

1       **Corrigendum to: Relationships between human activity and biodiversity in**  
2       **Europe at the national scale: spatial density of human activity as a core driver**  
3       **of biodiversity erosion (doi: 10.1016/j.ecolind.2018.03.010)**

4  
5

6                               Frédéric Gosselin<sup>1</sup> and Jean-Marc Callois<sup>2</sup>

7       <sup>1</sup>Irstea, UR EFNO, Domaine des Barres, F-45290 Nogent-Sur-Vernisson, France. Mail :  
8                               frederic.gosselin@irstea.fr

9       <sup>2</sup>Irstea, Département Territoires, 1 rue Pierre-Gilles de Gennes, F-92761 Antony Cedex,  
10                              France. Mail: jean-marc.callois@agriculture.gouv.fr

11

12

13       This corrigendum aims to correct the first three columns of Table 3 in Gosselin and Callois (2018),  
14       which was based on an erroneous program to calculate marginal Leave-one-out Information Criteria  
15       (LOOIC). Table 1 in the present paper replaces this previous Table 3. We discuss why the new results  
16       are more in agreement with the other results of Gosselin and Callois (2018) and why the marginal  
17       version of the LOOIC appears better than the conditional version.

18       **Statistical methods**

19               Here, the statistical models are the same as the ones in Gosselin and Callois (2018). They are  
20       Bayesian models which incorporate country random effects when observations were repeated in each  
21       country (for the two State Indicators and the Response Indicator), and which have a beta-binomial  
22       probability distribution for the two State Indicators and a zero-inflated beta distribution for the  
23       Response Indicator and the two Pressure indicators. The zero-inflated beta distribution is a direct sub-  
24       product of the zero-inflated cumulative beta distribution that Herpigny and Gosselin (2015;  
25       MTUnlimited2 version) proposed to analyze plant cover class data. Indeed, we used statistical  
26       methods with a priori relevant probabilistic properties relative to our data. Based on the lessons

27 learned on partly similar data from Gosselin (2015), we paid careful attention to the potential over-  
 28 dispersion of data as well as to the inclusion of random country effects.  
 29 We compared the models with the Leave-one-out Information Criterion (LOOIC) developed by  
 30 Vehtari et al. (2016). For State and Response indicators, we used the marginal version of the LOOIC  
 31 – i.e. the LOOIC integrated over the random effects –, for reasons discussed by Millar (2009, 2017),  
 32 and because the country random effect introduced a number of parameters which was of the same  
 33 order of magnitude as the number of observations. We calculated the marginal versions of the LOOIC  
 34 for 10,000 parameter values randomly drawn from the MCMC output by taking the mean of  
 35 probabilities of the observed data grouped by country over 1,000 random draws of the country  
 36 random effect. The original code in Gosselin and Callois (2018) was erroneous in that it did not take  
 37 into account the dependence between observations in the same country (i.e. the mean probability of  
 38 each observation was taken instead of the mean probability after grouping the observations of each  
 39 country). The new calculations used here correct this previous error.

40

## 41 Results

42

Model name	Extinct species	Threatened species	Protected Areas	SEAL	iSEAL
Null	15.91	13.10	<b><u>0.00</u></b>	46.86	19.93
eco	<b>4.37</b>	11.66	7.34	18.26	<b><u>0.00</u></b>
leco	<b>2.88</b>	<b>1.72</b>	6.47	<b><u>0.00</u></b>	<b>0.61</b>

Kuznets	15.56	12.00	6.02	42.09	17.91
IKuznets	17.35	13.40	<b>5.27</b>	48.01	19.70
Kuznetsa	<u><b>0.00</b></u>	<u><b>0.00</b></u>	10.27	12.95	<b>4.80</b>
IKuznetsa	<b>0.42</b>	<b>1.89</b>	<b>3.67</b>	6.58	<b>5.03</b>
demo	<b>5.16</b>	10.51	11.94	17.16	<b>0.82</b>
Idemo	<b>3.07</b>	<b>4.43</b>	<b>2.54</b>	<b>1.41</b>	<b>3.57</b>
FC	<b>1.91</b>	<b>4.05</b>	<b>4.45</b>	40.82	22.14
SC	12.64	9.83	6.16	52.64	24.38
NGOs	14.72	15.28	<b>5.24</b>	39.10	15.05
ERV	11.00	14.11	<b>3.12</b>	44.85	22.32

