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1 **Land grabbing on Brazil's**  
2 **Highway BR-319 as a spearhead**  
3 **for Amazonian deforestation**

4 Lucas Ferrante<sup>a,\*</sup>, Maryane B.T. Andrade<sup>b</sup> and Philip M. Fearnside<sup>c</sup>

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6  
7  
8 <sup>a</sup>PPG-Ecologia, National Institute for Research in Amazonia (INPA), Av. André  
9 Araújo, 2936, CEP 69067-375, Manaus, Amazonas, Brazil. (E-mail:  
10 lucasferrante@hotmail.com); ORCID ID: 0000-0003-2636-5713  
11

12  
13 <sup>b</sup>PPG-CFT, National Institute for Research in Amazonia (INPA), Av. André Araújo,  
14 2936, CEP 69067-375, Manaus, Amazonas, Brazil. (E-mail:  
15 btandrade.maryane@gmail.com)  
16

17 <sup>c</sup>National Institute for Research in Amazonia (INPA), Av. André Araújo, 2936 -CEP  
18 69067-375, Manaus, Amazonas, Brazil. (E-mail: philip.fearnside@gmail.com); ORCID  
19 ID: [0000-0003-3672-9082](https://orcid.org/0000-0003-3672-9082)  
20

21 \*To whom correspondence should be addressed. E-mail: lucasferrante@hotmail.com  
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26 **Abstract:** Brazil faces its greatest period of environmental setback, where “ruralists”  
27 (large landholders and their representatives) gain access to government land in the  
28 Amazon. New roads are being paved, such as Highway BR-319 connecting Porto Velho  
29 in Brazil’s notorious “arc of deforestation” to Manaus in relatively intact central  
30 Amazônia. This highway acts as a spearhead penetrating one of the Amazon’s most  
31 preserved forest blocks. Here we report how land grabbing (*grilagem*) is associated with  
32 illegal logging in the Amazon on one of the new frontiers of illegal logging in  
33 Amazonas via the BR-319 highway. Evidencing the illegality, lack transparency and  
34 control of the territorial order that allows access to public lands through a consolidated  
35 invasion with environmental infractions such as illegal logging and deforestation in a  
36 lawless land This is not just a process linked to the highway, as it also involves the  
37 actions of government agencies such as the National Institute for Colonization and  
38 Agrarian Reform (INCRA). Illegal logging is rampant and areas of government land are  
39 being marked out by land grabbers (*grileiros*) for illegal sale to arriving migrants. In  
40 addition to poor control and inspection by the agencies, which do not receive funding to  
41 perform their functions, the legal process despite environmental legislation requiring an  
42 environmental impact assessment (EIA) for “Lot C.” which is one of stretches where  
43 deforestation is advancing on public land, a judge has authorized paving this stretch  
44 without an EIA while deforestation advances, against the proper environmental  
45 legislation. Opening BR-319 and its associated side roads represents a path with no  
46 return to a tipping point of self-degradation and loss of Amazonia’s vital biodiversity  
47 and climate-stabilization functions under lack of assistance from scrapped territorial and  
48 environmental control agencies

49

50 **Keywords:** Amazon rainforest; conservation units; Indigenous lands; land-use policy;  
51 land invasion; land titling; environmental impact; environmental legislation; road  
52 ecology; tropical forest

53

54

## 55 **Introduction**

56

### 57 **Amazonia threatened by Brazil’s president**

58

59 Brazil’s current presidential administration has weakened and dismantled  
60 environmental and Indigenous agencies to favor “ruralists” (large landholders and their  
61 representatives) (Ferrante & Fearnside, 2019). Pressures have increased on the Amazon,  
62 where longstanding threats, such as cattle ranches (Fearnside, 2005), soy plantations  
63 (Fearnside, 2001), mines (Sontter et al., 2017; Ferrante & Fearnside, 2020a) and  
64 hydroelectric dams (Lees et al., 2016) are augmented by plans for new roads and  
65 monoculture expansion for large-scale biofuel production (Ferrante & Fearnside, 2018,  
66 2020b). President Jair Bolsonaro took office on 1 January 2019, and between January  
67 2019 and January 2020 deforestation in Brazilian Amazonia increased 74% compared to  
68 the same period in the previous year (Fonseca et al., 2020). Annual deforestation rates  
69 during the Bolsonaro administration exceed the annual deforestation rates observed in  
70 the biome over the last 12 years (INPE, 2021), reflecting the reversal in the public  
71 policies for protection of the Amazon.

72

73 President Bolsonaro has claimed that foreigners, especially Chinese, are  
74 planning to occupy the Amazon, and this argument has been central to justifying his  
75 own plans to occupy the region by building roads and stimulating agribusiness (Dias,  
76 2019). The president's discourse has stimulated illegal deforestation, burning, invasions  
77 of conservation units (protected areas for biodiversity) and Indigenous lands, as well as  
78 attacks on environmental inspection agents (Ferrante & Fearnside, 2019, 2020a;  
79 Hanbury, 2019; HRW, 2019). COVID-19 and militarization of environmental control  
80 now provide smokescreens for these events (Ferrante & Fearnside, 2020c). A boom in  
81 the market for bulldozers indicates a scenario of more deforestation ahead due to the  
82 expansion of agribusiness (ClimaInfo, 2020). Cumulative deforestation in Brazilian  
83 Amazonia has already reached a level that is approximately at the limit that the forest  
84 can tolerate without crossing a “tipping point” leading to environmental collapse  
85 (Lovejoy & Nobre, 2018; Walker, 2021).

### 86 87 **Land grabbing**

88  
89 A series of measures that facilitate land grabbing has been promoted by Brazil’s  
90 president with support from the ruralist voting-block in the National Congress (See  
91 Supplementary Material). “Land grabbing” (*grilagem*) in Brazil refers to illegal  
92 appropriation of large areas of government land (almost always under Amazon  
93 rainforest), after which these areas are often “regularized” (frequently by corrupt means)  
94 and, with or without “regularization,” the areas are usually later subdivided and sold  
95 (Brito et al., 2019). Note that this differs from the use of the term in Africa or Asia,  
96 where “land grabbing” refers to buying up of local agricultural land by foreign interests  
97 for export crops (Oliveira et al., 2021). In Brazil, land grabbers (*grileiros*) often hire  
98 gunslingers (*pistoleiros*) to violently expel any small farmers or other claimants  
99 (Fearnside, 2008).

