COLLECTIVE FOR DESIGN

An active teaching and learning methodology for collaborative art and design disciplines within the framework of sustainable development.

Marta Miaskowska
Jeremy Hugh Aston
Marta Varzim

This publication describes the work of research and analysis for teaching-learning methodologies in the context of training designers and artists for future international careers. It is a complete and detailed work where the different dimensions, from creativity to critical thinking, are explored and experimented within a series of workshops. From this, there was an investment in articles resulting from this reflection; namely, there was a refinement in the evaluation indicators and conclusions, making their contribution justified and relevant for higher education.

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The contents of this publication use a language that is clear and understandable, not only for specific scientific or artistic circles, but also for a wider audience. The Collective Design Method, in addition to didactic values, includes others that are difficult to overestimate. It shows the great value of respect for other people, their culture and different traditions, along with technological innovation, all working synergistically to create better, lower cost and more environmentally friendly products.

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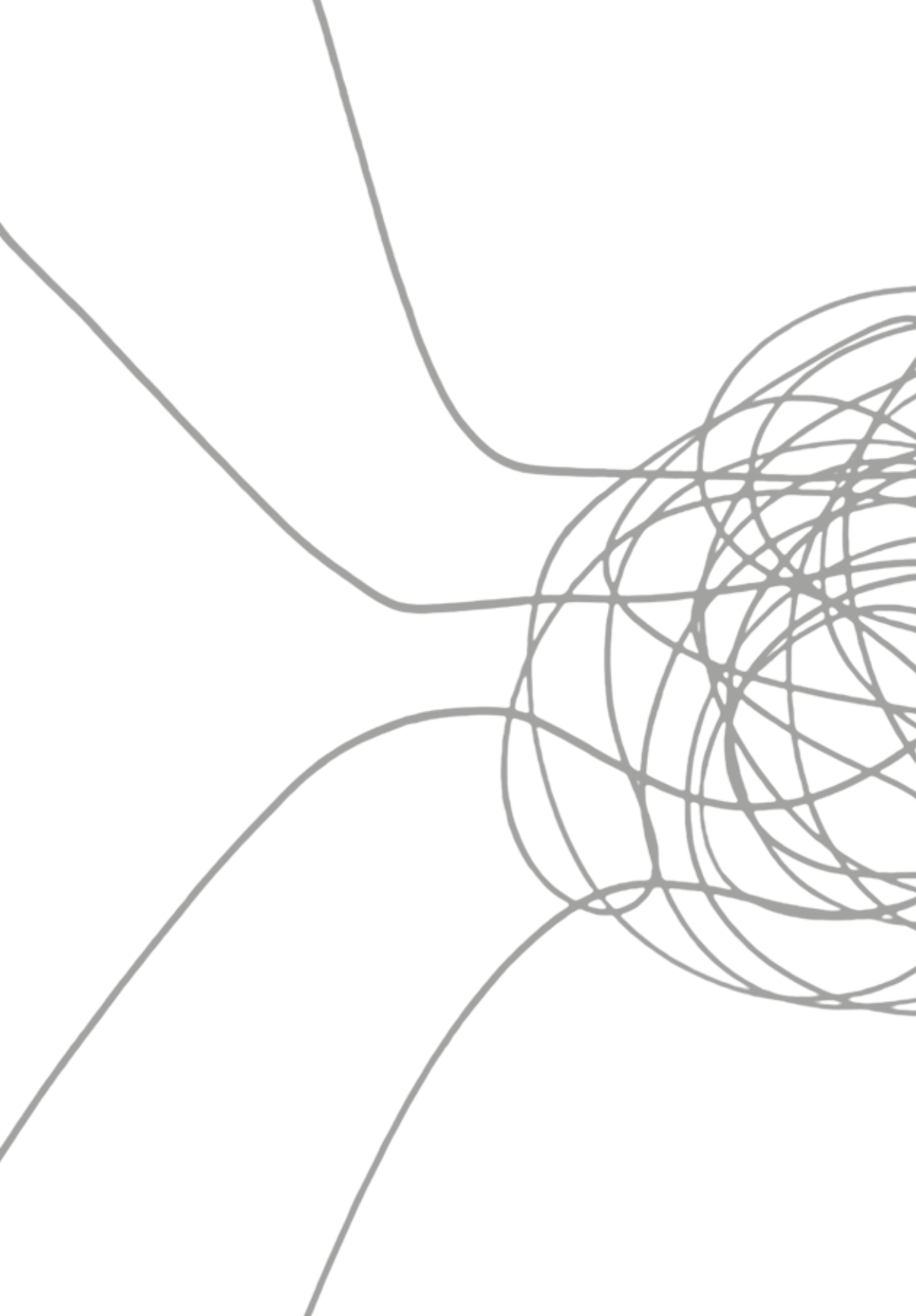
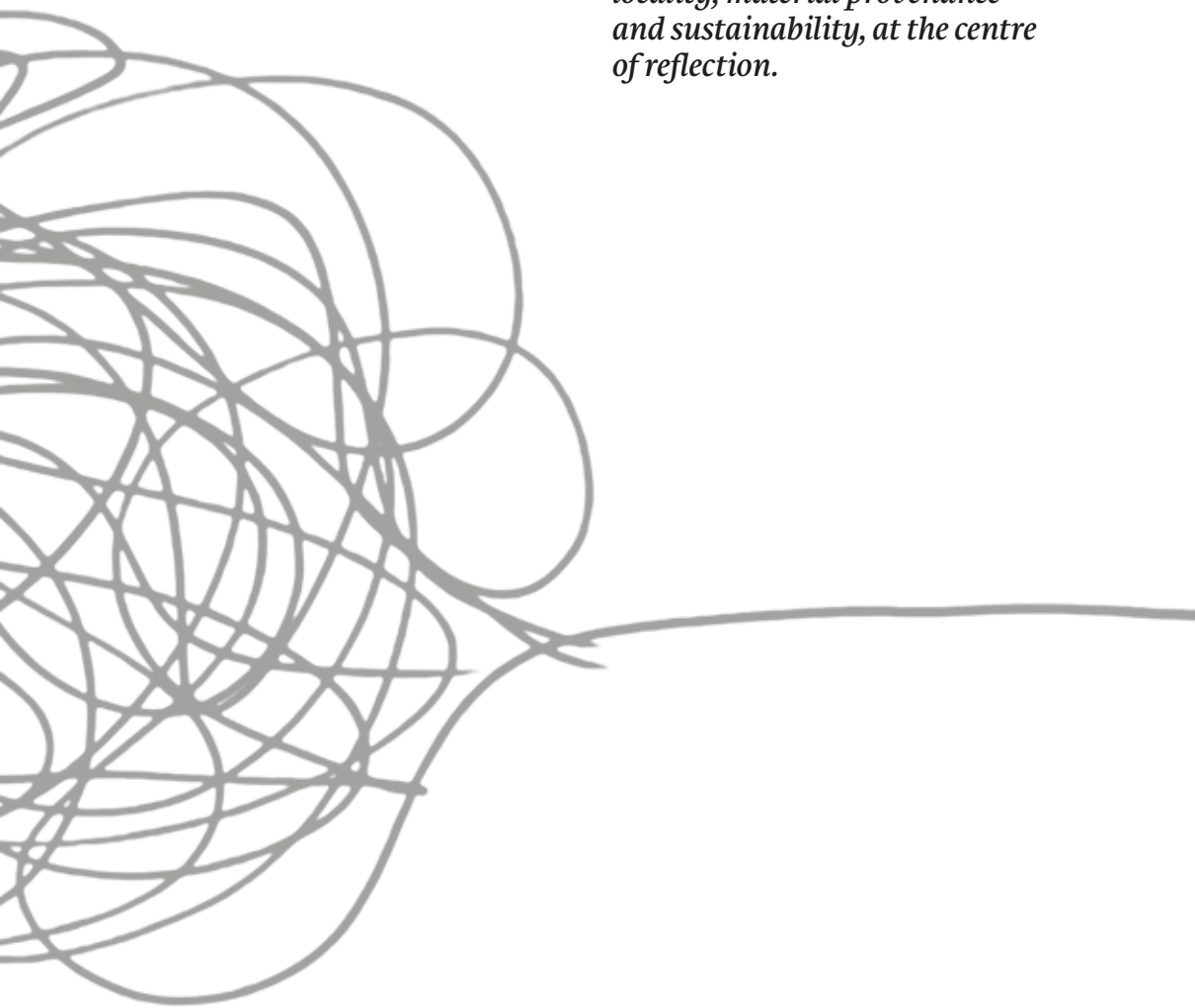


