

FORMAT		
1. Name of resource	Phil Trans of the Royal Society (B), theme issue on Biological collections for understanding biodiversity in the Anthropocene	
2. Location	https://royalsocietypublishing.org/toc/rstb/2019/374/1763	
3. Alternative location		
4. Author[s]	Meineke, E. K., Daru, B. H., Davies, T. J. and C. C. Davis (editors).	
5. Publisher/producer/host	Royal Society	
6. Year	2019	
7. Suggested citation	Meineke, E. K., Daru, B. H., Davies, T. J. and C. C. Davis (editors) (2019). Biological collections for understanding biodiversity in the Anthropocene. Phil. Trans. Roy. Soc. (B) 374(1763), https://royalsocietypublishing.org/toc/rstb/2019/374/1763	
8. Languages in which available	English (online version viewable in other languages)	
9. Geographic area resource relates to	Global	
10. Does the resource relate to a specific time frame?		
11. Type	Report	Yes
	Toolkit/Framework/Roadmap	
	Sign-post to other resource (database)	
	Case studies	
	Other	
12. If this is part of an initiative, what is the initiative?		
COLLECTIONS AND COLLECTIONS-BASED INSTITUTIONS		
13. Explicit links to collections	Yes	
14. Explicit links to museums/libraries/archives	Yes	
15. Types of institutions the resource covers	Museums	X
	Archives	
	Libraries	
	Other	X

16. Does the resource relate to specific disciplines?	Arts, humanities and social sciences: philosophy, psychology, religion, social sciences, law, politics, language, arts and recreation, architecture, literature, history, geography and ethnology, anthropology, archaeology	X
	Science, natural history, technology, medicine, engineering, manufacturing	X
17. If no explicit links to collections, justification for inclusion		
HOW IT CONTRIBUTES TO SUSTAINABLE DEVELOPMENT		
18. Collections-related activities the resource relates to (mark all that apply)		
Develop collections to protect and safeguard wider cultural and natural heritage more effectively , for example by targeting collecting to threatened forms of heritage in strategic ways		X
Use collections to promote learning and educational opportunities that contribute to sustainable development more effectively , for example education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development and/or skills development relating to collections		X
Use collections to promote cultural participation/social inclusion more effectively , for example by reducing barriers to participation, to ensure no-one is 'left behind'		
Use collections to promote sustainable tourism more effectively , for example by developing new products based on local cultural heritage, and/or considering the rights of stakeholder groups in relation to collections		
Use collections to support research that contributes to sustainable development (including all forms of personal and self-directed research at all levels that make use of stored collections) more effectively, for example by providing effective facilities, collections and information to meet researchers' needs		X
Make decisions around collections that contribute to sustainable development more effectively		
i. employment (recruiting, staff training, staff safety)		X

ii.	energy consumption, greenhouse gas emissions, reduction, monitoring and reporting	
iii.	waste management and reduction of waste	
iv.	transport (forms of transport, energy use)	
v.	commercial activities including copyright and IP	
vi.	governance and management	X
vii.	security, disaster preparedness and risk reduction	
Direct external leadership, partnerships and collaborations towards sustainable development more effectively , for example by developing impactful partnerships		X
19. Does the resource relate clearly to any international conventions (mark all that apply)?		
Culture conventions:		
1952, 71 Protection of Copyright and Neighbouring Rights		
1954 Protection of Cultural Property in the Event of Armed Conflict		
1970 Fighting Against the Illicit Trafficking of Cultural Property		
1972 Protection of the World Cultural and Natural Heritage		X
2001 Protection of the Underwater Cultural Heritage		
2003 Safeguarding of the Intangible Cultural Heritage		
2005 Protection and Promotion of the Diversity of Cultural Expressions		
Rio Conventions:		
Convention on Biological Diversity (CBD), Convention to Combat Desertification (UNCCD), Framework Convention on Climate Change (UNFCCC)		X
AIMS AND CONTENT		
20. What issues does the resource aim to address?	<p>“Human impacts, such as climate change, urbanization, and pollution, are changing what species live on earth and how they function. Yet, our knowledge of how we affect biodiversity and natural resources is limited due to a lack of long-term studies that span from before humans began to influence our environment to today. In this themed issue, we provide examples of how the billions of plant, fungal, and animal specimens kept behind the scenes in natural history museums have the potential to transform the field of global change biology. We suggest that museum specimens are underused given their capacity to reveal patterns that are not observable from other data sources. As these unparalleled resources are under threat due to budget cuts and other institutional pressures, we aim to shed light on the unique discoveries that are possible in museums and, thus, the singular value of natural history collections in a period of rapid change.”</p>	

