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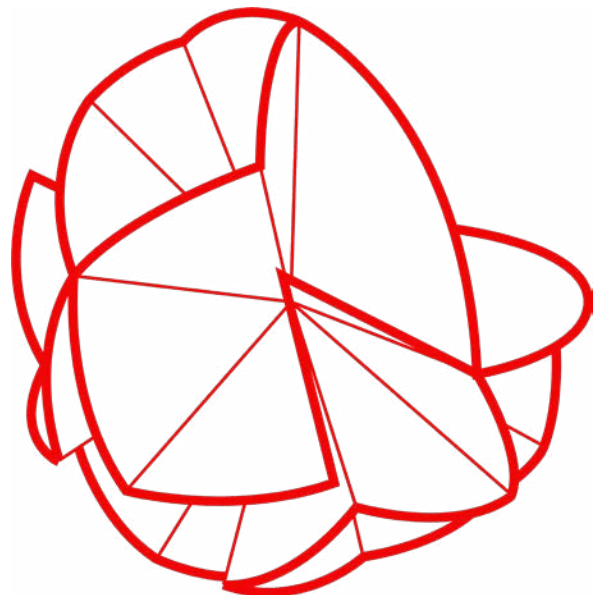
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# Disrupting Geographies in the Design World

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# From Sea to Fashion. Seaweeds as Material for a Sustainable Transition

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## **Abstract**

The essay addresses the reasons why fashion design is manifesting an increasing interest in the marine environment as a context where to identify new sustainable materials for fashion, focusing on the particular case of seaweeds. Through the analysis of some significant international case studies, the recent applications of a variety of biomaterials derived from algae are observed. This phenomenon is interpreted not only as a response to the emergencies of innovation and sustainability in fashion design, but also confirms the framework of a new materialism according to a posthuman perspective. Water shifts from being perceived as a natural element exploited and polluted by fashion into a place of making kin between human and non-human through the use of seaweeds. This is possible thanks to the collaboration of design, chemistry, biology and technology, that are orchestrated to redefine the expressive codes of contemporary fashion within a multispecies landscape.

## **Keywords**

Seaweeds

Biomaterials

New materialism

Posthuman fashion

Making kin

According to a 2017 report by the Ellen MacArthur Foundation, fashion textile industry uses approximately 93 billion cubic meters of water each year, equal to approximately 4% of the global freshwater withdrawal (Ellen MacArthur Foundation, 2017, p. 38). This data highlights how fashion generates an impact on the environment, which can be limited through the transition from linear models of production and consumption to circular and more sustainable models. An example of these attempts is the *Sustainable Textile Water Initiative (STWI)*, a multistakeholder platform for Swedish fashion brands focused on resource efficiency.<sup>2</sup>

Water has been a resource for textile manufacturing for fashion since its origins. First, artisan workshops<sup>3</sup> then, in the nineteenth century, modern industrial production systems were in fact established in places rich in running water, necessary in the various stages of processing<sup>4</sup> and to obtain the energy needed for machinery operations (A'Hearn, 1998; Fenoaltea, 2011; Basile & Ciccarelli, 2018). Since the second half of the twentieth century, the relationship between the textile industry and water has been marked by a growing awareness of the no longer sustainable impact on this resource. Concerns are due to its consistent need both for irrigation in the cultivation of fibres, and for its conversion into fabrics, as well as for the spillage of chemical substances used during the manufacturing processes and released into the aquifers (Porter et al., 1972; Ricchetti, 2017). If on the one hand the textile industry is now looking for solutions to reduce its water footprint (Hoekstra, 2008), favouring organic crops and circular production systems of traditional fibres (Aivazidou & Tsolakis, 2019), on the other hand it is showing a growing interest in experimenting with the production and use of new yarns and materials. As Badalucco and Cristofoli Ghirardello (2020, p. 30) underline, in fact, the growing sensitivity towards the theme of fashion's imprint on the environment has resulted in a renewed interest in the exploration of innovative fibres. This contribution investigates how in recent years water is not only considered a resource to be protected but is increasingly observed by fashion design as a natural environment capable of supplying biomaterials (Biofabricate & Fashion for Good, 2020); whereby seaweeds in particular have been and are being transformed into yarns and fabrics (Franzo & Moradei, 2022).