100  
101 On 10 December 2019 President Bolsonaro issued a provisional measure (MP-  
102 910), which allowed legalizing land claims up to 15 fiscal modules (1500 ha in  
103 Amazonia) through a mere “self-declaration” of ownership and, with the exception of  
104 special cases where there are indications of infractions, without any form of on-site  
105 inspection (PR, 2019). This has the effect of legalizing “land grabbing” in the Amazon  
106 (Branford & Borges, 2019). MP-910 was in effect for 120 days, after which the  
107 provisional measure was transformed into a proposed law (PL-2633/2020) (Câmara dos  
108 Deputados, 2020). When passed, this will be the third “land grabbers’ law,” the first  
109 two, in 2004 and 2017, having successively eased the restrictions on regularizing illegal  
110 land claims (Fearnside, 2020). Rodrigo Maia, the president of the Chamber of Deputies  
111 who allowed MP-910 to expire, did not allow either this bill or the bill (PL-191/2020)  
112 submitted to the National Congress by President Bolsonaro that would open Indigenous  
113 lands to mining, dams and agribusiness to be brought to the floor for a plenary vote.  
114 This suddenly changed on 1 February 2021 when the presidencies of both houses of the  
115 National Congress were won by the “Centrão” coalition of political parties that supports  
116 Bolsonaro on issues related to the “ruralist” agenda, making rapid approval likely  
117 (Ferrante & Fearnside, 2021). Similarly, a bill in the senate (PL-510) is moving forward  
118 that would also legalize claims based on self-declaration and without inspection  
119 (Senado Federal, 2021). The maximum area that can be legalized per claimant has  
120 successively increased: from 100 ha to 1500 ha in 2009 and to 2500 ha in 2017  
121 (Fearnside, 2021).

### 122 **Highway BR-319 a spearhead for Amazonian deforestation**

123

124

125 One of the ways to give access to land for expansion of agribusiness in the

126 Amazon is reconstruction of Highway BR-319 connecting Porto Velho in the state of

127 Rondônia, to Manaus in the state of Amazonas, thus linking the “arc of deforestation” to

128 vast areas of intact forest (Ferrante & Fearnside, 2019, 2020d; Mataveli et al., 2021;

129 Andrade et al., 2021; Ferrante et al., 2021). The highway was built in the early 1970s

130 and abandoned in 1988. A proposed reconstruction of the “middle section” of the

131 highway has yet to be approved – a first environmental impact assessment (EIA) was

132 submitted in 2009 and rejected as completely inadequate, and a second EIA was

133 submitted in 2020 and is rapidly progressing towards approval under strong political

134 pressure. In 2014 a means of circumventing the EIA requirement was found that would

135 allow a “maintenance” program for the road; the program has made the road passable,

136 although not paved, and has caused a substantial environmental impact (Fearnside,

137 2018). The “maintenance” program was announced in 2014 and began in practice in

138 2015 (Meirelles et al., 2018). In practice, this program is not restricted to

139 “maintenance,” having also replaced bridges with new ones compatible with the

140 planned reconstruction and upgraded the road in various ways that facilitate migration

141 of deforestation actors. Bus service between Manaus and Porto Velho was reestablished

142 in 2017, with the exception of the rainiest months.

143 It has been estimated that BR-319 and planned side roads will generate an

144 increase of the deforested area by more than 1200% by 2100 in the region between the

145 highway and Brazil’s border with Peru (dos Santos Júnior et al., 2018). The planned

146 AM-366 road would connect to BR-319, opening this “Trans-Purus” region to entry of

147 land-grabbers and other actors (Fearnside et al., 2020). AM-366 would traverse a vast

148 area of undesignated public land (*terras devolutas*), which is the category that is most

149 vulnerable to land grabbing (Azevedo-Ramos et al., 2020). The 15 December 2020

150 approval by the Brazilian Senate of a proposed law allowing foreign companies and

151 individuals to buy rural land (Senado Federal, 2020) could further increase pressure on

152 this critical area.

153 Reconstructing the highway was a campaign promise by then presidential

154 candidate Bolsonaro (Ferrante & Fearnside, 2019). BR-319 was abandoned due to lack

155 of economic viability, and it still lacks an economic-viability study (EVTEA). The

156 reconstruction project also lacks the consultation with Indigenous peoples required by

157 International Labour Organization (ILO) Convention 169 and by Brazilian Law No.

158 10,088/2019 (formerly No. 5051/2004), with at least 63 officially recognized

159 Indigenous lands impacted (Ferrante et al., 2020a). Two sections of the highway are to

160 be reconstructed: the “middle section” (km 250 to km 655) and “Lot C” (km 198 to km

161 250). On 5 August 2020 DNIT submitted the EIA for the “middle section” of Highway

162 BR-319 to IBAMA, and, after analyzing the report, IBAMA requested complementary

163 information in February 2021. DNIT announced that it would have this information by

164 the end of March, and, although delayed, the process will undoubtedly be completed

165 soon.

166 Unlike the “middle section,” the “Lot C” stretch never had an EIA prepared,

167 despite a unanimous court decision on 15 December 2014 that an EIA is constitutionally

168 required for this section (TRF-1, 2015). On 28 January 2019 a judicial decision rejected

169 a request by DNIT to remove the embargo on reconstructing “Lot C” without an EIA

170 (TRF-1, 2019). Nevertheless, on 24 June 2020 DNIT opened bidding for reconstructing

171 “Lot C” (DNIT, 2020), and on 20 August a judge rejected a request to suspend the

172 bidding made by the Federal Public Ministry (Campinas, 2020). The Federal Public

173 Ministry is a public prosecutor’s office created by Brazil’s 1988 constitution to defend

173 the rights of the people, including the right to an “ecologically balanced environment.”  
174 DNIT’s simply ignoring the requirement for an EIA was characterized by the Federal  
175 Public Ministry as being in “bad faith” (Ferrante & Fearnside, 2020d). On 30 June 2020  
176 the Federal Public Ministry submitted a suit requesting the court to halt the bidding for  
177 “Lot C” (JF, 2020), but the case languished in the hands of one of the judges, a contract  
178 was signed with a construction firm in December 2020, and finally on 1 March 2021 a  
179 decision was rendered upholding the original prohibition of reconstructing “Lot C”  
180 without an EIA, thus suspending the construction contract (Campinas, 2021; TRF-1,  
181 2021). Coincidentally the decision was rendered just 10 days after a publication by the  
182 present authors (Ferrante et al., 2021) exposing this situation. Politicians in Manaus  
183 were vociferous in criticizing the judge responsible (Elander, 2021), and on 7 April  
184 2021 the head of Brazil’s Superior Court of Justice reversed the decision and allowed  
185 reconstruction of “Lot C” to go forward (STJ, 2021).