This book addresses the need to re-evaluate current teaching--learning methods and aims to contribute to the preparation of art and design students for the international labour market, placing the issue of collectivity, locality, material provenance and sustainability, at the centre of reflection.



3.4

OCEAN PLASTIC: Towards New Experimental Making and Material Outcomes.

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ABSTRACT

The material culture of beachcombing in island communities offers a rich narrative backdrop for the exploration of socially responsible engagement with ocean plastic. Estimates vary widely, but a much-cited 2015 study by Jambeck et al. gives figures of between 8m to 12m tonnes of plastic entering the world's oceans each year. Later studies highlight the challenges of gaining more specific figures, given the near impossibility of measuring micro-plastic particles on a global scale (Boucher and Billard, 2019; Watt et al., 2021).

The island of Scarp, just off the Isle of Harris, was until 1972 home to a community of around 200 people. A treeless isle, the inhabitants relied on ocean currents to bring timber for building repairs, making furniture and even coffins. For today's inhabitants, the owners of four holiday homes, the sea brings myriad plastic objects that are often reclaimed for domestic use. This plenitude of plastic has led to three connected design explorations that foster and promote socially responsible community engagement in response to the problem of ocean plastic.

The first exploration is a cultural examination into the way in which islanders have utilised materials and objects as both practical and decorative objects. This has given rise to conversations about something seen as an environmental

catastrophe to many, a source of material to some, albeit from a highly randomised commodity supply chain, or to others a simple inevitability (Lambert, 2019).

In seeking to emphasise the potential of the plastic as a viable and abundant material source for forms of micro--manufacture, the second exploration conducted experiments and workshops in using ocean plastic as 3D printing filament. The distributive power of this form of digital fabrication might allow for more practical outcomes in remote communities (Vones et al., 2018; Lambert & Vones, 2019).

The third exploration attempted to adapt a mass production technique — injection moulding — for use on the beach. This in-situ craft production brings the manufacture to the source of the material in remote communities (Lambert, 2017).

The heritage of beachcombing in remote parts of the Highlands and Islands offers lessons in recycling and reuse, and through these material experiments serve as a reflective counterpoint to mass consumption and disposal in more populous areas of the industrialised world.

KEYWORDS:
Ocean-plastic; Making; Material-culture; Beachcombing; Design.

Introduction

The small and little known island of Scarp lies just a short boat ride from the north western edge of the Isle of Harris in the Outer Hebrides, 50 miles off Scotland's Atlantic coast. Abandoned by permanent residents in 1972, the island is now only used in summer by owners of four private holiday homes.

Ethnographic and oral histories collected from a number of people either born on Scarp or descended from *Scarpochs* revealed daily life on the island in its heyday and pointed to a rich narrative of resourcefulness in remote communities and a material culture of beachcombing (MacLean, 2015). Those who still use the island as a summer retreat have also provided valuable insights into life on the island some 50 years later. Both ex and present Scarpochs reveal much about their relationship to the sea in their use of materials washed up amongst the flotsam and jetsam of the island's south west facing beach, the *Mol Mòr* (Gaelic for "big beach"; see fig. 3.4.1).