"It is indeed remarkable that a raw material, presented to us in such vast quantities, should, up to the present date, have been allowed to remain without use or application, while the 'utilisation of waste products' forms so prominent a feature": this is Wentworth L. Scott's answer to the studies conducted by Edward C. C. Stanford on the properties and potential of seaweeds in manufacturing, textiles included. It is 1862 (Stanford & Scott, 1862, p. 198) and the author's statement demonstrates how the interest in seaweeds did not originate at the beginning of the twenty-first century,<sup>5</sup> but in the Victorian age. As items for collectors' classification purposes, seaweeds became a symbol of the intellectual and physical reconjunction through and with natural history. Commenting on the words of Margaret Gatty, author of *British Sea-Weeds* (1863), ecocritical researcher Stephen E. Hunt notes that this fusion of sea and nature creates a simultaneous sense of familiarity and estrangement amidst other creatures (Hunt, 2005, pp. 20-21). Hunt's reflection helps to understand the reasons for the current spread of seaweed-based materials in fashion and other design

1

The contribution is part of the work conducted at Università Iuav di Venezia by the Fashion Futuring research group, coordinated by professor Alessandra Vaccari.

2

Further information on: <https://siwi.org/sustainable-textile-water-initiative/>.

3

An example is Follina, a town in the province of Treviso (Italy), where in 1795 was established Lanificio Paoletti, a leading textile industry: the toponym derives from the fulling of the wool that spread there in the twelfth century thanks to the abundance of waterways.

4

The use of water in textile production takes place from the desizing and scouring phases, to dyeing and bleaching, unto the washing to remove chemicals, mercerization, printing or other finishings (Wang et al., 2013).

5

Stanford reports that the first patent for the use of algae in the production of fabrics was filed in 1855 by Charles Maybury Archer (Stanford & Scott, 1862, p. 188).



Fig. 1  
AlgiKnit, alginate yarn  
shopper



Fig. 2  
Algaeing, natural pigment  
Algadye 3.0



Fig. 3  
Tabinotabi, dress in  
seaweed fibre. Photo by  
Camilla Glorioso

disciplines, which do not seem to be exclusively limited to the search for innovative and sustainable materials. Indeed, as Chiara Scarpitti writes, the increasing cooperation between the worlds of design and the natural sciences is also due to the rise of independent design practices, which on an international level have translated the utopia of transdisciplinary dialogue into a reality (2020, p. 83).

### **Vibrant Textiles**

This contribution interprets the diffusion of seaweed biomaterials through the theory of new materialism proposed by Anneke Smelik (2018) within fashion studies. In line with the posthuman perspective that sees the interconnection between humans and non-humans (Braidotti, 2013), new materialism responds to the needs of a form of fashion where the human is decentralised. Thus, opens the horizon to the world of plants, animals and digital technologies. What posthumanism and new materialism share is, in fact, their effort to overcome dualisms. Consistently, posthuman fashion questions the notion of material agency (Smelik, 2018), engaging in the enhancement of the performative role triggered between body and dress in the process of embodiment (Smelik & Toussaint, 2016). Such are the reasons why materials made of seaweeds, plants associated with an idea of well-being and health deriving from their extensive use in cosmetics, appear to act as connectors between human body and water. This allows for the rediscovery of a renewed ecosystemic and non-binary balance. Furthermore, unlike fashion traditional materials whose imaginaries have been over time linked to fast fashion, intensive production and low sustainability, seaweeds are perceived as pristine, “vibrant”, as a living and intelligent material (Bennett, 2010).

The aquatic exploration in search of new materials to wear can be interpreted on the one hand as a metaphor for the *making kin* advocated by Haraway (2016) in the form of new alliances between biology, technology, design and the environment (Vanni et al., 2020; Payne et al., 2021), on the other hand as the effect of a multi-species contamination, in which organisms become themselves only with the assistance of other species (Tsing et al., 2015). The body, for the most part composed of water, is transformed into a support on which seaweed-based garments come back to life. As a consequence, seaweeds represent the raw material to build new aesthetics and communicative imaginaries through tangible experiences.