186 The 7 April 2021 decision releasing the reconstruction of “Lot C” was given by  
187 Judge Humberto Martins, who maintains a close relationship with the Bolsonaro family,  
188 and on 23 April 2021 one of the president’s sons revealed in an interview that Martins is  
189 one of the two top candidates to be Bolsonaro’s appointee to fill a seat on Federal  
190 Supreme Court that will become available on 5 July 2021 (Carvalho & Giovanaz,  
191 2021). Among his decisions favorable to the Bolsonaro family, Humberto Martins  
192 requested, on his own initiative, an investigation into the “disciplinary conduct” of the  
193 judge who is responsible for prosecuting the “Queiroz” case, which is one of the biggest  
194 corruption scandals surrounding the Bolsonaro administration and the president’s family  
195 (Onofre, 2020). As a prominent campaign promise, reconstructing Highway BR-319 is  
196 a personal priority for president Bolsonaro (Ferrante & Fearnside, 2019).

197 The motivations for judicial support for circumventing environmental legislation  
198 are unknown. Coincidentally, judge Martins justified his decision using the same  
199 fallacious talking points that have been employed by politicians in Manaus, such as that  
200 the highway is urgently needed to allow oxygen transport to Manaus in the COVID-19  
201 pandemic (STJ, 2021). The political convenience of blaming the January 2021 oxygen  
202 crisis in Manaus on the lack of BR-319 is clear, as this argument frees the local  
203 authorities of responsibility for not having arranged in a timely manner for oxygen  
204 shipments by the normal freight route (barges coming up the Amazon River from  
205 Belém) despite having over two months’ notice that oxygen supplies would be  
206 insufficient (Fearnside et al., 2021).

207 The judicial decision granting clearance for reconstructing and paving “Lot C”  
208 without an EIA was based on the argument that lack of the road represents a serious  
209 harm to public order, security, economy and health (STJ, 2021). The data from the  
210 present study show that these justifications are fallacious, since the “maintenance”  
211 program and the promise of paving have increased environmental crimes and the  
212 insecurity of traditional peoples in the areas affected by Highway BR-319. Invasion of  
213 the Apurinã do Igarapé São Jorge Indigenous Land and an illegal side road crossing the  
214 Apurinã do Igarapé Tauamirim Indigenous Land are examples (Fearnside et al., 2020a),  
215 as is an illegal side road from BR-319 entering an extractive reserve used by the Mura  
216 Indigenous people (Fearnside et al., 2020b).

217 The economic justification is also fallacious, since economic and logistical  
218 studies show that transporting freight to São Paulo by Highway BR-319 would be more  
219 expensive than other modes (Teixeira, 2007; Fleck, 2009). The public-safety argument  
220 is contradicted by the illegal deforestation that has increased along the highway as the  
221 road has become more passable, as we show in this paper. Improvement of the highway  
222 has also been accompanied by increasing illegal logging (Andrade et al., 2021). This is

223 also a factor that impacts industry according to the Federation of Industries of the State  
224 of Amazonas (FIEAM) (MPF, 2020).

225 The justification for reconstructing the highway to guarantee public health is not  
226 supported, since expenditure on the highway would be much higher than the cost of  
227 improving the health systems in the municipalities (counties) along the highway. Paving  
228 the highway does not ensure conditions for improvement of the health system. The  
229 precarious state of public health systems in municipalities that are interconnected by  
230 highways in the Amazon is well known (Sawyer, 2001).

231 The present study aims to show that the current lack of enforcement of  
232 environmental and Indigenous legislation and the overturning of judicial decisions  
233 requiring environmental studies for both sections of Highway BR-319 that are planned  
234 for reconstruction make this highway a spearhead for deforestation in one of the most  
235 preserved regions of the Amazon. Land grabbing, which is already underway, is central  
236 to this deforestation process.

