UNIVERSIDADE FEDERAL DO PARÁ
CÂMPUS UNIVERSITÁRIO DE BRAGANÇA
INSTITUTO DE ESTUDOS COSTEIROS
LABORATÓRIO DE ECOLOGIA DE MANGUEZAL

YAN CÁSSIO GATINHO LIMA

Distribuição das Florestas Anãs de *Avicennia germinans* (L.) L. (Acanthaceae) na Reserva Extrativista Marinha de Tracuateua, Nordeste do Pará

Bragança – PA
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Trabalho de Conclusão de Curso apresentado ao Colegiado do Curso de Licenciatura em Ciências Biológicas da Universidade Federal do Pará, Câmpus de Bragança, como requisito parcial para a obtenção do Grau de Licenciado em Ciências Biológicas.

Orientador: Dr. Marcus Emanuel Barroncas Fernandes

Coorientador: Dr. Madson Lucas Galvão de Brito

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Realização

Patrocínio

EPÍGRAFE

"O otimista é um tolo. O pessimista, um chato. Bom mesmo é ser um realista esperançoso".

Ariano Suassuna.

SUMÁRIO

Distribuição das Florestas Anãs de *Avicennia germinans* (L.) L. (Acanthaceae) na Reserva Extrativista Marinha de Tracuateua, Nordeste do Pará, costa Amazônica brasileira

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Distribuição das florestas anãs de *Avicennia germinans* (L.) L. (Acanthaceae) na Reserva Extrativista Marinha de Tracuateua, Nordeste do Pará, costa Amazônica brasileira

Resumo

A estrutura das florestas anãs é resultado direto de condições ambientais extremas, sendo fundamental compreender sua distribuição para orientar ações de conservação. Neste estudo, investigamos como a salinidade intersticial influencia a estrutura e distribuição das florestas anãs de *Avicennia germinans* na Reserva Extrativista Marinha de Tracuateua, Nordeste do Pará. Foram delimitadas 90 parcelas e medidos atributos estruturais como diâmetro, altura, densidade e dominância. A análise de agrupamento indicou três grupos estruturais distintos, com o grupo de maior porte concentrado próximo a canais de maré. A salinidade foi medida em períodos seco e chuvoso; constatou-se que no período seco ela teve efeito negativo significativo sobre a altura das árvores, enquanto no chuvoso esse efeito foi irrelevante. A área ocupada pelas florestas anãs correspondeu a 16,8% da RESEX, embora boa parte esteja fora dos seus limites legais. Os resultados mostram que a distribuição e estrutura dessas formações estão fortemente associadas a microgradientes ambientais, especialmente salinidade e disponibilidade hídrica. Concluímos que o estresse salino sazonal modela a estrutura das florestas anãs de *A. germinans*, e que o reconhecimento espacial dessas áreas é essencial para subsidiar a redefinição dos limites da unidade de conservação e compreender processos associados à expansão dos manguezais.

Palavras-chave: *Avicennia germinans* · Manguezal anão · Estresse salino · Gradiente ambiental · Reserva extrativista · Costa amazônica brasileira

Abstract

The structure of dwarf forests is a direct result of extreme environmental conditions, and understanding their distribution is essential to guide conservation actions. In this study, we investigated how interstitial salinity influences the structure and distribution of *Avicennia germinans* dwarf forests in the Tracuateua Marine Extractive Reserve, northeastern Pará. Ninety plots were delimited, and structural attributes such as diameter, height, density, and dominance were measured. Cluster analysis revealed three distinct structural groups, with the largest group concentrated near tidal channels. Salinity was measured during both dry and rainy seasons; it was found that during the dry season, it had a significant negative effect on tree height, while during the rainy season, this effect was negligible. The area occupied by dwarf forests corresponded to 16.8% of the RESEX, although much of it lies outside its legal boundaries. The results show that the distribution and structure of these formations are strongly associated with environmental microgradients, especially salinity and water availability. We conclude that seasonal saline stress shapes the structure of *A. germinans* dwarf forests, and that spatial recognition of these areas is essential to support the redefinition of conservation unit boundaries and to understand processes associated with mangrove expansion.

Keywords: *Avicennia germinans* · Dwarf mangrove · Salinity stress · Environmental gradient · Extractive reserve · Brazilian Amazon coast

Introdução

Os manguezais constituem um ecossistema importante devido à sua extensão global e alta produtividade (Komiyama et al. 2008; Giri et al. 2011). São formados por espécies herbáceas e arbóreas que se desenvolvem em zonas intermareais nos trópicos e subtrópicos que são caracterizadas por inundação periódica das marés e variações de salinidade (Tomlinson 1986). As espécies de manguezais são morfologicamente e fisiologicamente bem adaptadas para sobreviver em condições salinas, por isso essas florestas apresentam grande variabilidade em resposta a esses diferentes fatores ambientais (Naidoo et al. 2002; Naidoo 2006).

A combinação do déficit hídrico e a altas concentrações de salinidade são os principais causadores de estresse ambiental em espécies de árvores de mangue (Naidoo 2006; Virgulino-Júnior et al. 2020). Apesar desses fatores limitantes, as florestas de mangue conseguem se estabelecer com sucesso graças às estratégias ecológicas adotadas pelas espécies arbóreas que as compõem, sendo a tolerância a condições específicas definida pela faixa ideal ao longo de um gradiente (Naidoo 2006; Ramesh et al. 2024). As árvores do gênero *Avicennia* L. são consideradas as mais tolerantes à salinidade (Naidoo 2006; Virgulino-Júnior et al. 2020; Ramesh et al. 2024), embora o potencial dessas árvores para o crescimento e a assimilação de carbono sejam reduzidos com o aumento dos níveis de salinidade (Naidoo and Chirkoot 2004).

