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Summer Habitat Selection by Black Grouse in the Belluno Province (Eastern Italian Alps) (1) (*)

by

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Key words : Black Grouse, *Tetrao tetrix*, Italian Alps, Summer Habitat selection

SUMMARY

We report the preliminary results of a study aimed to evaluate the summer habitat selection by black grouse in the Belluno province (North Eastern Italian Alps). Thirteen sample areas (369 ha of average size, s.d.=129) for a total of 4797 ha were chosen to cover the different climatic and environmental conditions of the province. Each area was mapped from field surveys and with a G.I.S. software for land cover types (stands of *Fagus sylvatica* **FS**, *Picea abies* **PA**, mixed *Fagus s.* and *Picea a.* **FP**, *Pinus sylvestris* **PS**, *Larix decidua* **LD**, mixed *Larix d.* and *Picea a.* **PL**, *Pinus mugo* **PM**, *Alnus viridis* **AV**; mixed shrubs **MS** (*Juniperus* spp., *Salix* spp. and others); shrubs of *Rhododendron* spp. and *Juniperus communis* **RV**; grassland **G**; areas of grassland-forest transition **GFT**; mixed grassland and rocks **GR**; rock **R**), elevation (with classes of 200 m), slope (with classes of 15 degrees) and aspect (with classes of 45 degrees). Counts with pointing dogs were conducted during 1997, 1998 and 1999, and each observation was located on the map of its sample area. A circular area (buffer) of 100 m radius was digitized around each observation and habitat use was estimated from the buffers composition (vegetation type, elevation, slope, aspect), weighted for the proportion of individuals in each observation as respect to the total number of individuals. Elevation classes selected were in the range of 1500-1900 m, but there were exceptions due to artificial habitats at lower elevations; flat and steep areas, as well as «warm» aspect classes, were tendentially avoided, and moderate slopes and "cold" aspect classes were preferred. Selection for, or against, the different classes of elevation, slope

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and aspect was less marked than selection for land cover types. Forest types with dense cover were avoided, as well as areas were ground vegetation is scarce; there was a clear preference for **LD, RV** and **AV**. These results are in general agreement with the available information on the species, but they show that it is possible to obtain a significant ranking of preferences, for the categories and classes used, as a basis for producing habitat suitability models.

Introduction

In the Italian Alps the typical habitat of black grouse is the transition belt between forested and open areas (artificial pastures or alpine meadows), where a mosaic of sparse trees, mainly *Larix decidua*, *Picea abies*, *Pinus mugo* but also *Fagus sylvatica* according to elevation and climatic zone, shrubs, especially *Rhododendron* and *Vaccinium* spp., *Juniperus* spp., *Salix* spp., *Alnus viridis*, and grass patches can be found (De Franceschi, 1994). These habitats frequently originate from forest clearings made in the past by man to increase availability of pasture. Therefore, they are unstable, especially at low elevations where, in the absence of human interventions, the forest expansion can be very rapid. In the last few decades the number of livestock farms in the Italian Alpine regions has greatly diminished and many pastures have been dismissed, allowing an increase of forested areas at the expense of open areas. These habitat modifications are suggested as one of the possible causes of the reduction in black grouse populations that has been observed in the Italian Alps (De Franceschi, 1983, 1994).

The studies available on habitat requirements of black grouse in the Italian alpine range are generally descriptive, i.e. they report analyses, sometimes very detailed, of various habitat parameters that characterize study areas used by the species (De Franceschi, 1996; Bottazzo & De Franceschi, 1996), but no quantitative attempts of ranking habitat preferences have been published. However, this kind of information is important in order to understand the role of habitat modifications on population dynamics and develop habitat suitability models. We report here the preliminary results of a study on habitat selection by black grouse in a pre- and alpine area, the province of Belluno, located in the North-Eastern Italy. The study is part of a project aimed to describe the situation of the population and to identify guidelines for its management.

