.008	p = 0.273
M	p = 0.063	**p = 0.002**
F	**p = 0.039**	p = 0.291
MHF	**p = 0.011**	p = 0.441

Impacts to Chinese Tallow

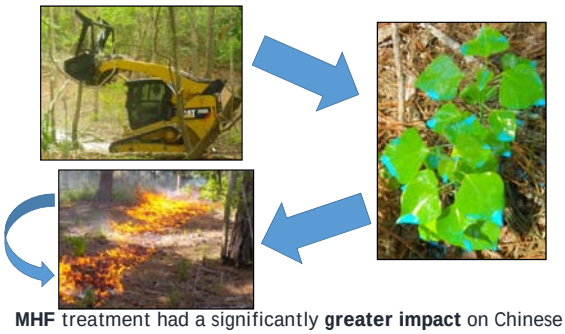
Treatment		2012	2013[1]	2014	2015
H					
	Density (trees/ha)	1002 ± 266	na	76 ± 34	80 ± 55
	Basal Area (m^2/ha)	15.2 ± 9.1	na	3.5 ± 1.3	0.9 ± 0.9
	Regeneration (% cover)	0.98 ± 0.6	na	0.67 ± 0.35	1.17 ± 0.28
HF					
	Density (trees/ha)	392 ± 287	na	400 ± 90	111 ± 60
	Basal Area (m^2/ha)	9.6 ± 6.5	na	1.7 ± 1.3	1.3 ± 0.9
	Regeneration (% cover)	1.08 ± 0.6	na	0.71 ± 0.37	0.82 ± 0.27
MH					
	Density (trees/ha)	841 ± 266	27 ± 12	49 ± 34	160 ± 56
	Basal Area (m^2/ha)	18.7 ± 6.1	1.7 ± 0.9	1.7 ± 1.3	1.3 ± 0.8
	Regeneration (% cover)	2.19 ± 0.6	3.0 ± 0.6	1.69 ± 0.35	1.0 ± 0.25
MHF					
	Density (trees/ha)	780 ± 266	20 ± 12	26 ± 34	22 ± 56
	Basal Area (m^2/ha)	14.8 ± 6.1	0.4 ± 0.9	0.2 ± 1.3	0.1 ± 0.2
	Regeneration (% cover)	1.18 ± 0.6	2.62 ± 0.6	1.56 ± 0.35	1.19 ± 0.25

Mastication treatments (**MHF & MH**) were significant in **increasing regeneration** of Chinese tallow

Chinese Tallow - Conclusion

Fire treatments (**MHF & HF**) were significant in **reducing the density** of Chinese tallow

Chinese Tallow – Conclusion



MHF treatment had a significantly **greater impact** on Chinese tallow density than all other treatments

Chinese Tallow – Conclusion

Impacts to the Community

ecological resistance…

the capacity of an ecological community to resist invasion

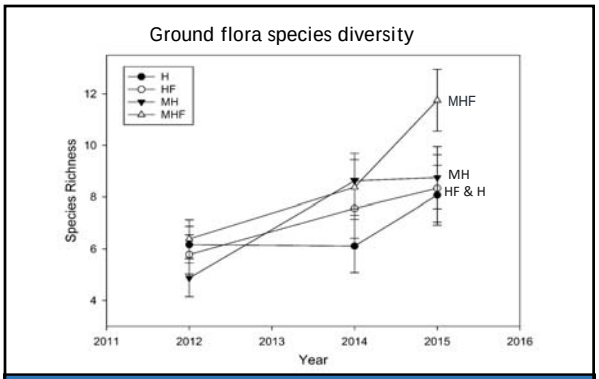
Impacts to the Community

NOT Parris Island - Brosnan Forest, Dorchester, SC

Impacts to the Community

	Trees		Saplings/Shrubs	
	BA (m2/ha)	Density (trees/ha)	BA (m2/ha)	Density (trees/ha)
H	32.8 ± 2.8	2000 ± 236	1.7 ± 0.3	8510 ± 1510
HF	31.0 ± 3.1	1387 ± 246	1.7 ± 0.3	7137 ± 1567
MH	26.7 ± 2.9	1026 ± 237	0.8 ± 0.3	6099 ± 1523
MHF	30.7 ± 2.9	1043 ± 237	0.9 ± 0.3	5135 ± 1523
	p = 0.49	p < 0.001	p = 0.01	p < 0.01
M	p = 0.28	**p < 0.001**	**p = 0.001**	**p < 0.01**
F	p = 0.71	p = 0.06	p = 0.93	p = 0.06
MHF	p = 0.87	**p = 0.02**	**p = 0.046**	**p < 0.01**