Na costa Amazônica brasileira, os manguezais são formados por três espécies arbóreas, *Rhizophora mangle* L. – nome popular: mangue vermelho ou mangueiro, *Avicennia germinans* (L.) L – nome popular: mangue preto, siriúba ou siribeira e *Laguncularia racemosa* (L.) C.F. Gaertn., – nome popular: mangue branco ou tinteiro. *Rhizophora mangle* é a mais dominante nesta região, esta espécie é dominante em ambientes salobros e de maior adaptação às áreas de baixa salinidade e de maior frequência de inundação (Menezes et al. 2008; Abreu et al. 2016).

Em contraste, as árvores de *A. germinans* é a segunda espécie arbórea mais dominante (Menezes et al. 2008). Domina áreas hipersalinas, formando florestas monoespecíficas com árvores altas ou anãs com características arbustivas (Medina et al. 2001; Virgulino-Júnior et al. 2020). Essa espécie conseguiu por desenvolver uma série de adaptações morfológicas e ecofisiológicas (Alongi 2009; Silva 2017). O estresse gerado pelas condições de salinidade extrema afeta a estrutura do manguezal, reduzindo sua estatura, o diâmetro do tronco e o tamanho das folhas (Silva 2017), transformando a floresta em um manguezal arbustivo, diferentemente do manguezal anão, onde a redução da estatura não é acompanhada pela redução do tamanho das folhas, por exemplo (Silva 2017). Dessa forma, o acúmulo de sal durante períodos de seca extrema e a hipersalinidade resultante causam um declínio em seu crescimento em altura (Suárez and Medina 2005; Lara and Cohen 2006).

Considerando a hipótese de que condições ambientais com alta salinidade podem ocorrer em vários locais ao longo da costa Amazônica brasileira, é provável que os manguezais da Reserva Extrativista Marinha (RESEX Mar) de Tracuateua, no município de Tracuateua, Pará, também apresentem distribuição de *A. germinans* com características anãs. Portanto, este estudo tem como objetivo mapear as florestas anãs de *A. germinans* na RESEX Mar de Tracuateua.

Material e métodos

Área de estudo e clima

A Reserva Extrativista Marinha de Tracuateua está localizada na região nordeste do Estado do Pará (Fig. 1). O clima dessa região é quente e úmido e, considerando a série dos últimos 40 anos, a temperatura média anual é de 26,5ºC, com precipitação anual e umidade relativa do ar média de 2.348,5 mm e 85%, respectivamente (INMET 2022). O período seco ocorre de julho e novembro, enquanto o período chuvoso de dezembro a junho (Moraes et al. 2005). A região é caracterizada por macromarés semidiurnas (DHN 2024), com amplitude de maré de 4–6 m (Souza-Filho 2005).

Atributos estruturais da vegetação

Para caracterizar a estrutura das florestas anãs serão demarcadas 90 parcelas de 5x5 m, totalizando 0.25 hectare (= 2.250 m^2). Em cada parcela, todos os indivíduos serão mensurados quanto à altura total (*h*) e circunferência do fuste. Dos indivíduos com comportamento arbóreo foi medida a circunferência à altura do peito (CAP; cm) a 1,3 m acima do solo, enquanto dos indivíduos de comportamento arbustivo foi medida a circunferência à altura da base da planta (CAB; cm) a 30 cm do nível do chão. Este último procedimento foi adotado mesmo quando a primeira bifurcação ou rebrota ocorreu abaixo de 30 cm (Silva 2017). A partir das medidas de circunferência (CAP e CAB) foram estimados o diâmetro do fuste (D; cm) e estimados os seguintes atributos estruturais: Frequência (F), Densidade (De; ind m^{-2}), Dominância (área basal – Do; m^2 ha^{-1}) e Valor de Importância (VI). Todas as informações foram colhidas conforme a Licença MMA/ICMBIO/SISBIO n° 77497-4.

