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# The social value of conservation initiatives in the workplace

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## 13 **Highlights**

14 - We explored how biodiversity-friendly initiatives at work can influence employees

15 - Biodiversity knowledge, perception, connectedness to nature and behaviour were explored

16 - Initiatives can have small but significant impact on conservation awareness and behaviour

17 - Initiatives can help connect people to nature averting the extinction of experience

18 - Benefits of conservation action at work are thus two-fold (social and ecological)

19

20

21 **Abstract**

22 The success of conservation efforts largely depends on broad-based public support.  
23 However, the growing separation between people and elements of nature, due to global  
24 processes such as urbanization, may decrease individual connection with nature and public  
25 support for conservation. Encouraging interactions between people and nature becomes,  
26 therefore, of major importance. As people spend most of the daily time at work, enhancing  
27 the interaction between people and biodiversity in their work places could sustainably  
28 benefit people and conservation directly (protecting biodiversity) and indirectly (via people's  
29 actions). Yet, to date, little effort has been made to explore biodiversity in workplaces and its  
30 influence on the knowledge, perception and behavior of employees.

31 In this study, we explored how top-down biodiversity-friendly initiatives  
32 (management of the outdoor areas, communication campaign with signs, exhibitions of  
33 nature photography) at work (power plant in rural France) can influence employees'  
34 biodiversity-related knowledge, attitudes and behaviors, using a before-after survey. We  
35 showed that the influence of such initiatives in the workplace can have small but significant  
36 impacts on awareness and behavior of employees in their private everyday life. By  
37 implementing new settings in the everyday life of the employees, the studied company (the  
38 French electricity company EDF) may have defined new social norms in the workplace. Thus  
39 conserving biodiversity in workplaces may mutually benefit conservation directly through  
40 preserving local biodiversity and indirectly by influencing and strengthening people's  
41 relationship to it.

42

43

#### 44 **Introduction**

45 Biodiversity continues to decline, despite the increase in conservation efforts (Rands et al.  
46 2010). Halting or decelerating this decline will largely depend on people’s daily actions and  
47 on the ability to generate strong public support for encouraging governments to implement  
48 effective conservation policies (Keniger et al. 2013). The support and enthusiasm of people  
49 are therefore essential (Ehrlich 2002). Yet, although most people are increasingly aware and  
50 concerned about environmental issues, very few do modify their behaviors accordingly  
51 (Koger and Winter 2010). One reason invoked to explain this gap between awareness and  
52 actions is related to the decreased feeling of interconnections between people and nature,  
53 resulting from an increased separation due to global processes such urbanization (Turner et  
54 al. 2004; Miller 2005; Strohbach et al. 2009). This issue is profoundly concerning, given the  
55 mounting evidence regarding the positive health and wellbeing outcomes of interacting with  
56 nature (Bratman et al. 2012; Keniger et al. 2013; Shanahan et al. 2015), but mostly since  
57 these interactions may influence the way people value nature and its conservation (Fuller  
58 and Irvine 2010).

59 Today, the majority of the world’s population lives in cities and spend most of their  
60 time indoors (Koger and Winter 2010), in particular at work, with limited interaction with  
61 elements of nature in their daily life (Miller and Hobbs 2002). This life style gradually  
62 separates people from the biological reality and contact with flora and fauna, resulting in an  
63 “extinction of experience” (Pyle 1978; Miller 2005). This extinction of experience is a major  
64 environmental and societal issue, because it can modify the way people value nature and,  
65 therefore, undermine conservation efforts (Soga and Gaston 2016). Indeed, some evidence  
66 already demonstrates that the experience of nature during childhood was (1) influential for  
67 those active in conservation (Chawla 1999); (2) related to people’s affinity for biodiversity

68 (Lindemann-Matthies et al. 2010; Shwartz et al. 2013) and also that this nature-deficit (Louv  
69 2008) could (3) influence the construction of individual environmental identity (Clayton  
70 2003), which consequently may decrease individual awareness and support for conservation  
71 (Noss et al. 2012). This extinction of experience is not merely an environmental concern,  
72 because it is well established that interaction with nature leads to a multitude of health and  
73 wellbeing benefits for people (reviewed by Keniger et al. 2013).

74         Averting this extinction of experience involves increasing both the *opportunity* to  
75 directly experience nature and the *orientation* towards engaging with nature (Lin et al. 2014;  
76 Soga and Gaston 2016). One straightforward way to achieve this goal is to promote daily  
77 interaction with biodiversity in the places where people live and work (Miller and Hobbs,  
78 2002). Urban policies and practices have already started to enhance biodiversity in urban  
79 areas (e.g., Skandrani and Prévot, 2015), which in turn may increase individual health and  
80 wellbeing (Maas et al. 2006, Fuller et al. 2007). Today, an average person spends much of  
81 his/her live at work (on average 8.0 hours per day during weekdays for Americans; BLS  
82 2012), making the workplace the most dominate everyday life surrounding. It is therefore  
83 important to understand to what extent interaction between people and biodiversity can be  
84 enhanced in the workplace and how this interaction could influence individual attitudes and  
85 behaviors.

