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Source: International Journal of Insect Science, 9(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/1179543317724756

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International Journal of Insect Science
Volume 9: 1–9
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DOI: 10.1177/1179543317724756

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ABSTRACT: Our hypothesis was that there will be greater ant biodiversity in heterogeneous native vegetation compared with *Arundo* stands. Changes in ant biodiversity due to *Arundo* invasion may be one of the ecological changes in the landscape that facilitates the invasion of cattle fever ticks from Mexico where they are endemic. Ants collected in pitfall traps were identified and compared between native vegetation and stands of *Arundo, Arundo donax* L., monthly for a year at 10 locations. A total of 82 752 ants representing 28 genera and 76 species were collected. More ants were collected in the native vegetation which also had greater species richness and biological diversity than ants collected from *Arundo* stands. It is suggested that the greater heterogeneous nature of native vegetation provided greater and more predictable nourishment in the form of nectars and more abundant arthropod prey when compared with *Arundo* stands.

KEYWORDS: Ant diversity, extrafloral nectaries, pitfall traps

RECEIVED: March 3, 2017. **ACCEPTED:** July 1, 2017.

PEER REVIEW: Five peer reviewers contributed to the peer review report. Reviewers' reports totaled 2484 words, excluding any confidential comments to the academic editor.

TYPE: Original Research

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Introduction

Incidence of cattle fever ticks, *Rhipicephalus* (=*Boophilus*) spp, breaching the US quarantine zone along the Rio Grande is on the increase motivating studies of ecological changes occurring concurrent to the establishment of the invasive *Arundo donax* L. (Poales: Poaceae). *Arundo*, also known as giant reed or carrizo cane, is native to the Mediterranean coasts of Europe and North Africa to south Asia. *Arundo donax* is an invasive weed of riparian habitats of the southwestern United States.[1–3] Classified as an invasive perennial species, it spread widely in riparian zones of Texas where it has altered wildlife habitats, created fire hazards, compromised water conservation efforts, affected flood control, and reduced visibility for law enforcement officers along the international border with Mexico. *Arundo* might also facilitate cattle fever tick, *Rhipicephalus* (=*Boophilus*) spp, invasion into the permanent quarantine zone along the Rio Grande between Del Rio and Brownsville, TX, by harboring known mammalian host such as white-tailed deer, *Odocoileus verginianus* (Zimmermann).[4–6]

Ants were chosen as a survey taxon because they are known predators of ticks[7–10] and are often represented by multiple species demonstrating high diversity.[11,12] The diversity and abundance of ants in native vegetation and *Arundo* along the Rio Grande basin in Texas have not been previously studied. The objective of this study was to compare and contrast ant diversity between *Arundo* and native vegetation along the Rio Grande River at the Texas-Mexico border.

The hypothesis was that there will be greater ant biodiversity in heterogeneous native vegetation compared with *Arundo* stands. Native vegetation containing a variety of plant species provides for greater occurrences of various edges and niches increasing opportunities for various ant species to have survival advantages over competitors including predator avoidance and opportunities for specialized relationships with myrmecophytic plants when contrasted with a monoculture.[11] Changes in ant biodiversity due to *Arundo* invasion may be one of the ecological changes in the landscape that facilitates the invasion of cattle fever ticks from Mexico where they are endemic.[13]

Materials and Methods

Study sites

Ant samples were collected from 10 Texas research sites located just north of the Rio Grande along the Texas-Mexico border (Table 1, Figure 1).

Ant sampling

Ants were sampled using pitfall traps (Figure 2). A trap comprised 470-mL polypropylene container (Ball, Fishers, IN, USA) 10.5 cm × 9.9 cm × 7.0 cm (height × top diameter × bottom diameter). A plywood shelter (30.5 cm × 30.5 cm) was supported ≈1.3 cm above the trap. Each trap contained a 50:50 mixture of propylene glycol and water. Trapping intervals were ≈30 d. Four traps were located 10 m apart within an *Arundo* stand, and 4 traps were similarly placed in native vegetation at each of the 10 locations.

Table 1. Ant sample study site locations along the Rio Grande, TX, USA.