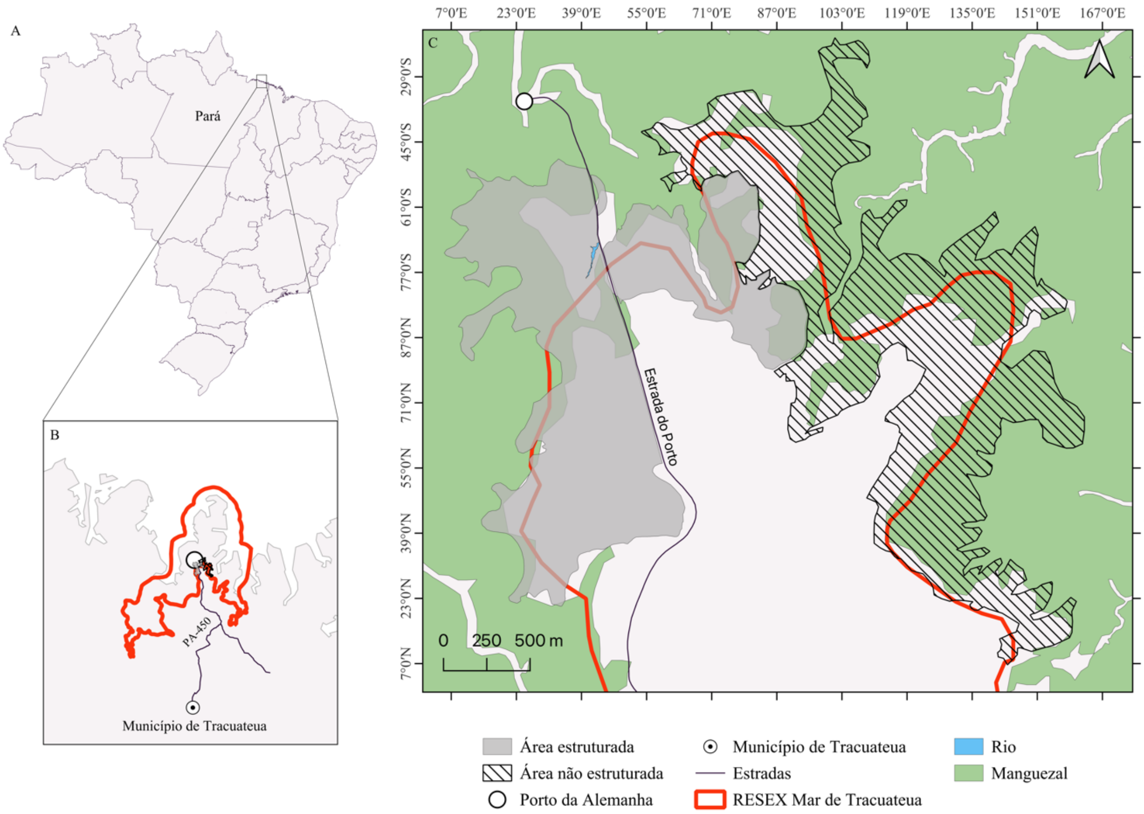

Fig. 1 Mapa das florestas anãs de *Avicennia germinans* na Reserva Extrativista Marinha (RESEX Mar) de Tracuateua, município de Tracuateua, Pará. A) Nordeste do Estado do Pará; B) Area da RESEX Mar de Tracuateua; C) Localização da área de estudo.

Salinidade da água intersticial

A salinidade (SAL) da água intersticial foi obtida com auxílio de um trado de 50 mm de diâmetro a um metro de profundidade. As amostras de água foram retiradas com o auxílio de uma seringa de 50 ml e uma mangueira flexível de um metro fixada na seringa. Para aferição da salinidade foi utilizado um refratômetro graduado de 0 a 100, com precisão de 01 UPS (American Optical modelo A366ATC). As coletas de salinidade foram realizadas pontualmente entre setembro-outubro de 2024 referente ao período seco. E de janeiro-março de 2025 referente ao período chuvoso.

Análises estatísticas

Os dados brutos dos atributos estruturais da floresta de *A. germinans* foram testados quanto à normalidade e homocedasticidade utilizando-se o teste de Shapiro-Wilk e Levene, respectivamente, para verificação dos pressupostos estatísticos. A análise de agrupamento, análise de cluster, foi conduzida para estratificar as classes de altura. A comparação dos parâmetros estruturais entre as classes de altura foi efetuada mediante análise de variância ANOVA. Adicionalmente, aplicou-se um modelo de regressão linear múltipla para avaliar o efeito da salinidade (nos períodos seco e chuvoso) sobre a variável resposta altura das árvores. Todas as análises estatísticas e gráficos foram feitos usando o software livre RStudio e Jamovi (R Core Team 2020; Jamovi 2024).

Resultados

Estrutura arbórea

A área total da RESEX Mar de Tracuateua é de 27.864,08 hectares, enquanto a área ocupada pelas florestas anãs de *A. germinans* corresponde a 468,4 hectares, representando 16,8% da reserva. No entanto, grande parte dessa vegetação está localizada fora dos limites legais da unidade de conservação (Fig. 1). Na área analisada para a estrutura arbórea (190,4 hectares) foi mensurada 2222 indivíduos, dos quais 93,7% pertenciam a *A. germinans*. As demais espécies de *L. racemosa* e *R. mangle* corresponderam a 6,2% e 0,1%, respectivamente. Indivíduos esparsos de espécies típicas do estrato herbáceo também foram registrados, como: *Spartina alterniflora* Loisel e *Sesuvium portulacastrum* (L.) L, assim como foram registrados *Ucides cordatus* (Linnaeus, 1763) na área de estudo. Todas as análises dos atributos estruturais da floresta anã estão descritas no Apêndice. Os maiores valores médios de diâmetro foram de 17,1 e 16,6 cm, ao passo que o menor valor foi de 2,4 cm. Os maiores valores médios de altura foram de 4,7 e 4,6 m. Ao passo que o menor valor foi de 0,9 m. Os maiores valores de Densidade Absoluta foram de 49 e 45 ind ha^{-1}, o menor registrado foi de 7 ind ha^{-1}. Os maiores valores de Densidade Relativa foram de 2.3 e 2.1%, o menor foi de 0.3%. Os maiores valores de Dominância Absoluta foram de 0,028 e 0,026 m^2 ha^{-1}, já o menor foi de 0,001 m^2 ha^{-1}. Os maiores valores de Dominância Relativa foram de 6,8 e 6,2%, já o menor foi de 0,1%. Por fim, os maiores valores de Valor de Importância foram de 107,8 e 106,4.

Através da análise de cluster foi possível obter três grupos distintos, baseados na altura média dos indivíduos por parcela (n=90). Os grupos foram formados no dendrograma nos seguintes pontos: o primeiro grupo de 0,3 – 1,2 m; o segundo grupo de 1,3 – 2,5 m; e o terceiro grupo de 2,6 – 7,0 m (Fig. 2).