21. Intended audience of resource	[Museums, scientists and other biodiversity workers]
22. Process of development	[Themed issue of authored articles]
23. Organisation/structure/contents	<p>Biological collections for understanding biodiversity in the Anthropocene</p> <p>Botanic gardens are an untapped resource for studying the functional ecology of tropical plants</p> <p>Using museum specimens to track morphological shifts through climate change</p> <p>Fossil Atmospheres: a case study of citizen science in question-driven palaeontological research</p> <p>Museum specimens of terrestrial vertebrates are sensitive indicators of environmental change in the Anthropocene</p> <p>Fungarium specimens: a largely untapped source in global change biology and beyond</p> <p>Facets of phylodiversity: evolutionary diversification, divergence and survival as conservation targets</p> <p>The use and misuse of herbarium specimens in evaluating plant extinction risks</p> <p>Historical collections as a tool for assessing the global pollination crisis</p> <p>Using insect natural history collections to study global change impacts: challenges and opportunities</p> <p>Museum specimens provide novel insights into changing plant–herbivore interactions</p> <p>Bookkeeping of insect herbivory trends in herbarium specimens of purple loosestrife (<i>Lythrum salicaria</i>)</p> <p>A novel proof of concept for capturing the diversity of endophytic fungi preserved in herbarium specimens</p> <p>The history and impact of digitization and digital data mobilization on biodiversity research</p> <p>Specimen-based analysis of morphology and the environment in ecologically dominant grasses: the power of the herbarium</p> <p>Herbarium specimens reveal substantial and unexpected variation in phenological sensitivity across the eastern United States</p>
FRAMEWORKS	
24. Framework structure	
25. Relevant policy considerations	Yes
26. Resources for implementation identified	Yes

27. Specific assessment points/indicators/milestones/action plan for monitoring	No
28. ASPECTS OF SUSTAINABILITY COVERED BY RESOURCE (mark all that apply)	
People (social sustainability)	
Planet (environmental sustainability)	X
Prosperity (economic sustainability)	
Peace	
Partnerships	X
29. CROSS-CUTTING CONSIDERATIONS COVERED BY RESOURCE (mark all that apply)	
Gender perspectives	
North and South perspectives	
HOW THE RESOURCE CONTRIBUTES TO AGENDA 2030 AND THE SDGs	
HOW AGENDA 2030 AND THE SDGs FEATURE IN THE RESOURCE	
30. SDGs and Agenda 2030 specifically mentioned?	No
31. SDGs specifically mentioned?	No
32. SDG targets specifically mentioned?	No
33. SDG indicators specifically mentioned?	No
SDGs AND SDG TARGETS AND LINKAGES	
34. Comments on SDG linkages	The resource can help collections-based institutions understand how their collections, development of these, and research undertaken can contribute to a range of SDG targets relating to biodiversity, including: 2.4 (sustainable agriculture), 2.5 (conserving crops and wild relatives, in seed banks and in other forms), 4.4 (skills for work), 4.7 (Education for Sustainable Development), 6.6 (conserving aquatic habitats), 9.1 (develop sustainable infrastructure, which includes scientific collections), 9.5 (support scientific research), 11.4 (strengthen efforts to protect and safeguard cultural and natural heritage), 12.8 (ensure people have information for sustainable development and lifestyles in harmony with nature), 13.1 (strengthen resilience to climate change and natural disasters in all countries), 13.3 (climate change education and institutional capacity), 14.2 (protect marine ecosystems), 14.A (increase marine science), 15.1