LOCATION	COUNTY	LATITUDE, LONGITUDE
Los Indios	Cameron	26.05, −97.74
North American Butterfly Association (NABA)	Hidalgo	26.180243, −98.364973
Bentsen-Rio Grande State Park	Hidalgo	26.1731300, −98.3825200
San Ygnacio	Zapata	27.048175, −99.430788
Laredo Community College (LCC)	Webb	27.5084, −99.5214
La Bota Ranch	Webb	27.6161258, −99.5569872
Comanche Ranch	Maverick	28.643901, −100.444024
Rosita Ranch	Maverick	28.643901, −100.444024
Sycamore Creek	Kinney	29.4410659, −100.1228475
Del Rio	Val Verde	29.3709, −100.8959

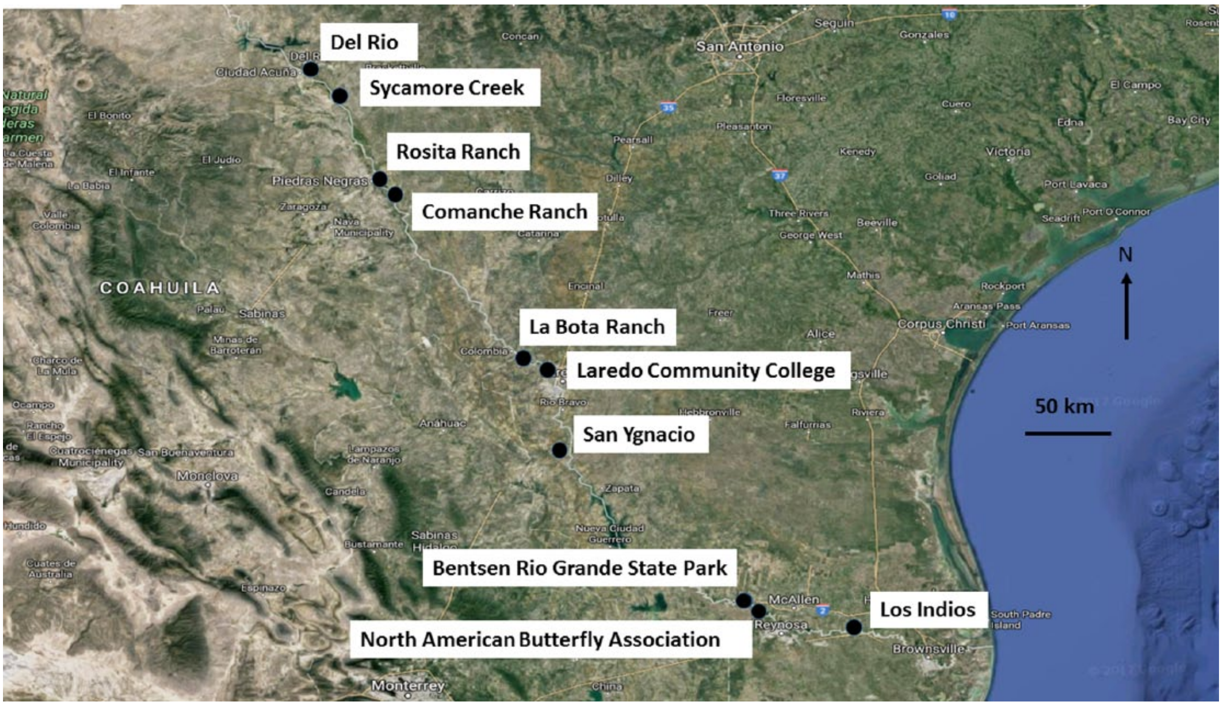

Figure 1. Study sites in the cattle fever tick quarantine zone along the Texas-Mexico border.

Monthly pitfall trap collections were conducted during January to December 2014 at each site. Ant identification was conducted with a stereoscopic microscope using taxonomic ant keys.[14–19] A survey of plants and the presence of extrafloral nectaries was conducted at each study site.

Statistical analysis

Diversity profile estimations were calculated using Spade (Species Prediction and Diversity Estimation).[20] Continuous diversity profile including species richness, Shannon entropy, Simpson index, and Chao2 as well as their effective numbers of species based on incidence data were calculated using species richness prediction and diversity estimation. Shannon entropy provides expected mean which increases with a species richness and evenness. Simpson index values increase as diversity decreases, whereas the inverse Simpson index values increase as diversity increases providing a dominance index giving more weight to common or dominant species. Chao2 estimates true species diversity of a sample using incidence data. Value differences were considered significant when their confidence intervals did not overlap. The program iNEXT[21–23] was used to plot sample size–based rarefaction and extrapolation sampling curves where this curve plots the species richness estimates for a rarefied and extrapolated sample with respect to sample size following bootstrapping 100 times

Figure 2. Standard pitfall trap.

