

¹ Demographic data from populations of the understory herb *Heliconia acuminata*
² (Heliconiaceae) in an experimentally fragmented tropical landscape (1997-2009)

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¹⁵ *Open Research Statement:* Data are available as Supporting Information and are also
¹⁶ available in Dryad at <https://doi.org/----->

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Author Note

18 *Corresponding author:* Emilio M. Bruna (embruna@ufl.edu)19 *Word count:* 4718 (text), 1729 (references)

20 The authors made the following contributions. Emilio M. Bruna: Methodology, Data
21 curation, Investigation, Funding acquisition, Conceptualization, Formal analysis,
22 Methodology, Project administration, Resources, Software, Supervision, Validation,
23 Visualization, Writing – original draft; Maria Uriarte: Methodology, Investigation, Funding
24 acquisition, Conceptualization, Formal analysis, Methodology, Project administration,
25 Resources, Software, Supervision, Validation, Visualization, Writing – review & editing;
26 Maria Rosa Darrigo: Methodology, Investigation, Project administration, Writing – review &
27 editing; Paulo Rubim: Methodology, Investigation, Project administration, Writing – review
28 & editing; Cristiane F. Jurinitz: Methodology, Investigation, Project administration, Writing
29 – review & editing; Eric R. Scott: Methodology, Data curation, Software, Validation,
30 Visualization, Writing – review & editing; W. John Kress: Methodology, Investigation,
31 Funding acquisition, Conceptualization, Methodology, Resources, Writing – review & editing.

32

METADATA

33 **I. CLASS I. Data Set Descriptors**

34 **A. Data set identity:** Demographic data from populations of the understory herb
35 *Heliconia acuminata* (Heliconiaceae) in an experimentally fragmented tropical landscape
36 (1997-2009).

37 **B. Data set identification code:**

- 38 1. Dataset File 1: HDP_plots.csv
39 2. Dataset File 2: HDP_1997_2009.csv

40 **C. Data set description:**

41 **1. Originators:** Emilio M. Bruna, Department of Wildlife Ecology and Conservation,
42 University of Florida, PO Box 110430, Gainesville, FL 32611-0430, USA and Center for
43 Latin American Studies, University of Florida, PO Box 115530, Gainesville, FL 32611,
44 USA.

45 **2. Abstract:** Habitat fragmentation is thought to be a leading cause of extinction, but
46 the demography of species in fragmented landscapes remains poorly understood. This
47 is particularly true in tropical ecosystems, where studies monitoring populations of
48 species in both fragments and areas of continuous habitat across all life-history stages
49 are virtually nonexistent. Here we report 12 years (1997-2009) of annual censuses of 13
50 populations of the Amazonian understory herb *Heliconia acuminata* (LC Rich.). These
51 surveys were conducted in plots established in the experimentally fragmented
52 landscape of the Biological Dynamics of Forest Fragments Project, located north of
53 Manaus, Brazil. The plots, each 50 x 100 m, are located in forest fragments of different
54 sizes (N = 4 plots in 1-ha fragments and N = 3 plots in 10-ha fragments) as well as
55 continuous forest (N = 6 plots). The population in each plot was censused annually, at

56 which time we recorded identified, marked, and measured new seedlings, identified any
57 previously marked plants that had died, and recorded the size of individuals that
58 survived. During the flowering season we conducted regular surveys to recorded the
59 identity of flowering plants and the number of inflorescences each produced. The
60 resulting dataset comprises >67000 plant x year records of N = 8586 plants, including
61 N = 3464 seedlings that became established after the initial census. These data have
62 been used in publications on topics ranging from how fragmentation-related reductions
63 in germination influence population dynamics to tests of statistical methods for
64 analyzing reproductive rates.

65 **D. Key words:** Amazon, Brazil, deforestation, demography, edge effects, forest
66 fragments, habitat fragmentation, integral projection models, matrix models, population
67 dynamics, vital rates.

68 CLASS II. RESEARCH ORIGIN DESCRIPTORS

69 A. Overall project description:

70 **1. Identity:** The *Heliconia* Demography Project

71 **2. Originators:** Emilio M. Bruna, W. John Kress, and María Uriarte

72 **3. Period of study:** 1997-2009

73 **4. Objectives:** Habitat fragmentation continues to be a major focus of research by
74 ecologists (Didham et al. 2012, Haddad et al. 2015, Brudvig et al. 2017, Resasco et al.
75 2017, Fletcher et al. 2018) decades after it was first identified as a threat to the
76 integrity of ecosystems (Harris 1984, Wilcove et al. 1986). A large body of empirical
77 research has documented myriad biotic changes associated with fragmentation,
78 including the local extinction of plant species from fragments (Harrison and Bruna
79 1999, Laurance et al. 2011). Although the demographic mechanisms underlying these

extinctions are rarely known (Bruna et al. 2009), they are often hypothesized to result from reduced rates of individual growth, reproduction, or survivorship in fragments (Laurance et al. 1998, Zartman et al. 2015). This is especially true tropical forest fragments, where abiotic conditions can be dramatically different from those in primary forest (reviewed in Broadbent et al. 2008). Tests of this hypothesis remain limited, however, by the paucity of long-term demographic data collected in both tropical forest fragments and continuous forest sites (Bruna et al. 2009).