	<p>(conserve freshwater ecosystems), 15.4 (conservation of montane biodiversity), 15.5 (prevent degradation of nature, conserve species), 15.8 (manage invasive species), 16.6 (effective, accountable and transparent institutions), 16.10 (protect fundamental freedoms and access to information), 17.6 (global partnerships drawing on science), 17.16 and 17.17 (global and national partnerships respectively).</p>
<p>35. SDGs and SDG targets the resource helps advance</p>	
<p>SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture 2.4 By 2030, ensure sustainable food production systems to implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.</p>	<p>Collections development related to sustainable food production where appropriate.</p> <p>Number of educational and awareness-raising programmes incorporating sustainable food production perspectives, and that aim to reduce the impact of disasters on communities.</p> <p>Number of targeted programmes that support those most exposed and vulnerable to disasters, whether locally or farther afield.</p> <p>Number of research activities drawing on collections that relate to resilient agricultural practices, helping mitigate and adapt to climate change, flooding and other disasters.</p> <p>Policies and plans in place to eliminate unsustainable food production from supply chains and in any food provision in collections-based institutions.</p> <p>Number of partnership activities drawing on collections that contribute to Disaster Risk Reduction plans, supporting resilient agricultural practices, and helping mitigate and adapt to climate change, flooding and other disasters.</p>
<p>SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture 2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through</p>	<p>Collections development related to genetic diversity of seeds, cultivated plants, farmed and domesticated animals (notably of local or at-risk varieties) and related wild species, for example in herbaria, museums, seed and gene banks, and seed libraries.</p> <p>Number of educational programmes related to genetic diversity of domesticated plants, animals and wild relatives.</p>

<p>soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed</p>	<p>Number of educational programmes related to fair and equitable benefits of use of genetic resources and associated traditional knowledge, following international agreements (e.g. Nagoya Protocol).</p> <p>Number of educational and awareness programmes for people to ensure that they are aware of their rights and protections in terms of traditional knowledge, and exploitation of genetic resources.</p> <p>Number of research activities that help understand traditional knowledge, and genetic diversity of crop plants and animals.</p> <p>Ensure that producers of crop plants and animals are fairly compensated.</p> <p>Policies and procedures in place to ensure legal compliance with fair and equitable benefits of use of genetic resources and associated traditional knowledge, following international agreements (e.g. Nagoya Protocol).</p> <p>Number of partnerships at national, regional and international levels, as appropriate, to soundly manage seed and plant banks.</p>
<p>SDG 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all 4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship</p>	<p>Number of young people and adults in skills-development activities and programmes drawing on collections, for employment, decent jobs and entrepreneurship</p> <p>Increase in number of young people and adults in such programmes</p> <p>Number and proportion of staff who have received training in the last year, to better support their contribution to the SDGs.</p> <p>Programs and processes in place to ensure the availability of a skilled workforce.</p>
<p>SDG 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all 4.7 By 2030, ensure that all learners acquire the knowledge and skills needed</p>	<p>Numbers of people in each type of programme drawing on collections from different demographic groups.</p> <p>Increases in numbers of people in each type of programme from different demographic groups.</p>