(Figure 4).[22] iNEXT was used to calculate coverage-based rarefaction and extrapolation where species richness estimates for rarefied and extrapolated samples for sample coverage.[21] Using incidence data, iNEXT was used to calculate sample completeness curve where this curve plots the sample completeness (as measured by sample coverage) with respect to sample size. The social nature of ants promotes clumping as members of a colony will recruit numerous nest mates to a particular location making analysis of incidence data (presence or absence) most appropriate.[24,25]

Calculated Hill number unifies the reported biological diversity parameter such that the Hill numbers 0, near 1, and 2 provide the communities' species richness, exponent of Shannon index, and inverse of Simpson index, respectively. More weight is give given to dominant species as the Hill number increases.[23] Coverage-based rarefaction and extrapolation sampling curve provide species richness estimates for rarefied sample and extrapolated sample with sample coverage up to double the reference sample size (Figure 4).

Results

After 12 months, a total of 82 752 ants representing 28 genera and 76 species were captured (Table 2). Only 7 species were captured from all 10 locations (see Table 2). Twenty species were captured at single locations (Table 2). Seven of the ant species were found only in the southern most test sites, Los Indios, North American Butterfly Association (NABA), or Bentsen R.G. In addition, 11 species were found only in the northernmost test sites, Comanche Ranch, Rosita Ranch, Sycamore Creek, or Del Rio. *Pheidole* was the most diverse genus represented by 21 species (Table 2).

Excluding the NABA site, 2-fold to 15.5-fold greater abundances of ants were captured, and more species were encountered, in the native vegetation than in *Arundo* at each test site (Table 3). Ant dominance (number of traps with ants × number of species captured at the respective locations) was higher in native vegetation (Table 3). With the exception of Bentsen R.G., all calculated estimates of biodiversity were greater in native vegetation than in *Arundo* (Table 4). Chao2 estimated that species richness was greater in at least 70% of the test sites. Diversity indicated by the exponential of Shannon index was greater in native vegetation compared with *Arundo* at 40% of the sites: Laredo Community College, Comanche Ranch, Sycamore Creek, and Del Rio (Table 4). Biodiversity as quantified using the inverse of the Simpson index was also greater in native vegetation than in *Arundo* at 40% of the sites. The number of estimated species shared between native vegetation and *Arundo* at each study site ranged from 40.9% to 23.7% (Table 3).

Total ants collected (mean ± SEM) were greater in native vegetation (6793.3 ± 1593.8) compared with *Arundo* (1421.2 ± 374.2: $F = 10.768$; $df = 1, 19$; $P = .004$). Ant dominance (mean ± SEM) was greater in native vegetation (216.0 ± 18.1) compared with *Arundo* (113.9 ± 11.6: $F = 22.476$; $df = 1$, 19; $P < .001$). Total species collected (mean ± SEM) was greater in native vegetation (27.4 ± 1.9) compared with *Arundo* (19.2 ± 1.4: $F = 11.913$; $df = 1$, 19; $P = .003$). Native vegetation has greater diversity than the *Arundo* with both the empirical and extrapolated calculations (Table 4, Figure 3). Greater species richness is found in natural vegetation than is found in *Arundo* indicated by nonoverlap of confidence limits (Table 4, Figure 4). More than 76% of the native vegetation possessed extrafloral nectaries (Table 5).

Discussion

Pitfall trapping of ants has been recognized as an effective monitoring technique.[26,27] The magnitude and diversity of ant assemblages reflect the responses of individual species to environmental conditions of native vegetation and *Arundo* stands. *Arundo* stands represent a new environmental setting different from native vegetation where food resources for ants differ. Thus, species distribution appears driven by resources resulting in the observed ant species assemblages.[28]

In the case of Los Indios, for example, the native vegetation has greater diversity than the *Arundo* with both the empirical and extrapolated calculations (Figure 3). Greater species richness in Los Indios natural vegetation is than found in *Arundo* indicated by nonoverlap of confidence limits (Figure 4). For Los Indios, the sample completeness curve indicates that the number of samples provided is adequate coverage of study area as indicated by the plateauing of the curve (Figure 4). The completeness curve provides a bridge between sample size–based and coverage-based rarefaction and extrapolation. Similar comparisons were conducted for all study sites as summarized in Table 4.

Presence of renewable and predictable food sources on vegetation will support greater populations of ants.[29–31] Composition of ant fauna differs between heterogeneous native vegetation and *Arundo* stands with the former supplying a heterogeneous supply of extrafloral nectaries and a greater

Table 2. Presence/absence of ants captured in pitfall traps in tick quarantine zone.

