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Original Paper

Flora of Ceará, Brazil: Heliotropiaceae

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Abstract

The taxonomic floristic survey of the Heliotropiaceae species in Ceará state is part of the "Flora of Ceará: knowing to conserve" project. The study was based on specimens deposited in national and international herbaria, relevant bibliography, images of type specimens, and field trips. Fourteen species belonging to three genera were recorded: *Euploca* (six spp.) was the most representative in number of species, followed by *Heliotropium* and *Myriopus* (four spp. each). *Euploca paradoxa* is endemic to Brazil, being a new occurrence for Ceará. Most species occur in Conservation Units, except for *Euploca humilis*, *E. paradoxa*, *Heliotropium angiospermum*, and *H. funkiae.* The species occur predominantly in dry habitats, such as Stepic Savanna (*Caatinga*), however some species have been recorded in more humid areas, such as Ombrophilous Forest and coastal vegetation.

Key words: Boraginales, floristic, Northeastern region, taxonomy.

Resumo

O objetivo deste estudo foi realizar o levantamento florístico-taxonômico das espécies de Heliotropiaceae no estado do Ceará como parte do projeto "Flora do Ceará: conhecer para conservar". O estudo foi baseado em comparações de caracteres morfológicos de espécimes depositados em herbários nacionais e estrangeiros, bibliografia especializada, fotos de espécimes-tipos, expedições de campo incluindo coletas e observações. No estado do Ceará, 14 espécies pertencentes a três gêneros foram registradas: *Euploca* (seis spp.) foi o mais representativo em número de espécies, seguido por *Heliotropium* e *Myriopus* (quatro spp. cada). *Euploca paradoxa* é endêmica no Brasil e constitui uma nova ocorrência para o Ceará. A maioria das espécies ocorre em Unidades de Conservação, com exceção de *Euploca humilis*, *E. paradoxa*, *Heliotropium angiospermum* e *H. funkiae*. As espécies ocorrem predominantemente em ambientes mais secos como a Savana Estépica (Caatinga), embora várias tenham sido registradas em áreas mais úmidas, como Floresta Ombrófila e vegetação costeira.

Palavras-chave: Boraginales, florística, região Nordeste, taxonomia.

Introduction

Heliotropiaceae was segregated from Boraginaceae *s.l.* (BWG 2016) and comprises approximately 450 species belonging to four genera, *Euploca* Nuttall, *Heliotropium* L., *Myriopus* Small, and the monotypic *Ixorhea* Fenzl, endemic from Argentina (BWG 2016). This family is widely distributed, although it is mainly concentrated in tropical and subtropical regions (Diane *et al*. 2016). Representatives of Heliotropiaceae are herbs to trees with simple and alternate leaves; pentamerous flowers, bisexual,

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solitary or arranged in terminal or axillary inflorescences of the thyrsus or scorpioids type; gynoecium frequently with nectariferous disk at the base of the ovary; fleshy or dry fruit, usually with 4 (rare 1–2) seeds. The family synapomorphies encompass the presence of a terminal style with a conical stigmatic head and the ring-shaped basal stigma (BWG 2016).

For Brazil 46 species (11 of which are endemic) belonging to the genera *Euploca*, *Heliotropium* and *Myriopus* (Flora do Brasil 2020) have been recorded. In northeastern Brazil, Heliotropiaceae is well represented and studies have focused on taxonomic treatments (Melo & Lyra-Lemos 2008; Melo 2012; Vieira *et al*. 2013, 2015; Melo *et al*. 2018), phylogeny (Cano *et al*. 2014; Luebert *et al*. 2016), floristic lists (Melo *et al*. 2009; Freitas *et al*. 2008), and descriptions of new species (Melo & Semir 2006; Melo 2007a).

Despite previous efforts focused on Heliotropiaceae in Brazil, the representatives of this family in Ceará state are poorly studied, and the data regarding the family in the state is outdated. In this context, studies related to the "Flora of Ceará: knowing to conserve" project have shown how underestimated the floristic diversity of the state, particularly, due to new records (Capistrano & Loiola 2015; Tabosa *et al.* 2016) and new species descriptions (Loiola 2013; Sampaio *et al*. 2016, 2019; Souza *et al*. 2016; Ribeiro *et al*. 2017; Santos *et al*. 2020) occurring frequently.

The present the taxonomic floristic survey of Heliotropiaceae in Ceará state providing identification keys, descriptions, and illustrations to recognize the genera and species and update information regarding ecological attributes and vegetation types as well as their geographic distribution.

Material and Methods

Ceará state is located in the Northeast region of Brazil (Fig. 1). Its territorial extension is 148,886 km^2 and covers 184 municipalities, with approximately 93% of its territory located in the semiarid domain (IPECE 2016). The average annual temperature varies between 24 °C to 26 °C and the average annual rainfall between 600 and 1,500 mm, which defines its rainy and dry seasons (Santos *et al*. 2009). The predominant soils are neosoils and argisoils, which cover 36% and 25% of the state's area, respectively (IPECE 2016).

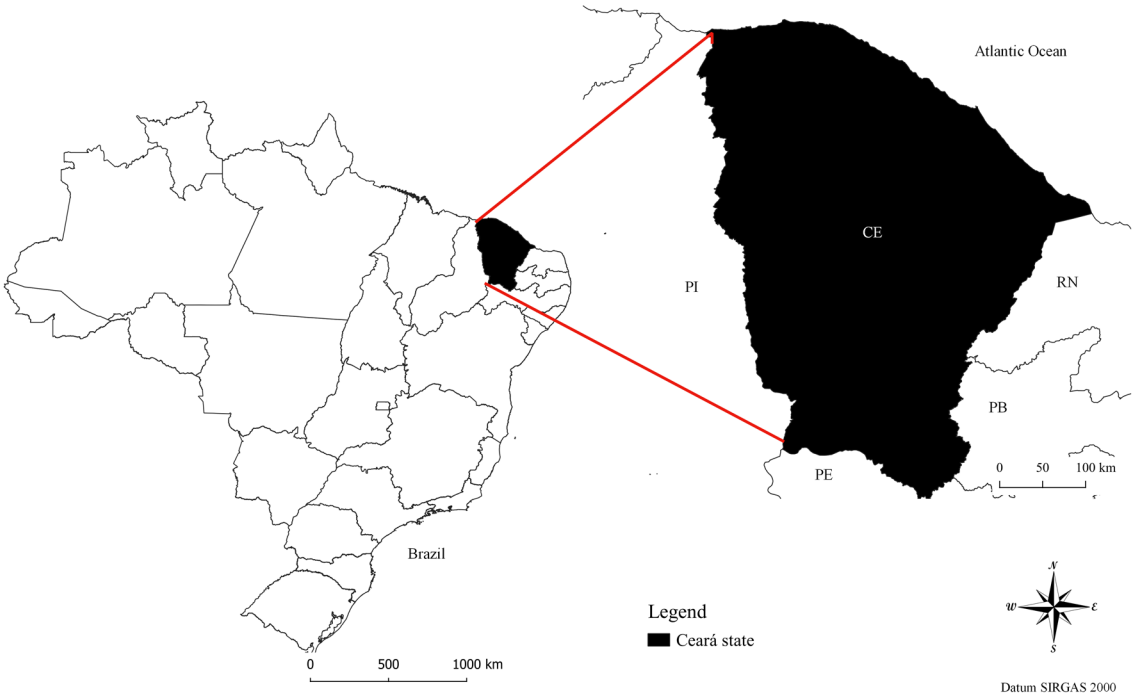

Figure 1 – Location of the state of Ceará, Brazil. PB= Paraíba state; PE= Pernambuco state; PI= Piauí state; RN= Rio Grande do Norte state.

The study was based on field samples collected from November/2017 to August/2018, as well as through observations of national (CEN, EAC, ESA, HCDAL, HST, HUEFS, HUFRN, HUVA, IPA, UEC) and international (K, MO) herbaria (acronyms according to Thiers, continuously updated). The collected material was herborized following the techniques described in Fidalgo & Bononi (1989) and deposited in the Caririense Dárdano de Andrade-Lima Herbarium (HCDAL) at the Regional University of Cariri (URCA). Duplicates were sent to the Prisco Bezerra Herbarium (EAC), at the Federal University of Ceará (UFC). When samples were insufficient, additional materials from other Brazilian states were used. In the absence of morphological structures in some materials, we use the term "not observed".

The genera and species were identified based on morphological features, through comparative analyses of exsiccates reviewed by specialists and photos of types and by consulting relevant bibliography (Fresenius 1857; Johnston 1927; Smith 1970; Guimarães *et al*. 1971; Miller & Nowicke 1990; Nagatani & Rossi 2000; Melo & França 2003; Melo & Sales 2004, 2005; Melo & Andrade 2007; Melo & Lyra-Lemos 2008; Melo 2007b; Cavalheiro *et al*. 2011; Ranga *et al*. 2012; Vieira *et al*. 2013; Melo & Sapf 2014; Melo 2015; Melo & Vieira 2017; Melo *et al*. 2018).

The morphological terminology followed Radford *et al.* (1974) and Harris & Harris (2001). The nomenclature for fruits followed Spjut (1994) and taxa names were based on International Plant Name Index (IPNI 2020). Data about habitat, habit, flowering and fruiting periods and popular names were obtained from exsiccate labels, relevant literature or field observations. The illustrative images of vegetative and reproductive structures were obtained from fresh or dry material with a photographic camera SAMSUNG model XT1672 coupled with a stereomicroscope ZEISS.

Species distribution was based on the model proposed by Rebouças *et al*. (2020) with the representatives of vegetation types registered at the 0.5° longitude × 0.5° latitude quadrants. When there were no geographic coordinates associated with the collection localities on exsiccate labels, we used the coordinates of the municipality from the geoLoc tool (CRIA 2019).

The vegetation was classified by local names and the corresponding terms were found in Figueiredo (1997) and the Brazilian Vegetation Technical Manual (IBGE 2012): Vegetation Complex of the Coastal Zone (comprises the Pioneer Psamophilous Vegetation, Forest behind the Dunes and Lowland Semideciduous Forest = Mata de Tabuleiro), Semideciduous Seasonal Forest (Mata Seca), Dense Ombrophilous Forest (Mata Úmida), Savanna (Cerrado), Arboreous Savanna (Cerradão), Stepic Savanna (Caatinga/ Carrasco), Arboreous Stepic Savanna (Caatinga Arbórea) and Vegetation under Fluvial and/ or Lacustrine Influence (Mata Ciliar).

Results and Discussion

Heliotropiaceae is represented in Ceará by three genera and fourteen species: *Euploca humilis* (L.) Feuillet, *Euploca lagoensis* (Warm.) Diane & Hilger, *Euploca paradoxa* (Mart.) J.I.M. Melo & Semir, *Euploca polyphylla* (Lehm.) J.I.M. Melo & Semir, *Euploca procumbens* (Mill.) Diane & Hilger, *Euploca salicoides* (Cham.) J.I.M. Melo & Semir, *Heliotropium angiospermum* Murray, *Heliotropium elongatum* (Lehm.) I.M. Johnst., *Heliotropium funkiae* Feuillet, *Heliotropium indicum* L., *Myriopus candidulus* (Miers) Feuillet, *Myriopus membranaceus* (A.DC.) J.I.M. Melo, *Myriopus rubicundus* (Salzm. *ex* DC.) Luebert, and *Myriopus salzmannii* (A.DC.) Diane & Hilger, corresponding to 39,47% and 12,72% of the species recorded in the Brazil and region Northeastern, respectively. Ceará state, present the third highest species richness in Northeast Brazil, following the states of Bahia (24) and Pernambuco (18) (Flora do Brasil 2020).

Heliotropiaceae species occur in the most varied types of vegetation: Vegetation Complex of the Coastal Zone, Semideciduous Seasonal Forest, Dense Ombrophilous Forest, Savanna, Arboreous Savanna, Stepic Savanna, Arboreous Stepic Savanna and Vegetation under Fluvial and/ or Lacustrine Influence. 71,42% (9) taxa were registered in Arboreous Stepic Savanna. Eight (57,14%) of the taxa occur in Conservation Units (UCs) in the state (Tab. 1). *Euploca paradoxa* is endemic to the Brazil and presented here as a new record to Ceará state (Tab. 1).

Regarding the analysis of the distribution of species in the Ceará state, *H. elongatum*, *E. procumbens*, *H. angiospermum*, *E. polyphylla* and *M. salzmannii* have wide distribution, followed by *M. rubicundus*, *M. candidulus*, *E. lagoensis*, *H. indicum* with median distribution and *E. paradoxa*, *E. humilis*, *M. membranaceus*, *E. salicoides* and *H. funkiae* with restricted distribution.

Table 1 – List of Heliotropiaceae species found in the state of Ceará with endemism to Brazil (EB), occurrence in UC, vegetation types and georeferenced squares.