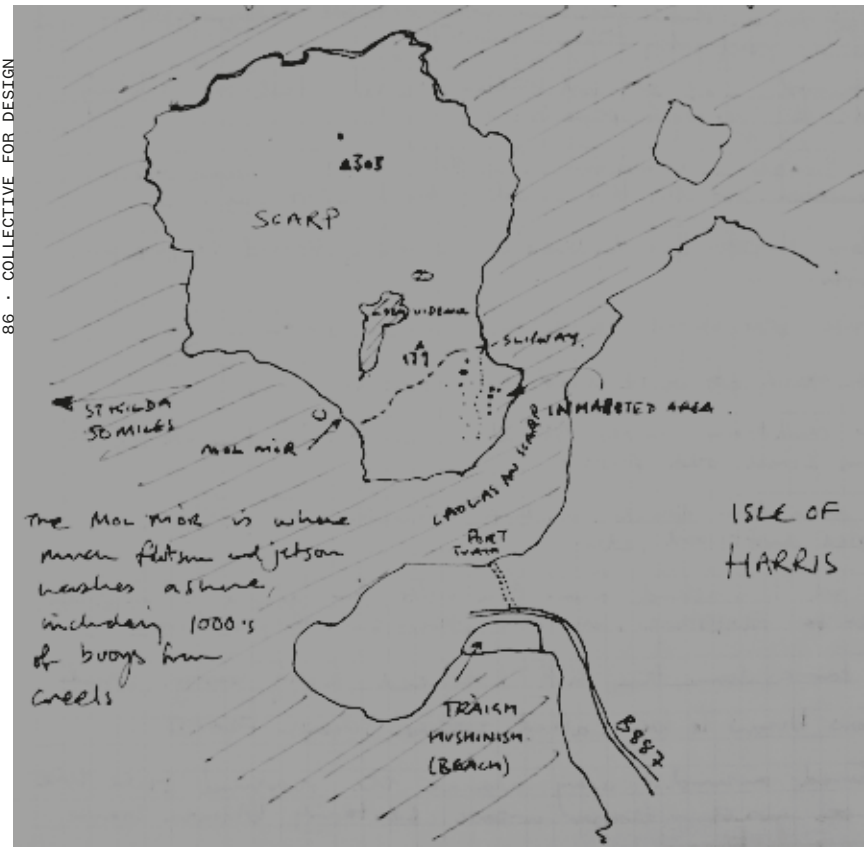

Fig. 3.4.1: Map of Scarp, copied from OS map (Ian Lambert 2015)

Today, much of the detritus found on the beach is plastic, including polypropylene rope, nets, crates, and trawl floats, HDPE and PET bottles, polyester pallet binding, polystyrene, and nylon rope, rubber boots, PVC pipe. Aluminium, steel and timber was also abundant.

Ocean plastic pollution has gained increasing public notice in the last ten years or so (Lambert & Vones, 2019). Estimates of the amount of plastic entering the oceans each year range from 5m tonnes to 13m tonnes (Jambeck et al., 2015), although "[...] no rigorous estimates exist of the total amount and origin of plastic debris in the marine environment" (2015, p.768). Later studies cite this research, but highlight the acute challenges of measuring micro-plastic pollution (Boucher and Billard, 2019; Watt et al., 2021). As far back as 2010, an episode of BBC Radio 4's Costing the Earth (Roberts, 2010) provided a detailed report on the Pacific Garbage Patch. This is a mass of plastics floating on or just below the surface that has collected in the north Pacific Ocean, and is rapidly growing (Lebreton et al., 2018). It was estimated to be twice the size of France in 2014 (Callan, 2014), and 50 percent bigger again four years later (Lebreton, 2018). It is in fact one of five gyres (Cózar et al., 2014).