SPECIES	SUBFAMILY	LI	NABA	BRG	SY	LCC	LB	CR	RR	SC	DR
1. *Aphaenogaster texana texana*	Myrmicinae	+	+	0	0	0	0	0	0	0	0
2. *Atta texana*	Myrmicinae	0	0	+	+	0	0	0	+	+	0
3. *Brachymyrmex depilis*	Formicinae	0	0	0	0	+	+	0	0	0	+
4. *Brachymyrmex patagonicus*	Formicinae	+	+	+	+	+	+	+	+	+	+
5. *Camponotus festinatus*	Formicinae	0	+	0	0	0	+	+	0	+	0
6. *Camponotus floridanus*	Formicinae	+	+	+	+	0	0	0	0	0	0
7. *Camponotus planatus*	Formicinae	+	+	+	0	0	0	0	0	0	0
8. *Camponotus sayi*	Formicinae	+	+	0	0	0	0	0	0	+	0
9. *Camponotus texanus*	Formicinae	+	+	+	+	+	0	0	0	+	0
10. *Cardiocondyla emeryi*	Myrmicinae	0	0	0	0	+	0	0	0	0	0
11. *Crematogaster crinosa*	Myrmicinae	0	+	0	0	0	0	0	0	0	0
12. *Crematogaster laeviuscula*	Myrmicinae	+	+	+	+	+	+	+	+	+	+
13. *Crematogaster lineolata*	Myrmicinae	0	+	0	0	0	0	0	0	0	0
14. *Crematogaster torosa*	Myrmicinae	+	+	0	0	0	0	0	0	0	0
15. *Cyphomyrmex rimosus*	Myrmicinae	+	+	+	+	+	+	+	0	+	0
16. *Dorymyrmex bicolor*	Dolichoderinae	0	0	0	0	0	+	0	0	0	+
17. *Dorymyrmex flavus*	Dolichoderinae	+	+	+	0	+	+	+	+	+	+
18. *Dorymyrmex insanus*	Dolichoderinae	0	0	0	0	+	+	0	+	+	+
19. *Forelius mccooki*	Dolichoderinae	+	+	+	+	+	+	+	+	+	+
20. *Forelius pruinosus*	Dolichoderinae	+	+	0	0	+	+	0	+	+	+
21. *Formica pallidefulva*	Formicinae	0	0	0	0	0	+	0	0	+	0
22. *Hypoponera opaciceps*	Ponerinae	0	0	0	0	0	0	+	0	0	0
23. *Hypoponera opacior*	Ponerinae	0	+	0	0	0	+	+	+	+	0
24. *Hypoponera punctatissima*	Ponerinae	0	0	0	+	0	0	0	+	0	0
25. *Labidus coecus*	Dorylinae	+	+	+	+	+	0	0	+	+	+
26. *Leptogenys elongata*	Ponerinae	+	+	+	0	0	0	+	+	+	+
27. *Monomorium minimum*	Myrmicinae	+	0	0	+	0	0	+	+	+	0
28. Monomorium pharoanis	Myrmicinae	0	0	0	0	0	0	+	0	0	0
29. —	Mutillidae (Family)	+	+	+	+	+	+	+	+	+	+
30. *Myrmecocystus mendax*	Formicinae	0	0	0	0	0	0	0	0	+	0
31. *Neivamyrmex nigrescens*	Dorylinae	0	+	+	0	0	0	0	+	0	0
32. *Neivamyrmex swainsonii*	Dorylinae	0	+	+	+	0	+	+	+	0	+
33. *Neivamyrmex texanus*	Dorylinae	0	0	0	0	0	0	0	+	0	0
34. *Odontomachus clarus*	Ponerinae	0	0	0	0	0	0	0	+	+	+
35. *Pachycondyla harpax*	Ponerinae	0	0	0	+	0	+	0	+	0	0
36. *Paratrechina terricola*	Formicinae	+	+	+	0	+	+	+	+	+	+
37. *Pheidole bicarinata*	Myrmicinae	+	+	+	0	+	+	+	+	+	+
38. *Pheidole cockerelli*	Myrmicinae	0	0	+	0	+	0	0	0	0	0
39. *Pheidole dentata*	Myrmicinae	+	+	+	+	+	+	+	+	+	+

Table 2. (Continued)