Materials and methods

The Belluno province and the sample areas

The Province (approximately 366.000 ha) is located in the North-Eastern Italian Alps, and runs approximately northward from the pre-Alps, at the edge of the Po-Valley, to the border of Austria. It is consequently divided, from

south to north, in three climatic districts (DEL FAVERO & LASEN, 1993) the «Esalpic», the «Mesalpic» and the «Endalpic» **(table I)**. The province is mountainous, and only in the southern portion elevations lower than 1000 m are predominant (**table I**). Due to the combined effects of elevation and climate, land use and vegetation change from the predominant cultivated fields and deciduous woods of the Esalpic district to the predominant coniferous forests and alpine pastures of the Mesalpic and Endalpic districts (**table I**).

In order to define the study area within the Province, we conducted a survey on the distribution of black grouse with standardised interviews to gamekeepers and qualified hunters. They were asked to locate on the maps (1:25.000) of their hunting districts the areas where leks and/or broods and/or shootings occurred. The results indicated that the species is distributed throughout the entire province, at elevations approximately comprised between 1000 and 2300 m. Within these limits, and distributed according to the different climatic and environmental conditions of the province, 13 sample areas were chosen for a total of 4797 ha (369 ha of average size, s.d.=129).

Table I. Main characteristics of the Belluno province
Principales caractéristiques de la province de Belluno

	Esalpic district	Mesalpic district	Endalpic district	Total Province
Area (ha)	147255	151720	66720	365695
Avg. annual precipitations (mm)	>1500	[a]1400	[a]1000	—
Avg. annual T (°C)	13-14	7-8	4-5	—
Elevation (% of area)				
<1000	70	15	3	36
1000-2000	29	70	66	51
>2000	1	15	31	13
Land use (% of area)				
Cultivated fields	23	5	4	12
Alpine pastures	5	7	13	7
Deciduous woodlands	32	3	0	5
Coniferous forests	15	66	48	3
Others	24	29	35	28

Description of sample areas

Information on morphological characteristics of the sample areas was obtained from a digital terrain model supplied by the provincial Council. Using a GIS software (ArcView© 3.1), each area was mapped for elevation (200 m intervals), slope (15° intervals), and aspect (with 45° intervals to obtain the following classes: North, **N**; North-East, **NE**; East, **E**; South-East, **SE**; South, **S**; South-West, **SW**; West, **W**; North-West, **NW**). Land cover types (see **table II**) were mapped with field surveys compared with aerial photographs.

Table II: land cover types used for the analysis of habitat preference
Types de couverture végétale et de physionomie des sites externes pour l'analyse de préférence quant à l'habitat

Land cover types	Description
Fagus sylvatica **FS**	Coppice stands with dense cover; ground vegetation is scarce.
Picea abies **PA**	Stands with variable cover, normally dense with scarce ground vegetation but more open at high elevations.
Mixed *Fagus sylvatica* and *Picea abies* **FP**	Mixed stands of the two species, usually with close canopy and scarce ground vegetation, found at lower elevations than **PA**.
Pinus sylvestris **PS**	Stands in dry areas, usually with steep slopes.
Larix decidua **LD**	Stands with usually sparse trees, ground vegetation abundant, variable from grass to *Rhododendron-Vaccinium* spp., to *Pinus mugo*.
mixed *Picea a.* and *Larix d.* **PL**	Mixed stands with denser cover and less ground vegeta tion than **LD**.
Pinus mugo **PM**	Stands with variable degrees of canopy closure and fragmentation
Alnus viridis **AV**	Usually fragmented in small patches within **G** or **PM**
Mixed shrubs **MS**	Shrubs of *Juniperus* spp., or *salix* spp., or others, varia bly fragmented within **G**
Rhododendron-Vaccinium **RV**	Shrubs of *Rhododendron* spp. and *Vaccinium* spp., variably fragmented within **G**
Open grassland **G**	Grazed or ungrazed grassland
Grassland-forest transition **GFT**	Areas where **G** is being colonised by one or more tree species (**FS, PA, FP, PL, LD**)
Mixed grassland and rock **GR**	Usually dry areas where the grass layer is low and interrupted by rocky formations
Rock **R**	Areas were the ground vegetation is very scarce, usually with steep slopes

Black grouse counts

Summer counts with pointing dogs were conducted within each sample area in 1997, 1998, and 1999. The areas were divided in sectors, which were thoroughly and simultaneously searched. The number of dogs was variable, but never lower than 1dog/50 ha. For this analysis, only adult hens were considered (i.e. one hen with a brood of five accounted for one observation), with the assumption that the habitat choice is made by the hen and in order to exclude, at this stage of the analysis, the effects of variable brood sizes. Males were not considered. Each observation was located on a map (1:10.000) of the sample area.