☞ The final episode of the BBC's Blue Planet II in 2017 with Sir David Attenborough marked a high point of recognition of the problem (Lambert, 2019).

☞ The study by Jambeck et al. is widely cited stating that reports of ocean plastics started to emerge in the early 1970s with estimates of around 6 million in 1975 (p.768). From this we could make a calculated guess exceeding 200 million tons in total today. However, this is wildly different to other estimates of surface plastics only that are much lower at 7,000 to 35,000 tons (Cozar et al., 2013, p. 10239), although they say that plastic that has sunk cannot be accounted for (p. 10243).

☞ One each in the north of south Pacific, and north and south Atlantic Oceans, and one in the Indian Ocean (cf. Ocean Clean Up, 2022).

There are multiple challenges in returning the plastic to large scale manufacturing, not least cost-effective retrieval: much of the plastic (up to 60%) in the ocean consists of particles smaller than 1mm in size (Roberts, 2010), although again, this figure is difficult to pinpoint (Boucher and Billard, 2019; Watt et al., 2021). National Geographic estimated that up to 70% of the plastic forming the large gyres sinks to the ocean floor (Bawden, 2014). If retrieved, the plastic needs to be cleaned of salt and microorganisms that will contaminate recycling, but even then, ocean plastic photo-degenerates in ultraviolet light after many years floating around. This, along with continuous contact with salt makes the ocean plastic brittle (Lambert & Vones, 2019). It can be returned to the recycling stream if mixed with plastic retrieved on land and a certain percentage of virgin plastics (Corbin, 2014; Hurst, 2012).

The investigation of the material culture of Hebridean islanders foregrounds the environmental threats that the sea debris brings today, and the possibility of recycling and repurposing plastic objects. This paper comprises three studies; the first on the material culture of beachcombing; the second emphasises the potential of ocean plastic as a material for digital micro-manufacture; the third, highly experimental, attempts the adaption of a mass production technique — injection moulding — for localised use on the beach.

Documented accounts from the Outer Hebrides point to a heritage of beachcombing dating back centuries (MacLean, 2015). There is a narrative of an historical resourcefulness and self-sufficiency which has changed as the use of sea-faring trade routes have advanced within a globalised economy. This distribution of an abundant waste material gives a narrative of the easy availability of many items in the industrialised world.

For islanders, the relationship with the sea is materially important and culturally defining. The sea can be seen as the bringer of 'gifts' and, with Scarp being treeless, driftwood was historically important for the building and repair of homes and furniture; making creels, and even coffins (MacLean, 2015). Other flotsam and jetsam washed ashore continues to be used by islanders in crafts and other forms of income generation.

Many homes across the larger neighbouring isles of Harris and Scalpay will have buoys and trawl floats hanging on fences and gate posts as decoration. PVC pipe, which is in plentiful supply from wrecked fish farms, is often used for drainage under footpaths, and sometimes filled with concrete and used as fence posts. Larger pipes can be split lengthways to make feeder troughs for livestock. Rope has obvious re-use potential and netting used as windbreaks or to prevent ground erosion. Many islanders have fish boxes — plastic crates from fishing industries — for storage and transportation. There is also a small craft industry repurposing found objects as tourist souvenirs, including floats made into bird feeders, and plastic fragments refashioned as buttons (fig. 3.4.2).

Fig. 3.4.2: Repurposed items at the Handmade Harris Craft Market in Tarbert by Lorna Wheeler. (Ian Lambert, 2019)

The Mol Mòr on Scarp is today littered with plastic, including polypropylene rope, nets, crates, and trawl floats, hundreds of HDPE and PET bottles, tangled masses of polyester pallet binding, polystyrene, and nylon rope, rubber boots, PVC pipe, as well as other materials including aluminium, steel and timber (see fig. 3.4.3). Such sights are not uncommon in other remote parts of the Scottish coastline.