Impacts to the Community



Impacts to the Community

Tree density
- The mastication treatments (MHF & MH) were significant at reducing tree density
- MHF treatment was also significant

Community – Conclusion

Shrub density and BA were significant by treatment type
- The mastication treatments (MHF & MH) were significant at reducing shrub density and basal area
- MHF treatment was significant at density and BA reduction when compared to other treatments

Community – Conclusion

MHF treatment had increased **ground flora richness**

Community – Conclusion

MHF treatment = reduction in Chinese tallow density & increase in herbaceous diversity

Bringing it Together

Objectives:

1. Determine the most effective management option to reduce Chinese tallow abundance and establishment

MHF

Integrated
treatment regime

Ecological-based
biology and ecology of Chinese tallow
ecology of the community

Bringing it Together

Objectives:

2. Determine treatment effect on native species abundance and diversity

Mastication resulted in positive response for oak species but reduced density of sapling slash pine

Mastication increased regeneration of slash pine but fire decreased regeneration

MHF treatment increased herbaceous richness

Bringing it Together

Objectives:
3. Promote native species diversity, open forest structure, and ecosystem function (frequent prescribed burning)

MHF

increased herbaceous plants

reduced shrub density

conditions for frequent prescribed fire
→ may continue to reduce Chinese tallow
→ may increase community resistance

Bringing it Together

moving forward…

frequent prescribed fire

limitations of our fire results

continued monitoring of treatment effects

Bringing it Together

Other Options

Herbicides

- Injection methods appear to be more effective than foliar applications (Johns et al 1999)
- Garlon 3A and Garlon 4 (triclopyr ester and amine formulations) may not provide consistent control of sprouting (Enloe et al 2015)
- Clearcast (imazamox) may provide Chinese tallow specific application – great for foliar applications

Other Options

Biocontrol

Dr. Gregory Wheeler, Ph.D.
Research Entomologist
USDA/ARS/Invasive Plant Res Lab

Picture courtesy of G. Wheeler

Dr. Wheeler and associates are working to develop safe agents that can be released for the control of Chinese tallow (and other invasive plants)

Bikasha Flea Beetle

→ adults can cause significant damage through leaf feeding

→ The larvae are the most damaging by burrowing into the roots and completely hollowing out the internal tissues.

Other Options

Biocontrol

Dr. Gregory Wheeler, Ph.D.
Research Entomologist
USDA/ARS/Invasive Plant Res Lab

Picture courtesy of G. Wheeler

→ Also testing *Gadirtha fusca* (Nolidae) – a defoliating caterpillar

→Testing is nearly complete and shows a safe and biological control of Chinese tallow

For more information contact: Greg.Wheeler@ars.usda.gov

Other Options

Economic Use

- Forest management (thinning/harvest) has been shown to increase Chinese tallow invasion in several forest types
  - If seed sources are in the area – have a plan to manage after operation (prescribed fire?)
  - Artificial regeneration (planting) may help to reduce invasion

Other Options

Economic Use

- Chinese tallow often has poor form and crooked stem prohibiting most conventional lumber applications (Shupe et al. 2008)
  - In mixed hardwood stands → could be harvested without affecting the quality of mixed hardwood structural flakeboard
  - Chinese tallow's low density and light wood color may be useful in composite panel construction
  - Low to medium secondary applications such as pallets, furniture, paneling, or medium density fiberboard (when combined with bagasse)

Other Options

Funding support: DoD, Army Corps of Engineers, & CESU

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Thank you!