237

## 238 **Methods**

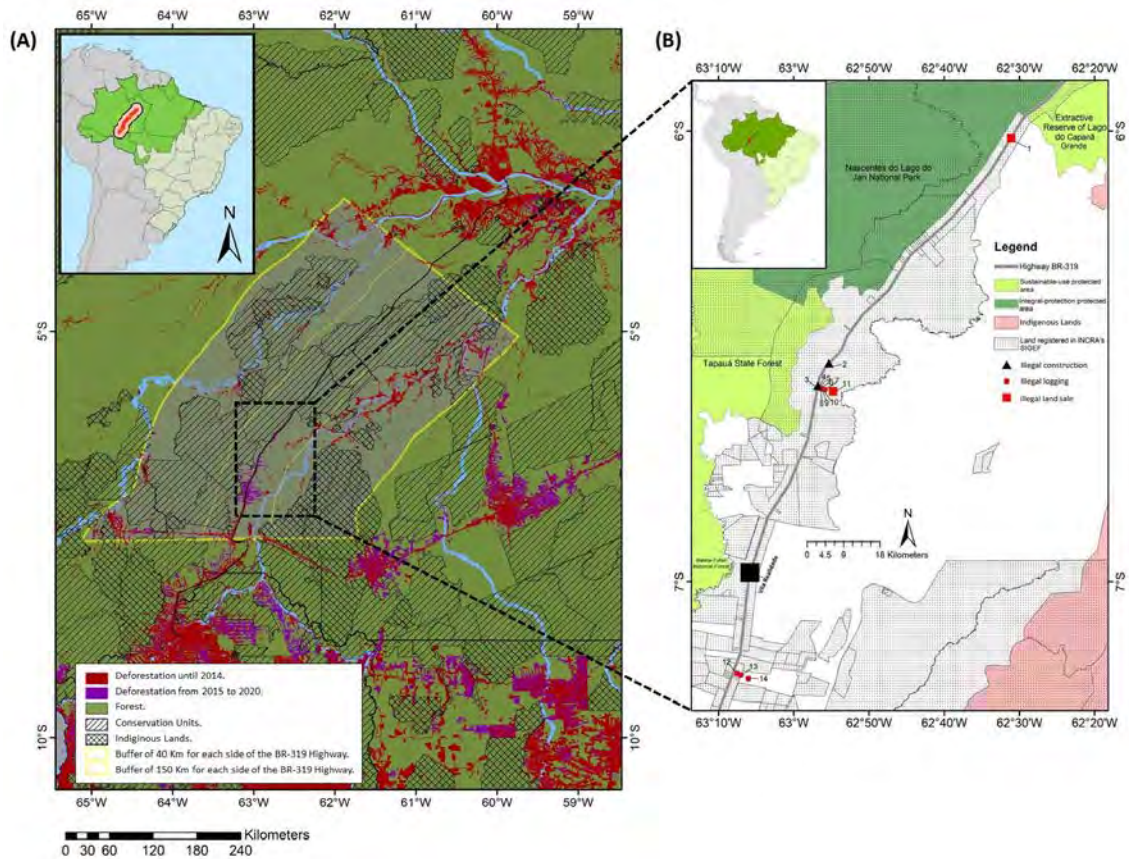
239

240 To assess deforestation along Highway BR-319 we used data from the  
241 Deforestation Monitoring Project in the Brazilian Amazon (PRODES) of Brazil's  
242 National Institute for Space Research (INPE, 2021) for buffers of 40 km and 150 km on  
243 each side of the road for the "middle section and "Lot C" (Figure 1A). To test whether  
244 Highway BR-319 influences deforestation we compared the annual deforestation rates  
245 in the Brazilian Amazon as a whole with the rates in the two buffers. Comparison with  
246 Brazilian Amazonia as a whole allows the effect of the highway to be differentiated  
247 from the region-wide variations in deforestation rate stemming from economic and  
248 other factors. We standardized the annual deforestation rate for each of the three  
249 categories (Brazilian Amazon, 40-km buffer and 150-km buffer) in relation to the area  
250 of each category, creating an index of deforestation proportional to the area. The trends  
251 in deforestation rates for each area were quantified by linear regression and the slopes of  
252 the regression lines were compared using the t-test. This allows determining whether the  
253 change in deforestation rate with time in the three categories differed during the period  
254 since the BR-319 "maintenance" program began in 2015. Deforestation in this period  
255 would have influence from both the "maintenance" program itself and the promise of  
256 reconstructing and paving the highway. Deforestation along BR-319 in this period  
257 would reflect the land grabbing and migration that have been stimulated by improved  
258 access and by the political promises of highway reconstruction.

259 We documented 14 sites of illegal deforestation on the "middle section" of  
260 Highway BR-319 that we observed *in loco* in 2019 (Figure 1B), and we compared these  
261 observations with public data from the Land-Tenure Network (*Malha Fundiária*)  
262 database of the National Institute of Colonization and Agrarian Reform (INCRA) and  
263 with and the agency's Land-Tenure Management System (SIGEF: *Sistema de Gestão*  
264 *Fundiária*) and the Rural Environmental Registry (CAR). The INCRA land-tenure  
265 database consists of information from the titling and regularization process  
266 (georeferencing, registration in the SIGEF, an INCRA evaluation and a "descriptive  
267 memorial" that includes data on applicants and supervisors). Our understanding of the  
268 land-occupation process and possible land conflicts also comes from informal  
269 conversations with actors active in deforestation and land grabbing, in addition to  
270 community members of traditional and Indigenous populations in or near the affected  
271 areas.

272



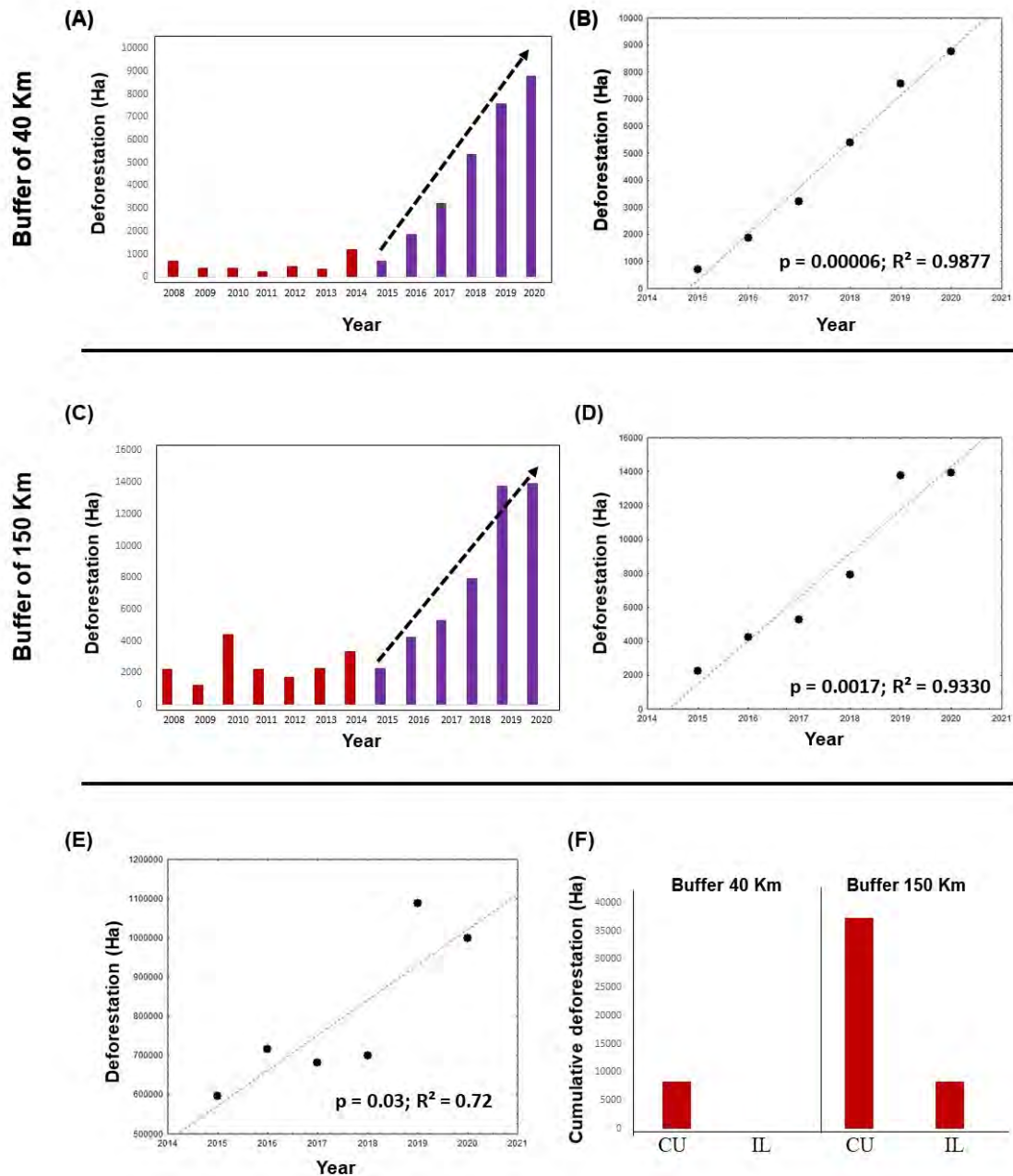


273  
 274 Figure 1. (A) Cumulative deforestation along Highway BR-319 from 1988 to 2020  
 275 (PRODES data). Deforestation in red represents cumulative deforestation from  
 276 1988 to 2014 before the highway “maintenance” program began. Deforestation  
 277 in purple represents cumulative deforestation from 2015 to 2020 (i.e., during the  
 278 “maintenance” program). (B) Points with land grabbing, illegal logging, illegal  
 279 mineral prospecting and illegal land sales observed on Highway BR-319.  
 280 Numbers in the figure are described in Table 2. The inset map of South America  
 281 shows Brazil’s “Amazon Biome” region in green, Highway BR319 as a black  
 282 line, and the area of the larger map as a red rectangle.  
 283