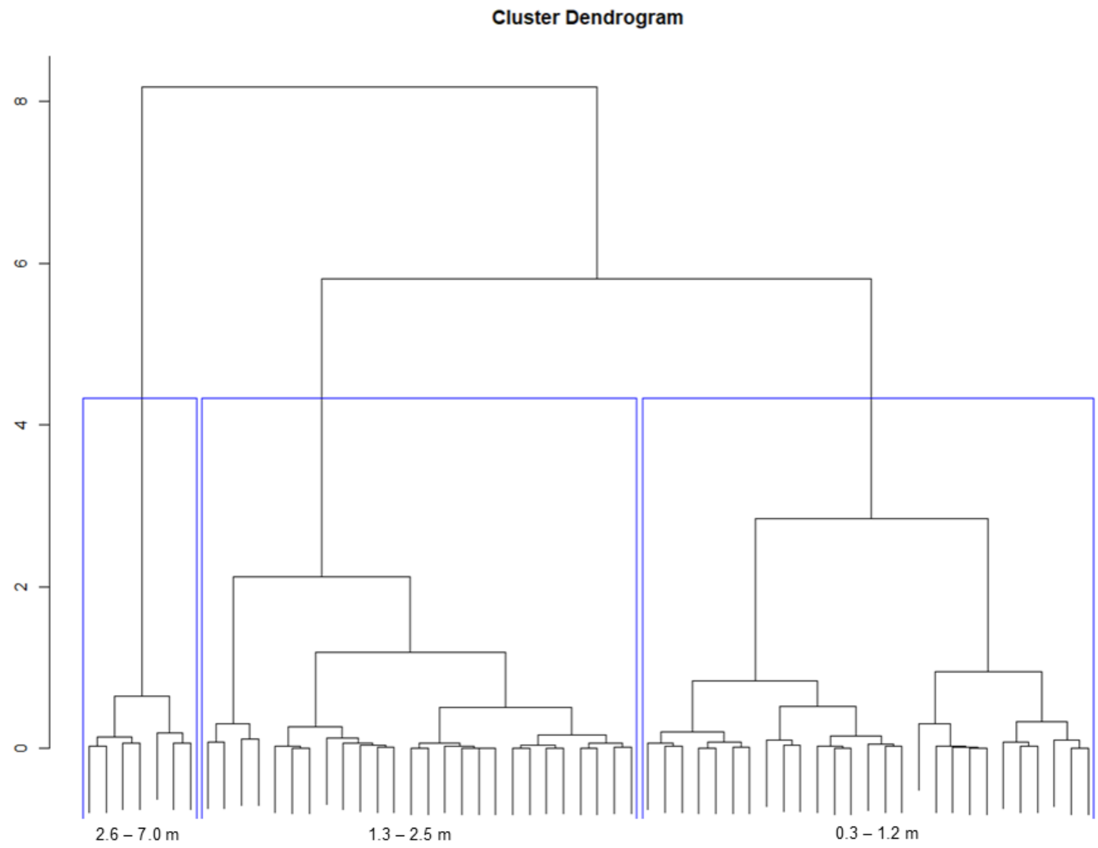

Fig. 2 Análise de cluster, mostrando a formação de três grupos distintos, baseados na altura média das árvores das florestas anãs de *Avicennia germinans* na Reserva Extrativista Marinha de Tracuateua, Tracuateua-PA.

A Tabela 1 apresenta os atributos estruturais de *A. germinans* na RESEX Mar de Tracuateua, organizados em três grupos de tamanho distintos. Quanto a densidade absoluta os maiores valores médios foram para grupo 2 (866 ind ha^{-1}), e menor no grupo 3 (573 ind ha^{-1}), padrão semelhante ao observado na densidade relativa, que oscila entre 42,3% a 28,0%, respectivamente. Quanto à dominância absoluta, os maiores valores médios foram para o grupo 3 (0,010 m^2 ha^{-1}), enquanto os menores foram para o grupo 1 (0,001 m^2 ha^{-1}). A dominância relativa os grupos 2 e 3 apresentaram valores semelhantes de 44,1%, ao passo que o grupo 1 foi de 11,9%. O valor de importância reflete a relevância ecológica de cada grupo, sendo os maiores valores encontrados para o grupo 2 (86,4), e o menor para o grupo 1 (41,6).

Tabela 1 Atributo estrutural com valores médios e desvio padrão para os grupos de *Avicennia germinans* na Reserva Extrativista Marinha de Tracuateua, Tracuateua-PA. D=Diâmetro do fuste, *h* = Altura Total; FrA= Frequência Absoluta, FR= Frequência Relativa; DeA=Densidade Absoluta, DeR=Densidade Relativa, DoA=Dominância Absoluta, DoR=Dominância Relativa e VI=Valor de Importância.

Grupo	D (cm)	*h* (m)	DeA (ind ha^{-1})	DeR (%)	DoA (m^2 ha^{-1})	DoR (%)	VI
1	2,5 ± 2,1	0,8 ± 0,3	608	29,7	0,001 ± 0,003	11,9	41,6
2	5,1 ± 3,6	2,0 ± 0,4	866	42,3	0,003 ± 0,013	44,1	86,4
3	9,7 ± 5,3	3,7 ± 1,0	573	28,0	0,010 ± 0,013	44,1	72,1
p	< 0,001	< 0,001	-	-	<0,001	-	-