86         To date, little effort was made to explore biodiversity in the workplace (Snep et al.  
87 2011) and its influence on the perception of the employees (Kaplan 2007). Workplaces often  
88 consist of a mixture between grey and green infrastructures (e.g., buildings, private  
89 gardens). From ecological perspective, these green spaces could increase connectivity (Snep  
90 et al 2009; Löfvenhaft et al. 2002), host diversity of common species and sometimes offer  
91 refuges for endangered species (Snep et al. 2011). Moreover, the roofs and balconies of

92 many workplaces could be converted to green roofs that can create several microhabitats  
93 (Bates et al. 2013) and enhance biodiversity (Madre et al. 2013). These “living roofs and  
94 walls” are designed as opportunities to reconcile humans and biodiversity in the urban  
95 environment (Francis and Lorimer 2011). From the social perspective, Kaplan’s (1993)  
96 pioneering study has pointed out that proximity and availability of nature in the workplace  
97 can foster many desired outcomes and even the simplest contact with nature (i.e., nature  
98 views from the office window) provides significant psychological benefits for employees. In a  
99 more recent work, she further demonstrated that employees preferred nature settings to  
100 places with major buildings areas (Kaplan, 2007). A recent study covering over seven  
101 thousand participant from 16 countries has demonstrated that having internal green spaces  
102 in the workplace can increase happiness and inspiration of employees and reduce boredom  
103 and anxiety (Human Spaces 2015). Yet, it is not clear to what extent efforts to conserve  
104 biodiversity at the workplace could influence employees’ relationship with nature and  
105 conservation.

106         In this study, we explored how the implementation of biodiversity-friendly initiatives  
107 in a workplace (a power plant) influenced employees’ relationship with biodiversity. From  
108 January 2012, the management team of the studied power plant in the west of France  
109 implemented several biodiversity-friendly practices in outdoor areas within the site.  
110 Together with these initiatives, a communication campaign (i.e., signs and exhibition of  
111 nature photography) was conducted, in order to inform employees in those practices. We  
112 explored the outcomes of these initiatives on employees’ relations to biodiversity by  
113 conducting a before-after survey. Specifically, we aimed to understand (1) how those  
114 initiatives influenced biodiversity-related perceptions, knowledge and connectedness of

115 employees with nature, and (2) to what extent these initiatives were translated into  
116 individual nature-related behavioral changes.

## 117 **1 Material and methods**

### 118 ***1.1 Study area***

119 The study was conducted in an industrial site, a power plant that produces electricity using  
120 coal and fuel oil in the western France. The power plant is located on the estuary of the Loire  
121 River to the Atlantic Ocean, about 30 kilometers west of the Nantes metropolis (one of the  
122 largest metropolis in France with about 900,000 inhabitants). The power plant and the small  
123 town adjacent to it 'Cordemais' (3000 inhabitants) are located within the European network  
124 of protected areas 'Natura 2000'. This protected area is mainly composed of extensively  
125 managed grassland and wet meadows grazed by cattle and surrounded by a dense network  
126 of hedgerows.

127 The industrial site is managed by the French electricity company EDF. During the  
128 recent years EDF has adopted a biodiversity-friendly approach for the management of its  
129 sites. This approach primarily aims at gathering environmental knowledge to better assess  
130 potential impacts on nature of EDF sites, so as to minimize those impacts by protecting  
131 ecosystems and the services they provide. More specifically, practices were selected to  
132 increase the diversity of local flowering species in order to promote the presence of  
133 pollinating insects and insectivore fauna. EDF started implementing the program in the  
134 Cordemais power plant from January 2012, introducing five practices as following: (1)  
135 creating flower-meadows using over 38 local species in three separated locations (near the  
136 reception, administrative and cafeteria buildings); (2) late mowing of remnant meadows  
137 located near the reception and cafeteria buildings; (3) identifying non-indigenous plant

138 species in order to remove them; (4) reducing the use of pesticides; and (5) using mulching  
139 by leaving behind mowed grass to allow natural soil enrichment and creating a composting  
140 platform for valuing green waste of the site, which was commissioned in January 2013.

141         The change toward more sustainable management of open spaces within the power  
142 plant was accompanied with a communication campaign aiming to explain the implemented  
143 actions process and to increase conservation awareness of employees and visitors. Two  
144 photo exhibitions about nature were installed, the first in summer 2012 and the second in  
145 summer 2013. They were both installed in two areas: one on the access road to the power  
146 plant and the other within the site. In addition, educational panels were placed in the power  
147 plant: two about the overall approach for biodiversity-friendly management and one near  
148 each flowering meadow areas or late mowing areas. Employees were also encouraged to  
149 read some informative articles and explanations about these actions on the EDF website and  
150 on the power plant internal pages.

151

## 152 **2.2. *Study design***

153 During July-September 2011, before the initiatives were implemented, we used the power  
154 plant mailing list to send online questionnaires to the 400 employees (Survey 1). The email  
155 contained the questionnaire and a few words about the study context. The questionnaire  
156 was filled out online using an internal software tool that employees knew and used regularly  
157 to give their opinion on different subjects and it was strictly anonymous. The questionnaires  
158 were first sent in early July 2011, a revival took place in August 2011, and the survey was  
159 stopped on the 15<sup>th</sup> September 2011. Two years later, after the pro-biodiversity initiatives  
160 were implemented, we passed exactly the same questionnaire by email to the employees, in  
161 July-September 2013 (Survey 2).



### 162 **1.3 Questionnaire design and measures**

163 We constructed a questionnaire based on previously developed and tested tools (European  
164 Commission 2013; Simon and Goeldner-Gianella 2012; Cosquer 2012) that were used to  
165 explore the relationship between individuals and biodiversity in Europe and France (see  
166 Appendix A for a translated version of the questionnaire). For each of the respondents we  
167 collected few socio-professional details including the gender [*gender*], age (categorical: <30,  
168 31-49 and 50< years old [*age*]) and profession (workers, employees with master's degrees  
169 equivalent and managers [*profession*]). The central part of our survey was set to measure  
170 changes in four main topics: biodiversity knowledge, biodiversity perception, connectedness  
171 to nature and nature-related behavior. The questionnaire contained 20 questions aiming to  
172 explore these themes (Appendix A).

