**Appendix S1.** (Extended version of Table 1) Unintended, *post hoc* functions of herbarium specimens with publications validating these uses, when available.

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| --- | --- | --- |
| **Specimen use** | **Description of potential applications** | **Citations** |
| ***Genetics*** *– archival DNA to quantify genetic differences among species, populations, and individuals* | | |
| Interspecific variation\* | taxonomic identification (DNA barcoding) | (Buerki and Baker, 2015; Xu et al., 2015) |
| Molecular systematics, evolution and phylogenetics | (Ranker and Worth, 1986; Windham & Hoffler, 1986; Bruns et al., 1990; Whitten et al., 1999; Zomlefer et al., 2006; Grusz et al., 2009; Staats et al., 2011; Särkinen et al., 2012; Tripp and Fatimah, 2012; Buerki and Baker, 2015; Weiß et al., 2015; Yeates et al., 2016) |
| Genotypic variation | ‘gene bank’ for measuring variation within and among population across species’ ranges and through time | (Rogers and Bendich, 1985; Whitten et al., 1999; Ristaino et al., 2001; Saltonstall, 2002; Ames and Spooner, 2008; Lambertini et al., 2008; Lister et al., 2008; Chun et al., 2010; Staats et al., 2011; Särkinen et al., 2012; Delye et al., 2013; Vandepitte et al., 2014; Martin et al., 2014; Weiß et al., 2015; Krinitsina et al., 2015; Brunet et al., 2016; Saville et al., 2016; Yeates et al., 2016) |
| archived propagules (‘seed vault’) for ‘resurrection’ studies | Allsopp, 1952; Johnson, 1985; Windham et al., 1986; Bowles et al., 1993; Nakahama et al., 2015 |
| ***Functional trait ecophysiology*** *-**intraspecific phenotypic shifts through time, space and across environmental gradients* | | |
| Morpho-physiology | plant height | (McGraw, 2001; Law and Salick, 2005; Buswell et al., 2011; Leger, 2013; Rollins et al., 2013; Dalrymple et al., 2015; Flores-Moreno et al., 2015) |
| leaf morphometrics (area, thickness, leaf mass per area, shape, dissection, toothiness) | (Parkhurst, 1978; Peñuelas and Matamala, 1990; Royer et al., 2010; Lambrinos, 2010; Bonal et al., 2011; Buswell et al., 2011; Dolan et al., 2011; Blonder et al., 2012; Guerin et al., 2012; Queenborough and Porras, 2014; Dalrymple et al., 2015; Flores-Moreno et al., 2015; Tomaszewski and Górzkowska, 2016; Beauvais et al., 2017) |
| leaf anatomy (stomatal, trichome, and vein densities) | (Aalders and Hall, 1962; Parkhurst, 1978; Barrington et al., 1986; Woodward, 1987; Peñuelas and Matamala, 1990; Beerling and Chaloner, 1993; Beerling and Woodward, 1993; Goertzen and Small, 1993; Paoletti and Gellini, 1993; Chen et al., 2001; Teece et al., 2002; Kouwenberg et al., 2003; Wagner et al., 2005; Miller-Rushing et al., 2009; Steets et al., 2010; Wagner-Cremer et al., 2010; Walls, 2011; Bonal et al., 2011; Tripp and Fatimah, 2012; Blonder et al., 2014) |
| belowground anatomy and morphology | none? |
| Tissue chemistry | nutrient chemistry (leaf N, C, P) | (Peñuelas and Matamala, 1990, 1993; Peñuelas and Azcón‐Bieto, 1992; Beerling and Woodward, 1993; Baddeley et al., 1994; Peñuelas and Estiarte, 1997; Peñuelas and Filella, 2001; Pedicino and Leavitt, 2002; Ryan et al., 2009; Wilson et al., 2009; McLauchlan et al., 2010; Mithen et al., 2010; Bonal et al., 2011; Delgado et al., 2013; Agnan et al., 2015; Korner et al., 2016; Rudin et al., 2017) |
| stable isotopes (∆13C, 𝛿13C, 𝛿15N, 𝛿18O) | (Peñuelas and Azcón‐Bieto, 1992; Peñuelas and Estiarte, 1997; Peñuelas and Filella, 2001; Teece et al., 2002; Helliker and Griffiths, 2007; Miller-Rushing et al., 2009; Wilson et al., 2009; Tripp and Fatimah, 2012; Delgado et al., 2013; Korner et al., 2016) |
| Deuterium isotopomer ratios (carbon metabolism proxy) | (Ehlers et al., 2015) |
| bioaccumulation or other effects of natural chemicals or anthropogenic pollutants (heavy metals, N deposition, particulates, smog, ozone) | (Herpin et al., 1997; Peñuelas and Filella, 2001; Kouwenberg et al., 2003; Ryan et al., 2009; Rudin et al., 2017) |
| protein, fatty acid, and amino acid composition | (Teece et al., 2002) |
| secondary metabolites in roots, leaves, or seeds | (Berenbaum and Zan, 1998; Zangerl and Berenbaum, 2005; Mithen et al., 2010) |
| Reproductive biology | flower or fruit number, morphology, size, anatomy | (Barrington et al., 1986; Carpenter et al., 2003; Knaus, 2010; Bontrager and Angert, 2016; Yu et al., 2016) |
| pollen transport networks | A.L. Johnson, unpublished |
| Phenology | Flowering time (and other phenophases) | (McConnell and Russell, 1959; Carpenter et al., 2003; Primack et al., 2004; Bolmgren and Lonnberg, 2005; Lavoie and Lachance, 2006; Miller-Rushing et al., 2006; Houle, 2007; Gallagher et al., 2009; Neil et al., 2010; von Holle et al., 2010; Robbirt et al., 2011; Zalamea et al., 2011; Panchen et al., 2012; Diskin et al., 2012; Li et al., 2013; Calinger et al., 2013; Diez et al., 2013; Hart et al., 2014; Barve et al., 2015; Bertin, 2015; Munson and Sher, 2015; Park and Schwartz, 2015; Rawal et al., 2015; Davis et al., 2015; Matthews and Mazer, 2016; Park, 2016; Spellman and Mulder, 2016; Yu et al., 2016; Mulder et al., 2017; Munson and Long, 2017; Willis et al., in press) |
| leaf-out time | (Everill et al., 2014; Zohner and Renner, 2014) |
| Herbivory | insect damage | (Goertzen and Small, 1993; Zangerl and Berenbaum, 2005; Youngsteadt et al., 2015; Schilthuizen et al., 2016) |
| effects of overabundant large herbivores | (Beauvais et al., 2017) |
| Phytopathology | disease presence and damage | (Ristaino, 1998; Koponen et al., 2000; Ristaino et al., 2001; Antonovics et al., 2003; Li et al., 2007; Malmstrom et al., 2007; Hood et al., 2010; Brunet et al., 2016; Saville et al., 2016) |
| Symbiosis | taxonomic or genotypic diversity of mycorrhizal fungi or bacterial symbionts in rhizosphere and roots | none? |
| endophyte presence and taxonomy | (White et al., 1992) |
| ***Non-target specimen research –*** *utilization of* *specimens preserved unintentionally with target collection originally of interest* | | |
| Soil science | soil preserved with specimen roots as source of edaphic or belowground microbial information through space and time | none? |
| Invertebrate zoology | insects or other organisms pressed with leaves for understanding plant-insect interactions, insect taxonomy, and invasion ecology | (Lees et al., 2011; Veenstra, 2012) |

*\*There are likely many more citations that use herbarium specimens as a source of DNA material, but do not explicitly highlight this method in abstract, title, or keywords.*

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