43 Table 1. Statistical comparison of models. Difference in Leave-one-out Information Criterion  
44 (LOOIC) values with the LOOIC of the best model fitted for the different explanatory models (by  
45 column). The lower the LOOIC, the better the model. The best model is underlined and models with a  
46 LOOIC relatively close to the best model– i.e. within six units of the best model – are in bold (as  
47 suggested in Millar, 2009). Only the models pertaining to the same target variable (models within the  
48 same column) are comparable. See Tables 1 and 2 in Gosselin and Callois (2018) for the content of  
49 the models. For the three first columns, the marginal version of the LOOIC is reported (see text).

50

## 51 **Discussion**

52 The new corrected values of the marginal LOOIC in Table 3 do not change any of the practical  
53 conclusions in Gosselin and Callois (2018). However, they are more coherent with the levels of  
54 significance of the estimators (Tables 4 to 7 in Gosselin and Callois 2018) than were the previous  
55 values obtained (Table 3 in Gosselin and Callois 2018). Indeed, in the previous table, the levels of  
56 significance of the most significant effects of explanatory variables were overall less significant for  
57 the Proportion of Extinct and Threatened species (Tables 4 and 5 in Gosselin and Callois 2018) than  
58 for the proportion of Sealed area or the dynamics of this proportion (Tables 6 and 7 in Gosselin and  
59 Callois 2018). Yet, previous differences in LOOIC values with the null model had indicated stronger  
60 differences for Extinct and Threatened species with respect to the dynamics in the proportion of  
61 Sealed areas (Table 3 in Gosselin and Callois 2018).

62 The new model comparison results presented herein in Table 1 establish an ordering that is more in  
63 line with the significance of the effects. This behavior is in agreement with McQuarrie and Tsai's  
64 (1999) results; for orthogonal regressions, they showed a direct link between the statistical  
65 significance of the effects of models and their Akaike Information Criterion (AIC), a criterion close to  
66 LOOIC for such simple settings. Our settings are not very different from orthogonal regressions since  
67 we mostly chose models with not too much correlated explanatory variables. The fact that the new  
68 marginal LOOIC are more coherent with the levels of significance of the estimators than were the  
69 previous values obtained is therefore welcome. In the case of the SC model for the proportion of  
70 Threatened species (Table 1), the results for marginal LOOIC shown in Table 1 are also more  
71 satisfactory than the conditional LOOIC results presented in Table SM1 (Supplementary material):  
72 given the two significant estimators involved in the model (Table 5 in Gosselin and Callois 2018),  
73 marginal LOOIC indicates that the SC model is better than the Null model, qualitatively in agreement  
74 with McQuarrie and Tsai (1999)'s results, while conditional LOOIC indicates that it is not as good as  
75 the Null model.

76

77 **Acknowledgements.** This research was supported by the French ministry in charge of Ecology  
78 through the DEB-Irstea convention (Action 16). We warmly thank Victoria Moore for her help in  
79 improving the clarity and style of the English manuscript.

80

81 **References:**

82 Gosselin, F., 2015. Reevaluating Europe's other debt with improved statistical tools. *Biodiv. Cons.*  
83 24, 205-211.

84 Gosselin, F., Callois, J.-M., 2018. Relationships between human activity and biodiversity in Europe at  
85 the national scale: Spatial density of human activity as a core driver of biodiversity erosion. *Ecol.*  
86 *Indicators* 90, 356-365.

87 Herpigny, B., Gosselin, F., 2015. Analyzing plant cover class data quantitatively: customized  
88 cumulative zero-inflated beta distributions show promising results. *Ecol. Informatics* 26, 18-26.

89 McQuarrie, A., and Tsai, C.L. 1999. Model selection in orthogonal regression. *Statistics & Probability*  
90 *Letters* 45(4):341-349.

91 Millar, R.B. 2009. Comparison of hierarchical bayesian models for overdispersed count data using  
92 DIC and Bayes' factors. *Biometrics* 65, 962-969.

93 Millar, R.B., 2017. Conditional vs marginal estimation of the predictive loss of hierarchical models  
94 using WAIC and cross-validation. *Statistics and Computing* 28, 375-385.