Species	EB	Conservation Unit	Vegetation types	Georeferenced squares
Euploca humilis	No	-	Arboreous Stepic Savanna	F5, G4
Euploca lagoensis	No	Reserva Particular do Patrimônio Natural Serra das Almas e Refúgio de Vida Silvestre Pedra da Andorinha.	Arboreous Stepic Savanna, Stepic Savanna, Vegetation under Fluvial and/or Lacustrine Influence, Semideciduous Seasonal Forest	B3, B4, C4, D6, E3, F3, G5
Euploca paradoxa	Yes	-	Arboreous Stepic Savanna, Stepic Savanna and Vegetation Complex of the Coastal Zone	B5, E5, F3
Euploca polyphylla	No	Área de Proteção Ambiental Redonda, Parque Botânico do Ceará e Área de Proteção Ambiental Dunas da Lagoinha.	Savanna, Stepic Savanna, Dense Ombrophilous Forest and Vegetation Complex of the Coastal Zone, Vegetation under Fluvial and/ or Lacustrine Influence	A3, B2, B3, B4, B5 B6, C2, C6, D5, D6, D7
Euploca procumbens	No	Estação Ecológica de Aiuaba, Parque Botânico do Ceará, Reserva Particular do Patrimônio Natural Serra das Almas, Floresta Nacional do Araripe-Apodi e Refúgio de Vida Silvestre Pedra da Andorinha.	Dense Ombrophilous Forest, Vegetation Complex of the Coastal Zone, Arboreous Stepic Savanna, Semideciduous Seasonal Forest, Arboreous Savanna, Stepic Savanna and Vegetation under Fluvial and/ or Lacustrine Influence	B3, B5, B6, C2, C5, C6, D3, D5, D6, E5, E6, F3, G4, G5
Euploca salicoides	No	-	Dense Ombrophilous Forest	C2
Heliotropium angiospermum	No	-	Arboreous Stepic Savanna, Semideciduous Seasonal Forest, Stepic Savanna, Vegetation Complex of the Coastal Zone, Dense Ombrophilous Forest and Vegetation under Fluvial and/ or Lacustrine Influence	C4, B3, C3, C5, D4, D5, D7, E4, E5, E6, G4, H5
Heliotropium elongatum	No	Estação Ecológica de Aiuaba e Reserva Particular do Patrimônio Natural Serra das Almas.	Semideciduous Seasonal Forest, Arboreous Savanna, Stepic Savanna, Vegetation Complex of the Coastal Zone and Vegetation under Fluvial and/ or Lacustrine Influence	A4, B2, B3, B5, B6, C3, C5, C6, D3, D7, E3, E5, F3, F5, G4, G5, H5
Heliotropium funkiae	No	-	Semideciduous Seasonal Forest	C5
Heliotropium indicum	No	Estação Ecológica de Aiuaba.	Arboreous Stepic Savanna, Stepic Savanna and Vegetation Complex of the Coastal Zone	A3, C3, C6, D7, E3 G3
Myriopus candidulus	No	Área de Proteção Ambiental Redonda, Jardim Botânico de São Gonçalo do Amarante e Parque Botânico do Ceará.	Dense Ombrophilous Forest, Vegetation Complex of the Coastal Zone and Vegetation under Fluvial and/ or Lacustrine Influence	A3, B2, B5, B6, C6, D7
Myriopus membranaceus	-	-	Dense Ombrophilous Forest and Stepic Savanna	B2, B4

Species	EB	Conservation Unit	Vegetation types	Georeferenced squares
Myriopus rubicundus	No	Reserva Particular do Patrimônio Natural Serra das Almas.	Arboreous Stepic Savanna, Stepic Savanna, Vegetation Complex of the Coastal Zone and Vegetation under Fluvial and/ or Lacustrine Influence	B3, B6, C3, C4, C5, C6, D5
Myriopus salzmannii	No	Reserva Particular do Patrimônio Natural Serra das Almas.	Arboreous Stepic Savanna, Dense Ombrophilous Forest, Semideciduous Seasonal Forest and Vegetation Complex of the Coastal Zone	B6, C2, C3, C5, C6, D3, F3, G4, G5

Taxonomic treatment

Heliotropiaceae Schrad., Commentat. Soc. Regiae Sci. Gott. Recente. 4: 192. 1819.

Herbs, shrubs, subshrubs or liana, erect, scandent, prostrate or decumbent; with simple trichomes, unicellular and/or glandular. Leaves alternate, subopposite, petiolate or sessile; lamine with various shapes, generally margin entire, sometimes revolute; apex mostly acute or acuminate; base attenuate or acute; venation brochidodromous, hyphodromous or eucamptodromous. Inflorescences terminal or axillary, scorpioids cymes. Flowers bisexual, actinomorphic, pedicellate or sessile; calyx tube usually short, presenting lobes often unequal to each other; corolla gamopetalous, lobes with different shapes and sometimes with appendages (*E. paradoxa*); stamens sessile or subsessile adnate to corolla tube, filaments short, linear; anthers dorsifixed; ovary superior, syncarpous, bicarpellate, usually 4-loculate, with one ovule at each locus; style terminal with a conical stigmatic head, ring-shaped basal stigma and a sterile apex, sometimes with two lobes; nectariferous disk at the base of the ovary present or not. Fruit drupaceous or schizocarpic, dry or fleshy, dividing into 1–4 mericarpids, with 1–2 seeds each. Embryo, straight or curved.

Key to the genera of Heliotropiaceae registered in the state of Ceará

1. Subshrubs scandent; venation brochidodromous; flowers sessile .....3. *Myriopus*
1'. Herbs, shrubs or subshrubs not scandent; venation hyphodromous or eucamptodromous; flowers pedicellate, sessile or subsessile.
    2. Venation eucamptodromous; fruit with 2 nutlets .....2. *Heliotropium*
    2'. Venation hyphodromous; fruit with 4 nutlets.....1. *Euploca*

1. *Euploca* Nutt., Trans. Amer. Philos Soc. 5(6[3]): 189-190. 1837[1836].

Herbs or subshrubs, erect, prostrate or decumbent. Leaves alternate, subopposite, sometimes spiraled; petiolate; blade membranaceous, chartaceous or subchartaceous, pilose; venation hyphodromous. Inflorescences terminal or axillary, with or without bracts, solitary or in groups of 2–4, pedunculate, slightly to strongly scorpioid, or with solitary flowers, axillary or terminal. Flowers pedicellate, sessile or subsessile; calyx of various shapes; corolla white or purplish, sometimes yellow in the fauce portion, entirely yellow, lobes of various shapes, ovate, wavy, orbicular or rarely elliptical; stamens included, sessile or subsessile, anthers dorsifixed, ovate, glabrous to pubescent, with glandular trichomes only at apex; ovary 4-locular, glabrous; 1 ovule per locule; style absent or present, terminal; stigma 1; nectariferous disk at the base of ovary. Fruit schizocarpous, nutlets 4, with 1 seed each. Seeds with curved embryo.

The genus is represented by about 100 species distributed in the tropics and subtropics of the world, especially in arid and semi-arid regions (Melo *et al*. 2018). In Brazil, it comprises 17 species (Melo 2020; Melo & Semir 2010), seven of which found in Ceará state, occurring in the Arboreous Stepic Savanna, Stepic Savana

(Caatinga/Carrasco), Vegetation under Fluvial and/ or Lacustrine Influence, Dense Ombrophilous Forest, and Lowland Semideciduous Forest. Among the species found, *Euploca paradoxa* constitutes a new record for the state of Ceará.

Key to the *Euploca* species in the state of Ceará

1. Solitary flowers.
   2. Corolla white, yellow only in the fauce; lobes never alternate by appendages ..... 1.2. *Euploca lagoensis*
   2'. Corolla yellow; lobes alternate by appendages ..... 1.3. *Euploca paradoxa*
1'. Flowers arranged in inflorescences.
   3. Inflorescences without bracts; missing style ..... 1.5. *Euploca procumbens*
   3'. Inflorescences bracteate; style present.
      4. Inflorescence peduncle sericeous; fruit sericeous ..... 1.4. *Euploca polyphylla*
      4'. Inflorescence peduncle tomentose; fruit densely hirsute or puberulous.
         5. Bracts narrowly elliptic; fruit densely hirsute ..... 1.1. *Euploca humilis*
         5'. Bracts narrowly ovate-lanceolate; fruit puberulous ..... 1.6. *Euploca salicoides*

1.1. *Euploca humilis* (L.) Feuillet, Phytokeys 61: 107. 2016. Figs. 2a; 3a-f

Herbs or subshrubs ca. 50 cm tall, erect or prostrate. Branches cylindrical, grayish, sometimes sulcate, tomentose. Leaves alternate, petiolate; petiole 0.5–1 mm long, glabrous to villous; blade 0.5–1.5 × 0.2–0.4 cm, elliptic to oblanceolate, apex acute, margin entire to slightly revolute, base acute, adaxial surface scabrous, abaxial surface tomentose; venation hyphodromous. Inflorescences 1.8–14 cm long, bracteate, terminal and axillary; bracts 2–2.5 × 0.3–0.6 mm, narrowly elliptic, sericeous, margin ciliated; peduncle 1.5–2.3 cm long, tomentose. Flowers 3.5–6 mm long, white, subsessile; calyx ca. 3.5 mm long, deeply lobed, externally tomentose, internally glabrous, lobes 1.8–2.5 mm long, ovate-elliptic; corolla 3.5–4.5 mm long, tubular, white, faucal area yellow, externally sericeous, internally glabrous, tube 2–2.5 mm long, lobes 1–2.5 mm long, obovate, apex rounded; stamens subsessile, anthers 0.5–0.8 mm long, apex acute, base rounded; ovary ca. 0.6 mm long, glabrous; nectariferous disk present with ca. 0.4 mm long, style evident ca. 0.2 mm long; stigma 0.2–0.3 mm long. Schizocarpic ca. 1.2 mm long, globose, densely hirsute, nutlets costate; seed not observed.

Examined material: Farias Brito, CE-021, 16.II.1985, fl. and fr., *Al. Gentry et al.* (EAC 14645). Iguatu, rodovia entre Iguatu e Várzea Alegre, 29.III.1985, fl. and fr., *A. Fernandes & Matos* (EAC 13075).

Euploca humilis presents great morphological variability, especially regarding the habit, erect or prostrate, and the length and shape of the leaves, elliptic to oblancelate, with margin slightly to strongly revolute. This species is morphologically related to *E. salicoides* mainly because they share stigma evident but differs by bracts narrowly elliptic (*vs*. ovate-lanceolate) and by the fruit densely hirsute (*vs*. puberulent). It occurs in Mexico, Antilles, Guyana and Venezuela (Melo & Semir 2010). In Brazil, it was recorded in the North (PA), Northeast (BA, CE, PB, PE, PI, RN and SE), Central-West (GO) and Southeast regions (MG) (BFG 2018; Melo 2020a.). In Ceará state, occurs in two municipalities, Farias Brito and Iguatu, in the Arboreous Stepic Savanna (Fig. 4F5 and G4), at altitudes between 217–337 m. The taxon was not registered in conservation units. Collected with flowers and fruits in February and March. Popular names no recorded.

1.2. *Euploca lagoensis* (Warm.) Diane & Hilger, Bot. Jahrb. Syst. 125(1): 48. 2003.

Figs. 2b; 3g-l

Herbs ca. 15 cm tall, prostrate. Branches green, glabrous, rarely pubescent. Leaves alternate, petiolate; petiole 0.7–1 mm long, subcylindrical, pubescent; blade 0.3–1 × 0.1–0.3 cm, membranaceous, narrowly elliptic, apex acute to acuminate, margin entire, sometimes ciliated, base attenuate, adaxial and abaxial surfaces puberulous; venation hyphodromous. Flowers 3.3–8 mm long, yellow, solitary, supra-axillary; peduncle ca. 0.3 mm long; calyx ca. 4.5 mm long externally densely pubescent, internally pubescent,

Figure 2 – a-m. Species of Heliotropiaceae – a. *Euploca humilis*; b. *Euploca lagoensis*; c. *Euploca paradoxa*; d. *Euploca polyphyla*; e. *Euploca procumbens*; f. *Euploca salicoides*; g. *Heliotropium angiospermum*; h. *Heliotropium elongatum*; i. *Heliotropium indicum*; j-k. *Myriopus candidulus*; l. *Myriopus rubicundus*; m. *Heliotropium funkiae*. (Photographs: a. *M. Oliveira*; b. *R. Queiroz*; c. *D.D. Vieira*; d-e. *K.S. Pereira*; f. *H.J.C Moreira*; g-h. *K.S. Pereira*; i. *J.I.M. Melo*; j. *V.S. Sampaio*; k. *L. Jales*; l *H. Redies* and m. *E.D. Lozano*).

lobes 2–2.6 mm long, lanceolate, equals; corolla 2.5–3.8 mm long, white, yellow in the fauce, tubular, externally and internally pubescent, tube 2–2.8 mm long, lobes 0.8–2 × 0.6–1.2 mm long, elliptic, rounded apex. Stamens sessile, anthers ca. 0.8 mm long, ovate. Ovary ca. 0.4 mm, long, pyriform, glabrous; style ca. 0.5 mm long, stigma ca. 0.3 mm long, conical-triangular, thickened basal disk. Schizocarp ca. 2 mm long, slightly puberulous, sulcate, pyriform, rostrate; nutlets with ca. 1.2 mm long, glabrous; seeds 4, ca. 1.5 mm long. **Selected material**: Aiuaba, Serra da Gameleira, 21.III.1991, fl., *A. Fernandes* (HST 60465). Barro, Açude na comunidade de queimados, 4.IX.2018, fl., *F.L. Lima 1239* (HUEFS). Crateús, Centro Ecológico Reserva Natural Serra das Almas, 05°80'50''S, 40°52'04''W, 10.I.2017, fl. and fr., *H.M. Meneses 14* (EAC). Itapajé, Serrote do meio, Reserva Mãe-da-lua, 26.X.2018, fl., *H. Redies 65* (EAC). Morada Nova, 21.IV.1997, fl., *A.S.F. Castro* (EAC 24899, HST 12067). Sobral, Reserva de Vida Silvestre Pedra da Andorinha, 04°04'05''S, 40°00'23''W, 10.V.2018, fl., *E.B. Souza et al. 5254* (HUVA). Santa Quitéria, Sabonete, 04°36'34.88''S, 39°53'47.58''W, 28.IV.2012, fr., *J.P. Souza 11103* (EAC, ESA).