SPECIES	SUBFAMILY	LI	NABA	BRG	SY	LCC	LB	CR	RR	SC	DR
40. *Pheidole flavens*	Myrmicinae	0	0	0	0	0	0	0	0	+	0
41. *Pheidole floridana constipata*	Myrmicinae	+	+	+	+	+	+	+	+	+	+
42. Pheidole floridana floridana	Myrmicinae	+	+	0	0	+	+	0	0	+	+
43. *Pheidole humeralis*	Myrmicinae	0	0	0	0	0	+	0	0	0	0
44. *Pheidole hyatti*	Myrmicinae	0	0	0	0	0	0	0	+	+	0
45. *Pheidole lamia*	Myrmicinae	0	0	0	0	0	0	0	+	+	0
46. *Pheidole mera*	Myrmicinae	+	0	0	0	0	+	0	+	+	0
47. *Pheidole metallescens*	Myrmicinae	0	0	+	0	0	+	0	+	+	0
48. *Pheidole moerens*	Myrmicinae	0	0	0	0	0	0	0	0	+	0
49. *Pheidole nuculiceps*	Myrmicinae	0	0	0	0	0	+	0	0	0	0
50. *Pheidole pelor*	Myrmicinae	0	0	0	0	0	0	0	0	+	0
51. *Pheidole porcula*	Myrmicinae	+	0	+	+	+	+	0	+	+	+
52. *Pheidole sciara*	Myrmicinae	0	0	0	+	+	0	+	+	+	0
53. *Pheidole spadonia*	Myrmicinae	+	0	0	0	0	0	0	0	0	0
54. *Pheidole tetra*	Myrmicinae	0	0	+	0	+	+	+	0	+	+
55. *Pheidole texana*	Myrmicinae	0	0	0	0	0	0	0	+	0	0
56. *Pheidole tysoni*	Myrmicinae	0	0	0	0	0	0	0	0	0	+
57. *Pheidole vallicola*	Myrmicinae	0	0	0	0	0	0	+	+	0	0
58. *Pogonomyrmex barbatus*	Myrmicinae	+	0	0	0	0	+	0	0	0	+
59. *Pogonomyrmex rugosus*	Myrmicinae	0	0	0	0	0	+	0	0	0	0
60. *Pseudomyrmex gracilis*	Pseudomyrmecinae	0	+	+	0	0	0	0	0	0	0
61. *Pseudomyrmex pallidus*	Pseudomyrmecinae	0	+	0	0	0	0	0	0	0	0
62. *Solenopsis aurea*	Myrmicinae	0	+	0	0	0	0	0	+	0	0
63. *Solenopsis geminata*	Myrmicinae	0	0	+	0	+	+	+	+	0	0
64. *Solenopsis invicta*	Myrmicinae	+	+	+	+	+	+	+	+	+	+
65. *Solenopsis molesta*	Myrmicinae	+	+	0	+	0	0	0	0	+	0
66. *Solenopsis texana*	Myrmicinae	+	+	+	+	+	+	+	+	+	+
67. *Strumigenys boneti*	Myrmicinae	+	0	0	0	0	0	0	0	0	0
68. *Strumigenys louisianae*	Myrmicinae	0	+	0	0	+	+	0	+	+	+
69. *Strumigenys membranifera*	Myrmicinae	0	0	0	0	+	0	0	0	0	0
70. *Tapinoma litorale*	Dolichoderinae	0	0	+	0	0	0	0	0	0	0
71. *Temnothorax subditivus*	Myrmicinae	+	+	+	+	0	0	+	+	+	+
72. *Temnothorax pergandei*	Myrmicinae	+	0	0	0	+	0	+	+	+	0
73. *Tetramorium bicarinatum*	Myrmicinae	0	+	0	0	0	+	0	0	0	0
74. *Tetramorium caldarium*	Myrmicinae	0	0	0	0	0	+	+	0	0	0
75. *Tetramorium lanuginosum*	Myrmicinae	0	0	+	0	+	0	+	0	0	0
76. *Tetramorium spinosum*	Myrmicinae	+	0	+	+	+	+	+	0	+	0
77. *Trachymyrmex turrifex*	Myrmicinae	0	+	0	0	+	+	+	+	+	+

Abbreviations: BRG, Bentsen R.G.; CR, Comanche Ranch; DR, Del Rio; LB, La Bota; LCC, Laredo Community College; LI, Los Indios; NABA, North American Butterfly Association; RR, Rosita Ranch; SC, Sycamore Creek; SY, San Ygnacio.

Table 3. Enumeration of ants captured in pitfall traps at 10 sample sites along the Rio Grande in Texas January to December 2014.