Data analysis

The proportional availabilities of the resource categories and classes studied were calculated as the proportions of each sample area in the various elevation, slope and aspect classes and land cover types. To estimate use, a circular area (buffer) of 100 m radius was preliminarily digitized around each observation, and the proportions of each buffer in the different resource categories and classes were calculated; these proportions were weighted for the proportion of observations in each buffer as respect to the total number of observations. The use expected (**UE**) for each resource category (ha) was calculated from the proportional availability of the given resource category in the totality of sample areas. The use observed (**UO**) was calculated from the weighted proportional composition of the totality of buffers. Distributions of UE and UO were compared with the chi-squared test. Selection ratios (**SR**) were calculated as :

$$\mathbf{SR_i} = p\mathbf{UO}_i/p\mathbf{UE}_i$$

where $p\mathbf{UO}_i$ and $p\mathbf{UE}_i$ are, respectively, the use observed and that expected for the class i of a given resource category as a proportion of the total use observed and expected for the category. Estimates of selection ratios and their standard errors were used to produce Bonferroni confidence intervals to assess probability (95%) of selection. Confidence limits were also used for the comparison of pairs of SR (MANLY *et al.*, 1993).

Results and discussion

Elevation, slope and aspect

The various elevation classes **(table III)** were differently selected (d.f. = 9, $\div^2$ =128.5, P<0.001). Elevations lower than 1500 m were avoided, with the exception of the class 900-1100 m that showed a significant preference. The elevation classes between 1500 and 1900 m were, conversely, significantly preferred, while those higher than 2100 m were again, and clearly, avoided. The significance of differences between pairs of selection ratios is given in **table IV**, and confirms that selection for, or against, the different classes was very clear. The selection against low elevations can be explained by the high proportion of forests found in this elevation range, with the exception of one sample area where artificial pastures within the 900-1100 m interval allow the presence of the species, giving the positive selection observed. The preference observed for the elevations classes between 1500 and 1900 m can be related to the fact that the forest-alpine pastures transition belt, which creates the general conditions favourable to black grouse, is mainly found in this interval. Similarly, the avoidance of higher elevations is most obviously linked to the reduction of cover vegetation in the alpine meadows-rock transition belt. These preference limits, as well as the possible use of low elevations in pre-alpine habitats, are

consistent with the indications of DE FRANCESCHI (1994) and BERNARD-LAURENT (1994) for the Alpine regions. They confirm that elevation is not, in itself, an important parameter for the species.

Table III : Selection of elevation classes (m above see level).
Sélection des classes d'altitude.

	Use		Selection Ratio	Confidence limits
	Expected	Observed	(SR)	
700-900	0.006	0.003	0.447	0.000*-1.613
900-1100	0.029	0.101	3.539	2.063-5.015
1100-1300	0.051	0.017	0.332	0.000*-0.687
1300-1500	0.071	0.037	0.518	0.148-0.889
1500-1700	0.137	0.188	1.371	0.973-1.769
1700-1900	0.297	0.382	1.286	1.057-1.515
1900-2100	0.256	0.236	0.923	0.691-1.155
2100-2300	0.133	0.036	0.271	0.075-0.467
2300-2500	0.021	0.000	0.000	0.000-0.000
2500-2700	0.000	0.000	0.000	0.000-0.000

Confidence limits lower than 1 show avoidance; confidence limits higher than 1 show preference
* negative inferior confidence limits have been replaced by 0.000

Table IV: Significant differences between estimated selection ratios of elevation classes*
Différences significatives entre les rapports estimés de sélection de classes d'altitude

	2300-2500	2500-2700	2100-2300	1100-1300	700-900	1300-1500	1900-2100	1700-1900	1500-1700
2300-2500									
2500-2700	-								
2100-2300	+	+							
1100-1300	-	-	-						
700-900	-	-	-	-					
1300-1500	+	+	-	-	-				
1900-2100	+	+	+	+	-	-			
1700-1900	+	+	+	+	-	+	-		
1500-1700	+	+	+	+	-	+	+	-	
900-1100	+	+	+	+	+	+	+	+	+