Most studies investigating the effects of forest fragmentation on tropical plants focus on trees (Cordeiro et al. 2009, Jurinitz et al. 2013, Zambrano and Salguero-Gómez 2014), in part because they are major reservoirs of carbon (Slik et al. 2010, Lasky et al. 2014). However, herbaceous species can comprise up to 30% of the plant species in lowland tropical forests (Gentry and Emmons 1987, Ribeiro et al. 2010, Iannone and Vargas 2022, Spicer et al. 2022), where they are habitat and food for myriad animal taxa and economically and culturally vital non-timber forest products (Nakazono et al. 2004, Athayde et al. 2006). Despite their biocultural importance, however, the way in which habitat fragmentation and other global change phenomena influences the population dynamics of tropical understory plants remains conspicuously understudied (Bruna et al. 2009).

The *Heliconia* Demography Project (HDP) was established to address the lack of data on the demography of understory plants in fragmented tropical landscapes. The core of the HDP is annual censuses of thirteen populations of *Heliconia acuminata* located in either continuous forest or experimentally isolated forest fragments at Brazil's Biological Dynamics of Forest Fragments Project (Laurance et al. 2011) The primary purpose behind their initial collection was to parameterize size-structured demographic models (Caswell 2000, Ellner and Rees

106 2006) with which to (1) compare the demography and population dynamics of *H.*
107 *acuminata* populations in fragments and continuous forest, and (2) test the
108 hypothesis that reductions in seedling establishment in forest fragments would
109 lead to population declines.

110 **5. Abstract:** Here we report 12 years (1997-2009) of annual censuses of 13 populations
111 of the Amazonian understory herb *Heliconia acuminata* (LC Rich.). These surveys
112 were conducted in plots established in the experimentally fragmented landscape of the
113 Biological Dynamics of Forest Fragments Project, located north of Manaus, Brazil.
114 The plots, each 50 x 100 m, are located in forest fragments of different sizes (N = 4
115 plots in 1-ha fragments and N = 3 plots in 10-ha fragments) as well as continuous
116 forest (N = 6 plots). The population in each plot was censused annually, at which time
117 we recorded identified, marked, and measured new seedlings, identified any previously
118 marked plants that had died, and recorded the size of individuals that survived.
119 During the flowering season we conducted regular surveys to recorded the identity of
120 flowering plants and the number of inflorescences each produced. The resulting dataset
121 comprises >67000 plant x year records of N = 8586 plants, including N = 3464
122 seedlings that became established after the initial census. These data have been used
123 in publications on topics ranging from how fragmentation-related reductions in
124 germination influence population growth rates to tests of statistical methods for
125 analyzing reproductive rates.

126 **6. Sources of funding:** The initial establishment of plots and the 1997-2002 surveys
127 were supported by grants to E. M. Bruna from the Smithsonian Institution (Graduate
128 Student Research Award), the University of California, Davis (Center for Population
129 Biology Graduate Research Grant, M. E. Mathias Graduate Research Grant), the
130 Biological Dynamics of Forest Fragments Project (Graduate Student Logistics Grant),
131 the National Science Foundation (Dissertation Improvement Grant INT 98-06351), and

the Ford Foundation (Dissertation Year Fellowship). The 2001-2005 surveys were supported a grant from the National Science Foundation to E. M. Bruna (Research Starter Grant DEB-0309819). The 2006-2009 surveys were supported by grants from the National Science Foundation to E. M. Bruna (DEB-0614149) and María Uriarte (DEB-0614339). Subsequent analyses and the preparation of these data for archiving were supported by the National Science Foundation (DEB-1948607).

138 B. Subproject description

139 1. Site description

140 a. **Site type:** Lowland tropical forest

141 b. **Geography:** The data were collected at the Biological Dynamics of Forest
142 Fragments Project (BDFFP, 2°30'S, 60°W), a 1000-km mosaic of lowland
143 forest, forest fragments, secondary forests, and pastures located
144 approximately 70 km north of Manaus, Amazonas, Brazil (Fig. 1).

145 c. **Habitat:** The BDFFP is dominated by tropical evergreen lowland forest
146 (i.e., ‘tropical moist forest’, *sensu* Holdridge (1967). The forest canopy at
147 the sites is ~35–40 m tall, with emergent trees of up to ~45 m
148 (Rankin-de-Mérona et al. 1992). The tree community at the BDFFP is
149 highly diverse: ~1300 species total (Laurance 2001), with as many as 280
150 tree species ha⁻¹ (Oliveira and Mori 1999). The understory is dominated by
151 stemless palms (Scariot 1999). All HDP plots are located in *terra-firme* (i.e.,
152 non-flooded) forest and none are bisected by streams.

153 d. **Geology:** Soils in the sites are nutrient-poor xanthic ferralsols, known as
154 yellow latosols in the Brazilian soil classification system. Despite their high
155 clay content they have poor water-retention capacity (Fearnside and

156 Leal-Filho 2001). The often rugged topography at the BDFFP ranges in
157 elevation from 50-150 m elevation (Gascon and Bierregaard 2001).

158 e. **Watersheds:** The BDFFP landscape includes catchments of the Urubu,
159 Cuieiras, and Preto da Eva rivers (Nessimian et al. 2008).

160 f. **Site history:** A complete history of the BDFFP can be found in Gascon
161 and Bierregaard (2001) and Bierregaard et al. (2002). Briefly, the BDFFP
162 reserves were established on three cattle ranches. Fragments were isolated
163 between 1980-1984 by felling the trees surrounding the patch of forest to be
164 isolated (Lovejoy et al. 1986). Fragment reserves were fenced to prevent the
165 incursion of cattle from the surrounding pastures. To ensure fragments
166 remain isolated, a 100m strip around each fragment is regularly cleared of
167 the secondary growth (Gascon and Bierregaard 2001). The structure and
168 species composition of the secondary growth that surrounds a fragment,
169 which is strongly dependent on whether fire was used to clear land prior to
170 planting pasture grasses (Mesquita et al. 2001), can have large effects on
171 the species composition, ecological processes, and abiotic conditions in
172 fragments (reviewed in Laurance et al. 2002, 2011). The BDFFP is
173 currently administered collaboratively by the Smithsonian Tropical Research
174 Institute and Brazil's Instituto Nacional de Pesquisas da Amazônia (INPA).