Distribuição espacial

A variação na altura da vegetação apresentou valores de 1,5 a 4,6 m (Fig. 3A). Essa distribuição sugere que as áreas com alturas maiores (até 4,6 m) estão concentradas em regiões específicas (regiões próximas ao rio) (ver Fig. 1), enquanto áreas com alturas menores (1,5 m) indicam as zonas de estresse salino sobre a vegetação de *A. germinans*. E esses padrões espaciais podem estar associados ao gradiente de inundação, salinidade e topografia. Os valores de densidade relativa variam entre 0,3 e 2,3%, refletindo a concentração de indivíduos de *A. germinans* por área (Fig. 3B). Valores mais altos (2,3%) indicam agrupamentos densos, possivelmente em zonas com menor estresse hídrico ou maior disponibilidade água, enquanto valores baixos (0,3%) sugerem dispersão ou supressão do crescimento devido a fatores de estresse. A dominância relativa (0,1 a 6,8%) mostra a influência de árvores de maior porte ou biomassa em certas áreas (Fig. 3C). Valores elevados (6,8%) podem indicar locais com árvores antigas ou condições favoráveis ao crescimento, enquanto valores mínimos (0,1%) apontam para áreas de baixa cobertura ou perturbação. A distribuição heterogênea sugere micro habitats distintos dentro da área de distribuição de *A. germinans*.

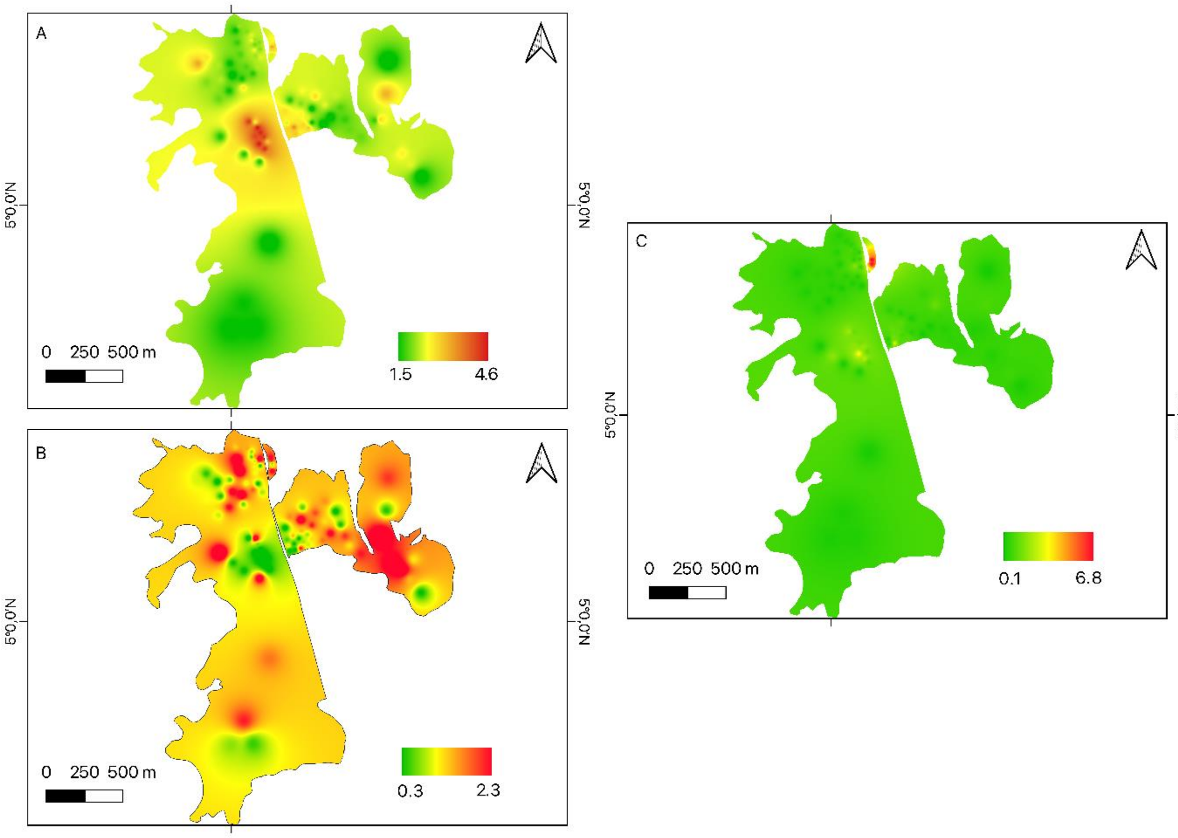

Fig. 3 Mapa de distribuição dos parâmetros estruturais das florestas anãs de *A. germinans* na Reserva Extrativista Marinha de Tracuateua, Tracuateua-PA. A) Distribuição espacial das classes de altura; B) Distribuição espacial da densidade relativa; C) Distribuição espacial da dominância relativa.

Influência da salinidade

A salinidade intersticial registrada no período seco apresentou média de 70,4 PSU, ao passo que no período chuvoso foi de 19,5. A análise dos efeitos sazonais da salinidade sobre a altura das árvores de *A. germinans* (Tabela 2), revelou que, no período seco, cada aumento de 1 unidade da salinidade, a altura das árvores diminui em ~0,06 m, com coeficiente altamente significativo (p = <0,001), indicando que a salinidade no período seco tem um efeito negativo sobre a altura. Para cada aumento de 1 unidade na salinidade no período chuvoso, a altura das árvores diminui apenas ~0,01m, com o coeficiente não estatisticamente significativo (p = 0,242), ou seja, a salinidade no período chuvoso não influencia significativamente a altura das árvores de *A. germinans*.

Tabela 2 Coeficientes do modelo de regressão linear múltipla para a influência da salinidade (período seco e chuvoso) sobre a altura das árvores de *Avicennia germinans*.