<p>to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development</p>	<p>Proportion of people involved in such programmes in relation to overall audience size.</p> <p>Evidence that learners have acquired knowledge and skills to promote sustainable development.</p>
<p>SDG 6. Ensure availability and sustainable management of water and sanitation for all 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes</p>	<p>Proportion of water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes in a good ecological condition.</p> <p>Information on, programmes relating to, and partnerships relating to water-related ecosystems drawing on collections and collections-based institutions in place, to support protection of these as effective nature-based solutions and ecosystem services.</p>
<p>SDG 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all</p>	<p>Development of research-useful collections to support reliable, sustainable and resilient use by researchers and others.</p> <p>Number and proportion of collections facilities and stores that support economic development and human well-being.</p> <p>Number and proportion of collections facilities and stores that provide affordable and equitable access for all.</p> <p>Investment in collections facilities.</p> <p>Inclusion of collections information in regional and transborder initiatives, notably via digital access for discoverability.</p>
<p>SDG 9. Build resilient infrastructure, promote inclusive and sustainable industrialization</p>	<p>Number and proportion of collections facilities that effectively support research and researchers.</p>

<p>9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending</p>	<p>Number and proportion of staff who are appropriately skilled to undertake and support collections-based research.</p> <p>Expenditure on initiatives to enhance and upgrade collections facilities.</p> <p>Numbers of staff engaged in supporting and developing research use based on collections.</p> <p>Number of initiatives to encourage innovation drawing on collections.</p> <p>Increase in number of research and development workers per 1 million people.</p> <p>Increase in public and private research and development spending being used to develop and make use of collections.</p>
<p>SDG 11. Make cities and human settlements inclusive, safe, resilient and sustainable 11.4 Strengthen efforts to protect and safeguard the world’s cultural and natural heritage</p>	<p><i>11.4.1 Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage</i></p> <p>Plans, policies and procedures in place for the safe use of collections for a variety of purposes, protecting and safeguarding both collections and those who use them.</p> <p>Plans, policies and procedures in place for the identification, safeguarding and protection of cultural and natural heritage at risk.</p> <p>Collecting programmes in place to protect, safeguard and make use of cultural and natural heritage, addressing the needs of communities and stakeholders, and ensuring that collections can be an effective resource for sustainable development.</p> <p>Number and diversity of educational, awareness-raising, research programmes, and partnerships that aim to strengthen protection of cultural and natural heritage.</p>
<p>SDG 12 Ensure sustainable consumption and production patterns</p>	<p><i>12.8.1 Extent to which (i) global citizenship education and (ii) education for sustainable development (including climate change education) are mainstreamed in (a)</i></p>

<p>12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature</p>	<p><i>national education policies; (b) curricula; (c) teacher education; and (d) student assessment</i></p> <p>Extent to which global citizenship education and education for sustainable development (including climate change education) are mainstreamed in formal, informal and non-formal education programmes and activities drawing on and related to collections.</p>
<p>SDG 13. Take urgent action to combat climate change and its impacts 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries</p>	<p>Plans in place for near and longer term to withstand and actively adapt to climate-related hazards and natural disasters.</p>
<p>SDG 13. Take urgent action to combat climate change and its impacts 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning</p>	<p>Plans in place to enhance positive contributions to addressing climate change through use of collections. Plans in place to ensure collections, collections institutions and broader society can adapt effectively to climate change.</p> <p>Plans in place for effective education and awareness raising on climate change mitigation, adaptation, impact reduction and early warning.</p> <p>Plans in place to reduce negative contributions of collections-related functions, e.g. measuring greenhouse emissions with plans and targets in place to reduce them.</p>
<p>SDG 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans</p>	<p>Proportion of marine and coastal areas in a good ecological condition</p> <p>Numbers of educational and awareness-raising programmes, research activities, and partnerships drawing on collections aiming to support protection of marine and coastal areas.</p>
<p>SDG 14 Conserve and sustainably use the oceans,</p>	<p>Number of collections-related activities that aim to increase scientific knowledge, and develop research</p>