Fig. 3.4.3: Plastic debris on the Mol Mòr, Islet of Scarp, near the Isle of Harris (Ian Lambert, 2015)

In a 2015 interview, one couple who had a holiday home on the island from 1980 to until recently, told how they improvised with many items retrieved from the Mol Mòr over the years, for repairs and making things. A tour of their home revealed examples of adapted objects and materials, which included PVC pipes to repair plumbing and irrigation systems; trawler floats, about 200mm in diameter appropriated as toys (they had a set of six orange and six yellow floats used for playing Petanque, with a smaller green float as puck); a nylon plastic board cut down for fish preparation; rope and string re-used in a number of ways; and an array of decorative objects, including a shark fishing lure.

☞ David and Lesley Cuddugan; interviewed by Diane MacLean with additional questions from Ian Lambert (recorded), Scarp 15 July 2015.

Startlingly, the couple told how the variety of objects washed ashore on Mol Mòr had diminished in the last 25 years, since New York had stopped dumping garbage in the sea in the early 1990s. They even recalled that in the 1980s their children used to return from the Mol Mòr with odd pairs of flip-flops, the same size. After a visit to the Mol Mòr to survey the plastic, it was put to them that it might be appreciated if the beach was cleaned up and the materials recycled. They were somewhat aghast at the idea. "Where would we get all our supplies?" one of them asked, the Mol Mòr being their very own "B&Q" ☞ B&Q is a major chain of British hardware stores. hardware store. It was also pointed out that the cost of recovery from such a remote place would be prohibitive. There are, arguably, grounds to preserve the site with all of its flotsam and jetsam in the heritage of beachcombing that has sustained island life for many years.

Either way, with such abundance of plastic, many questions arise about what else could be done with this material at a local level.

3D Printing with Ocean Plastic

The team started to consider ways in which the material could be used in digital micro-manufacture. A series of experiments were set up to explore how different types of plastics retrieved from the ocean would perform in 3D printing, and samples were collected for laboratory testing.

Close up photography magnified the material x5 and revealed how, to varying degrees depending on its type (e.g. polypropylene, HDPE, etc.), the plastic had become brittle after years of exposure to UV light and salt water, and had start to fragment into micro particles. It also showed contamination with biological material that had attached itself to the object. Technical data and formal identification of plastic types with the assistance of a polymer scientist informed experiments in creating filament and determining its performance (strength, printability and melt-flow). 3D printing filament is made relatively easily with inexpensive equipment for granulating plastics and a thermal extruder. In some cases, the resultant filament retained some of the contaminants, in spite of efforts to remove them, but also retained a smell of the sea. This smell was generally received positively and served as a reminder of the origins of the material.

Polypropylene mixed 50:50 with PLA was found to perform well and was used in a series of public engagement workshops at schools on the Isle of Harris and in Mallaig on the mainland, and at a research conference in 2019. Blue polypropylene mixed with white PLA gave rise to a filament that

had an aptly watery appearance. At one workshop the group chose to print simple rings (fig. 3.4.4), as they were small and quick to produce, and, as jewellery, had a symbolic value. One of the designs had "26.8kg", written on the side, from a conceptual narrative based on the amount of plastic each person in the world (7.6bn at the time of the workshop) would have to collect in order to retrieve all of the plastic estimated to have entered the ocean in the last 25 years (Lambert & Vones, 2019).