175 g. **Climate:** Mean annual temperature at the site is 26°C (range 19-39°C).
176 Annual rainfall ranges from 1900-2300 mm (Scott et al. 2022), with a
177 pronounced dry season from June-December in which there is <100 mm
178 rain per month.

179 2. Sampling Design & Research Methods

180 a. **Focal species:** *Heliconia acuminata* (Heliconiaceae) is a perennial,

self-incompatible monocot native to Amazonia (Kress 1990) and widely distributed throughout the Amazon basin (Kress 1990). Although many species of *Heliconia* grow in large aggregations on roadsides, gaps, and in other disturbed habitats, others, including *H. acuminata*, grow primarily in the shaded forest understory (Kress 1983). *Heliconia acuminata* is the most abundant understory herb throughout much of the BDFFP (Ribeiro et al. 2010); the other two *Heliconia* species found in the BDFFP reserves are either very rare (*H. latispatha*) and restricted saturated soils adjacent to streams (*H. tarumaensis*).

Each *Heliconia acuminata* has a basal rhizome from which emerge erect vegetative shoots with broad leaves. Reproductive plants have one or more flowering shoots, each of which has a single inflorescence. Plants grow slowly (Bruna and Ribeiro 2005, Gagnon et al. 2011) and the proportion of plants that flower is low (Bruna 2002, Bruna and Kress 2002). The primary herbivores of *Heliconia* species are Hispine beetles, whose larvae and adults scrape the surface of unrolled immamture leaves (Strong 1977). The beetle species associated with *H. acuminata* is *Cephaloleia nigriceps* Baly (Staines and Garcia-Robledo 2014); it actually does little damage to leaves but can cause extensive damage to bracts, flowers, and developing ovaries.

Heliconia can be propagated by segmenting the rhizome (Berry and Kress 1991, Bruna and Andrade 2011), and clonal spread is common in the *Heliconia* species found in open or disturbed habitats (Schleuning et al. 2008). However, recruitment in *H. acuminata* and other understory species is primarily via seeds (Bruna 1999, 2002). Plants that flower do so during the rainy season, with the propbability of

flowering increasing with plant size (Bruna and Kress 2002). The overwhelming majority of plants in our dataset that flowered (75%) produced a single inflorescence (range = 1-7). Inflorescences have an average 22.28 ± 1.17 SE flowers (range 4-62); each flower remains open for one day before falling from the plant. Pollen transfer experiments indicate self-compatibility is extremely low (Bruna and Darrigo, *unpubl. data*); successfully pollinated flowers can produce 1-3 seeds, with an average of 2 seeds per fruit (Bruna 2014).

Heliconia acuminata is pollinated by the ‘traplining’ hummingbirds *Phaeothornis superciliosus* and *P. bourcieri*. Visitation rates to flowers are extremely low (<1 visit hour⁻¹, Bruna et al. 2004), as are rates of fruit production (Bruna and Kress 2002). The fleshy blue fruits are consumed by birds (Uriarte et al. 2011); in our study sites the primary dispersers are the White-necked Thrush (*Turdus albicollis*), the Thrush-like-Manakin (*Schiffornis turdinus*), and several species of manakin (*Pipra erythrocephala*, *P. pipra*, *Lepidothrix serena*, and *Corapipo gutturalis*). The seeds germinate 6-7 months after dispersal, which coincides with the onset of the rainy season (Bruna 1999, 2002). Post-dispersal seed predation is negligible. Experiments revealed that few *H. acuminata* seeds germinate after one year unless protected from burial under leaf-litter (Bruna 1999, 2002), which is consistent with the generalization that few plant species in lowland tropical forests have seed banks (Vázquez-Yanes and Orozco-Segovia 1993).

b. **Taxonomy, systematics, and voucher specimens:** *Heliconia* is the only genus in the family Heliconiaceae. This family is distinguished from the others in the order Zingiberales by having inverted flowers, a single

233 staminode, and drupaceous fruits (Kress 1990). It is estimated that there
234 are 200-250 species of *Heliconia*, almost all of which are native to the
235 Neotropics. *Heliconia acuminata* L. C. (Rich.) (Richard 1831) is one of the
236 approximately 20 *Heliconia* species found in the Brazilian Amazon (Kress
237 1990). We deposited voucher specimens of *H. acuminata* collected in areas
238 adjacent to demographic plots at the herbaria of the Instituto Nacional de
239 Pesquisas da Amazônia (Accession Numbers INPA 189569-189573) and the
240 University of California, Davis (Accession Numbers DAV 69391-69396).

241 c. **Permanent Plots:** Surveys of *Heliconia acuminata* demography were
242 carried out in 13 permanent demographic plots distributed across the
243 BDFFP landscape (Bruna and Kress 2002). Six plots are in continuous
244 forest, four are in 1-ha fragments, and three are in 10-ha fragments (Fig. 1).
245 Each demographic plot is 50m x 100m and is subdivided into 50 contiguous
246 subplots of 10 x 10 m to facilitate the surveys. Plots in 1-ha fragments were
247 established in a randomly selected half of the fragment, plots in 10-ha
248 fragments are located in the center of the fragment, and plots in continuous
249 forest are located 500-4000 m from any borders with cattle pastures or
250 secondary forest (Fig. 2). The plots furthest apart are from each other are
251 separated by ~70 km.