Euploca lagoensis is mainly characterized by presenting branches glabrous or rarely pubescent with supra-axillary flowers, lobes lanceolate, ovary pyriform, and glabrous nutlets. It is distributed from Mexico, including the Antilles (Melo & Semir 2010). In Brazil, in North (AM), Northeast (CE, PB and PI), Central-West (GO and MS) and Southeast regions (MG and SP) (BFG 2018; Melo 2020a). In Ceará state, it was recorded in seven municipalities, in the Arboreous Stepic Savanna, Stepic Savanna, Vegetation under Fluvial and/or Lacustrine Influence, and Semideciduous Seasonal Forest (Fig. 4-B3, B4, C4, D6, E3, F3 and G5), at altitudes between 52–466 m. It was recorded in two Conservation Units (UC) of Ceará: Reserva Particular do Patrimônio Natural Serra das Almas and Refúgio de Vida Silvestre Pedra da Andorinha. Collected with flowers in January, March, April, May and September and fruits in January and April. Popular names no recorded.

1.3. *Euploca paradoxa* (Mart.) J.I.M. Melo & Semir, Kew Bull. 64(2): 289. 2009.

Figs. 2c; 3m-r

Herbs prostrate. Branches cylindrical, green, slightly to deeply sulcate, sericeous. Leaves alternate, petiolate; petiole 0.7–2.2 mm long, cylindrical the slightly sulcate; blade 0.3–2.5 × 0.2–0.5 cm, chartaceous, lanceolate, apex acute, margin entire, ciliate, base attenuate; adaxial and abaxial surfaces puberulous to villous; venation hyphodromous; bracts 3–3.5 × 1–2.5 mm lanceolate, externally and internally villous; peduncle 3–7.5 mm long, sulcate in the abaxial part. Flowers 3–8 mm long, solitary, axillary and terminal; calyx 2–3.1 mm long, green, persistent, lobate, externally villous, internally glabrous, lobes 0.6–3 mm long, apex acute, margin ciliate; corolla 1.8–3.5 mm long, entirely yellow, campanulate, externally slightly pubescent only in the region lobes, internally glabrous, tube 1.8–3.2 mm long, lobes 1.6–2.3 × 0.7–1.2 mm, undulate, orbicular, sulcate, alternated by appendices ca. 1.3 mm long, involute, falcate, lanceolate, apex rounded. Stamens subsessile, anthers ca. 1.2 mm long, ovoid, apex slightly pubescent, base cordate; ovary ca. 0.4 mm long, depressed-globose, glabrous; style ca. 1.3 mm long; stigma ca. 0.5 mm long, conical, thickened basal disk. Schizocarp 1.3–2 mm long, rostrate; nutlets with ca. 1.3 mm long, costate; seeds ca. 0.8 mm long, elliptic.

Examined material: Aiuaba, Serra da Gameleira, 21.III.1991, fl. and fr., *M.A. Figueiredo et al. 26* (EAC). Caucaia, Tabuleiro Grande, 21.XI.2004, fl., *A.S.F. Castro 1545* (EAC). Jaguaretama, assentamento Luiz Ferreira, 9.I.2011, fl., *A.S.F. Castro 2427* (EAC).

Euploca paradoxa can be easily differentiated from the other species of the genus as it presents corolla yellow with alternated lobes by appendages and stigma thickened at the base. Endemic to Brazil, with records in the Northeast (BA, CE, PB, PE and PI), Central-West (GO and MT) and Southeast regions (PR) (BFG 2018; Melo 2020a), being recorded for the first time in the state of Ceará. *Euploca paradoxa* has been recorded in of municipalities Aiuaba, Caucaia, and Jaguaretama in areas of Arboreous Stepic Savanna, Stepic Savanna and Vegetation Complex of the Coastal Zone (Fig. 4B5, E5 and F3), at altitudes between 29–466 m. The taxon was not registered in any conservation unit in the state. Collected with flowers in January, March and November and fruits in March. Popular names no recorded.

1.4. *Euploca polyphylla* (Lehm.) J.I.M. Melo & Semir, Kew Bull. 64(2): 289. 2009.

Figs. 2d; 3s-x

Herbs or subshrubs 20–30 cm tall, prostrate or decumbent. Branches cylindrical, green, sericeous. Leaves alternate or subopposite, petiolate; petiole 0.4–1.4 mm long; blade 0.4–1.3 × 0.1–0.3 cm, chartaceous, lanceolate or oblanceolate, apex acute, margin entire, base cuneate, adaxial and

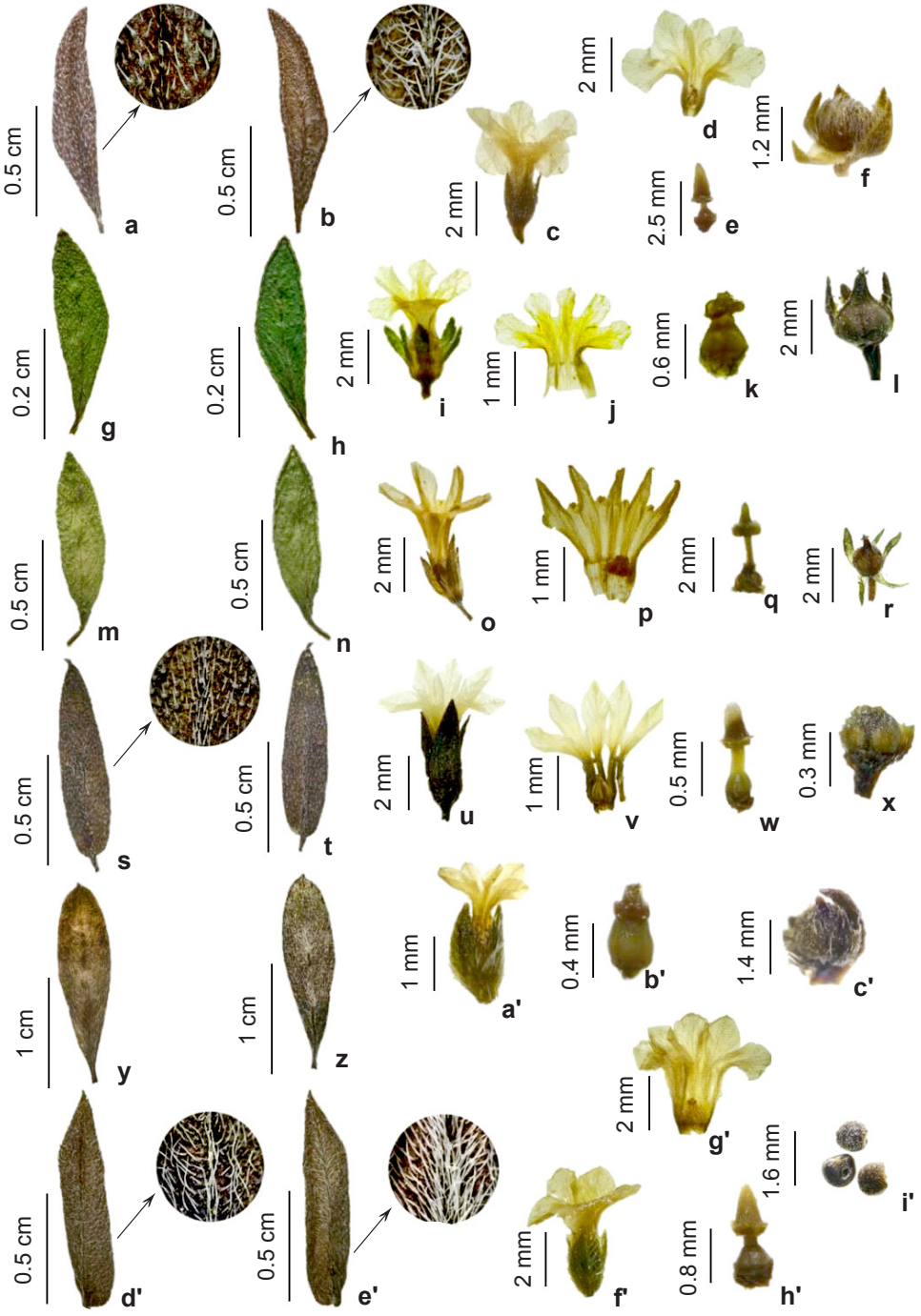

Figure 3 – a-i'. *Euploca* species recorded in Ceará state – a-f. *Euploca humilis* – a. leaf (adaxial surface with detail showing the trichomes); b. leaf (abaxial surface with detail showing the trichomes); c. flower; d. corolla in longitudinal section; e. gynoecium; f. fruit; g-l. *Euploca lagoensis* – g. leaf (adaxial surface); h. leaf (abaxial surface); i. flower; j. corolla in longitudinal section; k. gynoecium; l. fruit; m-r. *Euploca paradoxa* – m. leaf (adaxial surface); n. leaf (abaxial surface); o. flower; p. corolla in longitudinal section; q. gynoecium; r. fruit; s-x. *Euploca polyphylla* – s. leaf (adaxial surface); t. leaf (abaxial surface with detail showing the trichomes); u. flower; v. corolla in longitudinal section; w. gynoecium; x. fruit; y-c'. *Euploca procumbens* – y. leaf (adaxial surface); z. leaf (abaxial surface); a'. flower; b'. gynoecium; c'. fruit; d'-i'. *Euploca salicoides* – d'. leaf (adaxial surface); e'. leaf (abaxial surface); f'. flower; g'. corolla in longitudinal section; h'. gynoecium; i'. nutlets. (a-f. *Fernandes* (EAC 13075); g-l. *Meneses 14*; m-r. *Matos et al.* (EAC 5171); s-x. *Pereira 25*; y-c'. *Pereira 19*; d'-i'. *Souza et al. 3529*).

abaxial surfaces densely sericeous; venation hyphodromous. Inflorescences 2.5–7 cm long, scorpioid, bracteate, solitary, terminal, bracts 1.5–3 × 1–1.2 mm, chartaceous, ovate, narrowly elliptic, externally sericeous, internally glabrous; peduncle 0.2–0.5 mm long, sericeous. Flowers 5–6.5 mm long, yellow, sometimes white, pedicellate; calyx 3–3.7 mm long, green, deeply lobed, covering the entire corolla tube, externally and internally sericeous, lobes 2.5–3.7 mm long, unequal, apex acute; corolla 4–6 mm long, yellow to white, faucal area yellow, compressed at the top of the tube, externally sericeous, internally glabrous, tube 1.8–2.7 mm long, lobes 2–2.3 × 1–1.6 mm, ovate-deltoids. Stamens subsessile, anthers ca. 1 mm, ovoid, apex acute, base truncate; ovary ca. 0.6 mm long, subglobose, glabrous; style ca. 0.3 mm long; stigma ca. 0.5 mm long, conical, apex slightly pubescent. Schizocarp ca. 1.5 mm diam., subglobose, calyx append; nutlets sericeous; seeds ca. 1 mm long, trigone.

Examined material: Aquiraz, Praia do Muritipicu, Porto das Dunas, 12.VII.2002, fl., *A.S.F. Castro* (EAC 32256). Aracati, 11.VII.1964, fl., *F.J.A. Matos et al.* (EAC 5382). Bela Cruz, distrito Pedro Passos, 03°02'17"S, 40°07'20"W, 7.IX.2013, fl., *M.I.B. Loiola et al.* 2099 (EAC). Carnaubal, saída de Carnaubal p/ campo Maior, 16.VI.1979, fl. and fr., *A. Fernandes et al.* (EAC 6582, HST 12073). Caucaia, Parque Botânico do Ceará, 03°42'31"S, 38°38'32"W, 10.VIII.2018, fl., *K.S. Pereira 25* (EAC). Fortaleza, Pecém, 16.I.2008, fl., *A.M. Miranda 5643* (EAC). Icapuí, Apa de Redonda, 8.IX.2000, fl., *R.S. Oliveira 5* (EAC). Itapipoca, Sítio Bode, 18.II.2016, fl., *N.M.S. Ferreira 1* (EAC). Jericoacoara, Lagoa do Meio, 5.II.2000, fl., *L.Q. Matias 262* (EAC). Morada Nova, Fazenda Serraria, 25.IV.1997, fl., *M.A. Figueiredo et al. 735* (EAC). Paraipaba, APA Dunas de Lagoinha, 28.II.2004, fl. and fr., *Djane 11* (EAC). Quixadá, Fazenda Não Me Deixes, 13.VII.2005, fl., *F.S. Cavacante & E. Silveira 964* (EAC). Russas, 24.V.1941, fl., *P. Bezerra 218* (EAC). São Gonçalo do Amarante, dunas do Pecém, beira de estrada, 13.VI.2004, fl. and fr., *A.V. Vieira* (EAC 34222). Senador Sá, estrada para Uruoca, 03°19'31"S, 40°29'57"W, 18.VII.2014, fl., *M.I.B. Loiola et al. 2382* (EAC). Trairi, próximo à estrada para Fleixeiras, 23.V.1999, fl., *L.Q Matias et al. 165*. (EAC). Viçosa, Sítio Engenho Velho, 03°32'36"S, 41°23'26"W, 29.IV.2010, fl., *E.B. Souza et al. 835* (EAC).