## 284 Results and Discussion

285  
 286 For the entire BR-319 highway 89,328 ha was deforested between 1988 and  
 287 2020 within the 40-km buffer, and 300,116 ha was deforested when considering the 150  
 288 km buffer. After the highway “maintenance” program began in 2015, PRODES data  
 289 show highly significant increases in deforestation for both the 40-km ( $p = 0.00006$ ;  $R^2 =$   
 290  $0.98$ ) and 150-km ( $p = 0.0017$ ;  $R^2 = 0.93$ ) buffers (Figure 2A-D), indicating that the  
 291 increase in deforestation is linked to the “maintenance” program and to the political  
 292 promise of reconstructing and paving the highway. For the 150-km strip, deforestation  
 293 had been falling over the 2010-2013 period that immediately preceded the  
 294 “maintenance” program (Figure 2C). The increase in deforestation can be attributed to  
 295 the “maintenance” program and to the promise of paving the highway because, when  
 296 the deforestation trend within a given distance from the road (either 40 km or 150 km)  
 297 is compared with the trend in the entire Brazilian Amazon, the areas of influence of the  
 298 highway have higher rates of growth of deforestation as shown by the slopes of linear  
 299 regressions, and deforestation in the BR-319 area increased steadily over the entire  
 300 2015-2020 period, while for Brazilian Amazonia as a whole the deforestation rate

301 remained at a much lower level until it jumped in 2019 and 2020 under the influence of  
 302 the Bolsonaro administration (Figure 2).



303 Figure 2. (A) Annual deforestation within 40 km of Highway BR-319. (B) Annual  
 304 deforestation in a 40-km buffer for each year of the highway's “maintenance”  
 305 period. (C) Annual deforestation within 150 km of the highway. (D) Annual  
 306 deforestation in the 150-km buffer for each year of the highway's “maintenance”  
 307 period. (E) Annual deforestation in the entire Brazilian Amazon. (F) Cumulative  
 308 deforestation in conservation units (CUs) and Indigenous lands (ILs).  
 309

310  
 311 The comparison of the slopes of the linear regressions showed that the 40-km  
 312 buffer had a deforestation rate 2.5 times higher than the rate in the Brazilian Amazon  
 313 as a whole ( $p = 0.02$ ). The deforestation rate in the 40-km buffer was also significantly  
 314 greater than that in the 150-m buffer ( $p = 0.00005$ ) (Table 1). This shows that the  
 315 “maintenance” program and the promise of paving “Lot C” and the “middle section”

316 have influenced deforestation within 40 km of the highway, this increase in  
 317 deforestation being much higher than both that observed for the interfluvium between the  
 318 Purus and Madeira Rivers (the 150-km buffer) and the deforestation rate for the entire  
 319 Brazilian Amazon.

320

321 **Table 1. Comparison of deforestation rates in the areas of influence of Highway**  
 322 **BR-319 in relation to the Brazilian Amazon as a whole.**

	BRAZILIAN AMAZON	150-KM BUFFER	40-KM BUFFER
SLOPE:	0.0175	0.0178	0.0449
YEARS (N):	6	6	6
SE (REGRESSION):	0.0226	0.0100	0.0105
SE (SLOPE):	0.0054	0.0024	0.0025
<b>Comparison between the areas</b>			
	<b>Amazon vs. 150-km buffer</b>	<b>Amazon vs. 40-km buffer</b>	<b>40-km buffer vs. 150-km buffer</b>
DIFFERENCE:	0.0004	0.0274	0.0270
SE (DIFFERENCE):	0.0059	0.0059	0.0035
T-STATistic	0.0621	4.6037	7.8002
p:	0.952	0.002*	0.00005*

323

\* Significant values.

324

325 Deforestation has been stimulated by the “maintenance” program beyond the 40-  
 326 km distance that the environmental agency’s internal norms consider to be directly  
 327 impacted for the purpose EIAs for Amazonian roads (MMA, 2011: Anexo II, 2015), and  
 328 this “maintenance” program was not even considered sufficiently significant to be  
 329 required to have an EIA. In the municipality (county) of Tapauá an illegal side road that  
 330 begins beyond the 40-km range is currently progressing to connect to BR-319, cutting  
 331 through an Apurinã Indigenous land and a national park (Figure 3A-C; Fearnside et al.,  
 332 2020). Deforestation is also occurring in conservation units and Indigenous lands  
 333 (Figures 1A and 2F). In Indigenous lands this deforestation has been caused by  
 334 invaders, as in the case of the Tapauá side road (Fearnside et al., 2020).



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Figure 3. Sign demarcating the Apurinã do Igarapé São João Indigenous Land and forest cut by land grabbers in the municipality of Tapauá. (B) Opening of an illegal side road to connect Tapauá to Highway BR-319; here the side road follows the edge of the Apurinã do Igarapé São João Indigenous Land, after which it crosses the Apurinã do Igarapé Tauamirim Indigenous Land and the Nascentes do Lago Jari National Park. (C) Deforestation by land grabbers inside the Apurinã do Igarapé São João Indigenous Land. (D) Illegal deforestation at Point 8 on Highway BR-319. (E) Illegal deforestation at Point 9 on Highway BR-319. (F) Deforestation carried out for the occupation and sale of land at Point 11 on Highway BR-319. Photos A-C by Chief Waldomiro of the Apurinã People; D-F by Maryane Andrade.

No significant deforestation, including that in Indigenous lands, has been caused by Indigenous people themselves, contrary to President Bolsonaro’s claim that Indigenous people are to blame for the recent surge in deforestation and fire in Amazonia (see Ferrante et al., 2020b). In addition, when comparing deforestation within protected areas, Indigenous lands, conservation units (in both the “integral protection” and “sustainable-use” categories) and military areas along BR-319, there is less deforestation in Indigenous lands than in the other protected-area types (Figure 2F), demonstrating that the Indigenous people have better protected their territory than the federal government.

By comparing field observations with INCRA data we found a pattern of illegal deforestation and illegal appropriation and titling. We also saw land grabbing, subdivision of deforested areas, intimidation and illegal constructions (Table 2, Figure 3 and Supplementary Material, Figure S1). All 14 points analyzed showed some type of irregularity, and actors with strong influence on land grabbing in the region were identified. We also observed a discrepancy between INCRA’s Land-Tenure Network

363 database (“*Malha Fundiária*”) and the agency's Land-Tenure Management System  
364 (SIGEF: *Sistema de Gestão Fundiária*), showing that INCRA's public databases conflict  
365 with the internal database. This clouds the land-titling process in the Amazon and  
366 illustrates a general lack of transparency. According to INCRA's SIGEF, all of the plots  
367 of land (“*glebas*”) in which Points 1 through 13 are located were submitted for  
368 certification and were certified by INCRA after 2015. This was the year of the new  
369 promise to reconstruct and pave Highway BR-319 (Meirelles et al., 2018). According to  
370 INCRA's Land-Tenure Network, Points 4 to 11 had been titled in 1984 with title  
371 delivery in 1988. However, these areas were only occupied after 2015 as indicated both  
372 by satellite imagery and by the observations of INPA researchers who studied these  
373 PPBio plots from 2015 onwards. One of the titles was issued in 2000 in the name a  
374 person other than the original holder, and according to INCRA's SIGEF, the lot is held  
375 by yet another person.