252 Plots 1-ha fragments, 10-ha fragments, and three of the continuous
253 forest sites were established from January-April 1997, the remaining
254 three plots in continuous forest were established in January 1997. To
255 mark the plants, a team of 2-3 people slowly walked through each
256 subplot and located all *Heliconia acuminata* and marked them with a
257 wooden stake to which was attached an individually numbered
258 aluminum tag. The size of each plant was measured in two ways: (1)

259 by counting its number of vegetative shoots and (2) by measuring the
260 height of the plant from the ground to the top of its highest leaf
261 (rounded to the nearest cm). Three additional plots were established in
262 continuous forest sites in 1998 (CF 4-6); all plants in these plots were
263 tagged and measuring in the same way as in other plots.

264 d. **Frequency of Data Collection** Plots were censused annually at the onset
265 of the rainy season to coincide with seedling establishment (generally late
266 January to February). The exception to this was the three continuous forest
267 plots established in August 1998, which were censused in August 1999.
268 During each census team members recorded which plants died, the size (i.e.,
269 height and number of shoots) of all surviving plants, and the size of all new
270 seedlings, which were also marked with a numbered tag. Survey team
271 members also noted any new canopy gaps created by fallen trees or limbs,
272 estimated the proportion of any subplot that was affected by a treefall
273 (available at the HDP Github repository:
274 <https://github.com/BrunaLab/HeliconiaDataPaper>), and recorded if plants
275 were damaged by fallen branches or palm fronds (reported here).

276 Regular visits were made to all 13 plots throughout the rainy season to identify
277 reproductive individuals, at which time we recorded the number of reproductive
278 shoots (i.e., inflorescences) each plant had.

279 3. **Project personnel:** In addition to the Originators, other key personnel include the
280 Project Managers that were responsible for coordinating the annual censuses and other
281 field activities, BDFFP Technicians (“*Mateiros*”) that assisted with data collection and
282 provided logistical support in the field, and undergraduate and postgraduate field
283 assistants hired to assist with the surveys.

- 284 a. **Project Managers:** Paulo Rubim (2007-2012), Maria Beatriz Nogueira
285 (2002), Maria Rosa Darrigo (2002-2003), Cris Follman Jurinitz (2003),
286 Simone Benedet (2004).
- 287 b. **BDFFP Technicians:** Osmaildo Ferreira da Silva, Francisco Marques,
288 Alaercio Marajó dos Reis, João de Deus Fragata, Romeu Cardoso.
- 289 c. **Undergraduate & Postgraduate Field Assistants:** Olavo Nardy
290 (2000), Obed Garcia (2001), Sylvia Heredia (2001-2002), Maria Beatriz
291 Nogueira (2002), Cris Follman Jurinitz (2003), David M. Lapola (2003),
292 Denise Cruz (2003), Cristina Escate (2004), Bruno Turbiani (2005),
293 Elisabete Marques da Costa (2006), Wesley Dátilo da Cruz (2007),
294 Jefferson José Valsko da Silva (2007).

295 **CLASS III. DATA SET STATUS AND ACCESSIBILITY**

296 **A. Status**

297 1. **Latest update:** 2022-05-24

298 2. **Latest archive date:** 2022-05-24 (*to replace with date of archiving at Dryad*)

299 3. **Metadata status:** Complete (last update: 2022-07-27)

300 4. **Data verification & quality control procedures:** Following each survey, the
301 measurements of plant height and stem number were compared with those from the
302 previous year to identify potential errors in either plant measurement or entry (e.g., a
303 plant with 1 shoot in year t and 11 shoots in year t+1 is likely an error in data entry).
304 Discrepancies were investigated by referring to the original data sheets and, on
305 occasion, returning to the field to remeasure plants.

306 An extensive review of the data was also conducted in preparation for archiving.

We began by generating a list of potential anomalies that could indicate errors (e.g. extremely large changes in size from one year to the next, plants marked as dead that had subsequent measurements), and then wrote code to search for these anomalies using the R statistical programming language (Team 2014). We also used the `pointblank` library (Iannone and Vargas 2022), which similarly identifies cases in a dataset for review and validation. All records flagged were evaluated by E. M. Bruna by checking the values in the electronic records against the original data sheets. Corrections to the dataset were also made using R scripts; the code documenting and implementing these changes is archived at Zenodo [*url to be added upon acceptance*]. Questions regarding the dataset or code should be referred to E. M. Bruna, who will investigate and update the database or code as needed. Code for any post-publication updates is maintained at the HDP Github Repository.

320 B. Accessibility

321 1. **Storage location and medium:** Ecological Society of America Data Archives [url to
322 be added] and the Dryad Digital Repository [url to be added].

323 2. **Location of original data forms, electronic files, and archived copies:** Original
324 data sheets are stored at the University of Florida. Scanned copies of the data sheets
325 (in .pdf format) and the electronic copies of the data in (in .csv format) are stored on a
326 desktop computer at the University of Florida that is backed up daily to two portable
327 hard drives and two cloud storage services. The integrity of digital files is verified
328 semi-annually.

329 3. **Contact person(s):** Emilio M. Bruna, Department of Wildlife Ecology and
330 Conservation, Box 110430, Gainesville, FL 32611 USA. Phone: (352) 846-0634. Email:
331 embruna@ufl.edu

332 **4. Copyright restrictions:** None

333 **5. Proprietary Restrictions:**

334 **a. Proprietary restrictions:** None.