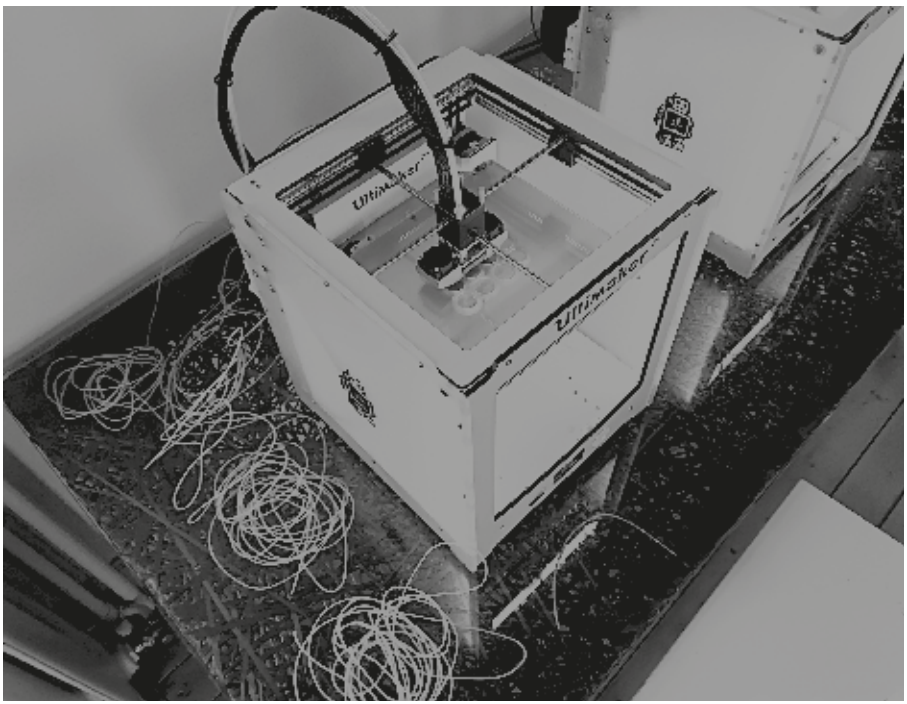

Fig. 3.4.4: Digital Crafts: 3D Printing Filament, Kathy Vones and Ian Lambert, 2019.

3D printing has become increasingly widespread and accessible, with some filament printers costing only a few hundred euros. This and the other equipment mentioned above are economically accessible and simple to use in a localised redistributed digital fabrication network, where some ocean plastic can go directly from beach to manufacture, not only for rings, which might seem like "crap jects" to some (Smith, 2012, np), but with utility objects and components printed from open-source STL files: "In such a [digital manufacturing] context, manufacturing may be presented as a network of contemporary cottage industries" (Newson, Suggett and Sudjic, 2016, p. 113), a form of artisanal economics and manu-digi-fractured objects which "offers digital artisans a position from which to oppose mass manufacturing" (Norris, 2016, p. 45).

3D printing is not without problems: as a process it can use 50 to 100 times more electrical energy than injection moulding to make an item of the same weight (Arieff, 2014, np). Injection moulding, a quintessentially mass production process, was explored as a craft process, with ocean plastic as the raw material. Inspired by Max Lamb's location specific process of casting pewter stools on the beach (2005), and, and Studio Swine's Sea Chair (2013), made aboard a fishing boat with the plastic retrieved from fishing nets, the fabrication was brought to the beach as an off-grid process. Washed-up polypropylene rope was easy to cut, and melted over a fire of driftwood to make a utility object, bearing the name of the location where the plastic has been retrieved, hence, *The Isle of Harris Fish Slice*. Here, an industrial material and process are adapted as hand-guided craft. However, the implementation of the process had particular challenges. Injection moulding normally occurs in factories with advanced machinery and carefully controlled temperatures. In this case, the making of the injection moulding tool (the cavity into which the molten plastic is injected) utilised 3D digital models and CNC cutting technology readily available in public maker spaces. A sealant gun was adapted as the means to inject the plastic (see fig. 3.4.5). Both were warmed on the fire to aid the flow of the molten material, while the polypropylene rope was melted in a saucepan to be poured into the injection device. While the temperature for injection moulding polypropylene, approximately 220°C, is easily controlled in a factory, on a beach over an open fire, the maker has to use tacit judgement on the viscosity and flow of the material. In the first attempt, the plastic was too hot and when solidified was brittle and snapped. At the second attempt, the plastic set with more flexibility, but failed to flow fully, because the vent holes, essential for displacing the air in the space in the moulding tool, hadn't been cleared after the first use. On the third attempt, the plastic boiled and when solidified it was so brittle it crumbled. At this point, the experiment was abandoned as, although outside and on a breezy day, this proved inadequate protection against the toxicity of the fumes. A respiratory mask with specialised filters is essential for all future experiments.