#### 173 **1.3.1 Individual awareness to biodiversity**

##### 174 **1.3.1.1 Biodiversity knowledge**

175 Biodiversity knowledge was measured following the Euro-Barometer of the European  
176 Commission (2013) and Simon and Goeldner-Gianella (2012): Familiarity with the concept of  
177 biodiversity [*biodiversity definition*] was assessed by summing the scores of two items. The  
178 first item explored whether the respondent knows the meaning of term "biodiversity"  
179 (yes/no); if s/he answered "yes", the respondent was asked to write a definition of the term.  
180 We scored the answer as following: no point for a negative answer, one point for a positive  
181 answer without definition, two points for a positive answer with definition referring to the  
182 diversity of plants and animals and three points for a positive answer with definition  
183 referring to interactions between all components of nature in the ecosystems. The second  
184 item asked respondents whether they think that ecosystems provide services to people

185 (yes/no/don't know) [*ecosystem services*]. Again, if the respondent answered "yes", s/he was  
186 asked to give examples. Respondents got no point for negative answer, one point if they did  
187 not know, two points for positive answer and three points if s/he gave a scientifically  
188 validated example according to the Millennium Ecosystem Assessment (MEA 2005).

### 189 1.3.1.2 Perception of the state of local biodiversity

190 The perception of the state of local biodiversity was assessed by three different items. The  
191 first (termed [*perception of main threats*]) asked respondents to identify the main threats for  
192 biodiversity in the town of the power plant. This multiple selection item included a list of ten  
193 potential threats (based on the IUCN list of threats) and answers were scored based on  
194 expert's opinion on the local threats. Three points were given to respondents who identified  
195 "urbanization" or "industry" as potential threats followed by "agriculture", "transports", or  
196 "global change" (two points), "invasive species" or "hunting" (one point) and no points were  
197 given for other answers (e.g., "hikers"). We considered the sum of each respondent's scores.  
198 The second item (termed [*local biodiversity perception*]) assessed in the 1-5 Likert scale  
199 (from "very bad" to "very good") the state of biodiversity within the power plant. The higher  
200 the score, the better respondent perceived the state of biodiversity. In the third item  
201 (termed [*local biodiversity assessment*]) respondents were asked to identify important areas  
202 for biodiversity within the power plant. Respondents could choose between 13 areas (e.g.,  
203 cafeteria building) within the power plant and its immediate proximity. The importance for  
204 biodiversity of these 13 sites was independently ranked (0 to 3 points) by experts, based on  
205 local biological reality and biodiversity surveys. Since biodiversity initiatives increased the  
206 biodiversity value of some sites (e.g., flowering meadows near reception building), this  
207 expert-based ranking changed between the two questionnaires surveys. To score the  
208 answers, we assigned to each site quoted by the respondent the biodiversity score assessed

209 by the expert. We summed all these scores for all the sites quoted by the respondent, to  
210 compute a final score for [*local biodiversity assessment*] for each respondent.

### 211 **1.3.2 Connectedness to nature**

212 We assessed the connectedness to nature using a derived version of the Inclusion of Nature  
213 in Self (INS) scale developed by Schultz (2002). This graphical measure examines to what  
214 extent an individual includes nature in cognitive representations of the self. Respondents  
215 were asked to choose out of six overlapping circles representing "nature" and "self", which  
216 picture best describes their relationship with the nature. The lowest connectedness to  
217 nature was attributed to respondents who selected the graphic with no overlap between  
218 circles and the highest connectedness was attributed to respondents who selected the  
219 graphic with 100% overlap between circles.

### 220 **1.3.3 Individual practices towards biodiversity**

221 We surveyed two specific individual behaviors: (i) the use of public green spaces and (ii)  
222 ecological management of private gardens. People have multiple reasons for visiting public  
223 green spaces and recent studies demonstrated that interacting with nature was not the only  
224 one (Irvine et al. 2013; Shwartz et al. 2013). Therefore, we explored declared motivation of  
225 visiting green spaces as an indicator of individual practices that could be influenced due to  
226 the program implemented. The [*motivations for visiting green spaces*] was assessed using  
227 two related questions exploring: (1) the frequency of visits to public green spaces (never,  
228 rarely, occasionally, frequently, and very frequently) and (2) the motivations for those visits.  
229 Respondents were asked to select three from a list of twelve possible answers. Answers  
230 were classified into four groups according to the strength of interaction with nature in the

231 *motivations* of the respondents for visiting public green spaces. The final score for each  
232 respondent was computed by multiplying the answer of the two questions (see Appendix B).

233 The second practice was related to the ecological management of private gardens.  
234 Private gardens evoke strong sense of place feelings (Gross and Lane 2007) and can generate  
235 meaningful connection with nature that could facilitate nature-related behaviors (Goddard  
236 et al. 2010). Enhancing biodiversity in domestic gardens is one of the objectives of many  
237 gardens owners (Davies et al. 2009). Thus, we explored nature-related practices conducted  
238 by the respondents in their private gardens [*practices in private gardens*] using two  
239 complementary questions (respondents that did not have any garden were excluded from  
240 this analysis): first, respondents were asked on the percentage of their garden surface that is  
241 kept un-managed (one point for 0%, two points for less than 5%, three points for 5%-15%,  
242 four points for 15%-40% and five points for more than 40%) (Following Cosquer 2012).  
243 Second, respondents were asked to choose their main motivation in a 7-items list. We  
244 scored their answer as following: zero when the motivation mentioned was related to  
245 laziness (convenience / lack of maintenance), one for reasons related to fear of nature (not  
246 to attract wild animals, fear of insects) or for aesthetical reasons (not aesthetic), two for  
247 positive aesthetic reason and three for reasons related to environmental awareness (for  
248 pollinators and for wild fauna and flora). The final individual score concerning practices in  
249 the private garden was computed by multiplying these two items.

