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BIOMASS AND BIOMASS REGENERATION AFTER DISTURBANCE IN SHRUB COMMUNITIES IN LEON PROVINCE (NW SPAIN)

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ABSTRACT

Aboveground biomass in 39 shrub communities in León province (NW Spain) were studied. The highest values of ligneous biomass were observed in Cytisus and Genista florida communities and in Cistus communities, the smallest in Thymus communities having heathlands and Genista hispanica and G. hystrix communities of intermediate values. There is a high correlation between biomass and cover, and between biomass and height of ligneous species. Some areas were selected for the evaluation of regeneration after different experimental disturbances.

INTRODUCTION

Shrub communities occupy vast acreages in Spain, and particularly in León province. However, they are hardly utilized despite the fact that they constitute a large amount of low cost energy (1). A better knowledge would allow for a better exploitation of these ecosystems.

The traditional use of these areas has usually been for grazing or farming and the normal managements are cutting, burning or ploughing of vegetal biomass.

The aim of this work is to give an overall view of the biomass of several types of shrub communities in León province (NW Spain), as well as their regeneration after the most common traditional disturbances. The evaluation of the biomass makes know the stock of available energy. On the other hand, regeneration studies are very interesting both in the long run as well as the short run because they are the basis in establishing the optimum management and use.

Over the last few years, there have been numerous studies on shrublands (2, 3) and specifically on shrub regeneration after disturbances (4, 5, 6, 7, 8, 9, 10).

MATERIAL AND METHOD

In order to evaluate the biomass, 39 shrub communities in León province were sampled (figure 1). Seventeen of them are heathlands, the most common shrubland in León province, five are Cytisus or Genista florida communites,

three are Cistus communities, four are Genista hispanica or G. hystrix communities and two are Thymus communities. The other eight communities cannot be clearly included in the previous types because they have intermediate characteristics.

In each one of these areas, cover and height of ligneous species were determined in ten sampling units of 1 m^2, located at random, and aboveground biomass was cut in three similar sampling units, ligneous species were separated and their dry weight was measured, afterwards they were kept for 12 hours at 100ºC. Final results are the mean values of the ten samplings, for cover and height, or the three samplings, for biomass.

Six areas were selected for the evaluation of regeneration of ligneous species. In each one, four sampling plots of 100 m^2 were established, which were cut, burnt and ploughed, and the fourth was left as a control plot. Before this, ligneous species were sampled and their importance values in terms of cover percentage were stated. Moist weight of aboveground shrub species from the plot cut was measured. Later, dry weight was valued from representative fractions of each species.

These experimental disturbances were carried out in 1985 or 1986 in four of the areas. One of these is a shrubland dominated by Genista scorpius: it is in Monte San Isidro, near León City, at an altitude of 900 m. Another two areas are neighbouring, located 1000-1200 m high, in Cota Isestil and Majada Setibar, respectively; in both of them, Erica australis subsp.