335 **b. Conditions of Reuse:** Any publication using data collected at the BDFFP
336 must include a BDFFP Technical Series Number in the Acknowledgments.
337 Authors can request this series number upon the acceptance of their article
338 by contacting the BDFFP's Scientific Coordinator or E. M. Bruna.

339 **c. Citation:** Authors of any publications or products using these data should
340 cite both this data paper and the Dryad data archive [*citation of Dryad*
341 *archive to be added upon acceptance*]. We also request that they provide E.M.
342 Bruna a copy of their article upon acceptance, which allows us to track the
343 dataset's usage, inform users of any corrections or updates, report articles
344 using the data to the funding agencies that provided support, and document
345 the different ways in which the scientific community uses the data.

346 **d. Disclaimers:** While the data are provided in good faith and are accurate
347 to the best of our knowledge, they are provided "as is". We do not assume
348 any legal liability or responsibility for their accuracy, completeness, or
349 utility. The responsibility for use and analysis of these data lies completely
350 with the user.

351 **CLASS IV. DATA STRUCTURAL DESCRIPTORS**

352 **A. Dataset File 1:** Descriptors of demographic plots

353 **1. Identity:** HDP_plot_descriptors.csv

354 **2. Size:** 14 rows (including header), NA bytes.

3. Format and storage mode: ASCII text, comma delimited. No compression scheme used.

4. Header information: The first row of the file contains the variable names.

5. Alphanumeric attributes: Mixed

6. Special Characters: Missing values are represented with NA.

7. Authentication Procedures: checksum (MD5:2d3ec96006667abab1ecc14e72055850)

8. Start & End Columns: Start: plot, End: yr_isolated

9. Variable Information: Each row is one plot, with the columns providing plot-specific values for each variable.

[INSERT TABLE 1 HERE]

B. Dataset File 2: *Heliconia* Demographic Data

1. Identity: HDP data 1997-2009.csv

2. **Size:** 66785 rows (including header), 3.79 kilobytes.

3. **Format and storage mode:** ASCII text, comma delimited. No compression scheme used

4. **Header information:** The first row of the file contains the variable names.

5 Alphanumeric attributes: Mixed

6. Special Characters: Missing values are represented with NA.

7. **Authentication Procedures:** Checksum (MD5:15bbb4869fe192649e93d3474d3145d1)

374 8. **Start & End Columns:** Start: plot, End: tag_number

375 9. **Data anomalies:** Plants that could not be found during a survey were recorded as
376 ‘missing’ but maintained on the survey list to be searched for in subsequent years. The
377 same is true of plants under branches or the crowns of fallen trees, which might not be
378 found for several years when the crown’s leaves dried and fell or the area under the
379 crown could be safely searched. The codes used to denote such cases are defined in
380 Table 2.

381 The stakes and numbered tags used to mark plants were sometimes displaced,
382 broken, or buried under leaf litter as a result of tree falls or other disturbances. If
383 a plant’s tag couldn’t be found after an extensive search, it would be marked
384 with a new tag. In some cases, it was straightforward to determine such a plant’s
385 original number when entering the survey data (e.g., when all plants in a
386 low-density subplot were found except one, which in the prior year was similar in
387 size as the plant found without a tag). In those cases, the plant’s prior
388 measurements were transferred to the new number and we logged the details of
389 the change in tag number; the log is available at the HDP Github repository. In
390 other cases, it was impossible to definitively determine a plant’s original number
391 (e.g., when two similarly sized plants in a subplots were both missing their tags).
392 In these cases the original number was maintained in the database with the
393 plant’s status noted as ‘missing’ in subsequent surveys. The record for the new
394 number indicates the plant with which it is associated is an established plant
395 that was found without a tag (see Section IV, Table 2) and not a new seedling.

396 There were also cases in which established plants were found without tags in
397 subplots where all previously tagged plants had already been located and
398 measured, indicating previous survey teams had failed to find and mark them.
399 These plants were marked, measured, and added to the database with a code

400 indicating they were a established (i.e., post-seedling) but previously unmarked
401 plant (See Table 2). Of the N = 947 plants in the dataset, 11% were found
402 without tags after the plot had been established. Almost half of these (49%) were
403 in the three plots where *H. acuminata* density was highest (CF-1, FF-7, CF-3).

404 Due to logistical constraints, no survey was conducted in plot CF-6 (Cabo Frio,
405 Continuous Forest) in 2003.

- 406 **8. Variable information:** Each row in the data set is a demographic plot, with columns
407 of data describing that plot. Blanks do not denote missing information, but rather
408 nothing relevant to report.

409 [INSERT TABLE 2 HERE]

410 **CLASS V. SUPPLEMENTAL DESCRIPTORS**

411 **A. Computer programs and data-processing algorithms:** The version of the R code
412 used to prepare the data for archiving can be found at Zenodo [*url to be added*].

413 Post-publication updates to the code or data can be found at the HDP Github Repository
414 (<https://github.com/BrunaLab/HeliconiaDataPaper>).

415 **B. Publications and results:** The following articles have included analyses of part or all of
416 the dataset. An update list can be found at the HDP Github repository
417 (<https://github.com/BrunaLab/HeliconiaDataPaper>).