#### 250 **1.4 Data analysis**

251 Seven separate linear models (LMs) were built to explore the influence of the biodiversity-  
252 friendly initiatives on employees' knowledge about biodiversity, perception of the state of  
253 local biodiversity and individual practices toward biodiversity. We first used five LMs to  
254 explore changes in *biodiversity definition, ecosystem services, perception of main threats,*

255 *local biodiversity perception* and *assessment* before and after the initiatives (dummy variable  
256 named *survey*). All non-categorical variables were scaled to standardise the effect sizes by  
257 subtracting the mean from each value and dividing by the standard deviation. Socio-  
258 demographic variables and connectedness to nature were added to the models to account  
259 for their potential effect. However, since 39.2% of respondents did not mention their  
260 *profession*, this variable was excluded from all models. We then built two additional LMs to  
261 explore the effects of *survey*, *biodiversity definition*, *ecosystem services*, *perception of main*  
262 *threats*, *local biodiversity perception*, *local biodiversity assessment* and *connectedness to*  
263 *nature* on the two nature-related behaviours separately (*motivations for visiting green*  
264 *spaces* and *practices in private gardens*). In these models, we included main effects and  
265 interactions between *survey* and other explanatory variables (excluding socio-demographic  
266 variables), to exhaustively investigate the potential mechanisms underlying changes in  
267 behavior. We checked for the absence of collinearity between the independent variables  
268 (variance inflation factors values  $< 2$ ; Zuur et al. 2007) and the impact of potential outliers  
269 using R packages AER (Kleiber and Zeileis 2008) and car (Fox and Weisberg 2011). We tested  
270 the model's assumptions for normality and non-constant error in variance using Shapiro-  
271 Wilk and Breusch-Pagan tests (respectively).

272 For model selection, we used the model-averaging approach, i.e., linear regression with  
273 multimodel inference (Burnham and Anderson 2002) with the MuMIn package (Barton  
274 2013). Following this method, all models are ranked on the basis of the Akaike's information  
275 criterion corrected for small sample size (AICc) (Burnham and Anderson 2002). For variables  
276 from the most parsimonious models (i.e.,  $\Delta AICc < 10$ ), we averaged their estimates and  
277 standard errors weighted by each model's AICc (Burnham and Anderson 2002). Model  
278 averaging yielded the post-probability (hereafter PP) of an explanatory variable affecting the

279 dependant variable and took into account the number of times the term appeared as  
280 significant in the selected models. A rule of thumb for using these post-probabilities was to  
281 consider that PP >0.95, 0.95–0.5, and <0.5 corresponded roughly to the classical p-values  
282 <0.01, 0.01–0.05, >0.05 (see Shwartz et al. 2013 and refs within for more details). Thus, we  
283 identified those variables for which PP>0.95 as being "strongly" supported by the model and  
284 variables for which PP>0.5 "moderately" supported.

## 285 **2 Results**

286 Response rates were similar before and after the initiatives: 37.25% of employees responded  
287 before (n=149) and 30% (n=119) after. Men represented 82.5% of the respondents, which is  
288 similar to the proportion of men among the power plants employees (i.e., 90%).  
289 Respondents were distributed rather evenly among the three age groups with a small bias  
290 toward younger employees (<30 years old represented 35.3% of respondents when this age  
291 group represented 23.1% of the power plant employees). The second group (31-49 years  
292 old) represented 38.6% of the respondents when they represented 43.8% of employees and  
293 the older employees (50< years old) represented 25.0% of the respondents when they  
294 represented 33.1% of employees. We found no significant difference in socio-professional  
295 variables between the two surveys (before and after the power plant initiatives on  
296 biodiversity). The distributions of age groups ( $\chi^2= 0.45$ , 2df,  $p = 0.80$ ), genders ( $\chi^2= 1.70$ , 1df,  
297  $p = 0.19$ ) and professions ( $\chi^2= 0.23$ , 2df,  $p = 0.89$ ) were similar the two parts of the survey.

### 298 **2.1 *Impact of the initiatives on biodiversity knowledge and perception***

299 The vast majority of respondents were familiar with the concept of biodiversity and  
300 ecosystem services and the initiatives did not influence degree of familiarity. Of the  
301 respondents 93% and 84% had already heard the word "biodiversity" and thought that the

302 natural spaces and greenspaces can give "services" to the society (respectively), but only  
303 44% and 25% gave a scientifically-relevant definition and relevant examples for services  
304 (respectively). However, this knowledge did not change significantly after the initiatives. We  
305 also found that men demonstrated lower knowledge compare to women (Table 1).

306 The majority of respondents were aware of the state of biodiversity in their local  
307 territory. Of the respondents 78% gave at least one item among the most threats on  
308 biodiversity based on the IUCN. Moreover, 90% of the respondents listed one out of the five  
309 expert-based biodiversity richest areas among the 13 proposed locations within the power  
310 plant. However, neither the *perception of main threats* nor the *local biodiversity assessment*  
311 within the power plant changed significantly after the initiatives (Table 1). On the other  
312 hand, the perception of biodiversity status within the power plant (*local biodiversity*  
313 *perception*) was higher after the initiatives (Table 1). Finally, individual connectedness to  
314 nature was positively and significantly correlated to most biodiversity knowledge and  
315 perception variables, excluding *perception of main threats*, for which we found that older  
316 employees were better aware of the main threats for biodiversity conservation in the town  
317 (Table 1).