The entry + indicates a significant difference between the row class and the column class; the entry – indicates no significant difference
* Selection ratios are listed in order of increasing value

Results for slope classes **(table V)** were less clear, and use was only tendentially different from availability (d.f. = 4, $\div^2$ =7.8, P =0.099). This result is at least partially influenced by the high standard errors of estimates that generated wide confidence limits. For this reason, no comparisons between pairs were made for slope. However, the selection ratios given in table 5 show, as a gene-

ral trend, that moderate slopes were preferred and steep slopes were avoided. Moderate slopes could be more favourable because they are less subjected to soil dampness and allow an easier flushing of the young birds when disturbed. Another possible reason is that, since the slopes are the areas that are abandoned earlier when use of pastures decreases, they are more rapidly colonized by *Rhododendron* and *Vaccinium* spp., which are selected by black grouse. Conversely, steep slopes tend to host a poor vegetation that is unsuitable for the species. In any case, these results need to be further confirmed.

Table V: Selection for slope classes
Sélection selon les classes de déclivité

	Use		Selection Ratio (SR)	Confidence limits
	Expected	Observed		
0-15°	0.315	0.291	0.921	0.796-1.047
15-30°	0.515	0.574	1.116	1.032-1.200
30-45°	0.149	0.111	0.742	0.559-0.925
45-60°	0.019	0.024	1.290	0.572-2.008
>60°	0.002	0.000	0.128	0.000*-0.828

Confidence limits lower than 1 show avoidance; confidence limits higher than 1 show preference
* negative confidence limits have been replaced by 0.000

Selection for aspect classes **(tables VI and VII)** was highly significant (d.f. = 7, $\div^2$ = 58.66, P<0.001). It is possible to see a pattern of avoidance for «sunny» and "warm" aspects classes and of preference for «shady» and «fresh» classes. There are various possible reasons for this finding. In mid summer daytime temperatures in the study areas can be quite high, especially at ground level. In addition, it has to be taken into account that counts started approximately at 8 a.m. and ended between 11 or 12 a.m., when birds are likely to be looking for shed from direct sunshine. However, the most probable reason is that the «fresh» aspect classes are richer in those vegetation types, such as *Vaccinium* spp. and *Alnus* spp., that are positively selected by black grouse. The sample size so far collected is not sufficient to conduct a more detailed analysis for these possibilities.

Table VI : selection for aspect classes
Sélection pour les classes d'exposition

	Use		Selection Ratio (SR)	Confidence limits
	Expected	Observed		
N	0.099	0.167	1.685	1.314-2.056
NE	0.153	0.182	1.191	0.941-1.440
E	0.175	0.085	0.486	0.329-0.643
SE	0.143	0.068	0.475	0.301-0.648
S	0.138	0.126	0.914	0.676-1.152
SO	0.110	0.124	1.122	0.827-1.416
O	0.098	0.134	1.362	1.020-1.704
NO	0.083	0.114	1.370	0.993-1.747

Confidence limits lower than 1 show avoidance; confidence limits higher than 1 show preference.

Table VII : Significant differences between estimated selection ratios of aspect classes*
Différences significatives entre les rapports estimés de sélection des classes d'exposition

	SE	E	S	SO	NE	O	NO
SE							
E	-						
S	+	+					
SO	+	+	-				
NE	+	+	-	-			
O	+	+	-	-	-		
NO	+	+	-	-	-	-	
N	+	+	+	-	-	-	-

The entry + indicates a significant difference between the row class and the column class; the entry – indicates no significant difference
* Selection ratios are listed in order of increasing value

Land cover types

The various land cover types **(Table VIII)** showed a significant difference in use as respect to availability (d.f. = 13, $\div^2$ = 166.6, P<0.001). As for other resource categories, selection ratios for various land use types had high standard errors, and consequently wide confidence intervals, that reduced the significance of estimates. This is in part due to the small proportional availability, and the resultant small proportion of observations, of certain types. Even with this caution, it is possible to identify a group of land use types that are significantly avoided, comprising **FS** and **PS**, which are totally unused, **GR** and **R,** which are strongly avoided, and **PM,** which is used less than how it is available; **FP** is also selected against, but the confidence interval of the selection