Euploca polyphylla is easily recognized by the habit, prostrate or decumbent, calyx 3–3.7 mm long., deeply lobed, covering the entire corolla tube, corolla with lobes ovate-deltoids and by the evident style. It occurs in Venezuela (Melo & Semir 2010) and Brazil, in the North (PA), Northeast (AL, BA, CE, MA, PB, PE, PI, RN and SE) and Southeast regions (RJ) (Melo 2020a). In Ceará state, it has wide distribution and occurs in 17 municipalities. It was recorded in the Savanna, Stepic Savanna, Dense Ombrophilous Forest and Vegetation Complex of the Coastal Zone, Vegetation under Fluvial and/ or Lacustrine Influence (Fig. 4A3, B2, B3, B4, B5 B6, C2, C6, D5, D6 and D7), at altitudes between 9–717 m. It is present in three Conservation Units (UC) of Ceará: It is present in three Conservation Units (UC) of Ceará: Área de Proteção Ambiental Redonda, Parque Botânico do Ceará and Área de Proteção Ambiental Dunas da Lagoinha. Collected with flowers in January, February, April, May, June, July, August, and September and fruits in February and June. Popular names: Grinalda de noiva, crista de galo, sete sangrias, erva mijona, vassourinha branca and fedegoso miudo.

1.5. *Euploca procumbens* (Mill.) Diane & Hilger, Bot. Jahrb. Syst. 125(1): 48. 2003.

Figs. 2e; 3y-c'

Herbs or subshrubs 30–60 cm tall, prostrate or erect. Branches green cinereous, tomentose. Leaves alternate, petiolate; petiole 0.3–1 cm long, slightly sulcate; blade 1–2.5 × 0.6–4 cm, obovate to elliptic, apex mucronate, margin entire, base attenuate, adaxial and abaxial surfaces sericeous to tomentose; venation hyphodromous. Inflorescences 1–7 cm long, ebracteate, terminal and axillary, peduncle 0.4–1.7 cm long, sulcate, densely tomentose. Flowers 1.2–2.5 mm long, white, slightly yellow in the inner part of the corolla, subsessil; calyx 0.8–2 mm long, green, deeply lobed, externally and internally pubescent, lobes 0.3–0.5 × 0.2–0.3 mm, ovate to lanceolate, unequal to each other, 4 equal and one longer with 1.6–0.5 mm long; corolla 1.5–2.3 mm long, white, yellow, tubular-salverform, externally pubescent, internally glabrous, tube 0.8–1.8 mm long, equal to or slightly shorter than the calyx, lobes 0.3–0.7 × 0.2–0.5 mm, ovate to lanceolate, apex obtuse. Stamens subsessile, anthers ca. 0.4 mm long, free between each other, apex acute, base rounded; ovary ca. 0.4 mm long, globose, glabrous; style absent; stigma ca. 0.4 mm long, conical, surface pubescent, thickened basal disk. Schizocarp 1.3–2.2 mm long, sericeous, subglobose; nutlets sericeous; seeds ca. 1.5 mm long.

Selected examined material: Aiuaba, Estação Ecológica de Aiuaba, 06°37'37"S, 40°81'52"W, 19.IV.2018, fl. and fr., *K.S. Pereira 19* (HCDAL). Caridade, Fazenda Feijão, 8.II.1991, fl. and fr., *L.C. Coelho* (EAC 18714). Caucaia,

Parque Botânico do Ceará, 03°42'29.3"S, 38°38'27"W, 10.08.2018, fl. and fr., *K.S. Pereira* 26 (HCDAL). Crateús, Centro Ecológico, Reserva Natura Serra das Almas, 05°08'49" S, 40°52'02"W, 10.I.2017, fl. and fr., *H.M. Meneses 08* (EAC). Crato, Floresta Nacional do Araripe, 23.V.1999, fl., *A.M. Miranda 3375* (HUEFS). Fortaleza, Rio Siqueira, Canidezinho, 12.VII.2001, fl. and fr., *S. César* (EAC 30976). Guaiúba, 1.VII.2004, fl. and fr., *M.G.V. Silva* (EAC 33106). Ipaumirim, Fazenda Bananeiras, 17.II.1958, fr., *P. Bezerra & J.G. Oliveira* (EAC 1793). Jaguaribe, Fazenda Mulungú, 10.VI.1943, fr., *P. Bezerra* (EAC 628). Missão Velha, 12.XI.2005, fl. and fr., *M.A.P. Silva 1975* (EAC). Morada Nova, Fazenda Serraria, 25.IV.1997, fl. and fr., *M.A. Figueiredo* (EAC 25364). Nova Olinda, Geosítio Pedra Cariri, 07°09'17"S, 39°68'06"W, 27.III.2018, fr., *K.S. Pereira 11* (HCDAL). Parambu, Fazenda Pau Preto, 23.IV.1982, fl. and fr., *E. Nunes* (EAC 11497). Pentecoste, Fazenda Vale do Curu, 03°49'14"S, 39°19'95"W, 6.X.2011, fl. and fr., *M.I.B. Loiola 1423* (EAC). Quixadá, Fazenda Não Me Deixes, 29.III.2001, fl. and fr., *R.C. Costa et al.* (EAC 32047). Santana do Cariri, Sítio Buriti, 30.12.1981, fl., *O.L. Peixoto 1645* (UEC). Senador Pompeu, margens do Rio Banabuiu, 21.I.1995, fl. and fr., *E.B. Souza* (EAC 21898). Sobral, Refúgio de Vida Silvestre Pedra da Andorinha, 04°03'32"S, 39°59'35"W, 8.XI.2017, fl. and fr., *E.B. Souza 4825* (HUVA). Tauá, 16.XII.1978, fl. and fr., *P. Bezerra & Matos* (EAC 5119).

Euploca procumbens can be distinguished by its branches green to cinereous, inflorescences without bracts, corolla 1.5–2.3 mm long, tube equal or slightly shorter than the calyx and missing stylus. It extends from the South United States to Argentina, including the Antilles (Melo & Semir 2010). It is distributed throughout Brazil, in the North (AC, PA, RO and RR), Northeast (AL, BA, CE, MA, PB, PE, PI, RN and SE), Central-West (GO, MT and MS), Southeast (MG and SP) and South regions (RS and SC) (Melo 2020a). In Ceará state, it has wide distribution and occurs in 20 municipalities. It was recorded in the Dense Ombrophilous Forest, Vegetation Complex of the Coastal Zone, Arboreous Stepic Savanna, Semideciduous Seasonal Forest, Arboreous Savanna, Stepic Savanna and Vegetation under Fluvial and/or Lacustrine Influence (Fig. 4B3, B5, B6, C2, C5, C6, D3, D5, D6, E5, E6, F3, G4 and G5), at altitudes between 21–847 m. It was recorded in five Conservation Units (UC) of Ceará: Estação Ecológica de Aiuaba, Parque Botânico do Ceará, Reserva Particular do Patrimônio Natural Serra das Almas, Floresta Nacional do Araripe-Apodi and Refúgio de Vida Silvestre Pedra da Andorinha. Collected with flowers and fruits practically all year. Popular name: falsa crista de galo.

1.6. *Euploca salicoides* (Cham.) J.I.M. Melo & Semir, Kew Bull. 64(2): 289. 2009.

Figs. 2f; 3d'-i'

Subshrub 20–30 cm tall, cespitose. Branches cylindrical, green, strigose with whitish trichomes of rust-based base. Leaves alternate, spiraled, petiolate or subsessile; petiole 1.5–5.4 mm long, cylindrical, sericeous; blade 0.5–1.5 × 0.2–0.6 cm, subchartaceous, discolor, elliptical, ovate-lanceolate, apex acute, margin slightly to strongly revolute, ciliate, base rounded, adaxial surface hirsute, abaxial surface strigose; venation hyphodromous. Inflorescences 1.5–23 cm long, scorpioid, bracteate, solitary, terminal; bracts subchartaceous, ovate-lanceolate, slightly to strongly revolute, externally and internally hirsute, peduncle 1.8–2.8 mm long, tomentose. Flowers 2.5–4 mm long, yellow, pedicellate or sessile; calyx 2.3–3.3 mm long, lobed, externally villous, internally glabrous, lobes 2–2.8 mm long; apex elliptical; corolla 2–5 mm long, yellow, externally pubescent only in the lobes region, internally glabrous, tube 1–1.7 mm long, lobes 1.2–2.2 × 1.2–2.4 mm, suborbicular, apex mucronulate; stamens subsessile, anthers ca. 0.8 mm long, ovate, apex acute, base cordate. Ovary ca. 0.7 mm long, subglobose, glabrous, nectariferous disk present, ca. 0.2 mm long, style evident ca. 1.2 mm long; stigma ca. 0.8 mm long, conical, thickened basal disk. Schizocarp ca. 2 mm long, globose, sulcate, puberulent; nutlets 0.8–1.5 mm long, trigone, puberulent; seeds ca. 1.3 mm long, ellipsoids.

Examined material: São Benedito, Inhuçu, 24.VII.1971, fl., *A. Fernandes* (EAC 2293).

Additional material: BRAZIL. RIO GRANDE DO NORTE: Apodi, Sítio Barra, 05°34'35"S, 37°34'23"W, 26.V.2015, fl. and fr., *E.B. Souza et al. 3529* (EAC).

Euploca salicoides is easily recognized by having branches strigose with whitish trichomes of its rust-based base. The leaves alternate, spiraled, petiolate or subsessile, corolla tubular, yellow, presenting suborbicular lobes and mucronate apex, and puberulent fruit. It's distributed in the eastern portion of Bolivia, Northeast Argentina, Paraguay and Brazil (Melo & Semir 2010). In Brazil it was recorded in the Northeast (BA, CE, PE and PI), Central-West (GO, MT and MS), Southeast (MG and SP) and South regions (PR and RS) (BFG 2018; Melo 2020a). In Ceará state, it was recorded only in the municipality of São Benedito, in Dense Ombrophilous Forest (Fig. 4C2), at altitude up to 901 m. The taxon was not registered in any conservation unit in the state. Collected with flowers in June and July and fruits in June. Popular names no recorded.

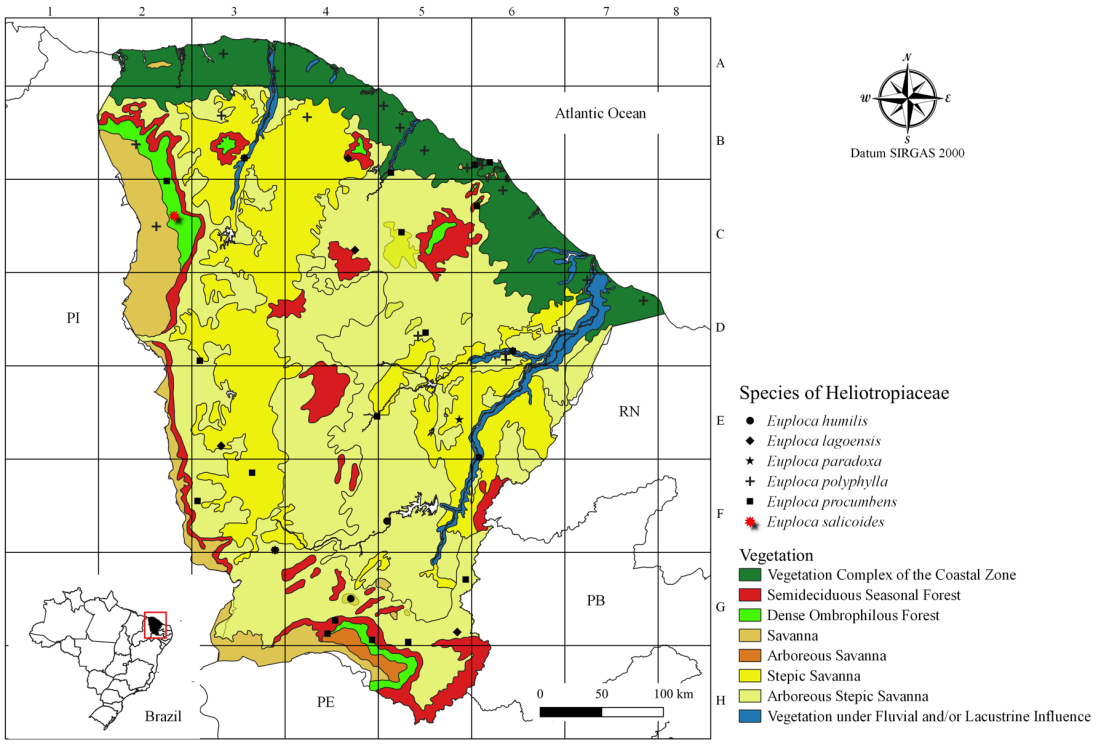

Figure 4 – Distribution and vegetation types associated with *Euploca* species in the state of Ceará, Brazil.