**Table 2. Status of points observed on Highway BR-319**

Reference number on the map (Figure 1)	Distance from the edge of the highway (m)	Type of infraction observed	Type of occupation
1	10	Illegal land sale*	Irregular
2	45	Illegal construction	Irregular
3	48	Illegal construction	Irregular
4	519	Illegal logging	Irregular
5	620	Illegal logging	Irregular
6	755	Illegal logging	Irregular
7	1,010	Illegal logging	Irregular
8	1,150	Illegal logging	Irregular
9	1,215	Illegal logging	Irregular
10	1,892	Illegal logging	Irregular
11	3,950	Illegal land sale *	Irregular
12	1,010	Illegal logging, illegal mineral prospecting	Irregular
13	2,115	Illegal logging, illegal mineral prospecting	Irregular
14	3,990	Illegal logging, ilegal mineral prospecting	Irregular

379 \*These lots were being sold despite being government land. Even after obtaining a title from INCRA, sale is not legally permitted until the land  
 380 has been occupied for an additional 10 years (PR, 2017).

381

382 Through informal conversations we identified an illegal invasion process at  
383 Point 1, where the land was resold to the current occupants by a land-grabber's agent  
384 who was responsible for deforesting the area. This area does not have any land-titling  
385 record or even a request for titling in the SIGEF, and there is also no CAR. The same  
386 land-grabber responsible for the invasion of Point 1 built two other houses on the side of  
387 the road (Figure 1: Points 2 and 3); Point 2 has no land title or registration record and is  
388 for sale. At Point 3, in conversation with the land-grabber's agent, he admitted the  
389 invasions and that he lives in the house at this point, but it belongs to his *patrão* or  
390 "boss" (i.e., the land-grabber himself) who lives in the city of Humaitá, this being the  
391 person to whom the most recent titles of lots were granted and where Points 3 to 11 are  
392 located. The "descriptive memorial" in INCRA's Land-Tenure Network indicates that  
393 the title to the lot in which Point 3 is located was awarded by INCRA in 2018, with the  
394 delivery of the title in 2019. The title to the lot and the record of delivery of the title by  
395 INCRA can be found in INCRA's Land-Tenure Network.

396 The land-grabber's agent accompanied our team at Points 4 to 11 and, according  
397 to him, he is aware of the illegalities that have been committed and said that he has  
398 already been arrested and that a new arrest would only be a matter of time. However,  
399 according to the SIGEF's descriptive memorial, the area where Points 4 through 11 are  
400 located is not certified and lacks the required inspection to be eligible for titling; the  
401 requests for titling are in the same name that appears for the landholding where Point 3  
402 is located -- the presumed "boss" of the land-grabber's agent. This process is worrying  
403 because it shows the advance of land grabbing and subsequent sale and deforestation on  
404 the edges of Highway BR-319, which has the potential to expand deforestation on a  
405 large scale affecting the forest's ecosystem services and the global climate (Fearnside,  
406 2020; Fearnside et al., 2020).

407 At Points 4 to 10 we observed illegal logging, with trails for dragging the logs  
408 and log-storage decks in the forest (Figure 3C-E). What is observed in the area does not  
409 follow any of the criteria required for legal forest management (MMA, 2006). In  
410 addition, Brazil-nut trees (*Bertholletia excelsa*) were being cut, which is prohibited (PR,  
411 2006). The logging is carried out under the command of the land-grabber's agent  
412 mentioned for Points 1 through 11. These areas are the locations of permanent plots for  
413 monitoring fauna and flora by the PPBio-INPA program. The land-grabber's agent even  
414 showed curiosity about the presence of researchers in the area and tried to intimidate  
415 one of the researchers, always carrying a gun in his hands when walking on the trail. At  
416 Point 11 we observed an invasion process with the removal of vegetation and  
417 subdivision of the land for sale.

418 We observed that, for this section of BR-319, the land-grabber's agent has  
419 invaded areas both on the edge of the highway and in land more distant from the road,  
420 removing vegetation, building houses and reselling land, and that this agent has a "boss"  
421 who has been acting to obtain land titles but does not live in any of the areas, as is  
422 required by Normative Instruction No. 100 of 30 December 2019 (INCRA, 2019). It is  
423 worrying that two different INCRA databases (the Land Register in INCRA's SIGEF  
424 and "land-tenure network" "*malha fundiária*") present discrepancies in the name of the  
425 landholder, demonstrating flaws in the system that can assist the land-grabbing process.

426 At Points 12, 13 and 14 we observed illegal logging and mineral prospecting.  
427 According to the SIGEF descriptive memorial, the areas where Points 12 and 13 are  
428 located are not certified and have their titles pending. Point 14 is located in government  
429 land (*terras da União*) according to the Land Register in INCRA's SIGEF and in the

430 SIGEF descriptive memorial, although the area has a CAR, which characterizes an  
431 attempt to declare occupation in order to request title.

432 According to Normative Instruction No. 100 of 30 December 2019 on land  
433 regularization in Brazil, an applicant must prove that he or she occupies the area and  
434 that there has been “direct, gentle and peaceful” productive use of the area by the  
435 applicant or by his or her predecessors since before 5 May 2014 (INCRA, 2019). The 5  
436 May 2014 limit was established on 15 March 2018 (PR, 2018), prior to which the limit  
437 was 22 July 2008 (PR, 2009). The term “direct” means that the claimant himself or  
438 herself must be living on the land in question, which is not the case for most large land-  
439 grabbers, as we observed here. The date requirement is also not met for areas we  
440 observed *in loco*, where the first deforestation occurred after 2014. According to  
441 INCRA’s land-tenure network database, many areas are larger than the 2500-ha limit  
442 established in 2019 for land regularization (INCRA, 2019).

443 INCRA’s Normative instruction No. 100 specifies that a prior on-site inspection  
444 (*vistoria prévia*) is mandatory prior to regularization if the land claim in question shows  
445 signs of fraudulent “fractioning” (subdivision into smaller land claims to fit within the  
446 legal limits on area) or if there are no signs of human occupation prior to 5 May 2014  
447 (INCRA, 2019). All of these conditions barring land regularization were observed in the  
448 area of the present study.