Preditor	**Estimativas**	**Erro padrão**	***t***	***p***
Altura	6,95	0,81	8,55	<0,001
Salinidade $_{seco}$	-0,06	0,01	-5,11	<0,001
Salinidade $_{chuvoso}$	-0,01	0,01	-1,19	*n.s.*

O mapa de gradiente de salinidade intersticial referente ao período seco ao longo dos limites das florestas anãs de *A. germinans* na RESEX de Tracuateua evidencia variações espaciais significativas na concentração de sal no solo, diretamente relacionadas à topografia, distância dos canais de maré e dinâmica de inundação (Fig. 4). As áreas mais próximas aos canais apresentam menores níveis de salinidade, representadas por tonalidades mais frias (azul e verde), com valor mínimo de 50 PSU. Por outro lado, nas regiões mais internas da RESEX, afastadas da influência direta das marés, a salinidade aumenta substancialmente, como indicado pelas tonalidades quentes (amarelo, laranja e vermelho), com valor máximo de 90 PSU.

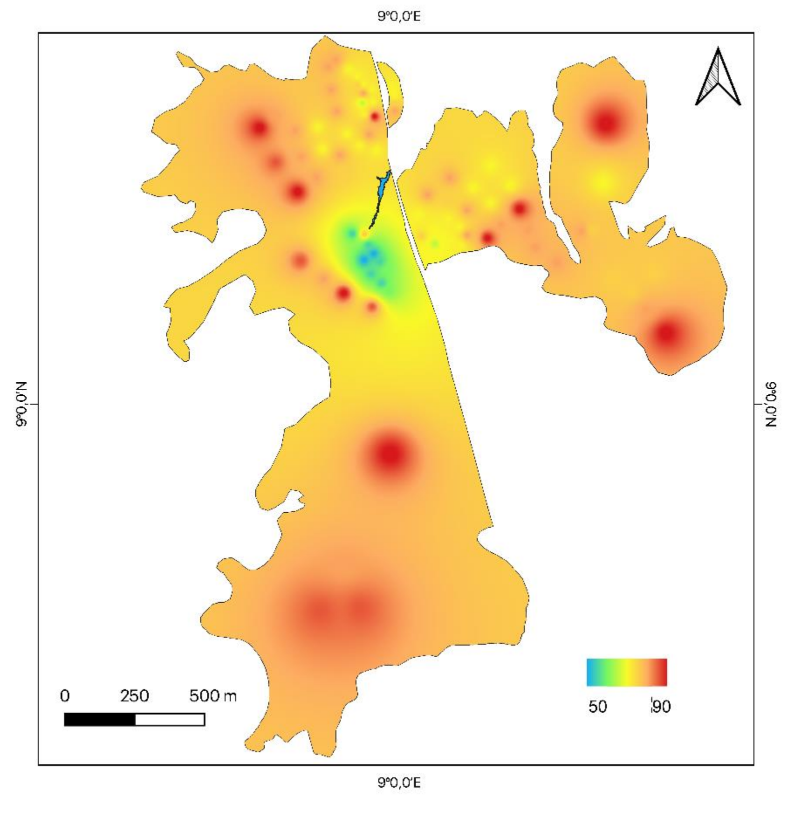

Fig.4 Mapa de distribuição do gradiente de salinidade ao longo dos limites das florestas anãs de *A. germinans* na Reserva Extrativista Marinha de Tracuateua, Tracuateua-PA.

Discussão

Apesar da ocorrência das espécies *R. mangle* e *L. racemosa* na área, suas contribuições em percentuais, no que se refere aos atributos estruturais, não foram expressivas, mostrando a dominância de *A. germinans* nas áreas analisadas (93,7% dos indivíduos), reforçando sua adaptação a esses ambientes hipersalinos (Suárez and Medina 2005; Virgulino-Júnior et al. 2020), haja vista essa espécie exibir mecanismos fisiológicos para lidar com o estresse salino, como glândulas foliares especializadas na secreção de sais (Naidoo et al. 2002; Suárez and Medina 2008).

A classificação da altura através análise de cluster revelou três grupos distintos (0,3 – 1,2 m; 1,3 – 2,5 m; 2,6 – 7,0 m), resultado semelhante encontrados para as florestas anãs de *A. germinans* da RESEX de Caeté-Taperaçu, Bragança, Pará (Silva 2017). Os resultados do presente estudo revelaram que o Grupo 3 (indivíduos com 2,6 – 7,0 m de altura) apresentou sua maior concentração nas áreas adjacentes aos canais de maré (Fig. 3), esta distribuição espacial está diretamente associada às condições ambientais mais favoráveis nesses locais, caracterizadas por i) maior disponibilidade hídrica, devido à frequência de inundações pelas marés; ii) reduzida concentração salina no solo, resultante do constante fluxo e renovação da água iii) melhor drenagem e oxigenação do substrato (Lara and Cohen 2006; Silva 2017). Esses fatores combinados criam um microambiente ideal para o desenvolvimento de indivíduos de maior porte de *A. germinans*, contrastando com as condições de estresse observadas em áreas mais distantes dos canais.

Por outro lado, os grupos 1 e 2 têm distribuição mais distantes desses canais de maré e a análise de regressão e os pontos de salinidade confirmou que a salinidade no período seco tem um impacto negativo significativo na altura das árvores (Fig. 4), enquanto no período chuvoso o efeito é insignificante (Silva 2017; Virgulino-Júnior et al. 2020). Esse resultado está alinhado com estudos que mostram que *A. germinans* ajusta seu potencial hídrico foliar para manter o potencial de pressão positivo, fator importante para o crescimento em condições de estresse (Naidoo 2006; Suárez and Medina 2008; Madrid et al. 2014). Todas essas características em termos de altura são uma resposta da planta às condições ambientais, disponibilidade de água, salinidade da água dos poros e limitação de nutrientes biodisponíveis (Romero-Mujalli and Melendez 2023).