## 318 2.2 ***Impact of biodiversity initiatives on individual practices towards biodiversity***

319 *Motivations for visiting green spaces* were best explained by respondents' *local biodiversity*  
320 *assessment and perception*, the knowledge variables and by the interaction between *survey*  
321 *and connectedness to nature* (Table 2). In more details, respondents that visit public green  
322 spaces to interact with nature were: (1) those with higher level of biodiversity knowledge;  
323 (2) those who assessed the biodiversity-rich locations in the power plant more accurately;  
324 and (3) those who perceived the state of biodiversity in the power plant to be poor. More  
325 interestingly, the initiatives seemed to have a complex influence on the declared motivation

326 to visit public green spaces. In general, both before and after the initiatives, we recorded a  
327 positive relationship between connectedness to nature and participants' nature-related  
328 motivations for visiting public green spaces. However, this relationship was stronger after  
329 the initiatives (Fig. 1). Thus connectedness to nature had a stronger influence on the  
330 declared motivation after the initiatives (Fig. 1).

331 The variable *Practices in the private gardens* was explained by all three biodiversity  
332 perception variables, *connectedness to nature* and the survey dummy variable (Table 2).  
333 Respondents who kept larger unmanaged area for biodiversity in their garden were the ones  
334 providing more accurate assessment of threats and biodiversity-rich locations in the power  
335 plant, more connected with nature and perceived the state of biodiversity in the power plant  
336 lower. Finally, respondents declared they keep more unmanaged area in their gardens for  
337 biodiversity oriented motivations after the initiatives than before.

338

### 339 **3 Discussion**

340 Conserving biodiversity in the places where people live and work was proposed as a mean to  
341 provide opportunities for meaningful interactions with the natural world (Miller 2005;  
342 Kowarik 2011; Dunn et al. 2006). In this study, we showed that the implementation of  
343 biodiversity-friendly initiatives in a workplace (here a power plant) by the management team  
344 has complex consequences on employees' knowledge, attitudes and declared behaviors.  
345 Contrary to our expectations, these initiatives did not have a significant impact on either  
346 employees' biodiversity assessment or their knowledge about biodiversity and ecosystem  
347 services. However, after the initiatives, employees seem to perceive correctly the better  
348 status of biodiversity in their workplace and the initiatives also seem to have affected



349 employees' declared practices towards biodiversity in their private lives, in direct and  
350 indirect manners. Indeed, after the initiatives, respondents were more likely to leave  
351 unmanaged areas in their gardens for biodiversity purposes than before. In a more indirect  
352 way, initiatives may have influenced participants' connectedness to nature in a way that  
353 enhanced them to seek more interaction with nature when visiting public green spaces.  
354 Thus, conserving biodiversity at work may mutually benefit conservation directly through  
355 preserving local biodiversity and indirectly by providing more opportunities for people to  
356 interact with nature and potentially strengthening people's relationship with it (Miller and  
357 Hobbs 2002).

358         The biodiversity-friendly initiatives provided by the company demonstrated an  
359 interesting influence on individual declared behaviors. This result can be interpreted as an  
360 effect of the new social norms defined by the company when implementing new settings in  
361 everyday life of the employees (Cialdini et al. 1990). These norms were both descriptive  
362 (flowering sites, meadows, photo exhibitions) and injunctive (education flyers explaining  
363 why the company was involved in this campaign). Following the theory of planned behavior  
364 (Ajzen 1991), norms (defined as "perceived social pressure to perform or not to perform the  
365 behavior", p. 188) impact the intention to act (and eventually action) at the same level as  
366 attitudes (which themselves are linked with values and identity). Indeed, social norms have  
367 been shown to have a prominent effect on individual behaviors (e.g., Schultz et al. 2007),  
368 even without being recognized as having a role by individuals who actually changed their  
369 behavior (e.g., Nolan et al. 2008). In our case, the fact that these new social norms were  
370 proposed by a personality with a high status (i.e. the employer) may have increased their  
371 effects on the employees (see Cialdini and Goldstein 2004). Indeed, the importance of the  
372 source credibility in the trust and adhesion to a world vision is prominent in environmental

373 communication (Koger and Winter 2010). Our results propose further that social norms and  
374 individual attitudes are interrelated in individual actions. We showed that initiatives have  
375 encouraged individuals already connected to nature to be even more prone to set nature-  
376 related behaviors (Fig. 1). Attitude and social norms are two out the three categories of  
377 motivation factors of individual actions in the theory of planned behavior (Ajzen 1991). We  
378 provided here new evidence that these factors can be related at the individual level.

379         Note that these small behavioral changes can further impact individual attitudes,  
380 following cognitive dissonance theory (Festinger 1957). Following this theory, when  
381 confronted with a disjunction between their behaviors and their attitudes, individuals tend  
382 to modify one of them in order to fill the gap between their thoughts and their actions  
383 (Osbaldiston and Schott, 2012). Concerning environment, Thøgersen (2004) proposed that  
384 small behavioral changes could affect environmental attitudes and become, therefore, more  
385 sustainable. We thus provided some evidence that conserving biodiversity in workplaces  
386 may mutually benefit conservation indirectly, by influencing and strengthening people's  
387 relationship to it. Furthermore, there is growing body of evidence that the interaction with  
388 nature could have several other benefits for people, such as improving wellbeing (e.g.  
389 Balmford and Bond 2005; Kaplan and Kaplan 1989; Ulrich 1984). Enhancing biodiversity in  
390 the workplace could therefore serve as a "win-win" solution that benefits both employees  
391 and biodiversity conservation (but see, Pett et al. 2016 for the people-biodiversity paradox).