	LI	NABA	BRG	SY	LCC	LB	CR	RR	SC	DR
Arundo										
Total	573	1045	377	214	2059	1063	1089	4310	1737	1745
Ant dominance	137	168	83	62	150	117	84	154	103	81
No. of species	23	25	23	14	18	18	15	23	21	12
Native vegetation										
Total	1607	1099	738	3317	11 461	5149	14 467	8583	11 884	9628
Ant dominance	248	276	111	173	238	149	257	224	287	197
No. of species	29	30	24	20	26	28	23	33	40	21

Abbreviations: BRG, Bentsen R.G.; CR, Comanche Ranch; DR, Del Rio; LB, La Bota; LCC, Laredo Community College; LI, Los Indios; NABA, North American Butterfly Association; RR, Rosita Ranch; SC, Sycamore Creek; SY, San Ygnacio.
Ant dominance = traps with ants × species.

Table 4. Ant biodiversity in *Arundo* stands and mixed native vegetation (±SE).

LOCATION	NO. OF OBSERVED SPECIES	CHAO2 ESTIMATED SPECIES RICHNESS	EXPONENTIAL OF SHANNON INDEX	INVERSE OF SIMPSON INDEX	CHAO2 ESTIMATED SHARED SPECIES (OBSERVED)
Los Indios					19.3 ± 0.9 (19)
Arundo	23	24.6 ± 2.1a	19.0 ± 1.5a	15.0 ± 1.7a	
Native	29	33.1 ± 4.8b	19.7 ± 1.1a	14.8 ± 0.9a	
NABA					28.3 ± 12.0 (19)
Arundo	25	29.4 ± 4.7a	14.8 ± 1.3a	9.5 ± 0.7a	
Native	30	46.3 ± 14.5a	14.9 ± 1.1a	9.4 ± 0.5a	
Bentsen R.G.					24.9 ± 8.1 (18)
Arundo	24	73.6 ± 59.1a	14.1 ± 2.2a	6.4 ± 1.1a	
Native	24	27.5 ± 3.8a	19.2 ± 1.4a	15.1 ± 1.4b	
San Ygnacio					12.0 ± 2.5 (11)
Arundo	14	16.2 ± 3.3a	11.4 ± 1.5a	8.1 ± 1.3a	
Native	20	28.8 ± 10.0b	13.1 ± 0.9a	10.4 ± 0.6a	
LCC					14.5 ± 1.4 (14)
Aroundo	18	20.6 ± 3.4a	11.1 ± 0.9a	8.2 ± 0.6a	
Native	26	32.0 ± 6.0b	14.6 ± 0.8b	10.0 ± 0.5a	
La Bota					18.3 ± 7.8 (11)
Arundo	20	51.8 ± 39.4a	10.7 ± 1.2a	6.6 ± 0.7a	
Native	22	34.2 ± 10.5a	11.5 ± 1.0a	7.2 ± 0.6a	
Comanche Ranch					10.5 ± 2.5 (9)
Arundo	15	24.5 ± 2.2b	8.3 ± 1.5a	4.7 ± 0.5a	
Native	23	28.7 ± 1.1a	13.2 ± 0.6b	9.6 ± 0.5b	
Rosita Ranch					27.3 ± 10.7 (18)
Arundo	31	54.5 ± 19.8a	17.9 ± 1.3a	11.2 ± 0.8a	
Native	33	44.8 ± 9.5b	19.1 ± 1.5a	12.4 ± 0.8a	
Sycamore Creek					32.4 ± 11.6 (19)
Arundo	23	36.2 ± 12.2a	14.4 ± 1.5a	8.2 ± 0.9a	
Native	40	47.4 ± 5.85b	22.2 ± 1.2b	13.9 ± 0.8b	
Del Rio					15.3 ± 11.8 (8)
Arundo	12	19.3 ± 8.0b	6.2 ± 1.1a	3.4 ± 0.4a	
Native	21	26.1 ± 5.3a	11.7 ± 0.7b	8.0 ± 0.6b	

Abbreviations: LCC, Laredo Community College; NABA, North American Butterfly Association.
Chao2 estimation of species richness is equivalent of diversity of order 0; exponential of Shannon index is equivalent of diversity of order 1; inverse of Simpson index is equivalent of diversity of order 2 (Chao et al., 2015). [a,b]Mean values in a column from the same location pair followed by the same letter are not significantly different as indicated by overlap of 95% confidence intervals.