- 418 1. Bruna, E. M. and W. J. Kress. 2002. Habitat fragmentation and the demographic
419 structure of an Amazonian understory herb (*Heliconia acuminata*). *Conservation
420 Biology*, 16(5): 1256-1266.
- 421 2. Bruna, E. M., O. Nardy, S. Y. Strauss, and S. P. Harrison. 2002. Experimental
422 assessment of *Heliconia acuminata* growth in a fragmented Amazonian landscape.

423 *Journal of Ecology*, 90(4): 639-649.

424 3. Bruna, E. M. 2002. Effects of forest fragmentation on *Heliconia acuminata* seedling
425 recruitment in the central Amazon. *Oecologia*, 132:235-243.

426 4. Bruna, E. M. 2003. Are plant populations in fragmented habitats recruitment limited?
427 Tests with an Amazonian herb. *Ecology*, 84(4): 932-947.

428 5. Bruna, E. M. 2004. Biological impacts of deforestation and fragmentation. Pages 85-90
429 in *The Encyclopaedia of Forest Sciences*. J. Burley, J Evans, and J Youngquist, (eds.).
430 Elsevier Press, London.

431 6. Morris, W. F., C. A. Pfister, S. Tuljapurkar, C. V. Haridas, C. Boggs, M. S. Boyce, E.
432 M. Bruna, D. R. Church, T. Coulson, D. F. Doak,, S. Forsyth, J-M. Gaillard, C. C.
433 Horvitz, S. Kalisz, B. E. Kendall, T. M. Knight, C. T. Lee, and E. S. Menges. 2008.
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459 **C. Other relevant publications and datasets:** The following data archives and articles

460 include information (e.g., seeds per fruit, seed germination rates, seedling survival rates,

461 plant growth rates following damage) that can be used in concert with the census data to

462 conduct demographic modeling and other analyses. An updated list can be found in the

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488 contrasting land-use histories. *Journal of Tropical Ecology* 21(1):127–131.

489 **ACKNOWLEDGMENTS**

490 This work would not have been possible without the technicians and field assistants
491 participating in the annual surveys, the logistical support provided by the BDFFP staff, and

492 the organizations providing financial support. Sharon Y. Strauss, Susan P. Harrison, and
493 Patricia Delamônica Sampaio provided invaluable feedback during the project's
494 establishment. Charles L. Staines identified the Hispine beetle. This paper is publication
495 number -- in the BDFFP Technical Series.

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Variable	Definition	Codes	Storage
plot	Code used to identify a plot	FF1-FF7: plots in fragments CF1-CF6: plots in continuous forest	string
habitat	Habitat type in which a plot is located	one: 1-ha fragment ten: 10-ha fragment forest: continuous forest	string
ranch	Ranch in which a plot is located	Porto Alegre, Esteio, Dimona	string
bdffp_no	The BDFFP Reserve Number for the reserve in which plot is located	2017, 2018, 1104, 1301, 2206, 1202, 3209, 1501, or 'none' (for plots outside BDFFP reserve boundaries)	string
yr_isolated	Year in which a fragment was initially isolated	1980, 1983, 1984	integer

Variable	Definition	Codes	Range	Storage
plot	Plot in which plant is located	FF1-FF7, CF1-CF6	-	string
subplot	Subplot in which plant is located	A1-A10, B1-B10, C1-C10, D1-D10, E1-E10, (CF3 only: F6-F10, G6-G10, H1-H10, J1-J10)	-	string
plant_id	Unique ID number assigned to plant	-	1-8660	integer
year	Calendar year of survey	-	1998-2009	integer
shts	No. of shoots when surveyed (Units: shoots; Precision: 1)	-	0-24	integer
ht	Plant height when surveyed (Units: cm; Precision: 1)	-	0-226	integer
infl	No. of inflorescences (if flowering) (Units: Inflorescences; Precision: 1)	-	1-7	integer
recorded_sdlg	Plant was new seedling	TRUE = seedling FALSE = not a seedling)	-	logical
found_without_tag	Plant was found without a tag	TRUE = established plant with no tag FALSE = seedling or previously marked plant	-	logical
treefall_status	Plant was under fallen branch/tree	under branchfall, under treefall, under litter, NA	-	string
census_status	Status in a census	measured = plant alive, measured dead = plant died between this and prior census missing = plant not found in census	-	string