392         However, we should be aware of some limitations of our study and their potential  
393 implications. First, according to all questionnaire surveys, we assumed that declared  
394 behaviors reflect actual respondents' behaviors, ignoring potential discrepancies between  
395 declarations and facts. These potential biases could have been addressed by asking more  
396 questions to the respondents to add internal consistency to the data (Yin 2003), or by

397 observing actual behaviors. We also did not measure whether people notice the changes in  
398 biodiversity, or took part in the proposed activities, quantifying this aspect could have  
399 strengthened our understanding and conclusions. Other studies have demonstrated some  
400 contradicting results regarding lay people assessment of species diversity (Fuller et al. 2007;  
401 Lindemann-Matthies et al. 2010; Shwartz et al. 2014; Pett et al. 2016). Although we did not  
402 ask people to estimate species richness or diversity, we did investigate their perception  
403 about the state of biodiversity within and in the near vicinity of the power plant. In  
404 accordance, we found that employees perceived that state of biodiversity was better after  
405 the initiatives, only in the power plant. These results correspond with the results of the  
406 ecological surveys conducted. Furthermore, we also found that the vast majority of the  
407 respondents (90%) identified specific biodiversity-rich areas in the same way as experts.  
408 These results coincide with Bayne et al. (2012) who demonstrated a positive and strong  
409 correlation between people's ranking of disturbance levels (aerial photos) in boreal forest  
410 areas and measures of disturbance and the diversity of forest specialist birds.

411       Alternatively and similarly to another study (Kaplan 2007), these results could also  
412 indicate a pro-environmental skewed study population, due to our obligation to introduce  
413 the research subject (i.e., biodiversity) in the request email sent to the employees. Thus,  
414 while respondents were representative of all the employees in age, gender and profession,  
415 the surveyed population could have been biased toward employees with pro-environmental  
416 profile. Indeed, the panel of respondents, who live near or within a Natura 2000 protected  
417 area, showed a relatively high knowledge and affinity to biodiversity compared to general  
418 French public. For instance, 93% of our respondents have heard the word "biodiversity"  
419 compared to 78% (2010) and 87% (2013) of general French public (Euro-Barometer,  
420 European Commission 2013). This potential bias can explain the high level of knowledge and

421 correct assessment biodiversity rich areas, but also the lack of straightforward influence of  
422 the initiatives on employees' knowledge, perception and declared behavior. Moreover, we  
423 cannot determine whether the differences in the answers to the questionnaire after the  
424 initiatives were due to real changes in perception, or simply since employees were more  
425 aware of the project and that resulted in a response bias. More qualitative in-depth  
426 interviews could have shed light on this important bias. Future research should aim to  
427 compliment such quantitative approach with more qualitative interview that may help  
428 validate the results and better understand mechanisms (see Shwartz et al. 2012).

429 Finally, all our results have been achieved in the French (and more broadly western  
430 cultural context). Yet, several studies underlined the variations in attitudes to nature across  
431 cultures (e.g. Buijs et al. 2009, Corral-Verdugo et al. 2008) and cannot be generalized to  
432 other cultures without caution.

## 433 **4 Conclusions**

434 Although we cannot overrule the influence of these potential biases, our results are  
435 consistent with theories and models developed in conservation psychology to explain  
436 individual attitudes and behaviors toward the environment (see Stern 2000 and Clayton  
437 2012). We showed that biodiversity-friendly initiatives provided by the company were not  
438 sufficient to have strong influence on people's knowledge and attitudes towards  
439 biodiversity, but did influence declared pro-environmental behaviors. However, we believe it  
440 is highly important to keep on exploring the social personal benefits, in terms of wellbeing of  
441 employees for instance. A recent multi-cultural study demonstrated the benefits both  
442 employers and employees can gain from enhancing green infrastructure in the workplace  
443 (Human Spaces 2015). For instance, when exploring the elements most wanted in the office,

444 presence of nature (indoor plants) came second in importance (mentioned by 20%  
445 interviewees) after having natural light (44%). Therefore, a number of leading organizations  
446 are now providing employees opportunities to interact with nature at work such initiative  
447 can also enhance employees' creativity and happiness sat work (Human Spaces 2015). The  
448 context of our study was different than the study describe above (office vs. open power  
449 plant), but future research could benefit from further investigation of how enhancing nature  
450 in different type of workplaces could help aligning the agendas of employers, employees and  
451 conservation directly (protecting biodiversity) and indirectly (through enhancing the  
452 connection between people and nature). Our results present a new call for employers to  
453 take into account the environments they offer to their employees, including green spaces,  
454 and provide elements for further discussion on the importance of Biophilia in the workplace.

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464

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633

634 **Table 1:**

635 Results of four linear models exploring knowledge (biodiversity definition and ecosystem services) and perception (main threats, local  
 636 biodiversity perception and assessment) before and after the implementation of the biodiversity initiatives in the power plant, while accounting  
 637 for three profile variables (gender, age and connectedness to nature). Estimated average coefficients  $\pm$  S.E. are presented for all variables.  
 638 Important (PP>0.95) and moderately important (0.5<PP<0.94) variables are flagged with \* or \*\* respectively and PP is presented in parentheses.

Variables	Biodiversity knowledge		Biodiversity perception		
	Biodiversity definition	Ecosystem services	Perception of main threats	Local biodiversity perception	Local biodiversity assessment
Intersect	0.34 $\pm$ 0.26	-0.01 $\pm$ 0.30	-0.26 $\pm$ 0.24	-0.43 $\pm$ 0.23	-0.59 $\pm$ 0.24
Survey (before)	-	-	-	-	-
Survey (after)	0.08 $\pm$ 0.12	-0.01 $\pm$ 0.07	0.00 $\pm$ 0.06	0.52 $\pm$ 0.12**(1.00)	0.05 $\pm$ 0.06
Age (<30)	-	-	-	-	-
Age (31-49)	-0.00 $\pm$ 0.06	0.12 $\pm$ 0.15*(0.67)	0.37 $\pm$ 0.20*(0.84)	0.07 $\pm$ 0.13	0.01 $\pm$ 0.06
Age (50<)	-0.02 $\pm$ 0.08	-0.11 $\pm$ 0.17*(0.67)	0.32 $\pm$ 0.21*(0.84)	0.19 $\pm$ 0.22	0.00 $\pm$ 0.06
Gender (female)	-	-	-	-	-
Gender (man)	-0.66 $\pm$ 0.16**(1.00)	-0.29 $\pm$ 0.21*(0.81)	-0.09 $\pm$ 0.15	-0.03 $\pm$ 0.10	0.01 $\pm$ 0.09
Connectedness to Nature	0.06 $\pm$ 0.06*(0.62)	0.08 $\pm$ 0.07*(0.71)	0.03 $\pm$ 0.05	0.05 $\pm$ 0.06*(0.56)	0.15 $\pm$ 0.06**(0.96)