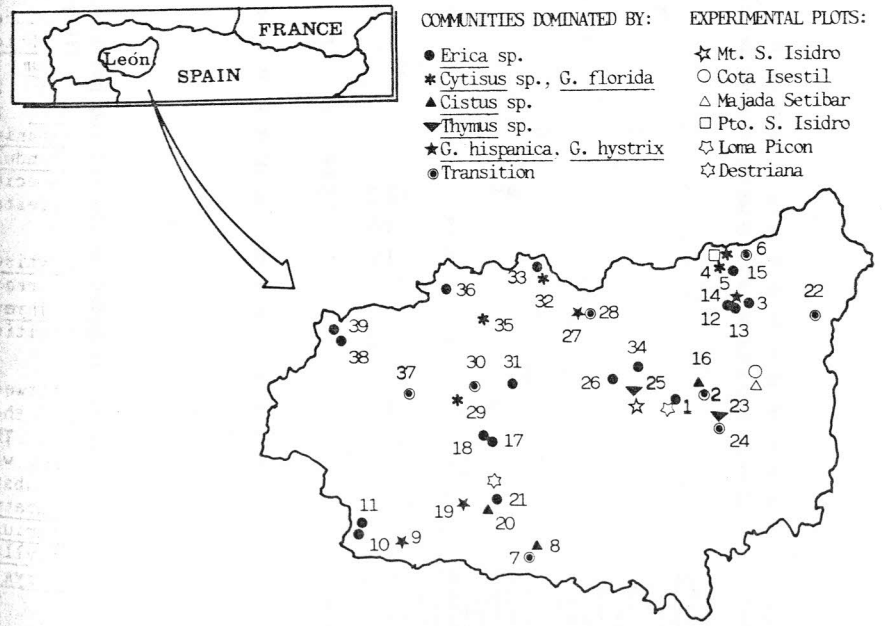

Figure 1. Situation of the areas studied.

aragonensis is the dominant species, but in the first one it is, in practice, the only ligneous species while in the second one there are some other heathland species. The fourth area is a damp heathland, dominated by Calluna vulgaris and located in Puerto San Isidro, at an altitude of 1600 m.

In these areas, regeneration of ligneous species was studied by estimating the volume (11) and evaluating cover over the following years. The study will be continued until the distubed plots recover a similar structure to the one it previously had.

In the other two areas the experimental disturbances were carried out in the summer of 1989. Therefore, there are no data on their regeneration yet, but there are data on the initial biomass in the plot cut. In one of the areas, called Destriana and located at an altitude of 1000 m, two series of four plots were established, one in a section dominated by Cistus laurifolius and the other in a section dominated by Cistus ladanifer, because of the great interest in finding out the regeneration after the different disturbances in an ecotonic area between the both species. In the other area, Loma Picon, at an altitude of 980 m, two series of plots were also established; in one of them, Cistus laurifolius is the dominant species, in the other it is co-dominant with Erica australis subsp. aragonensis and Arctostaphylos uva-ursi. In this case, the aim is to compare the regeneration between species which can resprout vegetatively (Erica) and species which can only reproduce by seeds (Cistus).

RESULTS AND DISCUSSION

Biomass values of ligneous species in the areas studied were included in table 1. The dominant species are, by their bigger biomass, Erica australis subsp. aragonensis in seven areas, Chamaespartium tridentatum in five, Erica umbellata in four, Calluna vulgaris in three, Erica arborea in two, Genista florida subsp. polygaliphylla in four, Cytisus scoparius in four, Cytisus multiflorus in one, Genista hystrix in two, Genista hispanica in two, Cistus ladanifer in two, Cistus laurifolius in one, Lavandula stoechas subsp. pedunculata in one, and Thymus mastichina in one. The species of great aboveground biomass in each area is usually the species of greater cover as well, coinciding in 32 of 39 areas studied.

The mean height of the upper layer exceedes 2 m in two Cytisus communities (areas 15 and 35) and it is lower than 60 cm in sixteen areas, including all of Genista hispanica and G. hystrix communities, Thymus communities and eight heathlands, while all Cistus and Cytisus communities exceed this height.

There is a clear correlation (Pearson correlation coefficient) between cover and biomass values of species in each area (r=0.56), and the correlation is even greater between biomass and height (r=0.80). The correlation between cover and biomass values of each ligneous species was also calculated. Significant values were observed for Erica australis subsp. aragonensis (r=0.59), Calluna vulgaris (r=0.82), Chamaespartium tridentatum (r=0,68) and Halimium alyssoides (r=0.94), as well as for Cytisus scoparius, C. multiflorus, C. cantabricus and Genista florida subsp. polygaliphylla, considered as a whole (r=0.79), and for Thymus mastichina and T. zygis (r=0.96). In all cases the degree of security is 99%.