2. *Heliotropium* L., Sp. Pl. 1: 130. 1753.

Herbs, shrubs or subshrubs, erect. Leaves alternate, subopposite, rarely opposite, petiolate; venation eucamptodromous. Inflorescences scorpioid, congest, terminal, falsely terminal and/or axillary. Flowers sessile; calyx persistent or not; externally hirsute, strigose, internally glabrous, corolla white or purplish with faucal area yellowish or parts completely yellowish, tubular or obcampanulate, externally hirsute, hispid, strigose, internally glabrous; lobes presenting varied shapes, undulate, orbicular. Stamens sessile or subsessile, free between each other. Ovary subglobose, glabrous, 2 locular, sometimes falsely 4 locular due to the formation of a septum; ovule 1–2 por locule; style terminal; stigma of different shapes, sessile or not. Schizocarp or drupe, 2 nutlets with 2 seeds. Seeds elliptic or trigone.

Heliotropium includes about 300 species distributed in tropical and subtropical regions across the globe, mainly in open and semi-arid habitats (Frohlich 1981). In Brazil, nine species have been recorded (Melo 2020b; Melo & Semir 2010), four of them in the Ceará state, registered predominantly in Stepic Savanna (Caatinga/Carrasco) and Semideciduous Seasonal Forest, but have also been recorded with little frequency in Lowland Semideciduous Forest, Vegetation under Fluvial and/or Lacustrine Influence, and Ombrophilous Forest.

Key to the *Heliotropium* species in the state of Ceará

1. Branches never fistulous; blade elliptic to ovate, margin entire; peduncle pubescent; stigma umbraculiform.
   2. Adaxial surface strigose, abaxial surface strigose to tomentose; ovary subglobose; fruit schizocarp.....2.1. *Heliotropium angiospermum*
   2’. Adaxial and abaxial surfaces glabrous; ovary globose; fruit drupe.....3. *Heliotropium funkiae*

1’. Branches fistulous; blade rhombic, margin uneven, peduncle hirsute; stigma clavate or subcapitate.
   3. Stigma clavate; anthers oblong; nutlets juxtaposed.....2.2. *Heliotropium elongatum*
   3’. Stigma subcapitate; anthers oblong-ovate; nutlets divergent.....2.4. *Heliotropium indicum*

2.1. *Heliotropium angiospermum* Murray, Prodr. Mexa. Gott. 217-219. 1770. Figs. 2g; 5a-f

Herbs or subshrubs 70–90 cm tall, erect or suberect. Branches never fistulous, difuse, strigose to scabrous. Leaves alternate to subopposite, sometimes opposite, petiolate; petiole 0.3–1.5 cm long, sulcate, hirsute; blade 2–8 × 1–3.5 cm, membranaceous, elliptic to ovate, apex attenuate to acuminate, margin entire, ciliate, base attenuate, ovate to elliptic, adaxial surface strigose, abaxial surface strigose to tomentose; venation eucamptodromous. Inflorescence 1–23 cm long, scorpioid, lax to congestion, entire or forked, subterminal and axillary; peduncle 2–5 cm long, pubescent. Flowers 1–3.3 mm long, white, sessile; calyx 1–1.8 mm long, lobate, externally strigose to pubescent, internally pubescent to sericeous, lobes 1.3–2 × 0.6–0.9 mm, apex acute; corolla 2.5–4 mm long, white to purplish, obcampanulate, externally strigose in the median portion, internally tomentose, tube 2.5–3 mm long, subcilindrical, lobes 0.5–1.8 × 1–1.5 mm, orbicular, apex obtuse to rounded. Stamens, subsessile, free; anthers 1–1.6 mm long, ovate, apex apiculate, base cordate; ovary ca. 0.4 mm long, subglobose, glabrous; style entire, atrophied; stigma widely conical, sessile. Schizocarp ca. 3 mm diam., depressed-globose, verruculose; nutlets 2, ca. 1.3 mm long, costates, elliptic; seed not observed.

Selected examined material: Capistrano, Serra de Baturité, 30.V.1994, fl., *J. Medeiros et al.* (EAC 21544). Caridade, Povoado do Pedanga, 04°11'83"S, 38°59'24"W, 28.III.2009, fl., *A.C. Bezerra 27* (EAC). Choró, Faz. Riachão, 5.V.1997, *M.A. Figueiredo* (EAC 25504). Ipú, localidade de Manuíno, 4.IV.2017, fl., *F. Araújo et al. 169* (EAC). Itatira, próximo a Serra do Céu, 3.VIII.1984, fl. and fr., *A. Fernandes et al.* (EAC 12777). Jati, Sítio Saboeiro, 3.IV.2013, fl., *D.G. Oliveira 973* (HVASF). Limoeiro do Norte, 15.X.1996, fl., *Cícera* (IPA 43315). Maranguape, rodagem de Maranguape, 29.III.1955, fl. and fr., *A. Fernandes* (EAC 1152). Mombaça, 29.IV.2014, fl., *W. Batista 366* (EAC). Nova Olinda, geossitio Pedra Cariri, 27.III.2018, fl. and fr., *K.S. Pereira 10* (HCDAL). Pentecoste, Fazenda Experimental Vale do Curu, 03°48'34"S, 39°20'46"W, 19.IV.2012, fl., *M.I.B. Loiola 1453* (EAC). Quixadá, subida para Serra do Estevão, 6.IV.2005, fl. and fr., *J.I.M. Melo et al. 495* (EAC, HST). Quixeramobim, Fazenda Riachão, 5.V.1997, fl. and fr., *M.A. Figueiredo* (EAC 25504). Quixeré, Fazenda Mato Alto, 05°12'00"S, 37°48'00"W, 13.VI.1996, fr., *E.L. Paula-Zárate et al. 241* (EAC). Santana do Cariri, estrada para o Pontal de Santa Cruz, 27.III.2018, fl. and fr., *K.S. Pereira 11* (HCDAL). Santa Quitéria, Fazenda Itatiaia, 27.IV.1984, fl., *A. Fernandes et al.* (EAC 12522). Senador Pompeu, Várzea de Banabuiú, 21.I.1995, fr., *E.B. Souza* (EAC 21889). Sobral, Empraba Caprino, 03°42'00"S, 40°21'00"W, 3.VII.2002, fl. and fr., *M. Mamede 113* (EAC). Tabuleiro do Norte, 11.III.2014, fl., *L.M. Versieux 650* (EAC).

Heliotropium angiospermum differs from the other species of the genus by its branches strigose to scabrous, leaves alternate to subopposite, corolla obcampanulate, and stigma widely conical and especially by the fruit depressed-globose, verruculose. It occurs in the South United States (Texas), Antilles, Chile, Argentina, and in Brazil (Frohlich 1978). In Brazil, practically in all Northeast region (AL, BA, CE, PB, PE, PI, RN and SE) and the Southeast region (MG and RJ) (BFG 2018; Melo 2020b). In Ceará, it has broad distribution and occurs in 19 municipalities. It was recorded in the Arboreous Stepic Savanna, Semideciduous Seasonal Forest, Stepic Savanna, Vegetation Complex of the Coastal Zone, Dense Ombrophilous Forest and Vegetation under Fluvial and/or Lacustrine Influence (Fig. 6C4, B3, C3, C5, D4, D5, D7, E4, E5, E6, G4 and H5), at altitudes between 25–794 m. The taxon was not registered in any conservation unit in the state. Collected with flowers and fruits all year. Popular names no recorded.

2.2. *Heliotropium elongatum* (Lehm.) I.M. Johnst., Contr. Grey Herb. 81:18. 1928.

Figs. 2h; 5g-l

Herbs 20–60 cm tall, erect or suberect. Branches fistulous, scabrous, hirsute. Leaves opposite to subopposite, petiolate; petiole 1–3.5 cm long, partially alate, hirsute; blade 2–10 × 2.5–7.5 cm membranaceous, rhombic, apex acute to acuminate, margin uneven, base attenuate, sometimes asymmetric, adaxial surface bullate, pubescent to strigose, abaxial surface strigose to tomentose; venation eucamptodromous. Inflorescence 2–15 cm long, scorpioid, congestion, terminal and axillary; peduncle 1.5–4 cm long, hirsute. Flowers 3–8.1 mm long, white with faucal area purplish and internally yellow, sessile; calyx 1.2–2 mm long, externally strigose, internally pubescent, lobes 0.8–1.5 × 0.2–0.5 mm, apex acute; corolla 2.8–4 mm long, white or purple, inner perianth yellowish, hypocrateriform, externally hispid, internally glabrous, tube 2–3.6 mm long, cylindrical, lobes 1.5–2 mm long, orbicular, apex rounded. Stamens subsessile, free; anthers ca. 1.5 mm long, oblong; ovary ca. 0.6 mm long, subglobose, glabrous; style ca. 0.5 mm long, conspicuous; stigma ca. 0.3 mm long, clavate.

Schizocarp ca. 4.3 mm diam., mitriform, hispid; nutlets juxtaposed, costate; nutlets 2, apex slightly dentate; seed not observed.

Selected examined material: Aiuaba, Estação Ecológica de Aiuaba, 06°47'29"S, 40°16'15"W, 25.IV.2018, fl. and fr., *K.S. Pereira 23* (HCDAL). Barbalha, casas populares, 17.I.2007, fl., *S.L. Cartaxo et al.* (HCDAL 2926). Barro, rumo a Cavalcante, 21.XI.1984, fl. and fr., *B. Freitas* (CEN 8755). Canindé, Fazenda Urânia, 18.V.1985, fl. and fr., *B. Freitas et al.* (EAC 13595). Caridade, Fazenda

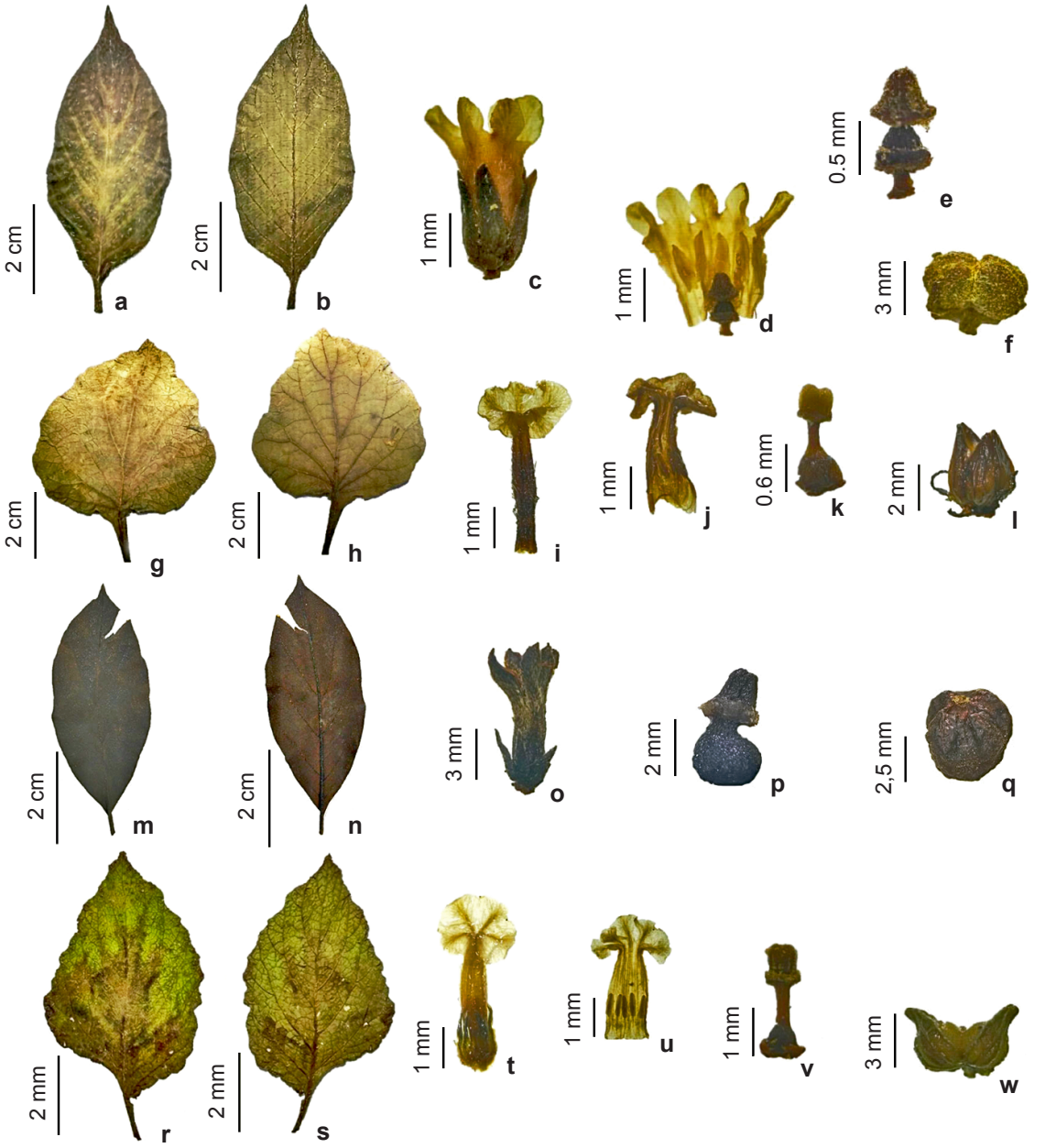

Figure 5 – a-w. *Heliotropium* species in the state of Ceará – a-f. *Heliotropium angiospermum* – a. leaf (adaxial surface); b. leaf (abaxial surface); c. flower; d. corolla in longitudinal section; e. gynoecium; f. fruit; g-l. *Heliotropium elongatum* – g. leaf (adaxial surface); h. leaf (abaxial surface); i. flower; j. corolla in longitudinal section; k. gynoecium; l. fruit; m-q. *Heliotropium funkiae* – m. leaf (adaxial surface); n. leaf (abaxial surface); o. flower; p. gynoecium; q. fruit; r-w. *Heliotropium indicum* – r. leaf (adaxial surface); s. leaf (abaxial surface); t. flower; u. corolla in longitudinal section; v. gynoecium; w. fruit. (a-f. *Melo 495*; g-l. *Pereira 23*; m-q. *Fernandes* (EAC 4151); r-w. *Loiola 2147*).