639 **Table 2:**

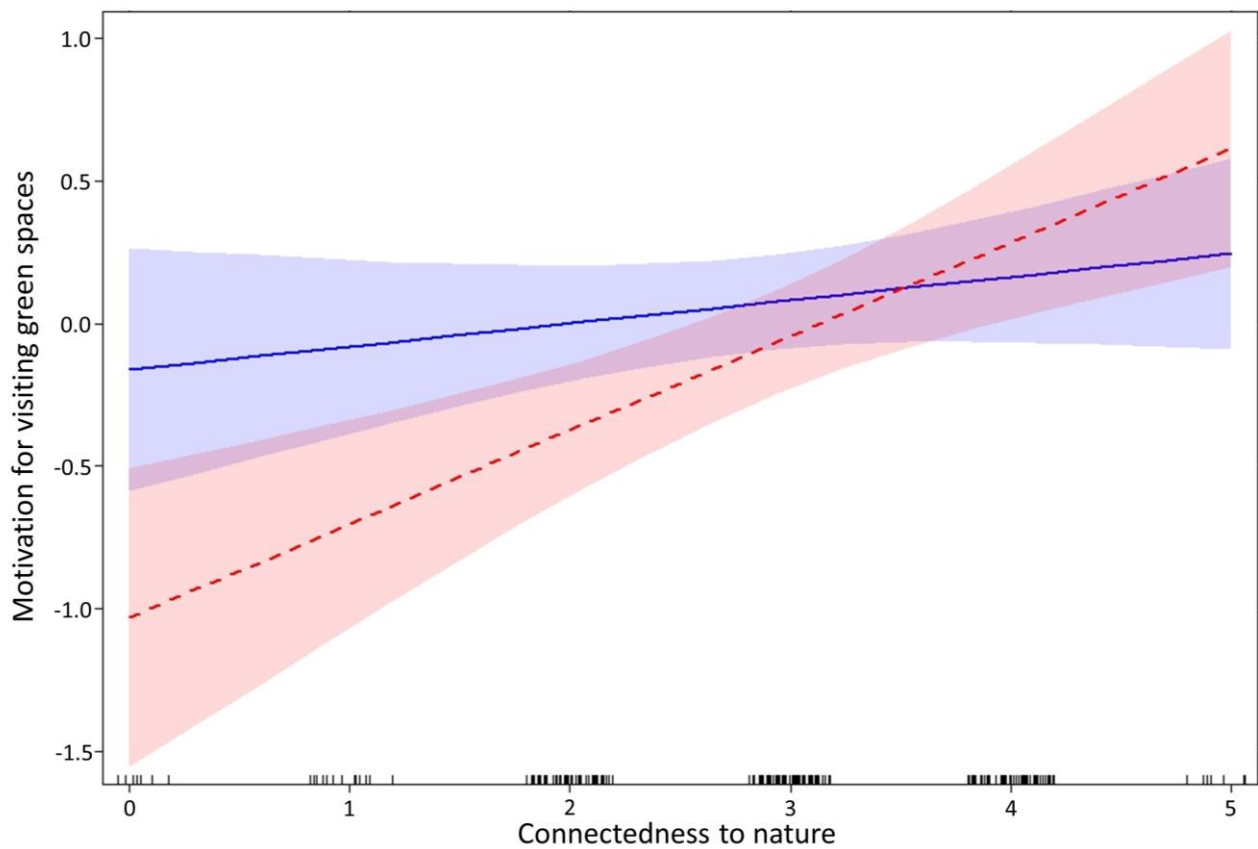
640 Results of two linear models exploring respondents' practices towards biodiversity before and after the  
 641 implementation of the biodiversity initiatives in the power plant, while accounting for three profile  
 642 variables (gender, age and connectedness to nature). Estimated average coefficients  $\pm$  S.E. are  
 643 presented for all variables. Important ( $PP > 0.95$ ) and moderately important ( $0.5 < PP < 0.94$ ) variables are  
 644 flagged with \* or \*\* respectively and PP is presented in parentheses.

