Institution: Falmouth University		
Unit of Assessment: 32		
Title of case study: The Bee Brick: building habitat for solitary bees one brick at a time		
Period when the underpinning research was undertaken: 2014-2021		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): **Kate Christman**	**Role(s) (e.g. job title):** **Senior Lecturer**	**Period(s) employed by submitting HEI:** **2012-present**
Period when the claimed impact occurred: From December 2014		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

The UK has more than 250 species of bee, 90% of which are solitary. Numbers are declining dramatically, in part due to habitat loss from the construction industry. The Bee Brick provides integrated habitat for solitary bees. Since it went on sale in 2014 it has had impact across several impact domains. Bee Brick research informed the UK Government's 2030 National Pollinator Strategy and was cited in a NERC-funded policy report for national planners. It has impacted construction policy and practice: Brighton & Hove and Cornwall Councils, the Duchy of Cornwall, and eight construction companies have directed new builds to include a Bee Brick. Awareness of the needs of solitary bees was raised among communities, schools, teachers and pupils. The commercial impact has been extensive, with over 21,000 bricks sold worldwide including the UK, Europe, Brazil, USA, Canada, and New Zealand. All this has led to around 350,000 additional individual cavities for solitary bees.

2. Underpinning research

Rationale: Biodiversity loss is a key issue worldwide. Bees are the main pollinators in most ecosystems as well as of agricultural crops and play a critical role in this crisis. The UK has more than 250 bee species, but numbers are declining dramatically, in part due to habitat loss from urbanization. 90% of the UK's bee population is solitary bees, which can adapt well to urban environments. The opportunity to capitalise on bees' resilience in the face of urban encroachment and ensure that habitats are provided for the next generation of pollinating bee species provided the impetus for this design research project, which aimed to create sustainable habitats for bees to promote biodiversity within sub/urban communities.

Initial scoping: Existing bee nesting boxes are made from a wide range of materials, and designs vary enormously in size. Garden 'ornaments' rather than tools for responsible development, despite setting the status quo for 'bug hotels,' miss the opportunity to inform customers of the importance of habitat for pollinators and the wider ecosystem. The research process that informed the production of the Bee Brick was not only one of design but one that required a thorough understanding of the life of a solitary bee and their natural behaviour; close collaboration with Bio scientists was therefore crucial.

Figure 1. Bee brick

Research team: Kate Christman, Senior Lecturer in Graphic Design since 2012, is the lead researcher at Falmouth University. Project advisors during the design process include Dr Rosalind Shaw, Research Fellow in the Environment and Sustainability Institute (ESI) at Exeter University as scientific consultant, advising on pollination, biodiversity in the built environment, and bee behaviour, as well as other colleagues within the ESI; and Plymouth University who undertook structural testing of prototypes.

Research process, findings, and outcomes: The research followed an iterative design process, complemented by scientific testing. It addressed structural (size, shape, material, cost) and biological (what material and cavities bees require and prefer) requirements and constraints [1].

***Material**:* There is no consensus on the best material for bee nesting boxes, though the most common are wood, reeds, cardboard, glass, and plastic. As these are clearly inappropriate as structural building components, cast concrete was chosen: it is strong, permeable, easily moulded and inexpensive to produce; and it is already used to nest by some species of solitary bee. Various combinations (including waste material from the china clay industry, ground granulated blast-furnace slag and fly ash) were tested using compression and thermal testing on the mix design to establish its suitability as a cast construction material. This determined that 75% of each brick be comprised of granite waste material from the china clay industry, and 25% granite aggregate and cementitious material as a binding agent.

***Structure**:* Nesting requirements of solitary bees had to be balanced with structural requirements. Initial sketches to explore the basic aesthetic of the habitat used various hole sizes and pattern exploration, inspired by the natural patterns and cavities within walls, crumbling buildings, exposed mud and sand banks commonly inhabited by solitary bees. These were followed by technical drawings, ergonomic studies and material experiments. Nesting cavity diameters of 5-7 mm encourage the most common solitary bees, red masons and leaf cutters, which favour this size. Similar considerations were made for cavity length: to conform to standard UK brick dimensions 215x102.5x75mm, a cavity length of 80mm is moulded part way into the brick. This struck a balance between plentiful habitat and compromising the brick's structural integrity and appearance, since the pattern and colour of the nesting site can affect bees' orientation.

3. References to the research

[1] Christman, K. Bee Brick (2014) https://repository.falmouth.ac.uk/2078/
[Devices and Products]
Listed in REF2 (Output identifier: 431)

- *"The very reason we set up the Innovation Awards was to find and promote initiatives like Green&Blue's Bee Brick. We couldn't be more excited that such a fantastic idea has won."* Tom MacMillan, Director of Innovation, *Soil Association*, December 2014

4. Details of the impact

The local economy has been bolstered not only through those employed to produce Bee Bricks but also through other initiatives for the business community; additionally, there has been impact on policy and practice across the construction industry, construction companies and local and national policy-makers and planners embracing Bee Brick as a central facet of their work. The

local community has also benefited, with children, parents, and schools changing behaviour. All of this contributes to the overarching environmental impact: an increase in habitat for solitary bees.