ratio is not significant. The avoidance of **FS** can be related to the dense canopy cover of this type (mainly coppiced woods, found in the sample areas of the Esalpic district at low elevations). That of **PS** can be due to the fact that these stands grow in steep, dry slopes where also the undergrowth is scarce and unsuitable for black grouse. The selection against **R** and **GR** is most probably due to the scarcity of vegetation for cover and feeding of this land cover types. The avoidance of **FP** and **PM** is less marked than that observed for the previous types. These stands, in the study areas, tend to be very dense, and in this case they are unsuitable for hens and broods, which are the source of data on use for this study. However, various field observations confirm that single adult birds, often males, use **PM** during the moult and for wintering. Two other forest types, **PA** and **PL**, did not show any significant selection. These vegetation types are often colonizers of abandoned pastures and tend to be less dense than the previous forest types. Therefore, their edges are used by the species. In any case, at this stage of the study we believe that the result is not conclusive and requires further confirmation. The selection for **G**, **GFT** and **MS** was positive, although not significant because of the high variability of confidence limits. All these types are characterized by dense ground vegetation, more or less fragmented, as that is generally required in summer by Black grouse (BERNARD-LAURENT, 1994; DE FRANCESCHI, 1996). Finally, **LD**, **RV** and **AV** were significantly preferred. These vegetation types are generally very diversified, due to the interspersion of trees and/or patches of shrubs and grass, and can be very important, both for cover and feeding, for the presence of *Vaccinium* spp.

Table VIII : Selection for land cover types
Sélection pour les types de couverture du sol

	Use		Selection Ratio (SR)	Confidence limits
	Expected	Observed		
FS	0.056	0.000	0.000	0.000-0.000
PS	0.024	0.000	0.000	0.000-0.000
GR	0.092	0.034	0.372	0.090-0.653
R	0.097	0.044	0.453	0.152-0.754
FP	0.031	0.018	0.585	0.000*-1.201
PM	0.137	0.092	0.677	0.374-0.980
PA	0.073	0.075	1.028	0.512-1.545
PL	0.093	0.099	1.061	0.604-1.518
G	0.175	0.211	1.206	0.873-1.539
GFT	0.085	0.107	1.255	0.738-1.772
MS	0.020	0.030	1.465	0.267-2.664
LD	0.037	0.070	1.896	0.909-2.882
RV	0.048	0.120	2.488	1.527-3.450
AV	0.031	0.099	3.197	1.822-4.571

Confidence limits lower than 1 show avoidance; confidence limits higher than 1 show preference
* negative inferior confidence limits have been replaced by 0.000

The ranking of selection ratios shown in **Table IX** is quite clear and confirms the patterns above described.

Table IX : Significant differences between estimated selection ratios of land cover types*
Différences significatives entre les rapports de sélection estimés pour les types de couverture du sol

	FS	PS	GR	R	FP	PM	PA	PL	G	GFT	MS	LD	RV
FS													
PS	-												
GR	+	+											
R	+	+	-										
FP	-	-	-	-									
PM	+	+	-	-	-								
PA	+	+	-	-	-	-							
PL	+	+	+	-	-	-	-						
G	+	+	+	+	-	+	-	-					
GFT	+	+	+	+	-	-	-	-	-				
MS	+	+	-	-	-	-	-	-	-	-			
LD	+	+	+	+	-	-	-	-	-	-	-		
RV	+	+	+	+	+	+	+	+	+	-	-	-	
AV	+	+	+	+	+	+	+	+	+	+	-	-	-

The entry + indicates a significant difference between the row class and the column class; the entry – indicates no significant difference
* Selection ratios are listed in order of increasing value