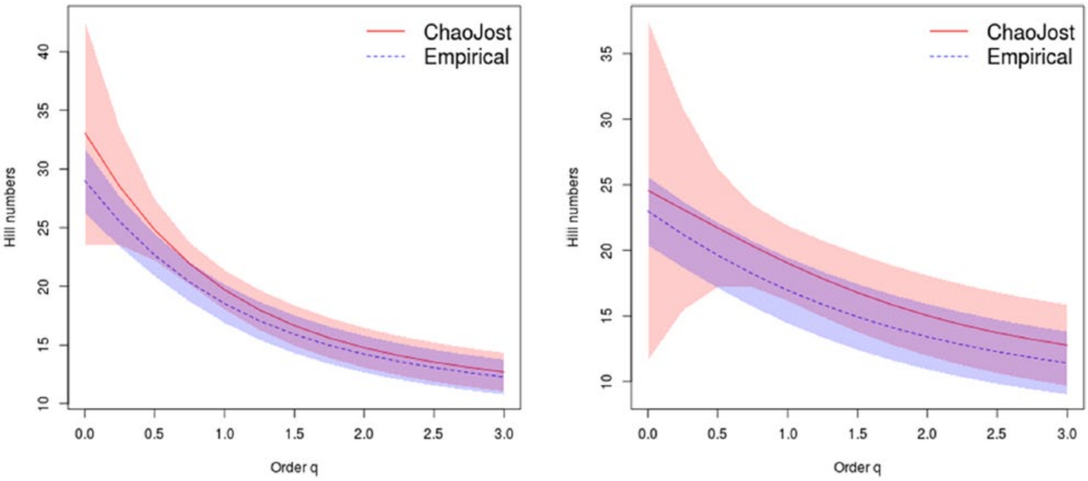

Figure 3. Los Indios ant diversity index Hill number plots, native vegetation (left), and *Arundo* (right) (Chao et al., 2015).