Feijão, 19.XI.1989, fl. and fr., *B. Freitas* (EAC 16894). Crato, Caldeirão do beato José Lourenço, 11.IX.2008, fl., *A.C.A. Morais 99* (EAC, HCDAL). Crateús, RPPN Serra das Almas, 05°08'28"S, 40°54'57"W, 6.IV.2018, fl. and fr., *K.S Pereira 17* (HCDAL). Fortaleza, Parque Santa Rosa, 5.VII.2001, fl. and fr., *S. César* (EAC 30966). Guaiúba, 19.II.2004, fl., *M.G.V. Silva* (EAC 33490). Iguatu, E 20 Z Firino, 06°25'48"S, 39°58'09"W, 16.V.2010, fr., *L.R.O. Normando et al. 332* (EAC). Itarema, Riacho, 21.XII.2006, fl. and fr., *G.O. Araújo 1* (EAC). Jaguaruana, 20.VI.1998, fl., *K.B. Barbosa 10* (MOSS). Jati, reservatório atalho, 14.XI.2012, fl. and fr., *F.F.S. Silva 603* (HVASF). Mauriti, povoado Umbuzeiro, 25.XII.2009, fl. and fr., *A.C.C. Silva 169* (ASE). Missão Velha, Gameleira São Sebastião, 39°14'31"W, 07°24'97"W, 12.I.2018, fl. and fr., *K.S. Pereira 4* (HCDAL). Orós, Cinco Barras, 9.VII.1984, fl., *F.C.F. Silva 173* (ALCB). Quixeramobim, 16.I.2008, fl. and fr., *A.M. Miranda et al. 5622* (HST). Quixeré, Fazenda Mato Alto, 13.V.1997, fl. and fr., *M.R.L. Melo 81* (HUEFS). Santa Quitéria, Itatiaia, 26.IV.1984, fl. and fr., *A. Fernandes et al.* (EAC 12461). Santana do Cariri, Serra do Araripe, 30.XII.1981, fl. and fr., *A.L. Peixoro & P.L. Peixoto 1635* (HST, UEC). Senador Pompeu, Varzea de Banabuiú, 21.I.1995, fl. and fr., *E.B. Souza* (EAC 21900). Sobral, Fazenda da UVA, 28.II.2005, fl. and fr., *J.E. Alves et al.* (EAC 38955). Tauá, Chácara Tia Lena, 1.XI.1999, fl., *K. Veríssima 19* (MOSS). Tururu, Comunidade Quilombola de Água Preta, 24.I.2015, fl. and fr., *J.C.M.S.M. Sobczack 1* (EAC). Viçosa do Ceará, Sítio Matador, 5.VI.1982, fl. and fr., *F. Bruno* (EAC 11512).

Heliotropium elongatum is similar to *H. indicum*. These species share the general habit and a partially winged petiole. However, *H. elongatum* differs from *H. indicum* by its adaxial surface bullate (*vs.* flat), stigma clavate (*vs*. subcapitate), and mitriform fruit with nutlets juxtaposed (*vs.* fruit with nutlets divergent). It is restricted to South America, reaching Bolivia, Paraguay, Argentina, Uruguay, and Brazil (Johnston 1928). In Brazil it occurs in the North (PA and TO), Northeast (AL, BA, CE, MA, PB, PE, PI, RN and SE), Central-West (GO, MT and MS), Southeast (MG, RJ and SP) and South regions (RS) (BFG 2018; Melo 2020b). In Ceará state, it has broad distribution and occurs in 25 municipalities. It was recorded in the Semideciduous Seasonal Forest, Arboreous Savanna, Stepic Savanna, Vegetation Complex of the Coastal Zone and Vegetation under Fluvial and/or Lacustrine Influence (Fig. 6A4, B2, B3, B5, B6, C3, C5, C6, D3, D7, E3, E5, F3, F5, G4, G5 and H5), at altitudes between 12–717 m. It is present in two Conservation Units (UC) of Ceará: Estação Ecológica de Aiuaba and Reserva Particular do Patrimônio Natural Serra das Almas. Collected with flowers and fruits all year. Popular name fedegoso.

2.3. *Heliotropium funkiae* Feuillet, Phytoneuron 2020-12: 1. 2020. Figs. 2m; 5m-q

Shrubs erect. Branches never fistulous, glabrous the slightly pilose. Leaves alternate, petiolate; petiole 4–7 mm long, cylindrical to slightly sulcate; blade 2–9 × 1–5 cm, chartaceous, elliptic to ovate, lanceolate, apex acute, margin entire, undulate, base atenuate, adaxial and abaxial surfaces glabrous; venation eucamptodromous. Inflorescences 2–3.3 cm long, scorpioid, terminal; peduncle 0.5–1 cm long, sulcate, pubescent. Flowers 0.8–1.3 cm long, white to yellow; calyx ca. 0.4 mm long, lobed, externally and internally pubescent, lobes 0.4–1 mm long, acute, margin ciliate; corolla 3–4 mm long, white, externally pubescent, internally glabrous, tube 2.5–3.5 mm long, cylindrical, lobes 1–1.5 × 0.3–0.8 mm long, ovate, linear, apex acute. Stamens sessile; anthers ca. 1.2 mm long, free, lanceolate, apex acute; ovary ca. 0.6 mm long, globose, glabrous; style inconspicuous, stigma ca. 0.2 mm long, sessile, conical-triangular. Drupe ca. 4 mm diam., glabrous, globose; seed not observed.

Examined material: Aratuba, Sítio Jacarandá, 18.X.1978, fl. and fr., *A. Fernandes* (EAC 4151).

Heliotropium funkiae can be easily recognized by its leaves leathery, glabrous or glabrescent, inflorescences distinctly scorpioid, and especially by its sessile stigma conical-triangular. It occurs in Guyana and Paraguay (Funk *et al*. 2007), reaching Mexico to Central America and West Indies, from Northern to Western South America (Miller 1988). In Brazil, it occurs in the Northern (AC, AM, PA, RR and TO), Northeastern (AL, BA, CE, MA, PB, PE and SE), Central-West (GO, MS and MT), Southeastern (ES, MG, RJ and SP) and Southern regions (PA and SC) (BFG 2018; Melo 2020b). In Ceará state, *Heliotropium funkiae* has restricted distribution, recorded only in the municipality of Aratuba, in the Semideciduous Seasonal Forest (Fig. 6C5), at altitude up to 838 m. The taxon was not registered in conservation units in the state. Collected with flowers and fruits in October. Popular names no recorded.

2.4. *Heliotropium indicum* L., Sp. Pl. 1: 130. 1753. Figs. 2i; 5r-w

Herbs to subshrubs 0.3–1 m tall, erect. Branches, angular, fistulous. Leaves alternate or subopposite, petiolate; petiole 1–8 cm

long, attenuate; blade 1.6–12 × 1.5–7.5 cm, membranaceous, ovate-elliptic to ovate-deltoid, sometimes rhomboid, apex acuminate, margin uneven, base truncated, adaxial and abaxial surfaces flat, pubescent; venation eucamptodromous. Inflorescence 2–14 cm long, scorpioid, congestion in the portion apical, axillary and terminal; peduncle 1–4.5 cm long, hirsute. Flowers 2–6.6 mm long, white, sessile; calyx 1.6–4 mm long, externally hirsute, internally glabrous, lobes 1.5–3.5 × 0.2–0.6 mm long, apex lanceolate; corolla 2.3–4.7 mm long, white to slightly purple, hypocrateriform, externally hirsute, internally glabrous, tube 2.5–3.5 mm long, subcylindrical, lobes 1.2–2 mm long, orbicular, apex rounded to slightly unequal. Stamens sessile; anthers ca. 1 mm long, oblong-ovate, apex apiculated, base cordate; ovary ca. 0.3 mm long, glabrous; style 1.3–3.5 mm long; stigma ca. 1 mm long, subcapitate. Squizocarp 2.8–3.7 mm long, glabrous, nutlets divergent, costate; seeds ca. 1.2 mm long, ellipsoids.

Selected examined material: Aiuaba, Estação Ecológica de Aiuaba, 06°40'12"S, 40°10'45"W, 7.I.1997, fl. and fr., *L.W. Lima-Verde et al. 366* (EAC). Aquiraz, 9.II.1992, fl., *L.P. Félix 5523* (HST). Crateús, próximo a linha férrea, 3.III.2010, fl. and fr., *A.M.M. Carvalho* (EAC 46483). Jijoca de Jericoacoara, Rua Tio Dão, 02°53'60"S, 40°27'13"W, 5.XI.2016, fl. and fr., *J.C.N. Sousa Júnior 1* (EAC). Quixeré, Fazenda Mato Alto, 05°12'13"S, 37°49'10"W, 13.V.1997, fl. and fr., *L.M.R. Melo et al. 81* (EAC). Santa Quitéria, sabonete, 28.IV.2014, fl., *J.P. Souza et al. 11099* (ESA).

Heliotropium indicum may be confused with *H. elongatum*, mainly due to the general shape of the inflorescence and the partially winged petiole. However, it is distinguished by having adaxial surface flat (*vs.* adaxial surface bullate), stigma subcapitate (*vs.* clavate), above all, by the fruit with nutlets divergent (*vs.* fruit with nutlets juxtaposed). It occurs in the tropical regions of the globe (Miller 1988). In Brazil it is distributed in almost the entire territory, in North (AC, AM, AP, PA, RO and TO), Northeast (AL, BA, CE, MA, PR, PE and PI), Central-West (DF, GO, MT and MS), Southeast (ES, MG, RJ and SP) and South regions (PR, RS and SC) (BFG 2018; Melo 2020b). In Ceará state, it was recorded in seven municipalities, in vegetation Arboreous Stepic Savanna, Stepic Savanna and Vegetation Complex of the Coastal Zone (Fig. 6-A3, C3, C6, D7, E3 and G3), at altitudes between 14–274 m. It is present in Estação Ecológica de Aiuaba. Collected with

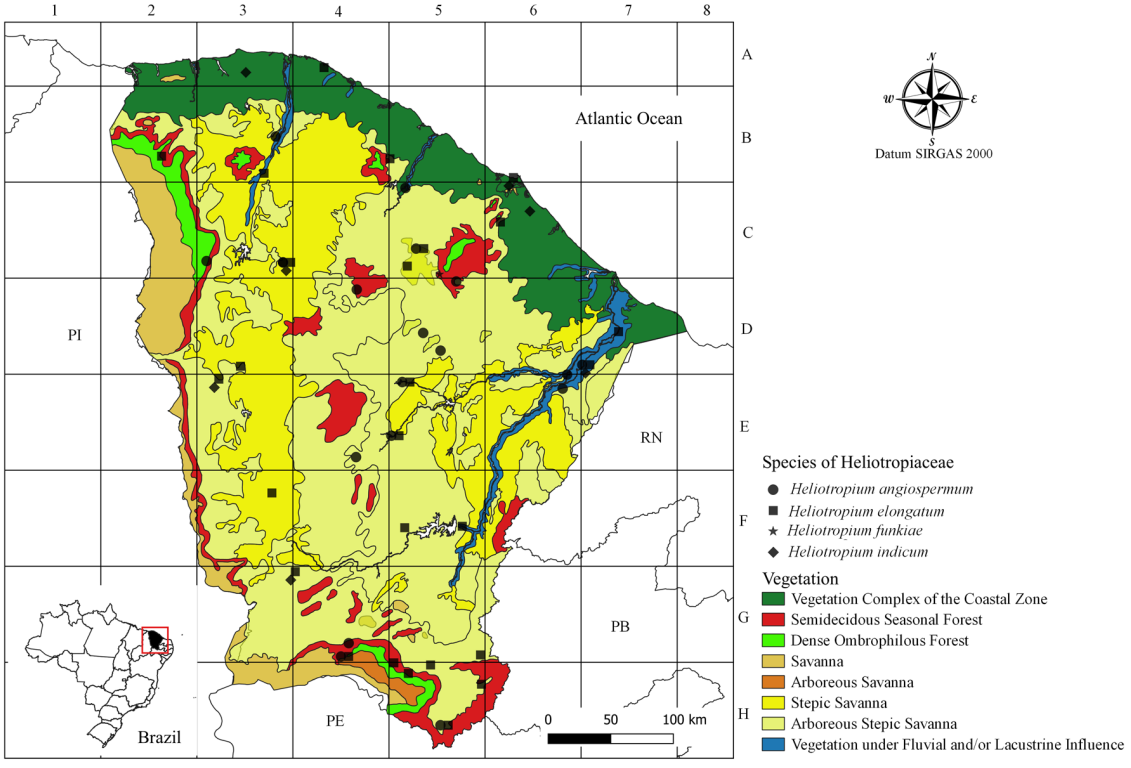

Figure 6 – Distribution and vegetation types associated with *Heliotropium* species in the state of Ceará, Brazil.

flowers in January, February, March, April, May and November and fruits in March and November.