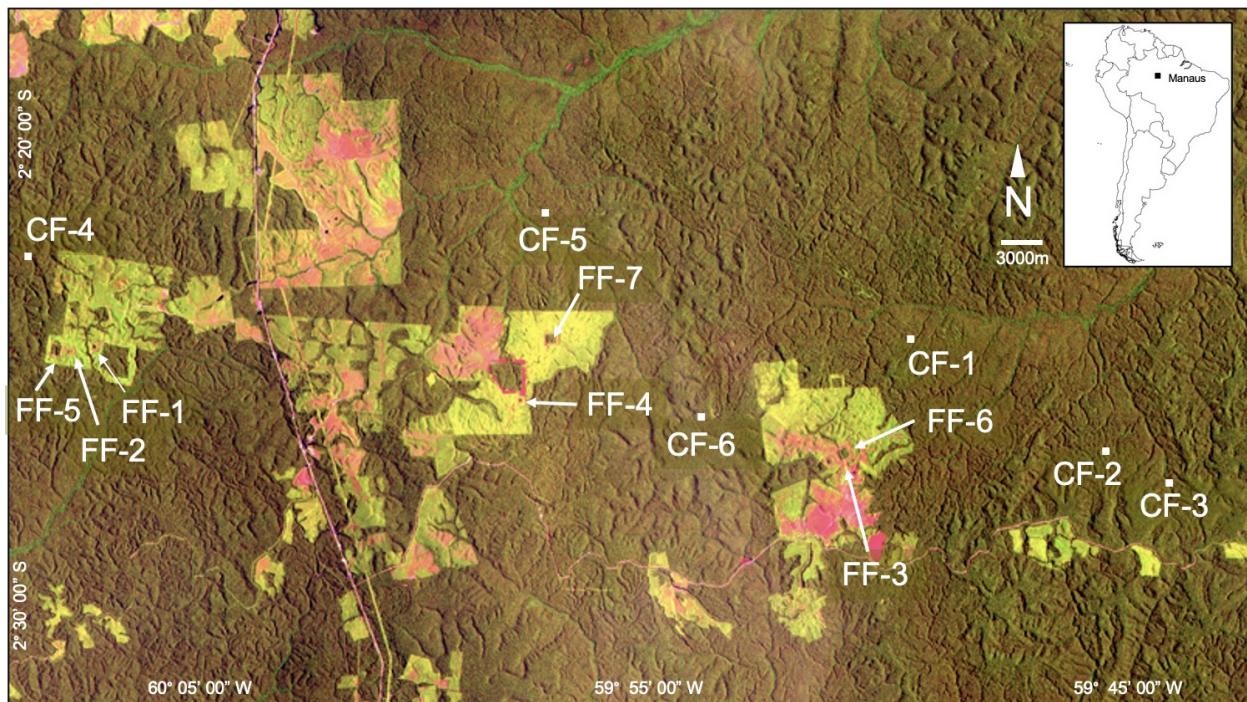


Figure 1. Satellite image of the Biological Dynamics of Forest Fragments Project showing the location of the *Heliconia* Demographic Plots and landscape cover at the time plots were established. Plots are located in Continuous Forest (CF1-CF6) or Forest Fragments (FF1-FF7). Dark green is primary forest, light green is regenerating forest, and red indicates pasture and recently cleared areas. The BDFFP is located 70 km north of Manaus, Brazil (inset map); for additional details on each plot see Table 1.

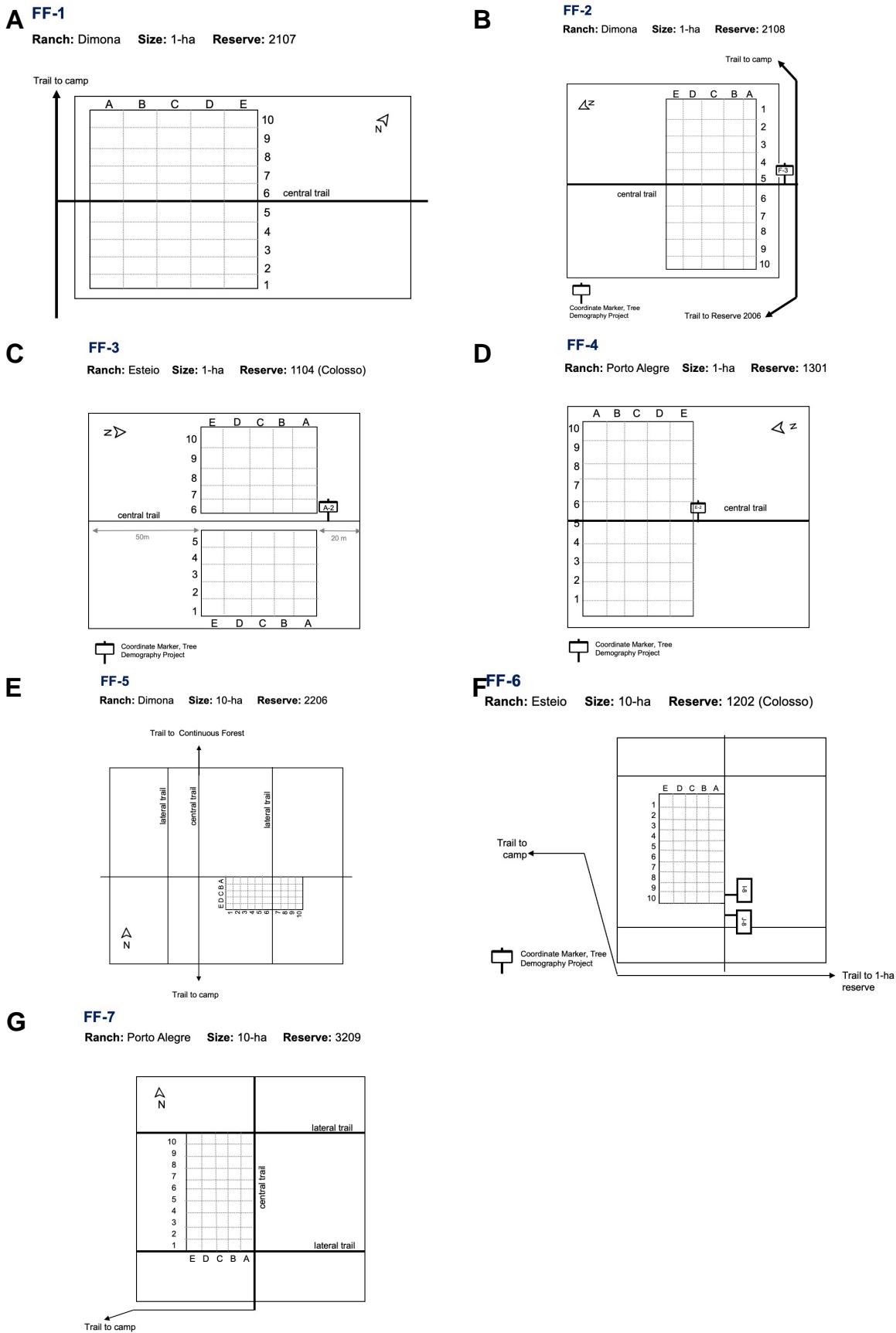
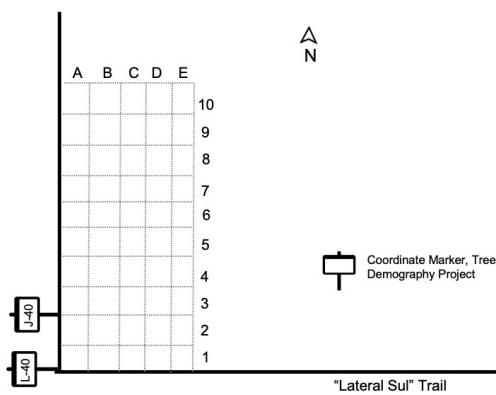