This novel inquiry used improvisation to explore the feasibility of an off-grid industrial process as a means of crafting meaningful objects in situ for local use. For this to be viable in future, greater sophistication in the technology is required for both temperature control and the capturing of fumes. However, the process and resultant artefacts provide a material narrative that indicates potential viability.

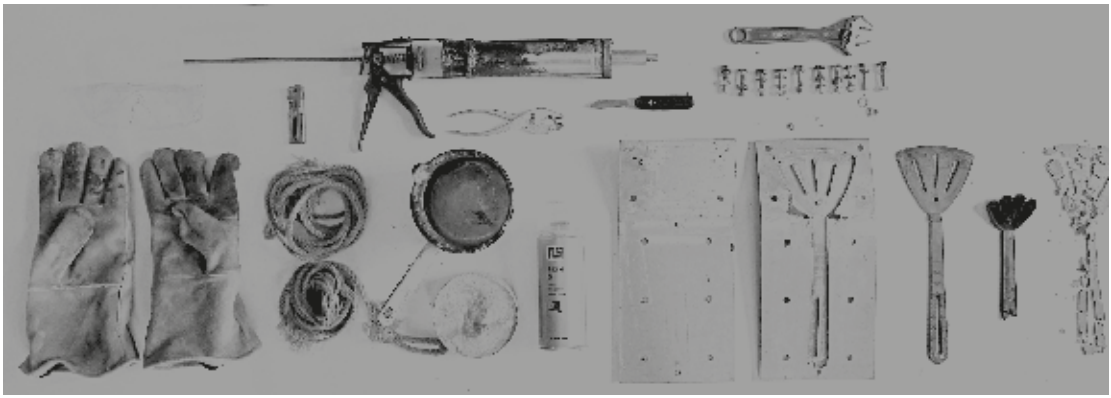

Fig. 3.4.5: In-situ Manufacture: The Isle of Harris Fish Slice. (Ian Lambert, 2017)

Conclusion

Beachcombing and the re-use of lost objects and materials chimes with a *freeganesque* local sustainability, but does not scratch the surface of the problem of ocean plastic. Much of the larger plastic items on the beaches comes from maritime industries, particularly fish farms, but are in some ways the least of the problem. Smaller fragments of plastic that are difficult to collect, more likely to be absorbed into nature, or drawn back into the sea, or mistaken as food by wildlife. Storm water that cut away at streambanks on Scarp and Harris revealed an alarming stratification of plastic fragments in the soil several feet down.

No claim is made for this work as being a solution — indeed, experiencing the extent of the ocean plastic problem in remote places such as the Outer Hebrides first hand has emphasised that individuals can only have a relatively limited impact. This work is a small gesture intended to bring further understanding to the wider public.

The inquiry into the beachcombing and the survey of plastic debris gave rise to explorations into the potential of ocean plastic as a raw material. Utilising ocean plastic is a narrative on it as a catastrophe and contributes to a much larger community of activism that can demonstrate impact, and its potential to be returned to manufacturing cycles: responses to the problem can multiply accordingly.

Retrieving the plastic will be a vexing problem that will be with us for centuries. It is a pernicious material reality requiring a multitude of multidisciplinary teams working from many different perspectives, including the prevention of plastic entering the ocean. Political and corporate will has yet to emerge to a satisfactory degree.

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