Impact on local businesses and commerce

Christman is co-founder and creative director at Green&Blue, a product design company granted B Corporation® status in 2018 (certification for businesses that meet the highest standards of verified social and environmental performance). Green&Blue creates habitat for species displaced by urbanisation (bird feeders, bird houses, bird baths and bat roosts as well as Bee Bricks). All products are designed and manufactured in Cornwall using traditional techniques and following the launch of the Bee Brick the company employs six members of staff. Over 21,000 Bee Bricks sold have been worldwide. The impact of Bee Bricks' success has been felt across the local business community. Green&Blue has inaugurated local businesses initiatives, including *Seaside Saturday*, a biannual event (launched in 2016) promoting 15 local businesses. *"Seaside Saturday has always been an event I've particularly looked forward to both as a business and a customer. Full to the brim with so many lovely, local businesses. Over the years it's become even bigger and is always really busy with a warm, bustling friendly atmosphere."* Sophie Reeves, *Going Loopy*; and the *Shred* project (launched in 2019) that collects community cardboard recycling waste and shreds and repurposes it into packing material.

Impact and changes in construction practice

Green&Blue has worked with individual construction companies who have begun incorporating Bee Brick into their standard building practice:

- The Duchy of Cornwall, a private estate owned by the Duke of Cornwall HRH Prince Charles, committed in 2017 to embedding the Bee Brick in new homes at its Nansledan Estate project in Cornwall, and Poundbury near Dorchester. Nansledan is a 540-acre extension to the coastal town of Newquay on the north coast of Cornwall, which over time will comprise a community of more than 4,000 homes. The Estates Surveyor for the Duchy sought information about Bee Brick and presented it at the Nansledan Consortium meeting in August 2017, leading to the decision that new builds at Nansledan should contain a Bee Brick. [6]

Between 2015 and 2020, eight construction companies across south and southwest England started to incorporate Bee Brick into their builds:

- *"There really wasn't a question in using Bee Bricks: why wouldn't you? They're easy to install, will help to improve bee habitats […] and will ultimately make a positive contribution to our wildlife in the south west."* Neil Edwards, Assistant Director of Development, Westward Housing [7]
- *"We support the view that relatively simple measures can help preserve wildlife over the longer-term. For Legacy, this is about best practice and minimising impact on the environment. […] we hope to extend the areas in which nature can flourish and provide a safe habitat in which bees and other species in decline can nest. We hope to work with Green&Blue again in the future to create richer biodiversity throughout our developments."* Nick Long, Managing Director, Legacy Homes [7]

Impact and changes in national policy

Christman's Bee Brick research led to her attending the National Pollinator Strategy meeting on the 15th December 2017. She presented the Bee Brick to the panel, and together with other key stakeholders informed the resulting National Pollinator Strategy 2030 [1]. This resulted in support from local MP George Eustice, who in 2017 visited Green&Blue's offices with Michael Gove MP (then Secretary of State for the Environment), who said, *"the Bee Brick [is] certainly the sort of innovative habitat creation options that [DEFRA] would want to build into discussions about design"* and would *"consider raising in conversations with industry representatives" and* offered to collaborate to monitor impact [2]. Installing a Bee Brick was recommended and cited in a 2017 Natural Environment Research Council (NERC) funded report by the Universities of Glasgow and Oxford that aims *"to support asset managers, engineers, conservation and biodiversity teams, decision-makers and other end-users to help them better identify [green grey*

infrastructure] options and evaluate these against business-as-usual grey engineering approaches" [3].

Impact and changes in planning conditions

Stemming from the National Pollinator Strategy 2030, local planning authorities began to explicitly recommend or require Bee Brick in planning policy and practice:

- In June 2020 Brighton & Hove Council's officer report *Swift Boxes and Bee Bricks in New Developments* responded to the Notice of Motion put to the March 2020 Tourism Development and Culture Committee requiring a Bee Brick in all suitable new builds [4].
- Cornwall Council's 2018 Biodiversity: Supplementary Planning Document is to assist those planning applications in Cornwall to *"understand how to ensure that biodiversity is protected, conserved and enhanced as a consequence of development."* It recommends that 50% of new houses should incorporate a Bee Brick. Their Biodiversity Guide showcases the Bee Brick stating for developments of two or more houses every other building needs to have a bee brick built in [5].