De fato, grandes variações na estrutura dos manguezais podem ser observadas em diferentes pontos ao longo da costa Amazônica brasileira, formando um contínuo de tipos de vegetação resultante das transformações hidrológicas, químicas e geomorfológicas que atuam no sistema (Alongi 2011). Nesse contexto, as florestas anãs de *A. germinans* representam um desses sistemas que são moldados por essas dinâmicas locais. Esses dados estruturais das florestas anãs de mangue podem auxiliar na análise dos impactos decorrentes das mudanças ecossistêmicas e da expansão dos manguezais para regiões mais internas, à medida que novos habitats salobros se tornam disponíveis por meio de inundações e consequentemente de mudanças na salinidade (Souza-Filho et al. 2023). Dessa forma, os resultados deste estudo representam uma contribuição relevante, tanto para reduzir as incertezas sobre a distribuição dessas florestas na RESEX Mar de Tracuateua, quanto para embasar estratégias de redefinição dos limites da reserva, garantindo a proteção integral das áreas de manguezal. Entretanto, é necessário suprir lacunas do conhecimento científico sobre essas formações anãs de *A. germinans*, visando melhor compreender sua expansão para os campos salinos na RESEX Mar de Tracuateua. Tais informações são fundamentais para traçar estratégias de mitigação das mudanças climáticas, bem como a quantificação dos estoques de carbono nessas áreas revela-se uma das informações-chave para a compreensão do funcionamento dessa fisionomia dos manguezais amazônicos.

Conclusão

Concluímos que a estrutura das florestas anãs de *A. germinans* é fortemente influenciada por condições ambientais locais, especialmente pelos gradientes de salinidade e disponibilidade hídrica. A salinidade intersticial no período seco afeta negativamente o crescimento em altura, enquanto no período chuvoso esse impacto é irrelevante. A análise estrutural e espacial revelou que os indivíduos de maior porte estão concentrados próximos aos canais de maré, indicando que essas áreas oferecem condições mais favoráveis ao desenvolvimento da espécie. Por outro lado, os indivíduos de menor estatura estão associados a zonas de maior estresse salino. Esses efeitos ambientais distintos moldam a estrutura da vegetação em escalas locais e regionais. Portanto, o mapeamento detalhado dessas formações anãs pode ser utilizado como ferramenta de gestão ambiental, contribuindo para a redefinição de limites das unidades de conservação e para estratégias de mitigação dos impactos das mudanças climáticas, especialmente em relação à expansão das florestas de mangue para áreas hipersalinas internas. Dessa forma, os dados obtidos oferecem subsídios para o planejamento de ações de conservação desse ecossistema costeiro.

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Apêndice

Apêndice 1 Atributos estruturais com valores médios para as florestas anãs de *A. germinans* na Reserva Extrativista Marinha de Tracuateua, Tracuateua-PA. D=Diâmetro do fuste, Alt = Altura Total; FrA= Frequência Absoluta, FR= Frequência Relativa; DeA=Densidade Absoluta, DeR=Densidade Relativa, DoA=Dominância Absoluta, DoR=Dominância Relativa e VI=Valor de Importância.

Parcela	D (cm)	Alt (m)	FrA	FR (%)	DeA (ind ha^{-1})	DeR (%)	DoA (m^2 ha^{-1})	DoR (%)	VI
1	14.5	2.4	1	100	33	1.5	0.020	4.7	106.3
2	15.1	2.7	1	100	31	1.5	0.021	4.9	106.4
3	15.1	3.4	1	100	19	0.9	0.022	5.3	106.2
4	17.1	2.9	1	100	21	1.0	0.028	6.8	107.8
5	16.6	2.3	1	100	34	1.6	0.026	6.2	107.8
6	5.4	2.4	1	100	24	1.1	0.003	0.8	101.9
7	6.1	2.1	1	100	22	1.0	0.008	2.0	103.0
8	4.6	2.5	1	100	23	1.1	0.002	0.5	101.6
9	5.1	2.0	1	100	15	0.7	0.003	0.6	101.3
10	3.8	2.0	1	100	41	1.9	0.002	0.4	102.3
11	5.1	2.1	1	100	26	1.2	0.003	0.7	101.9
12	5.3	1.9	1	100	21	1.0	0.003	0.7	101.7
13	5.6	2.7	1	100	19	0.9	0.003	0.8	101.6
14	6.3	2.5	1	100	17	0.8	0.005	1.1	101.9
15	4.4	2.4	1	100	20	0.9	0.002	0.5	101.4
16	4.1	2.0	1	100	25	1.2	0.002	0.5	101.6
17	3.2	1.8	1	100	45	2.1	0.001	0.3	102.4
18	3.8	1.7	1	100	42	2.0	0.002	0.4	102.4
19	3.6	2.1	1	100	25	1.2	0.002	0.4	101.5
20	3.9	1.4	1	100	24	1.1	0.003	0.6	101.7
21	2.4	1.5	1	100	32	1.5	0.001	0.1	101.6
22	2.7	1.5	1	100	40	1.9	0.001	0.2	102.1
23	3.0	2.1	1	100	21	1.0	0.001	0.2	101.2
24	4.1	2.2	1	100	16	0.7	0.002	0.6	101.3
25	3.9	2.2	1	100	13	0.6	0.002	0.4	101.0
26	3.9	1.8	1	100	22	1.0	0.002	0.4	101.5
27	3.5	1.6	1	100	28	1.3	0.001	0.3	101.6