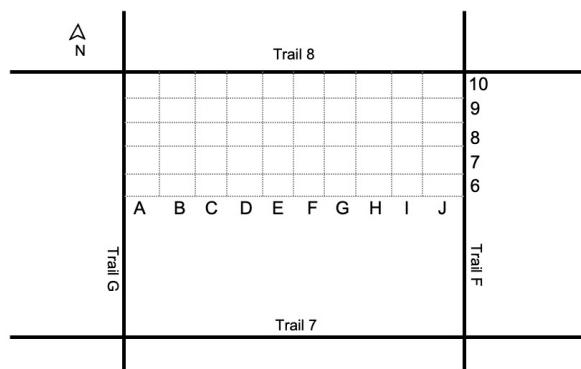
Figure 2. Schematic of the orientation and layout of each *Heliconia* Demographic Plots in Forest Fragments.

**A
CF-1**

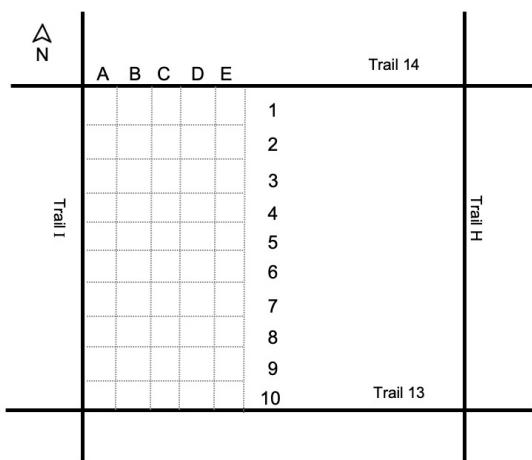
Ranch: Esteio **Size:** Continuous Forest **Reserve:** 1301 (Florestal)

**B****CF-2**

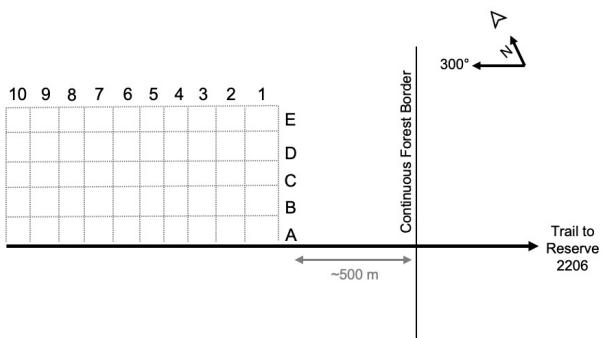
Ranch: Esteio **Size:** Continuous Forest **Reserve:** 1501 (Km 41)

**C
CF-3**

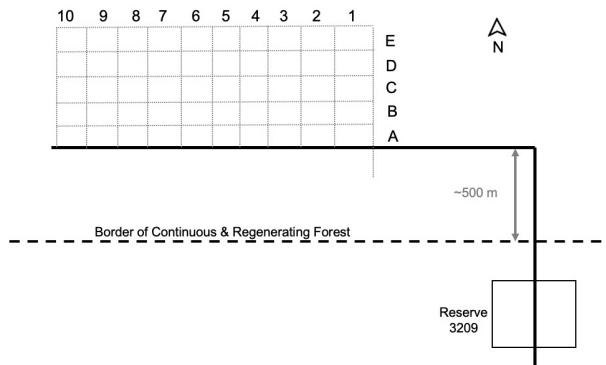
Ranch: Esteio **Size:** Continuous Forest **Reserve:** 1501 (Km 41)

**D****CF-4**

Ranch: Dimona **Size:** Continuous Forest **Reserve:** NA

**E****CF-5**

Ranch: Porto Alegre **Size:** Continuous Forest **Reserve:** NA

**F****CF-6**

Ranch: Porto Alegre **Size:** Continuous Forest **Reserve:** 3402 (Cabo Frio)

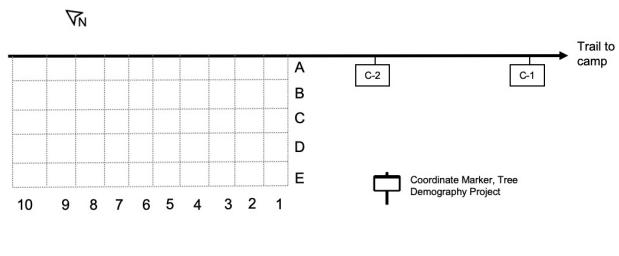


Figure 3. Schematic of the orientation and layout of each *Heliconia* Demographic Plot in Continuous Forest.