Impact and changes in primary education

Outreach has included engaging with over 1,300 children across six schools in Cornwall. As well as Christman delivering assemblies over 2018-19, 1,000 children participated in *Wear Stripes Wednesday* on 4 July 2018 (part of Solitary Bee Week, a Green&Blue run event to raise awareness of bee conservation). A resource pack for teachers developed for Solitary Bee Week and associated reading list was available for free on the Solitary Bee week website (https://www.solitarybeeweek.com) website, run by Green&Blue [8]. Schools, teachers, and pupils have all changed behaviour as a result [9]:

- *"I gave some sugar water to a poorly bee and when I went back it had flown away so I know I helped it. The lady in assembly taught me that, so I told my mum and it worked!"* Year 2 pupil, Cubert School
- *"Bees like to hide in holes, so we bought one of those bee houses to make homes as their habitats are disappearing."* Year 3 pupil, Cubert School
- *"The impact of the Solitary Bee event was more than just activities on the day it was held. The school has cultivated wildflower meadow areas […], been awarded a Woodland Trust Gold award [and its] environmental area also continues to be a haven for wildflower species and an excellent location for nature-based art and literature, following on from some of the similar activities enjoyed by so many on Solitary Bee Day."* John Faulker, Year 1 Teacher, Cubert School
- *"The Solitary Bee assembly was simply fantastic for our staff and pupils. I don't think any of us understood how important solitary bees are to our lives and how we need to make changes and adaptations in order to support them. It was a fascinating presentation that gave each and every one of us something to seriously consider and lots of new knowledge. Our school has now got some Bee Bricks to install to start helping straightaway."* Alistair Johnson, Headteacher, Perranporth School

Impact on, and changes in, public awareness

Other outreach activities and social media supporters further enhanced public awareness of solitary bees and their nesting needs [8]. On 5 January 2019, Adam Cormack (then Head of Communications for the Wildlife Trusts, now Head of Campaigning, Woodland Trust) tweeted that he had an inhabited Bee Brick in his house, receiving 9.1k Retweets and 44.4k Likes; a further link to buy a Bee Brick received 665 Retweets and 3.9k Likes. This led to extensive media coverage in early 2019, when Bee Brick featured in a range of national TV and print media. The public interest continued to provide publicity not only for the Bee Brick but the plight of solitary bees. This led to a 422% increase in traffic to the Green&Blue website against the same period the year before, and a 52% increase in sales. The partnership with the Eden Project also gave rise to Plan Bee, an exhibition run by the Eden Project that featured Bee Brick and a talk by Christman on 26 January 2019 to 60 members of the public with colleagues from University of Exeter, the Wildlife Trust and Cornwall Council. This led to a 200% increase in Bee Brick orders from the Eden Project shop against the same period the year before.

Impact on the habitat/environment

With over 21,000 Bee Bricks sold, there are a potential 350,000 more cavities available for solitary bees to nest in within an urban environment than without the Bee Brick. Based on the 9.4% occupancy rate observed in the 2017 study, this amounts to a potentially additional 32,900 breeding solitary bees.

5. Sources to corroborate the impact

[1] National Pollinator Strategy 2030 (2018), DEFRA https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794706/national-pollinator-strategy.pdf

[2] Letters from Rt Hon Michael Gove, Secretary of State, *Department of Environment, Farming, and Rural Affairs*, 21st October 2017 and 8th December 2017

[3] Naylor, L., Kippen, H., Coombes, M., et al. (2017) 'Greening the Grey: a framework for integrated green grey infrastructure', University of Glasgow report http://eprints.gla.ac.uk/150672/37/150672Full.pdf (pg 83, AP-U4)

[4] Brighton & Hove Council. Tourism, Development & Culture Committee. (June 2019). Swift Boxes and Bee Bricks in New Developments https://present.brighton-hove.gov.uk/documents/s142052/Swift%20Boxes%20and%20Bee%20Bricks%20in%20New%20Development.pdf

[5] Regional planning
- Cornwall Council (2018) Biodiversity: Supplementary Planning Document https://www.cornwall.gov.uk/media/38341273/biodiversity-guide.pdf
- Cornwall Council Biodiversity Guide (2018), Bee Brick Case Study, pg 61

[6] Duchy of Cornwall new builds
- Nansledan Estate https://nansledan.com/sustainability/bee-bricks

[7] Construction company practice
- Westward Housing https://www.plymouthherald.co.uk/news/local-news/houses-cornwall-being-built-bricks-2560563
- Legacy Homes www.legacyhomes.co.uk/latest-news/solving-the-housing-crisis-for-the-birds-and-the-bees

[8] Solitary Bee Week resources
- Suggested reading www.solitarybeeweek.com/suggested-reading
- Educational resource pack www.solitarybeeweek.com/ed-pack

[9] Teacher and pupil testimonials
- Year 1 Teacher, *Cubert School* (email, 18th March 2020)
- Deputy Head, Year 6 Teacher & Years 2,3,5,6 pupils, *Cubert School* (email 6th March 2020)
- Headteacher, *Perranporth School* (email 6th March 2020)

[10] Media featuring Bee Brick
- File containing details of media coverage, including items from *Twitter*, the *BBC* (x 1), *The Sun* newspaper, *Country Living Magazine*, *The Telegraph*, *iNews* newspaper, *Grand Designs* magazine and the *Chelsea Flower Show*