The aboveground ligneous biomass varies between 7533 g/m^2, in a Genista florida subsp. polygaliphylla dominated community, with a height of 2-3 m, and 382 g/m^2 in a Thymus mastichina dominated community. The mean

TABLE 1

Biomass values of ligneous species and height of the uppest layer in the studied shrublands

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Erica umbellata	73												1				657				11	454				364													
Calluna vulgaris	39					1276							5	2546		205	40					387				172		320								21			
Halimium umbellatum	1	35					3														9					1													
Cistus laurifolius	231																2835							238				28					544	449					
Erica australis	2170		402		1144		1692			587	26	823						1784	275											1285		499	128		114	89	422	639
Chamaesp. tridentatum	1		757		151					748	446	820					11	116						325		168			559		131	166	2	336	948	1046	452
Cytisus scoparius				791								11					73	3				66	3	1	82				401				52						
Thymus mastichina					509												3						363								791				618				
Sant. rosmarinifolia																							3																
Halimium alyssoides		80	116				2			102	134							66			4	1140				3		1246		4	163			3	86		210	
Erica arborea			619													21																							
Genista florida				5356		139										7300																468	143		777	525		
Daboecia cantabrica												2																					1		2738	1215			
Vaccinium myrtillus						11						32				6												24											
Ulex cantabricus						258																																20	
Thymus zygis									49						15										7														
Lavandula stoechas																50							16	161	504			43	56									
Cistus ladanifer								1869												753																30			
Genista hystrix									1827								18		1400																				
Litodora diffusa															7	1						37					17								1				
Erica vagans														209																									
Genista hispanica															1651												585												
Helianthemum canum															9												34		1										
Erica cinerea																		64																					
Cytisus cantabricus																												1160										
Cytisus multiflorus																													1270								12	
Genista falcata																																					114	
TOTAL BIOMASS (g/m^2)	2437	906	1894	5865	1434	1545	1697	1859	1876	1437	606	1694	2755	1682	7533	2961	726	2030	1430	1039	467	1630	382	725	593	696	636	2850	1313	490	2007	1259	1321	863	4135	549	2921	1699	1111
HEIGHT OF UPPER LAYER (cm)	77	79	69	148	86	40	92	71	58	66	37	113	61	40	226	114	20	86	42	99	23	89	41	52	52	28	33	80	89	67	78	116	52	33	233	31	170	94	49

values of biomass in groups of similar areas are:

	$\bar{X}$	$S_{(n-1)}$
Cytisus communities	4021	2771
Cistus communities	1953	964
Heathlands (height > 60 cm)	1939	450
G. hispanica and G. hystrix communities	1406	545
Heathlands (height < 60 cm)	793	293
Thymus communities	488	149

With regard to the experimentaly disturbed areas, the aboveground ligneous biomass from the plot cut is included in table 2, as well as cover and height of the upper layer before cutting, and four years after cutting. The greatest biomass is detected in the area called Loma Picon 1 (440 kg of

TABLE 2
Moist weight and estimated dry weight in the experimental cut plots. Cover and height values before cutting and 4 years after cutting.

	BIOMASS			BEFORE CUTTING		AFTER CUTTING	
	MOIST WEIGHT (Kg/100 m^2)	DRY WEIGHT (%)	DRY WEIGHT (g/m^2)	COVER (%)	HEIGHT (cm)	COVER (%)	HEIGHT (cm)
MT. S. ISIDRO							
Genista scorpius	38	50.6	192	24.6	60	-	-
Rosa sp.	1	-	-	1.9		-	
COTA ISESTIL							
Erica australis	165	56.4	931	62.3	120	30.4	72
MAJADA SETIBAR							
Erica australis	31	52.1	161	28.6	90	36.1	78
Erica umbellata	14	52.3	73	38.4		10.7	
Calluna vulgaris	12	55.9	67	17.8		3.2	
Arctost. uva-ursi	7	48.4	34	14.6		-	
Halimium alyssoides	1	39.3	4	6.7		15.3	
Chamaesp. tridentatum	1	50.0	5	1.6		2.0	
PTO. S. ISIDRO							
Calluna vulgaris	118	52.0	614	75.2	50	6.4	
Erica tetralix	22	50.2	110	18.5		32.0	15
Vaccinium myrtillus	+	-	-	0.5		6.8	
DESTRIANA 1							
Cistus ladanifer	276	62.5	1725	62.4	148		
DESTRIANA 2							
Cistus laurifolius	358	68.0	2434	73.4	149		
Chamaesp. tridentatum	6	73.0	44	11.3			
LOMA PICON 1							
Cistus laurifolius	440	74.2	3265	68.7	152		
LOMA PICON 2							
Cistus laurifolius	216	72.1	1557	37.4	129		
Erica australis	154	67.8	1044	49.1			
Arctost. uva-ursi	18	44.1	79	44.5			