<b>Variable type</b>	<b>Variable</b>	<b>Motivations for visiting green spaces</b>	<b>Practices in private gardens</b>
<b>Socio-economic</b>	Intercept	0.07 $\pm$ 0.13	0.02 $\pm$ 0.19
	Gender (female)	-	-
	Gender (male)	0.02 $\pm$ 0.09	-0.10 $\pm$ 0.17
	Age (18-30)	-	-
	Age (31-49)	-0.02 $\pm$ 0.09	-0.02 $\pm$ 0.01
	Age (50 and more)	0.04 $\pm$ 0.12	0.06 $\pm$ 0.15
Context	Survey (before)	-	-
	Survey (after)	-0.17 $\pm$ 0.13**(0.97)	0.10 $\pm$ 0.14*(0.81)
<b>Relation to nature</b>	Connectedness to nature	0.11 $\pm$ 0.09**(1.00)	0.24 $\pm$ 0.08**(1.00)
<b>Biodiversity knowledge</b>	Biodiversity definition	0.14 $\pm$ 0.09*(0.86)	-0.03 $\pm$ 0.06
	Ecosystem services	0.06 $\pm$ 0.08*(0.63)	0.05 $\pm$ 0.06
<b>Biodiversity perception</b>	Perception of main threats	3.9E-3 $\pm$ 0.06	0.06 $\pm$ 0.09*(0.50)
	Local biodiversity perception	-0.03 $\pm$ 0.07*(0.57)	-0.16 $\pm$ 0.10*(0.86)
	Local biodiversity assessment	0.20 $\pm$ 0.08**(0.98)	0.08 $\pm$ 0.09*(0.84)
<b>Interactions</b>	Context & Biodiversity definition	-0.02 $\pm$ 0.07	-9.2E-3 $\pm$ 0.56
	Context & Ecosystem services	9.2E-3 $\pm$ 0.06	0.01 $\pm$ 0.06
	Context & Perception of main threats	0.04 $\pm$ 0.09	-0.04 $\pm$ 0.10
	Context & Local biodiversity perception	-0.04 $\pm$ 0.10	0.04 $\pm$ 0.11
	Context & Local biodiversity assessment	-0.06 $\pm$ 0.11	0.12 $\pm$ 0.17
	Context & Connectedness to nature	0.26 $\pm$ 0.17*(0.85)	-0.01 $\pm$ 0.07

646 **Figure 1:**

647 The significant interaction between employees' motivations for visiting public green spaces  
648 and connectedness to nature before (blue) and after (dashed red) the implementation of the  
649 biodiversity initiatives in the power plant. The bands indicate the confidence intervals and  
650 the ticks the density of the data (respondents).

651



652

653



<b>Domains and questions</b>	<b>Format</b>	<b>Scoring range</b>
<i>Socio-professional details</i> - gender - age - profession	Dichotomous closed-ended Multiple-choice closed-ended Multiple-choice closed-ended	male/female 1-3 classes 1-3 classes
<i>Familiarity biodiversity definition</i> */** - Have you ever heard the word "biodiversity" If yes, can you give your definition in a few words?	Dichotomous closed-ended Open-ended question	Yes/No 0-3 points
<i>Familiarity ecosystem services</i> */** - In your opinion, the natural spaces and greenspaces can provide "services" to the society? If yes what services do you think?	Dichotomous closed-ended Open-ended question	Yes/No/Don't know 0-3 points
<i>Local Knowledge</i> * - In your opinion, what could threaten biodiversity at the town of Cordemais? - Can you identify areas of the workplace and its proximity where biodiversity is most important to you?	Multiple-choice closed-ended (11 choices; more than one selection possible) Multiple-choice closed-ended (13 choices more than one selection possible)	0-3 points 1-16 points
<i>Connectedness to nature</i> *** please choose the design that best describes your relationship to nature	Multiple-choice closed-ended (6 choices)	0-5
<i>Biodiversity perception</i> ** - In your opinion, what is the state of biodiversity in your workplace?	Multiple-choice closed-ended (5 options)	1-5
<i>Use of public green spaces</i> *** - How frequently do you visit public green spaces? (never, rarely, occasionally, frequently, and very frequently)  - Why?	Multiple-choice closed-ended (5 choices)  Multiple-choice closed-ended (12 choices more than one selection possible; Appendix B)	1-5 points  Classified to 0-4 points
<i>Practices in the private gardens</i> *** - Do you have a private garden? If yes, what is the percentage of your garden surface that you kept un-managed?  Why?	Dichotomous closed-ended Multiple-choice closed-ended (5 choices)  Multiple-choice closed-ended (7 choices)	NA/1 1-5  Classified to 0-3 points
<i>Other questions (no taken into account for this study)</i> - Within the power plant, the nature is present. - Can you identify areas of the workplace and its proximity where you would like to see more biodiversity?	Likert Multiple-choice closed-ended (choices 13)	1-5 1-16

655 \* Borrowed or adapted from European Commission (2013)

656 \*\* Borrowed or adapted from Simon and Goeldner-Gianella (2012)

657 \*\*\* Borrowed or adapted from Cosquer (2012)

658

659 **Appendix B:** Use of public greenspaces (Borrowed or adapted from Cosquer (2012))

660

661 a. “Do you visit green spaces and natural areas?”

662 Multiple-choice closed-ended coded 1 to 5: never, rarely, occasionally, frequently, and very  
663 frequently

664

665 b. “Why ?” to evaluate the motivation for visiting public greenspaces

666 *Respondents were asked to select maximum three out a list of twelve possible answers and*  
667 *answers were classified into five groups according to the strength of interaction with nature*  
668 *in the motivation of the respondents for visiting green spaces. We kept the maximum scores*  
669 *for each respondent. .*

670

Possible answers	Reason was linked to nature	Temporary scoring range
1. I do not see the point	No, absence of interest	0
2. There are no park near my home	Weak, other	1
3. I do not have time	Weak, other	1
4. The parks are too crowded	Weak, other	1
5. Activities with the kids	Medium, social activity	2
6. Walking a pet	Medium, social activity	2
7. Relaxing with family / friends	Medium, social activity	2
8. Outdoor recreation	Strong , activities in nature	3
9. Picnic	Strong , activities in nature	3
10. Relaxation / breathing	Strong , activities in nature	3
11. Sport	Strong , activities in nature	3
12. Observe nature	Very strong, explicitly	4

671

672 *The final score for each respondent was computed by multiplying the answers of the two*  
673 *questions (a. and b.). For example, if a respondent choose “never” because “The parks are*  
674 *too crowded” and “Walking a pet”, for this question, the final score is: 1 x 2 = 2*

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