Popular names: "cravo de anum", "cravo de urubu" and "crista-de-galo".

3. *Myriopus* Small, Man. S.E. Fl. 1131: 1508. 1933.

Shrubs, subshrubs, scandent, with lenticels or absent. Leaves alternate, petiolate. Venation brochidodromous. Inflorescences scorpioid, paniculiform, sometimes with branches secondary (secundiflorous), terminal, axillary, lax or congested. Flowers sessile; lobes slightly unequal each other, persistent; corolla white, green or orangish, tubular, lobes involute. Stamens epipetalous, sessile, anthers equal each other. Ovary of different shapes, locules 2, ovules 2 per locule; style terminal, cylindrical; stigma short or narrowly conical. Drupe with 4-lobes. Seed 1 per lobe, embryo curved.

The genus has approximately 25 species, distributed exclusively in the Neotropics, with the Caribbean and Brazil being the main centers of taxonomic diversity (Melo *et al*. 2018). In Ceará state, it is represented by four species, associated with Ombrophilous Forest, Vegetation Complex of the Coastal Zone in Lowland Semideciduous Forest, and Vegetation under Fluvial and/or Lacustrine Influence and rarely, in Stepic Savanna (Caatinga/ Carrasco) and Arboreous Stepic Savanna.

Key to the *Myriopus* species in the state of Ceará

1. Branches without lenticel; inflorescences pyramidal, congested; corolla with a dilatation on the upper part; ovary ovoid ..... 3.1. *Myriopus candidulus*
1'. Branches with lenticel; inflorescences scorpioid, lax; corolla compressed in the lower half of the tube; ovary never ovoid.
   2. Subshrubs; branches glabrous to strigose; presence of dilated base trichomes on the adaxial and/ or abaxial surface .....3.3. *Myriopus rubicundus*
   2'. Shrubs scandent; branches pubescent or tomentose; absence of dilated base trichomes on the adaxial and / or abaxial surface.
      3. Flowers 0.8–3.7 mm long; stigma elongated ca. 0.8 mm long; ovary subglobose ....3.2. *Myriopus membranaceus*
      3'. Flowers 2–6.2 mm long; stigma short ca. 0.2 mm long; ovary pyriform .... 3.4. *Myriopus salzmannii*

3.1. *Myriopus candidulus* (Miers) Feuillet, J. Bot. Res. Inst. Texas 2(1): 264. 2008. Figs. 2j-k; 7a-f

Shrubs scandent ca 1 m tall. Branches cylindrical, with intense whitish pubescence, lenticel absent. Leaves alternate, petiolate; petiole 0.3–0.7 cm long, cylindrical, sulcate, densely tomentose with whitish trichomes; blade 1.5–7.8 × 1.3–3.3 cm, chartaceous, lanceolate to elliptic, apex acute to acuminate, margin entire, base attenuate, adaxial surface pubescent with partly trichomes base dilated, abaxial surface whitish, densely villous; venation brochidodromous. Inflorescences 2–10 cm long, pyramidal, congest, terminal and axillary; peduncle 0.4–1.6 cm long, tomentose. Flowers 4–6 mm long, sessile; calyx 3.2–4 mm long, deeply lobed, externally villous, internally glabrous, lobes 2.7–3.8 mm long, lanceolate, unequal to each other, apex acute; corolla 3.8–5.3 mm long, externally densely villous in the, internally glabrous, tube 2.7–3.8 mm long, with a dilatation on the upper part of the tube, lobes 1–2.3 mm long, linear, apex apical. Stamens sessile; anthers 0.4–0.8 mm long, lanceolate; ovary ca. 2 mm long, glabrous to subglobose; style ca 1.5 mm long; stigma evident ca. 1 mm long, conical-triangular, thickened basal disk. Drupe ca. 1.5 mm long, subglobose, densely tomentose; seed not observed.

Selected examined material: Acaraú, Fazenda Arroz, 24.IV.1994, fl. and fr., *F.J.A. Matos* (EAC 5425). Aquiraz, loteamento Novo Aquiraz, 8.XII.1988, fl., *A. Figueiredo* (EAC 16372). Caucaia, Parque Botânico do Ceará, 29.I.1998, fl., *A. Fernandes & E. Nunes* (EAC 26115). Fortaleza, Cidade dos Funcionários, 2.III.1994, fl., *I.M.B. Sá 147* (EAC). Icapuí, APA de Redonda, 8.IX.2000, fl., *R.S. Oliveira 14* (EAC). Marco, São Geraldo, 10.XI.1989, fl., *M.A. Figueiredo et al.* (EAC 16302). São Gonçalo do Amarante, Jardim Botânico de São Gonçalo do Amarante, 03°56'44''S, 38°38'53''W, 20.IV.2018, *E.M.P. Lucena 69* (EAC). Ubajara, Planalto da Ibiabapa, 27.I.1996, fl., *F.S. Araújo 1154* (EAC).

Myriopus candidulus differs from the other species of the genus in the area by branches with

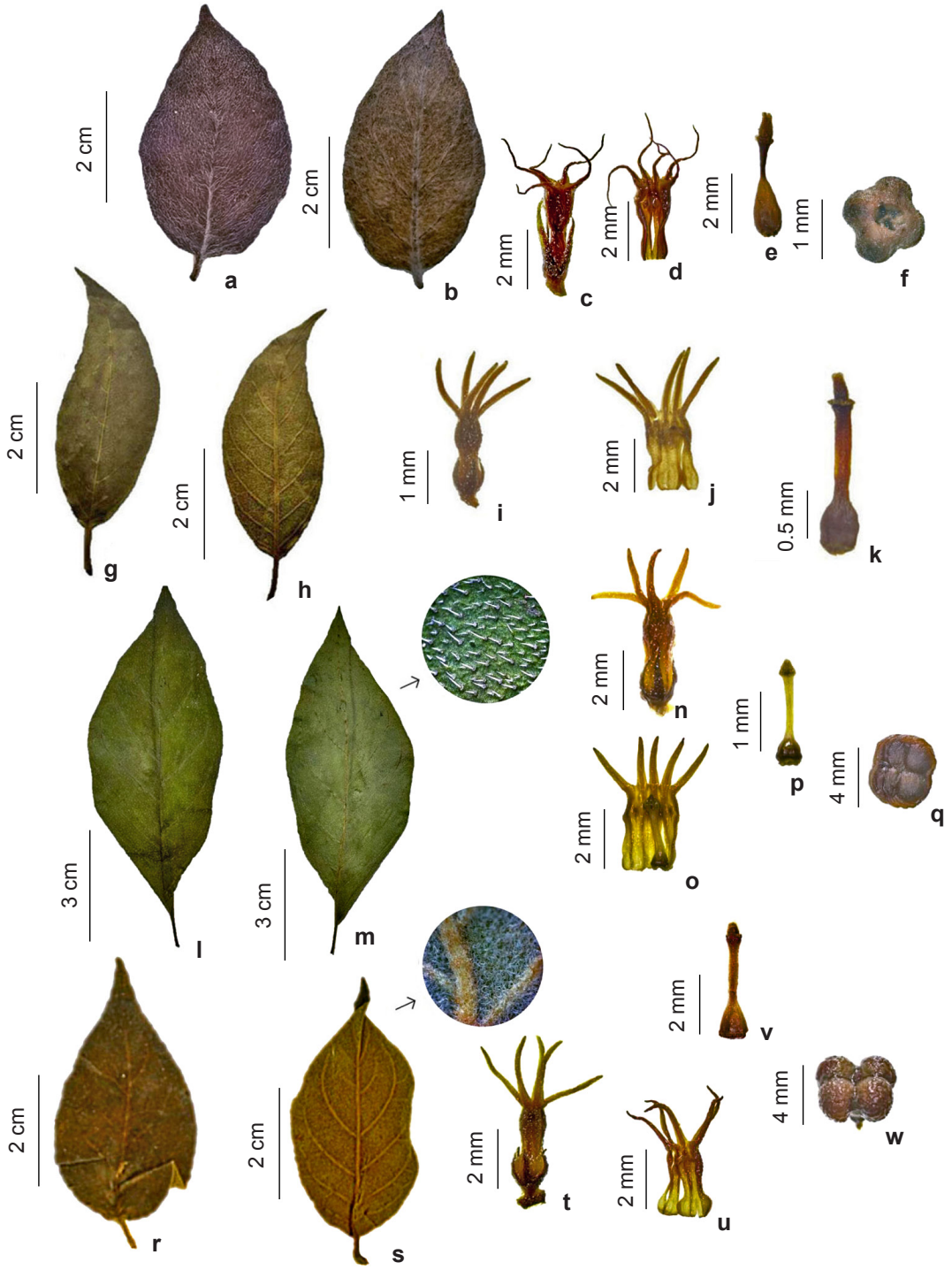

Figure 7 – a-w. *Myriopus* species in the state of Ceará – a-f. *Myriopus candidulus* – a. leaf (adaxial surface); b. leaf (abaxial suface); c. flower; d. corolla in longitudinal section; e. gynoecium; f. fruit; g-k. *Myriopus membranaceus* – g. leaf (adaxial surface); h. leaf (abaxial surface); i. flower; j. corolla in longitudinal section; k. gynoecium; l-q. *Myriopus rubicundus* – l. leaf (adaxial surface); m. leaf (abaxial surface); n. flower; o. corolla in longitudinal section; p. gynoecium; q. fruit; r-w. *Myriopus salzmannii* – r. leaf (adaxial surface); s. leaf (abaxial surface); t. flower; u. corolla in longitudinal section; v. gynoecium; w. fruit. (a-f. *Oliveira 14* and *Magalhães 194*; g-k *Santos 372;* l-q. *Souza et al. 4544*; r-w. *Lima-Verde et al. 392*).

intense whitish pubescence, lenticel absent and the presence of thickened basal disk. It's occurs in Venezuela, Brazil and Guyana (Feuillet 2008). In Brazil, it is distributed in the Northeast (BA, CE, MA, PB, PE, RN and SE) and Southeast regions (RJ and SP) (BFG 2018; Cavalheiro *et al*. 2020). In Ceará state, was registered in eight municipalities, occurring in vetegation of Dense Ombrophilous Forest, Vegetation Complex of the Coastal Zone, and Vegetation under Fluvial and/or Lacustrine Influence (Fig. 8A3, B2, B5, B6, C6 and D7), at altitudes between 14–847 m. The species was registered in three Conservation Units (UC) of Ceará: Área de Proteção Ambiental Redonda, Jardim Botânico de São Gonçalo do Amarante and Parque Botânico do Ceará. Collected with flowers in January, March, April, September, November and December and fruits in April.

Popular names no recorded.

3.2. *Myriopus membranaceus* (A. DC.) J.I.M. Melo, Prodr. 9: 530. 1845. Fig. 7g-k

Shrubs scandent. Branches cylindrical, pubescent or tomentose, yellowish, lenticel present. Leaves alternate, petiolate; petiole 2.5–9.5 mm long; blade 2–7 × 0.8–2.5 cm, membranaceous, lanceolate, ovate, apex acute to acuminate, sometimes cuspidate, margin entire, base obtuse, adaxial and abaxial surfaces less pubescent; venation brochidodromous. Inflorescences 5–10 cm long, scorpioid, short tops, terminal; peduncle 1–1.8 cm long, tomentose. Flowers 0.8–3.7 mm long, orange, sessile; calyx 1–2 mm long, deeply lobed, externally densely pubescent, internally slightly pubescent, lobes 0.8–1.5 mm long, apex acute, margin ciliate; corolla 1.5–3 mm long, tube cylindrical, externally pubescent, internally glabrous, tube 1.8–2.3 mm long, cylindrical, lobes 1.5–2 × 0.2–0.3 mm, ovate, apex acute. Stamens subsessile; anthers ca. 0.4 mm long, linear, apex acute, base cordate; ovary ca. 0.6 mm long, subglobose, glabrous; style ca. 0.9 mm long; stigma ca. 0.8 mm long, thickened basal disk. Drupe not observed.

