Functional traits are useful for identifying plant community response to environmental change and effect on ecosystem functions \citep{diaz2007,lavorel2002,laliberte. Functional traits have many predicted connections to soil carbon and other biogeochemical processes, particularly relevant to the global carbon cycle and sequestration of atmospheric CO2. Aboveground material contributes to soil carbon primarily via deposition of litter material \citep{valery2004}, and subsequent decomposition rates and processes of that material. Changes in community composition can affect soil carbon storage through changing the chemical and physical structure of litter \citep{liao2007}. Plant litter may become recalcitrant, or resistant to decay, in soil due to abiotic conditions such as oxygen availability, water levels, pH, and ambient nutrients, or biotic conditions, particularly the microbial and macroinvertebrate decomposer communities. However, litter characteristics, measured by traits, are strongly tied to decay rates in soil \citep{cornwell2008}. This study aims to examine the traits linked to litter chemistry and structure.

Decomposition research has found a variety of green leaf economic traits impact decomposition rate of both leaf \citetext{specific leaf area/leaf mass area and leaf nitrogen \citealp{devries2012,cornwell2008}, and leaf carbon \citealp{britson2016}} and litter material \citetext{litter carbon and dry matter content \citealp{freschet2012}}. These traits are part of the leaf economic spectrum (LES), which conceptualises a trade-off between nutrient acquisitive and nutrient conservative plant ecological strategies, based on a finding that nearly 3/4 of global variation in key leaf traits are captured by a single axis in multidimensional trait space \citep{wright2004}. This single axis of variation suggests species tend to be either highly productive, producing a large volume of high-quality litter that provide a quick return on C, N, and P investment, or highly persistent, producing fewer low-quality leaves that have a slower return on investment \*\*different citation here. Abiotic and biotic conditions mean even labile tissue can become recalcitrant in a particular environment, but tissue high in chemically complex carbon forms, such as lignin, are much more likely to become recalcitrant in soil. Specific leaf area and dry matter content are calculated using leaf/litter dry weight, which itself encompasses a range of tissue material including nutrients, proteins, carbon, and others (Fig 1). So, while these economic spectrum traits have provided strong correlation to decay rate, they are not direct measures of tissue carbon chemistry.

We have long known that lignin in particular is a strong predictor for decay rate \citealp{britson2016,cornwell2008,makkonen2012,freschet2012a,freschet2012}; composed of three kinds of heavily-linked benzene-propane, thermal stability of lignin is high, and as such it is more difficult to decompose. While organic biomass consists of a range of material, lignin joins hemicellulose and cellulose as three primary components collectively termed `lignocellulosic biomass’ distinct structure that decompose at different rates in different conditions. Hemicellulose is composed of simple sugar monomers with random, amorphous structure. These have little strength and are easily hydrolysed \citep{muller-hagedorn2007}. Cellulose forms long polymers of glucose units without many branches, making these linear crystals more stable than simple sugars. Some decomposition work has examined the ability of other biomass components to predict decay \citetext{including cellulose \citealp{britson2016}, and a range of other organic compounds identified by infrared spectroscopy \citealp{lang2009}}, but there has not been a clear/consistent examination of biomass components in species and across trait space. The approximate decomposition of litter tissue suggests the lignocellulosic composition of leaf carbon may not be related to SLA or to the LES at all.

Economic spectrum traits generally accepted methodologies for their measurement, complying with guiding principles of trait measurement, which suggest methods should be straightforward and reproducible \citep{perez-harguindeguy2013}. Wet chemistry assays are the most common methods to measure biomass components in tissue, but are costly in environmental impact, time, and funds. A potential alternative is `thermogravimetric analysis’ (TGA), during which mass is recorded while subjected to rising temperatures; mass loss over this thermal gradient can be regarded as the sum of the degradation of the main components of that biomass \citep{hu2016,barneto2009,yang2006,cheng2015,perejon2011,orfaoe2001chen2017,muller-hagedorn2007}. Mass fractions of each of three primary components - hemicelluloses, cellulose, and lignin - can be mathematically deconvoluted from the multi-peaked decay rate curve, a method which has been validated by studies comparing estimates to experimental measurements \citep{yang2006,barneto2009}. Much of the published literature use software to conduct the deconvolution \citetext{for example OriginPro \citealp{chen2017}, PeakFit \citealp{strandberg2017,perejon2011}, Fityk \citealp{perejon2011}, or Datafit \citealp{cheng2015}}, so while it has been used to identify species' recalcitrance \citetext{for example in seagrasses \citealp{trevathan-tackett2015}, and eucaplyts \citealp{orfao2001}}, the deconvolution procedure can be challenging to replicate and has not been deeply examined for its application to comparative studies.

In the present study, we examine and demonstrate the application of TGA for estimating the partitioning of litter carbon, into what we call ‘biomass traits’, in 29 wetland species, using an open source mixture model we developed for the deconvolution. We measure a range of functional traits included in the LES and related to litter decomposition, to assess their relationship and coordination with our measured biomass traits to determine how carbon components integrate into the existing trait spectrum, and to guide whether we can use that spectrum to generalise carbon investment in biomass tissue.