28	3.7	1.1	1	100	34	1.6	0.002	0.4	102.0
29	3.6	1.4	1	100	19	0.9	0.002	0.4	101.3
30	4.5	2.2	1	100	11	0.5	0.002	0.5	101.1
31	3.6	2.7	1	100	17	0.8	0.002	0.5	101.3
32	3.3	3.3	1	100	22	1.0	0.001	0.3	101.3
33	5.4	2.8	1	100	11	0.5	0.002	0.5	101.1
34	3.5	2.9	1	100	24	1.1	0.001	0.3	101.4
35	6.0	2.3	1	100	18	0.8	0.005	1.1	102.0
36	8.4	3.6	1	100	13	0.6	0.007	1.7	102.3
37	7.2	2.7	1	100	13	0.6	0.006	1.5	102.1
38	11.7	3.0	1	100	10	0.5	0.013	3.2	103.7
39	7.8	2.6	1	100	25	1.2	0.006	1.5	102.7
40	7.0	2.6	1	100	31	1.5	0.005	1.2	102.6
41	6.6	2.9	1	100	21	1.0	0.004	0.9	101.9
42	7.5	3.0	1	100	22	1.0	0.005	1.3	102.3
43	6.1	2.4	1	100	21	1.0	0.003	0.8	101.8
44	7.0	2.6	1	100	25	1.2	0.006	1.4	102.6
45	4.4	1.4	1	100	24	1.1	0.002	0.4	101.6
46	2.8	1.1	1	100	49	2.3	0.001	0.2	102.5
47	2.4	0.9	1	100	27	1.3	0.001	0.2	101.4
48	2.5	1.1	1	100	33	1.5	0.001	0.2	101.8
49	2.6	1.2	1	100	31	1.5	0.001	0.2	101.7
50	8.2	2.6	1	100	36	1.7	0.006	1.5	103.2
51	8.4	4.7	1	100	20	0.9	0.008	1.8	102.8
52	8.2	4.5	1	100	12	0.6	0.007	1.7	102.2
53	8.6	4.3	1	100	11	0.5	0.009	2.1	102.7
54	8.3	4.2	1	100	11	0.5	0.009	2.1	102.6
55	12.5	4.6	1	100	9	0.4	0.017	4.0	104.4
56	9.4	4.4	1	100	7	0.3	0.012	2.8	103.1
57	10.0	4.3	1	100	9	0.4	0.009	2.3	102.7
58	7.3	3.5	1	100	12	0.6	0.006	1.3	101.9
59	7.9	3.0	1	100	12	0.6	0.006	1.5	102.0
60	7.3	2.8	1	100	11	0.5	0.005	1.2	101.8

61	4.7	1.6	1	100	26	1.2	0.002	0.5	101.8
62	4.4	2.0	1	100	39	1.8	0.002	0.5	102.3
63	6.9	2.5	1	100	19	0.9	0.004	1.0	101.9
64	6.5	2.8	1	100	29	1.4	0.004	0.9	102.3
65	6.1	2.4	1	100	24	1.1	0.004	0.9	102.0
66	5.6	2.3	1	100	26	1.2	0.003	0.7	102.0
67	8.1	2.3	1	100	12	0.6	0.007	1.6	102.1
68	4.9	1.8	1	100	16	0.7	0.003	0.7	101.5
69	4.0	1.7	1	100	30	1.4	0.002	0.4	101.8
70	4.7	1.9	1	100	24	1.1	0.002	0.5	101.7
71	4.7	1.9	1	100	31	1.5	0.002	0.5	102.0
72	3.8	1.7	1	100	33	1.5	0.001	0.3	101.9
73	7.0	3.2	1	100	17	0.8	0.005	1.1	101.9
74	4.5	2.8	1	100	42	2.0	0.002	0.4	102.4
75	4.5	2.3	1	100	36	1.7	0.002	0.4	102.1
76	5.4	2.6	1	100	36	1.7	0.003	0.7	102.4
77	5.6	2.3	1	100	24	1.1	0.003	0.8	101.9
78	2.4	1.0	1	100	30	1.4	0.001	0.2	101.6
79	6.1	2.4	1	100	25	1.2	0.004	0.9	102.0
80	10.1	2.7	1	100	16	0.7	0.009	2.0	102.8
81	3.5	1.6	1	100	14	0.7	0.001	0.3	100.9
82	3.8	1.6	1	100	36	1.7	0.001	0.3	102.0
83	3.3	1.6	1	100	43	2.0	0.001	0.2	102.2
84	4.6	1.9	1	100	22	1.0	0.002	0.5	101.5
85	4.1	2.0	1	100	23	1.1	0.002	0.4	101.4
86	3.5	1.2	1	100	16	0.7	0.001	0.3	101.0
87	3.8	1.4	1	100	18	0.8	0.001	0.3	101.2
88	3.5	1.4	1	100	21	1.0	0.001	0.3	101.2
89	3.6	1.5	1	100	31	1.5	0.001	0.3	101.7
90	3.1	1.2	1	100	27	1.3	0.001	0.2	101.5

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Negotiation research spans many disciplines (Thompson 1990).

This result was later contradicted by Becker and Seligman (1996).

This effect has been widely studied (Abbott 1991; Barakat et al. 1995a, b; Kelso and Smith 1998; Medvec et al. 1999, 2000).

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Book chapter

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Online document

Cartwright J (2007) Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1. Accessed 26 June 2007

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