Examined material: Itapipoca, 8.VI.2015, fl., *F.D.S. Santos 372* (HUVA). Ubajara, Planalto da Ibiapaba, 15.X.1998, fl., *A. Fernandes et al.* (EAC 27761).

Myriopus membranaceus was already considered a local form of *M. salzmannii*, (Johnston 1930), but differs by the adaxial and abaxial surfaces pubescent (*vs*. densely pubescent), flowers 0.8–3.7 mm long (*vs.* 2–6.2 mm long), stigma with ca. 0.8 mm long (*vs*. short ca. 0.2 mm long), and ovary subglobose (*vs.* pyriform). It's occurs in Argentina (Cavalheiro *et al*. 2011) and Brazil, where it is distributed in the Northeast (BA, CE and PE), Central-West (GO), Southeast (ES, MG, RJ and SP) and South regions (RS and SC) (BFG 2018; Cavalheiro *et al.* 2020). In Ceará state, it was recorded two in the municipality of Itapipoca and Ubajara, in vegetation Dense Ombrophilous Forest and Stepic Savanna (Fig. 8B2 and B4), at altitudes between 108–847 m. The taxon was not registered in any conservation unit in the state. Collected only with flowers in June and October.

Popular names no recorded.

3.3. *Myriopus rubicundus* (Salzm. *ex* DC.) Luebert, Taxon 60(3) : 677. 2011. Figs. 2l; 7l-q

Subshrubs scandent 2–2.5 m tall. Branches cylindrical, glabrous to strigose, lenticel present. Leaves alternate, petiolate; petiole 0.4–1 cm long, cylindrical, sulcate, strigose; blade 3–10.5 × 1–6.5 cm, membranaceous, very delicate, ovate to lanceolate, apex acute to acuminate, margin entire, slightly ciliated, base acute to obtuse, sometimes obliquous, adaxial and abaxial surfaces strigose with trichomes base dilated discoide; venation brochidodromous. Inflorescences 3.5–5.5(–10) cm long, scorpioid, free, position terminal; peduncle 0.5–2 cm long, strigose to sericeous. Flowers 3.3–6.4 mm long, orange, sessile; calyx 2.6–4 mm long, deeply lobed, externally strigose, internally glabrous, lobes 0.9–3.5 mm long, lanceolate of sizes unequal, apex acute to acuminate; corolla 2.5–4.0 mm long, tubular, compressed into the lower half of the tube, externally sericeous, internally glabrous, tube 1.3–2 mm long, with contrition in the middle, lobes 1.5–2.7 × 0.1–0.3 mm long, linear, involute, apex filiform. Stamens sessile; anthers 0.5–0.7 mm long, ovate to lanceolate, apex apiculate; ovary ca. 0.5 mm long, ovoid, glabrous, nectariferous disk present ca. 0.4 mm long; style ca 1 mm long, stigma ca. 0.4 mm long, short, pubescent. Drupe ca. 4 mm long, green immature and orange when ripe, subglobose, pyrenians 4, glabrous to hirsute; seeds 4.

Selected examined material: Aquiraz, sopé do Serrote da Preaoca, 8.IV.2006, fr., *A.S.F. Castro 1724* (EAC). Apuiarés, 15.III.2008, fr., *Edilberto et al.* (EAC 53244). Canindé, Fazenda Imburanas da Volta, 3.IV.2015, fr., *A. S.F. Castro 2863* (EAC). Caucaia, Iparana, 30.III.1997, fr., *A.S.F. Castro* (EAC 24772). Crateús, RPPN Serra das Almas, 05°8'29"S, 40°54'59"W, 6.IV.2018, fr., *K.S. Pereira 16* (HCDAL). Groaíras, Marrecas, 03°53'52"S, 40°24'05"W, 7.IV.2017, fl. and fr., *E.B.S. Souza et al.* 4544 (EAC). Quixadá, Lages, 6.IV.2005, fr., *J.I.M. Melo et al. 502* (EAC). Santa Quitéria, Itatia, 7.VI.1984, fl., *A.*

Fernandes et al. (EAC 12697). Sobral, Serra da Meruoca, 03°37'56"S, 40°24'24"W, 5.II.2016, fl., *E.B. Souza et al. 3781* (EAC).

Myriopus rubicundus differs from the other species of the genus by its membranaceous leaves, very delicate trichomes with dilated base on the adaxial and/or abaxial surface, and ovary ovoid. It's occurs in Bolivia, Paraguay and northern Argentina (Smith 1970; Foster 1958; Perez-Moreau & Cabrera 1983). In Brazil, it is distributed in the North (TO), Northeast (AL, BA, CE, PB, PE and RN), Central-West (DF, GO and MS), Southeast (ES, MG, RJ and SP) and South regions (PA and SC) (BFG 2018; Cavalheiro *et al*. 2020). *Myriopus rubicundus* has median distribution in Ceará territory and occurs in nine municipalities. It was recorded in the Arboreous Stepic Savanna, Stepic Savanna, Vegetation Complex of the Coastal Zone and Vegetation under Fluvial and/or Lacustrine Influence (Fig. 8-B3, B6, C3, C4, C5, C6 and D5), at altitudes between 14–197 m. The species was registered in the Reserva Particular do Patrimônio Natural Serra das Almas. Collected with flowers in February, March, April and June and fruits in March and April.

Popular names no recorded.

3.4. *Myriopus salzmannii* (DC.) Diane & Hilger, Bot. Jahrb. Syst. 125(1): 47. 2003. Fig. 7r-w

Shrubs scandent ca. 3 m tall. Branches cylindrical, densely tomentose, yellowish, lenticel present. Leaves discolorous, alternate, petiolate; petiole ca. 0.3–1 cm long, villous; blade 2–7 × 1–2.7 cm, membranaceous, ovate to lanceolate, apex acute to acuminate, margin entire, base acute to obtuse, adaxial and abaxial densely pubescent surfaces with trichomes yellowish to whitish; venation brochidodromous. Inflorescences 4–6 cm long, scorpioid, free, summits delicate, position terminal or axillary; peduncle 1–2 cm long, tomentose. Flowers 2–6.2 mm long, orange, sessile; calyx 1.2–2 mm long, lobed, externally villous, internally glabrous, lobes 0.8–2 mm long, lanceolate of sizes unequal; corolla 4–5.5 mm, compressed in the lower half of the tube, externally sericeous, internally pubescent, tube 1.6–2 mm long, tubular with a contour in the middle and dilated in the base, lobes 1.5–2.3 × 0.1–0.2 mm long, linear, apex filiform. Stamens sessile; anthers 0.4–0.7 mm long, ovate to lanceolate, apex acute; ovary ca. 1.2 mm long, pyriform, glabrous; style ca. 2 mm long; stigma ca. 0.2 mm long, narrowly

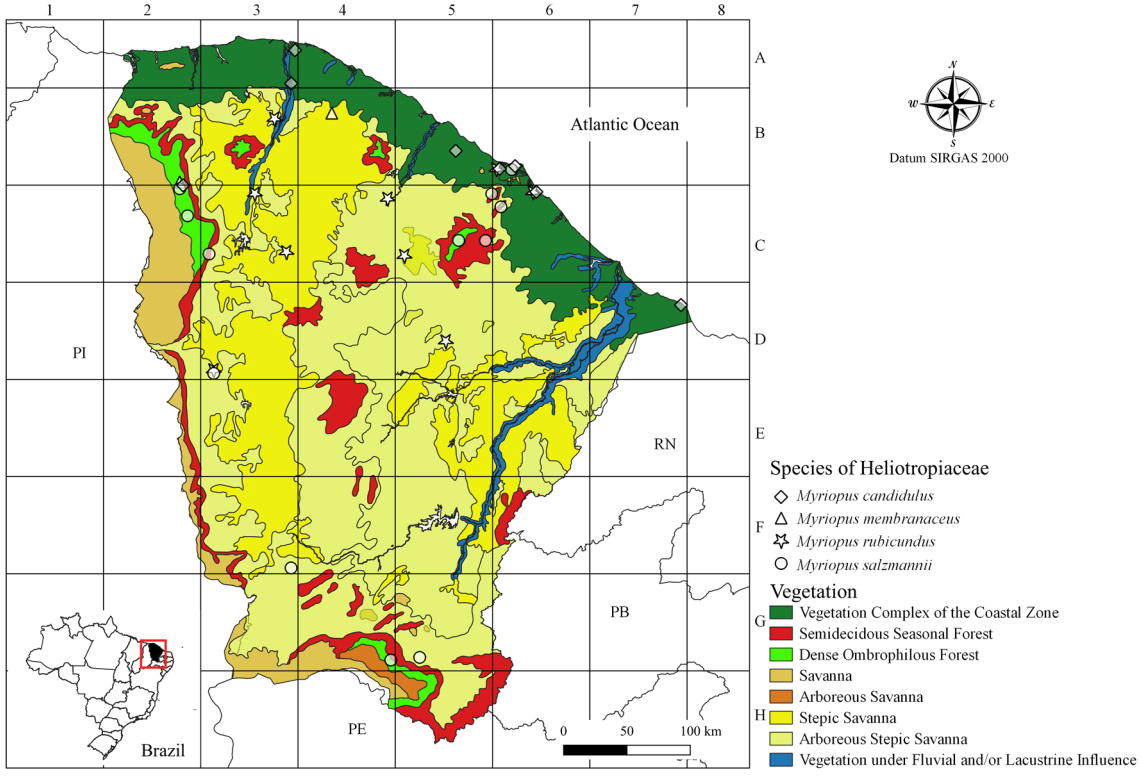

Figure 8 – Distribution and vegetation types associated with *Myriopus* species in the state of Ceará, Brazil.

conical, pubescent. Drupe ca. 4 mm long, light green when young, yellow when ripe, glabrous, globose; seeds 4, ca. 2–1.3 mm long, depressed-globose, ventrally joined.

Selected examined material: Aiuaba, strada da confiança, placa do IBAMA, 06°43'41"S, 40°19'16"W, 5.II.1997, fl. and fr., *L.W. Lima-Verde et al. 392* (EAC). Barbalha, Sítio Pinheiros, 07°21'51.2"S, 39°20'22.7"W, 730 m, 7.XI.2017, fr., *K.S. Pereira 2* (HCDAL). Crateús, Serra das Almas, 25.II.2002, fr., *F.S. Araújo & J.R. Lima 1300* (EAC). Crato, Serra dos Prazeres, 5.III.1995, fl., *F.S. Cavalcante 234* (EAC). Fortaleza, dunas da Praia do Futuro, 9.II.1996, fl., *A.S.F. Castro* (EAC 23942). Ipú, Bica do Ipú, 19.XII.1979, fl., *E. Nunes & P. Martins* (EAC 7879). Maranguape, pé da serra, 31.VII.1954, fl., *A. Ducke.* (EAC 995). Pacatuba, Serra da Aratanha, Sítio Pitaguari, 1.X.1979, fl., *P. Martins & A.J. Castro* (EAC 6996). Pacotí, Sítio Sta Madalena, 9.X.1980, fl. and fr., *E. Nunes & P. Martins* (EAC 8949). Redenção, Sítio Canadá, 9.X.1980, fr., *E. Nunes & P. Martins* (EAC 8969). São Benedito, Serra da Ibiapaba, 4.I.1942, fl., *P. Bezerra 353* (EAC). Tianguá, Chapada da Ibiapaba, 7.X.1989, fr., *A. Fernandes et al.* (EAC 16234). Ubajara, Jaburuna/Sul, Pl. Ibiapada, 21.II.1995, fl., *F.S. Araújo* (EAC 22923).

Myriopus salzmannii is recognized by its discolour leaves and inflorescences scorpioid with summits delicate. This species is morphologically similar to *M. membranaceus,* but differs by its has densely pubescent (*vs*. less pubescent), larger flowers ca. 2–6.2 mm long (*vs*. 0.8–3.7 mm long), and mainly by stigma short ca. 0.2 mm long (*vs*. elongated ca. 0.8 mm long), and pyriform ovary (*vs*. subglobose). It's occurs in Bolivia, Colombia, Paraguay, and Northern Argentina (Foster 1958; Perez-Moreau & Cabrera 1983). In Brazil, it is restricted to the Northeast (BA, CE, PB, PE, PI and RN) and Southeast regions (ES and RJ) (BFG 2018; Cavalheiro *et al*. 2020). In Ceará state, it has broad distribution and occurs in 13 municipalities**.** It was recorded in the Arboreous Stepic Savanna, Dense Ombrophilous Forest, Semideciduous Seasonal Forest, and Vegetation Complex of the Coastal Zone (Fig. 8B6, C2, C3, C5, C6, D3, F3, G4 and G5), at altitudes between 21–90 m. The species was registered in the Reserva Particular do Patrimônio Natural Serra das Almas. Collected with flowers in January, February, March, July, and October and fruits in February and November. Popular names no recored.

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