<p>seas and marine resources for sustainable development 14.A Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries</p>	<p>capacity for the conservation and management of marine biodiversity, and to support its sustainable use.</p>
<p>SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements</p>	<p>Proportion of terrestrial and inland freshwater systems in a good ecological condition.</p> <p>Information on, programmes relating to, collections development, and partnerships relating to terrestrial and freshwater systems drawing on collections in place, to support their protection and effective functioning.</p>
<p>SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 15.2 By 2020, promote the implementation of</p>	<p>Proportion of forests in a good ecological condition.</p> <p>Information on, programmes relating to, collections development, and partnerships relating to forests drawing on collections in place, to support their protection and effective functioning.</p>

<p>sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally</p>	
<p>SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 15.4 By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development</p>	<p>Proportion of mountain ecosystems, including their biodiversity, in a good ecological condition.</p> <p>Information on, programmes relating to, collections development, and partnerships relating to mountain ecosystems and their biodiversity drawing on collections in place, to support their protection and effective functioning.</p>
<p>SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species</p>	<p>Number and proportion of habitats, notably endangered habitats, and species with favourable conservation status, with special reference to locally, nationally and globally endangered species.</p> <p>Information on, programmes relating to, collections development, and partnerships relating to habitats and species drawing on collections in place, to support their protection and continued existence.</p> <p>Measures taken to enhance biodiversity value of green space associated with collections institutions.</p>
<p>SDG 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss</p>	<p>Number and proportion of invasive alien species for which effective measures are in place to reduce their impact on land and water ecosystems.</p> <p>Information on, programmes relating to, collections development, and partnerships relating to invasive alien</p>

<p>15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species</p>	<p>species, to support their effective management, and to prevent spread and impact.</p>
<p>SDG 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. 16.6 Develop effective, accountable and transparent institutions at all levels</p>	<p><i>16.6.2 Proportion of the population [audience/users/non-users] satisfied with their last experience of public services</i> Access to information, and accountability policies and mechanisms, in place.</p> <p>Effective institutional arrangements, both for own working and for working in partnership with other sectors, in place.</p> <p>Plans and arrangements in place for extraordinary circumstances such as natural and human-caused disasters.</p> <p>Effective arrangements in place to fulfil legal and social obligations and responsibilities.</p> <p>Effective arrangements in place for transparent communication and reporting of institutional performance.</p> <p>Effective arrangements in place for transparent decision-making and accountability.</p>
<p>SDG 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. 16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements</p>	<p>Adopt and implement constitutional, statutory and/or policy guarantees for public access to information.</p> <p>Plans in place, and plans implemented to enhance public access to information relating to collections.</p> <p>Plans in place, and plans implemented to support fundamental freedoms, in line with human rights, national and international agreements and legislation.</p> <p>Plans and procedures in place for public access to information relating to the operation and management of collections-based institutions.</p>

	Complaint mechanism in place for public to use where public access to information and fundamental freedoms not supported or fulfilled.
SDG 17. Partnerships for the goals 17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge-sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism	Number and diversity of North-South, South-South and triangular co-operations and projects to support access to science, technology and innovation and enhance knowledge-sharing on mutually agreed terms.
SDG 17. Partnerships for the goals 17.14 Enhance policy coherence for sustainable development	Proportion of policies that incorporate sustainable development considerations, linking to SDGs and targets. Incorporation of policy considerations from outside the collections sector into policies of collections-based institutions, to facilitate partnerships and effectiveness.
SDG 17. Partnerships for the goals 17.16 Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries	Number and/or increase in number, and diversity of global and international multi-stakeholder partnerships that share collection-related knowledge, expertise, technology and financial resources to address the SDGs, or that otherwise involve collections-based organisations and institutions. Number and/or increase in number, and diversity of global and international multi-stakeholder partnerships involving developing countries that share collection-related knowledge, expertise, technology and financial resources to address the SDGs.
SDG 17. Partnerships for the goals	<i>17.17.1 Amount of United States dollars committed to public-private and civil society partnerships</i>

17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships		Number and/or increase in number, and diversity of local, national and regional multi-stakeholder (public, public-private and civil society) partnerships that address the SDGs drawing on collections, or that otherwise involve collections-based organisations and institutions.			
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	