449 For Points 1 to 11 we identified actions by the same land-grabber’s agent, with 9  
450 of these points being georeferenced. These sites were spread over a distance of 150 km.  
451 This land-grabbing agent told one of us that he sells land on behalf of his “boss” in  
452 Humaitá (the municipal seat) and offered to sell us land for R\$3000 (US\$729.92) per  
453 hectare if located beside Highway BR-319 and for only R\$20 (US\$4.86) per hectare if  
454 located at a distance from the highway, provided that the buyer cuts down the forest and  
455 occupies the site. Such a low value per hectare exposes his probable real intentions:  
456 establishing initial occupations and clearings in the area at a distance from the road so  
457 that the remaining land can be sold to later arrivals at a much higher price, and also  
458 increasing occupation of areas both near and far from the road as *faits accomplis* in  
459 order to obtain political support for legalizing much larger areas. The land-grabber’s  
460 agent stated that his goal is to deforest and populate the entire area along Highway BR-  
461 319, presumably referring to the sparsely occupied “middle section” that extends for  
462 406 km.

463 According to presidential decree of 2009 and Normative Instruction No. 100 on  
464 land regularization in Brazil, it is required that there be a public consultation prior to  
465 land regulation in “areas of social interest,” as is the case for BR-319. Social-interest  
466 status was determined by the Federal Public Ministry. We observed an area for which  
467 INCRA had issued titles dated 2 August 2018 that had not had a public consultation,  
468 which indicates that the titles are illegal. In addition to the public hearing, all land  
469 regularization in an “area of social interest” after 15 March 2018 is required to be  
470 approved at a meeting of a group of agencies that includes the Ministry of the Economy,  
471 the National Foundation of the Indian (FUNAI), the Brazilian Forest Service (SFB) and  
472 the state environmental agencies (PR, 2018), but no such meeting has been held to date  
473 and no regularization has been approved by the group.

474 The processes of occupation and land grabbing are intrinsically linked to the  
475 beginning of highway “maintenance” program in 2015, since the locations of the  
476 deforestation that we visited and georeferenced were in lots that had received approval  
477 in INCRA’s SIGEF after 2015. Titles currently being granted by INCRA are in  
478 violation of the agency’s own regulations because granting these titles violates the legal



479 parameters that INCRA established in 2009 and maintained in the subsequent versions  
480 issued in 2018 and 2019 (PR, 2009, 2018; INCRA, 2019), making these titles illegal.

481 One of the political arguments for the paving of the BR-319 highway is that the  
482 highway would improve access for inspections and thus restrain environmental  
483 infractions, but we show that the opposite effect is more likely: greater traffic is  
484 responsible for land invasion and deforestation. This is already apparent on the BR-319  
485 where a highway “maintenance” program has spurred deforestation but not resulted in  
486 governance to control environmental crimes (Santos, 2020).

487 The results described here show that the titling of illegal land claims on BR-319  
488 intensified after the paving plans were announced. This suggests that paving will not  
489 bring governance, but rather will increase deforestation and land grabbing in the region.  
490 While titling of illegal land claims is often portrayed as a means of slowing  
491 deforestation by removing the motivation to clear in order to justify titles, a recent study  
492 using satellite data to document deforestation in 10,647 landholdings between 2011 and  
493 2016 shows clearly that the opposite effect has resulted from Brazil’s “*Terra Legal*”  
494 land-titling program, with titled small and medium landholders increasing their  
495 deforestation and large landholders being unaffected (Probst et al., 2020). Reforms to  
496 approve land regularization by the federal government reward those who have  
497 committed environmental crimes and stimulate land grabbing by creating the  
498 expectation of future pardons (Fearnside, 2020b; Maisonnave & Almeida, 2020).

499 On 2 December 2020 the Ministry of Agriculture (MAPA) and INCRA  
500 published a joint ordinance that will outsource to the Brazilian municipalities the  
501 process of land regularization of federal government land (MAPA & INCRA, 2020).  
502 The ordinance is an incentive to land grabbing in the region, since municipal  
503 governments in Brazilian Amazonia are often complicit in environmental crimes. For  
504 example, the government of one of the municipalities along BR-319 (Tapauá) has been  
505 using its bulldozers to open an illegal side road connecting to the highway, cutting  
506 through an Indigenous land and a national park (Fearnside et al., 2020). In 2018 in the  
507 municipality of Humaitá (which encompasses the southern portion of Highway BR-  
508 319), the mayor and members of the municipal council were arrested for their  
509 involvement in an attack that set fire to the local offices of IBAMA and of the Chico  
510 Mendes Institute of Biodiversity (ICMbio) (Farias, 2018).

511 In addition to the illegal processes observed in the present study, Brazilian  
512 legislation has been violated by government actions such as an official call for bids and  
513 subsequent signing of a contract with a construction company for paving “Lot C”  
514 without environmental studies being completed, putting the region's biodiversity and  
515 ecosystem services at risk (Ferrante & Fearnside, 2020d; Ferrante et al., 2021). Such  
516 actions need to be revoked and not repeated. Given that the lower court decision  
517 requiring environmental studies for “Lot C” has now been overturned by the head of the  
518 Superior Court of Justice, the option that remains is an appeal to the Federal Supreme  
519 Court. This would be justified given the unprecedented environmental collapse that  
520 reconstructing BR-319 could cause, especially in the absence of environmental studies  
521 and consultation with Indigenous peoples (Ferrante et al., 2021).

522 The data from the present study show that “Lot C” and the “middle section” are  
523 being targeted by specialized land-grabbing gangs and that illegal land claims have  
524 often gained recognition by INCRA, which is the agency responsible for inspecting and  
525 preventing illegal occupations. The bidding and construction contract for “Lot C”  
526 without prior environmental studies and consultation with Indigenous peoples must be  
527 questioned, and the involvement of federal deputies and judges merits investigation by  
528 the appropriate authorities.

529 It is also necessary to immediately suspend the ordinance published on 2  
530 December 2020 (MAPA & INCRA, 2020) that outsources to municipalities the  
531 regularization of claims to federal government land because it can be expected to  
532 greatly increase the legalization of land that is being illegally occupied in the Amazon,  
533 such as the areas claimed through the land grabbing documented in the present study.  
534 The involvement of public authorities in the process of legalizing irregularly occupied  
535 areas adds to the need to suspend the paving and maintenance of Highway BR-319 until  
536 environmental and economic-feasibility studies have been completed and approved for  
537 both the “middle section” and “Lot C” and the consultation of all impacted Indigenous  
538 peoples has been carried out.

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## Supplementary Material

### Land grabbing on Brazil's Highway BR-319 as a spearhead for Amazonian deforestation

Lucas Ferrante<sup>a,\*</sup>, Maryane B.T. Andrade<sup>b</sup> and Philip M. Fearnside<sup>c</sup>

<sup>a</sup>PPG-Ecologia, National Institute for Research in Amazonia (INPA), Av. André Araújo, 2936, CEP 69067-375, Manaus, Amazonas, Brazil.