Conclusions

The resource categories used in this work were chosen in order to be consistent with definitions used in forestry or in land use maps, since one of the aims of the study was to obtain indications for a habitat suitability model. To this purpose, there were clear preferences for certain elevation, slope and aspect classes, as well as for land cover types. Elevation classes selected were in the range of 1500-1900 m, where the preferred vegetation types normally occur, but there were exceptions due to artificial habitats at lower elevations; flat and steep areas, as well as warm aspect classes, tended to be avoided, and moderate slopes and fresh aspect classes were preferred. Forest types with dense cover were avoided, as well as areas were ground vegetation is scarce; there was a clear preference for *Larix d.* stands, *Rododendron-Vaccinium* spp and *Alnus v.* shrubs. These results are in general agreement with the available information on the species, but they show that it is possible to obtain a significant ranking of preferences, for the categories and classes used, as a basis for producing habitat suitability models. In general, selection for, or against, the different classes of elevation, slope and aspect was less marked than selection for vegetation types. To this regard, it is most probable that morphological parameters and land cover types are interrelated, but the simple statistical approach used

here is unsuitable for identifying these relationships. In addition, from an ecological point of view the preferences observed suggest a variety of hypotheses to be tested in order to understand the reasons driving the habitat choices of black grouse. In this perspective, sample areas have been now increased to 20, to equilibrate the proportional availabilities of certain resource categories, and a more detailed description of certain land cover types has been obtained.

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RESUME : Sélection de l'habitat estival par le Tétras lyre dans la province de Belluno (Alpes du Nord-est d'Italie)

Les résultats préliminaires d'une étude sur la sélection de l'habitat estival par le Tétras lyre dans la province de Belluno (Alpes du Nord-Est), sont reportés. Treize zones d'échantillon ont été choisies dans la province (avec une hauteur entre 700 et 2500 m, une surface moyenne de 369 ha (d.s.= 129) et une surface totale de 4797 ha), couvrant différentes conditions climatiques et d'environnement. Pour chaque zone d'échantillon, les cartes de la végétation (boisements de *Fagus sylvatica* **FS**, *Picea abies* **PA**, *Fagus s.* avec *Picea a.* **FP**, *Pinus sylvestris* **PS**, *Larix decidua* **LD**, *Larix d.* avec *Picea a.* **PL**, *Pinus mugo* **PM**, *Alnus viridis* **AV**; arbustes mixtes **MS** (*Juniperus* spp., *Salix* spp. autres) arbustes de *Rhododendron* spp. et *Juniperus communis* **RV**; prairies **G**; zones de transition prairies-forets **GFT**; prairies avec rochers **GR**; rochers **R**), de la hauteur (en classes de 200 m), de l'inclinaison (en classes de 15 grades) et de l'orientation (en classes de 45 grades) ont été produites. Les recensements au chien d'arrêt en été conduits en 1997, 1998 et 1999 et chaque observation a été localisée sur la cartographie de sa zone d'échantillon. L'utilisation de l'habitat a été calculée à partir de la composition (végétation, hauteur, inclinaison, orientation) d'un cercle de 100 m de rayon autour de chaque observation, pondérée par la proportion d'individus de l'observation sur le nombre total d'individus. Les classes de hauteur entre 1500 et 1900 m sont préférées, mais des classes moins hautes peuvent être utilisées quand on y trouve des pâturages artificiels; les classes d'inclinaison moyenne et les

classes d'orientation moins chaudes sont préférées, tandis que les classes d'inclinaison trop faibles ou trop pendantes et les classes d'orientation plus chaudes sont évitées. En général, la sélection en faveur ou contre les différentes classes de hauteur, inclinaison et orientation a été moins marquée que la sélection trouvée pour la végétation. En général, les boisements trop fermés et les pelouses trop ouvertes sont évités; on a trouvé une claire préférence pour **LD**, **RV** et **AV**. Nous concluons que les paramètres utilisés sont adéquats pour une analyse de la préférence de l'habitat à l'échelle de grandes surfaces. Les index de sélection trouvés sont bien évidents pour beaucoup de paramètres de description de l'environnement, mais pour d'autres, qui sont moins représentés dans les zones d'échantillon, une confirmation avec plus de données est nécessaire. Avec cet approfondissement, les index de sélection obtenus dans cette étude pourraient être utilisés dans un modèle d'évaluation de la qualité de l'habitat pour l'espèce dans la province ainsi que dans des régions sub-alpines et alpines similaires.

Mots-clés : Tétras lyre, *Tetrao tetrix*, Italie, Alpes, sélection de l'habitat, période estivale

De gauche à droite : Egbert Strauß, Christiane Seiler, Sonja Ludwig, Robert Kaminiarz, Simonetta Fuser, Maurizio Ramanzin, Vladimir Bejcek, Philip Warren. Photo M. Loneux.