moist weight in 100 m^2, which corresponds to 3265 g/m^2 in dry weight); in this area Cistus laurifolius is clearly dominant, with big and old specimens (there are other ligneous species, but their biomass is not important). The other three Cistus communities also have greater biomass than the heathlands, while the least ligneous biomass was observed in Monte San Isidro (38 Kg of moist weight in 100 m^2, which corresponds to 192 g/m^2 in dry weight); the dominant species is Genista scorpius, although its cover is less than 25%.

The regeneration of ligneous species is very little in Monte San Isidro, in part, due to the effect of grazing by sheeps and rabbits. Cota Isestil and Majada Setibar heathlands are the most recuperated, after the fourth year of the disturbances. Erica austalis subsp. aragonensis can resprout after burning or cutting and it can also reproduce by seeds, the latter being the only possibility in the ploughed plot, with slower regeneration. In Puerto San Isidro, Erica tetralix recovers faster than Calluna vulgaris because C. vulgaris does not resprout. However, the regeneration process is not still finished, so it is not possible to assure that this latter species will not recuperate its initial dominance as it tends to increase its cover. There are still no data on regeneration of Cistus communities.

CONCLUSIONS

The high biomass observed in some of the shrublands studied shows their great stock of available energy, although the election of the best management and use would need ulterior studies in each concrete case. A reasonable use could lead to an improvement of these communities and, simultaneously, to an economic profit. This would allow for a greater appreciation and protection of shrublands, traditionally considered as marginal areas.

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BIOMASS RESOURCES FOR ENERGY IN MALAYSIA

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ABSTRACT

This paper describes the range of biomass resources in Malaysia, and the current uses and extent of utilisation. Most of the resources are wastes of which only a small fraction is employed for combustion in the traditional industries of Malaysia. The types of biomass and wastes are described with the current recovery rates and uses. Some trends are identified for changes in arisings and opportunities identified for greater utilisation.

INTRODUCTION

In a developing country such as Malaysia, socio-economic advancement depends largely on natural resource exploitation. Malaysians, like their counterparts in the developed countries, have expectations for and the right to a better quality of life. Ever since Independence in 1957, this goal has been pursued by successive Malaysian governments through the implementation of pragmatic socio-economic policies and programmes embodied in the respective development plans called the Malaysian Plans (1-4)

As the country is endorsed with only limited mineral resources, Malaysia has had to base its socio-economic strategies and programmes in its most abundant natural resources, namely, forest and land. The forest has generated the much needed funds for development while the land has provided employment opportunities for the creation of new wealth. As a consequence, successive development plans have been dominated by large scale land development schemes.

Most of the land developed for crops (such as rubber, oil palm and paddy) were converted from the forest. As a result, large tracks of forest were cleared within a relatively short period. The massive clearance of forest and the rapid development of the agricultural sectors have resulted in the generation of a high amount of biomass wastes.

The primary objectives of this paper are:

1. To highlight the quantity and form of forestry, and agricultural wastes
2. To identify the current utilisation of biomass for energy
3. To suggest possible alternative for utilising biomass residues.

FORESTRY RESIDUES

The forest is the source of timber which generates the necessary revenue for development while the land provides opportunities for gainful employment and the creation of wealth. The clearing of forests within a relatively short period has led to the generation of a huge amount of