<sup>b</sup>PPG-CFT, National Institute for Research in Amazonia (INPA), Av. André Araújo, 2936, CEP 69067-375, Manaus, Amazonas, Brazil.

<sup>c</sup>National Institute for Research in Amazonia (INPA), Av. André Araújo, 2936 -CEP 69067-375, Manaus, Amazonas, Brazil.

\*To whom correspondence should be addressed. E-mail: lucasferrante@hotmail.com

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## Attempts to “flexibilize” land titling to legalize land grabbing in the Amazon

On 5 February 2020, President Jair Bolsonaro submitted a proposed law (PL 191/2020) to the National Congress (Congresso Nacional, 2020). If passed (as is likely), it would open indigenous lands to mining activities and agribusiness for non-indigenous people, with disastrous consequences both for the indigenous people and for the Amazon forest (Ferrante & Fearnside, 2020). Brazil’s Indigenous Lands protect more Amazon forest than do federal conservation units (Nogueira et al., 2018).

A provisional measure (MP901) has been also presented by President Jair Bolsonaro, which would reduce the percentage of the areas of rural properties that Brazil’s Forest Code requires to be maintained as a “legal reserve” from 80% to 50% in the Amazonian states of Roraima and Amapá (Congresso Nacional, 2019). This would be likely to presage a similar change for other Amazonian states. Although this provisional measure has also expired, it is worrisome that a proposed law may be drafted to implement the same provisions, as in the case of MP910.

In addition to measures that facilitate land grabbing and encourage deforestation on public lands (Ferrante & Fearnside, 2019), the federal government has taken steps to open indigenous lands to agribusiness. Among these is Normative Instruction No. 9/2020 signed by the head of the National Foundation for the Indian (FUNAI) on 24 April 2020, which regulates the issuing of the “Declaration of Recognition of Limits” document, allowing occupation and even sale of areas in indigenous lands (Batista, 2020; FUNAI, 2020). Indigenous lands are under great pressure from agribusiness, loggers and mining (both by large enterprises and individual “wildcat” miners), and murders of indigenous leaders have increased substantially for this reason (Hanbury, 2019; HRW, 2019). Normative Instruction No. 9/2020 would regularize the invasion in indigenous lands and of the lands that are legally protected for other traditional peoples.

At a ministerial meeting on 22 April 2020, environment minister Ricardo Salles opined that the government should seize the “opportunity” presented by media’s attention being focused on the COVID-19 pandemic in order to approve “infra-legal” changes to regulations on the environment and on regularization of illegal land claims, calling for the government to “let the herd of cattle pass through,” the “cattle” referring to the changes to gut regulations (Youtube, 2020).

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## Map of land in the Rural Environmental Registry (CAR) in the study area

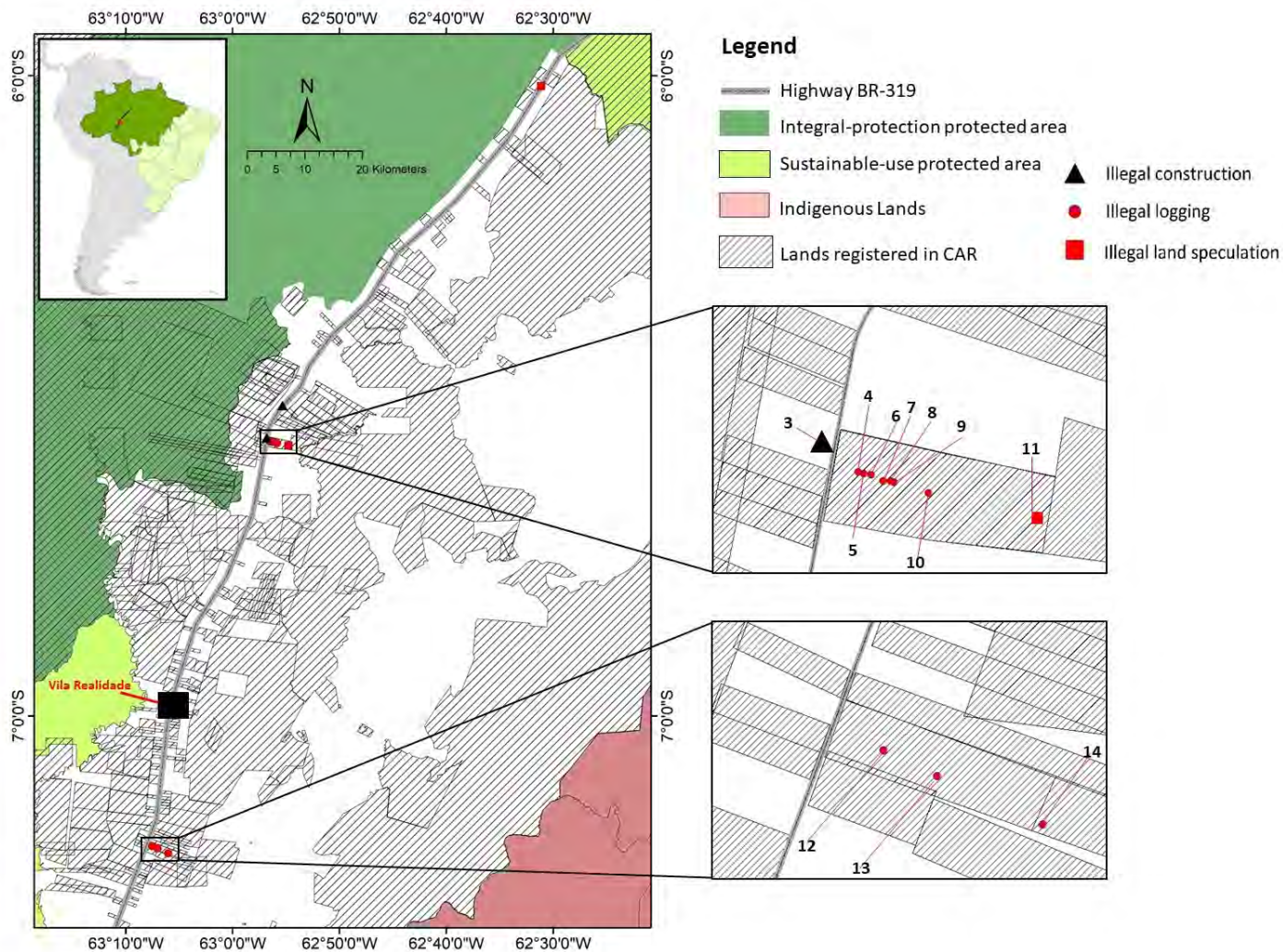


Figure S1 Land in the Rural Environmental Registry (CAR) in the study area. Numbers in the figure are described in Table 1 in the main text. The inset map of South America shows Brazil's "Amazon Biome" region in green, Highway BR319 as a black line, and the area of the larger map as a red rectangle.