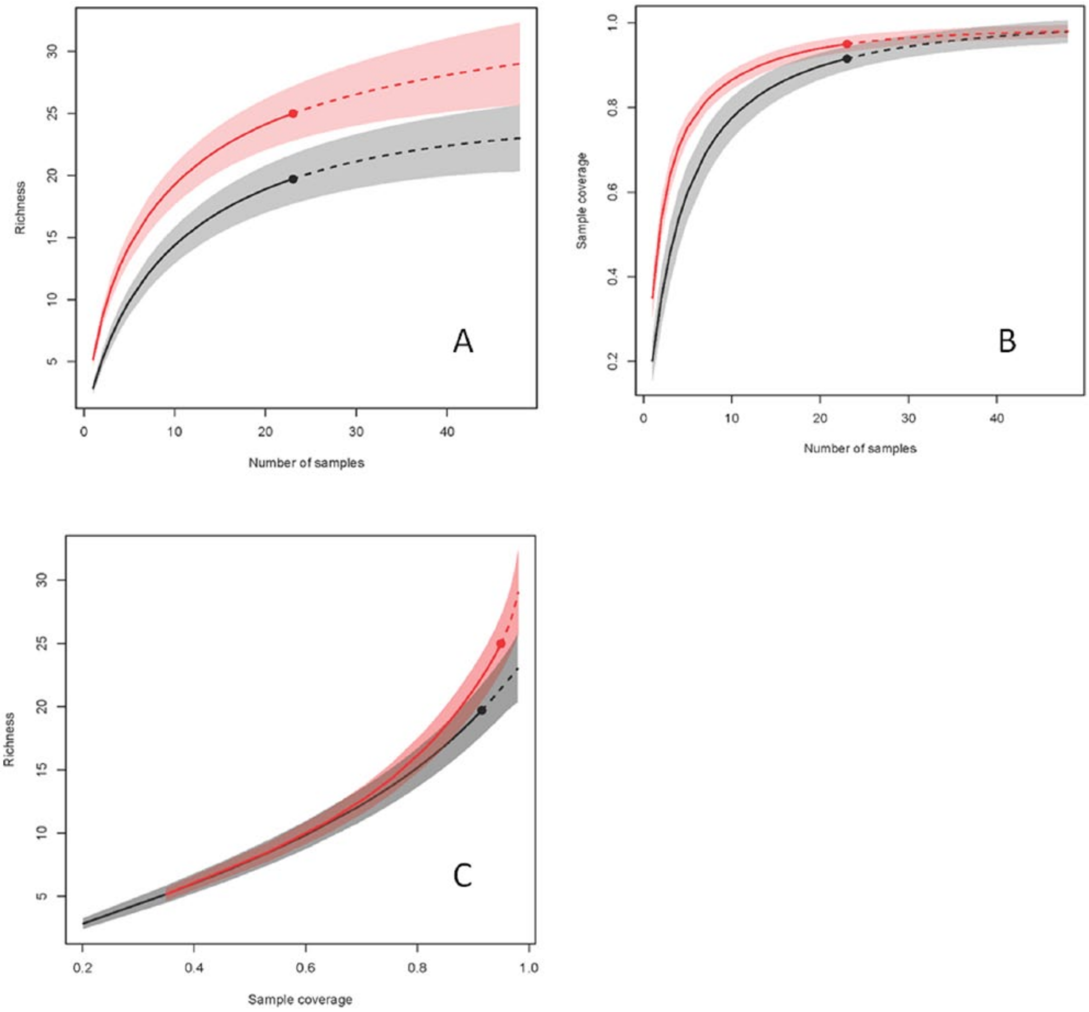

Figure 4. Los Indios ant species richness and diversity comparing *Arundo* and natural habitat. Chao2 (Chao and Jost, 2012) used as estimator of species richness and suggested estimator of sample coverage. (A) Sample size–based rarefaction and extrapolation sampling curve: species richness estimates for a rarefied and extrapolated sample with sample size up to double the reference sample size. (B) Sample completeness curve: sample completeness (as measured by sample coverage) with respect to sample size. This curve provides a bridge between sample size–based and coverage-based rarefaction and extrapolation. (C) Coverage-based rarefaction and extrapolation sampling curve: species richness estimates for rarefied sample and extrapolated sample with sample coverage up to double the reference sample size.

Table 5. Presence/absence of plants and EFNs at 10 sample sites along the Rio Grande in Texas January to December 2014.

SPECIES	EFN	COMMON NAME	LI	NABA	BRG	SY	LCC	LB	CR	RR	SC	DR
Prosopis glandulosa	+	Mesquite	+	0	0	+	+	+	+	+	+	+
Celtis laevigata	0	Hackberry	0	+	+	0	0	+	+	+	+	0
Ulmus crassifolia	+	Cedar elm	+	+	+	+	+	+	+	+	+	+
Acacia spp	+	Acacia	0	+	+	0	0	+	+	0	+	0
Acacia rigidula	+	Blackbrush	+	+	+	+	+	+	+	+	+	+
Celtis pallida	+	spiny hackberry	+	0	+	+	0	+	+	+	0	0
Acacia smallii	+	Huisache	+	+	+	+	+	+	+	+	+	+
Mimosa pigra	0	Mimosa	0	0	+	+	0	+	+	+	+	0
Opuntia lindheimeri	+	Prickly pear cactus	+	+	+	+	+	+	+	+	+	+
Triadica sebifera	+	Chinese tallow	+	+	+	0	+	+	+	0	+	+
Ricinus communis	0	Castor bean		0	+	+	0	0	+	0	+	0
Cenchrus ciliaris	+	Buffel grass		+	+	+	+	+	+	+	+	+
Panicum maximum	+	Guinea grass		+	+	+	+	+	+	+	+	+
Triadica sebifera	+	Chinese tallow	+	+	+	0	+	+	+	0	+	+
Ricinus communis	0	Castor bean	0	+	+	0	0	+	0	+	0	0
Cenchrus ciliaris	+	Buffel grass	+	+	+	+	+	+	+	+	+	+
Panicum maximum	+	Guinea grass	+	+	+	+	+	+	+	+	+	+

Abbreviations: BRG, Bentsen R.G.; CR, Comanche Ranch; DR, Del Rio; EFNs, extrafloral nectaries; LB, La Bota; LCC, Laredo Community College; LI, Los Indios; NABA, North American Butterfly Association; RR, Rosita Ranch; SC, Sycamore Creek; SY, San Ygnacio.

reservoir of arthropods.[31–33] Many species of the native flora have extrafloral nectaries including trees and shrubs (Table 5). Reducing the dominance of *Arundo* and the subsequent re-establishment of native vegetation could increase the diversity and abundance of ant communities within the cattle fever tick permanent quarantine zone.

Extrafloral nectar is important for ant survival and growth and vitality of ant colonies. Ant richness and abundance will be higher where the availability of resources is greatest from water to extrafloral nectar to flower nectar being particularly important during dry periods.[34–36] Ants are obligated to search for other alternate sources of food and water including arthropod plant pests as prey where acquisition of resources by generalists with ant presence is influenced by availability of resources.[34,35]

Arundo stands provide a simpler environment with less resources when compared with native vegetation which results in repressed ant communities with less biodiversity.

Acknowledgements

The authors thank reviewers for meaningful improvements of this manuscript.

Author Contributions

All authors contributed equally.

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