### **From Seaweeds to Biomaterials**

This contribution focuses on the transformation of the seaweed plant into yarn, fabrics, garments and accessories, analysing some international case studies that demonstrate how the theory of a new materialism can be applied to develop a posthuman perspective in fashion. Committed to bringing matter and body experience back to the centre of the debate, posthuman fashion weaves a multitude of inedited interconnections within the living world. Seaweeds are biomasses that grow in the ocean waters of the world; the type mainly used is the Kelp algae native to the Icelandic fjords. They do not contain fibres ready for textile spinning, though the yarns are made with cellulosic fibres manufactured by incorporating a small amount of dried and ground into powder seaweed material (Bak et al, 2019).

Among the brands involved in the making kin is AlgiKnit, an American start-up born in 2016 as part of the *Bio Design Challenge* of the FIT in New York. AlgiKnit creates resistant but biodegradable yarns with Kelp seaweed Fig. 1. The alginate of the algae is pulverised and transformed into a water-based gel to which natural dyes are added, to lastly be extruded into long strands according to a technique already described in the 1940s (Delf, 1943, p. 152). As stated by the brand, science and design come together in this project to combat climate change, encouraging a closed-cycle and low-impact textile industry. "In materials science we are now finding more inspiration in nature," says Schiros (Cirino, 2018), one of the founders of the project and associate professor at FIT where she experiments on new materials for fashion (Schiros et al., 2021). Another patent for the transformation of seaweeds into yarn is of the Austrian company Lenzing, whose SeaCell fibre is obtained by incorporating the brown seaweed *Ascophyllum nodosum* collected in the Icelandic fjords, dehydrated and pulverised, in a natural cellulose fibre obtained from beech. However, it must be noted that from the product technical data sheets the percentage of seaweed still appears very low, justified to allow adequate and persistent technical performance (Fangueiro et al., 2014, p. 248). Similar is the process adopted by the Israeli start-up Algaeing founded by Renana Krebs, which is developing two products with algae: either combined with cellulose to obtain a natural and biodegradable fibre, or transformed into the natural dye Algadye 3.0 Fig. 2.

The use of seaweed-based yarns and fabrics is increasingly diffused in the collections of global brands, both high-end and fast fashion (Bittau, 2021). Even if in some cases these actions seem to respond more to communication and marketing needs, interpretable as greenwashing strategies, other experiences demonstrate the real potential of such materials for clothes and accessories design by stimulating fertile connections with specific or local contexts. In this direction a significant case is Tabinotabi Fig. 3, an independent brand born in Venice in 2018 with the aim of using exclusively seaweed fabric. Tabinotabi demonstrates how fashion is capable of inventing imaginaries starting from the criticalities of a context. As evidence, the apparition of seaweed clothes in the shop windows near the Rialto bridge that recalls the literary metaphor of Venice, which nonetheless also denounces its current invasion that represents a problem for the lagoon. During an interview,<sup>6</sup> the founder Alessandra Defranza declares that customers and tourists are particularly intrigued by the process that transforms seaweed into a wearable garment, and immediately try to carefully grasp its visual, tactile and olfactory characteristics (Vaccari & Franzo, 2021, p. 78). Seaweed are also protagonists in the high-tech pieces conceived by the brand Vollebak. Among others, it has created a compostable t-shirt to be buried in the garden at the end of its life, where it biodegrades in 8-12 weeks based on temperature and humidity fig. 04. In line with the brand's approach to an artificialization of nature, the t-shirt is composed of eucalyptus and beech pulp fibres, mixed with algae grown in a laboratory inside bioreactors. The t-shirt is printed with green ink based on spirulina algae, a natural pigment that oxidises and fades with air, inviting the customer to take care of the garment as if it were a living being. Care is also at the core of Biogarmentry non-woven fabric designed by Roya Aghighi in collaboration with AMPEL Lab and the Botany Lab of the University of British Columbia. Inspired by the challenge of providing survival to photosynthetic cells of algal origin on cellulose and proteins-based fabrics, these *living clothes* are activated in the sun and are a literal





Fig. 4  
Vollebak, biodegradation  
of the Plant and Algae  
t-shirt



Fig. 5  
Biogarmentry, living  
clothes



Fig. 6  
Daniel Elkayam x Nat-2,  
algae sneakers

invitation to take care of the personal wardrobe fig. 05. The last case is Nat-2, a sustainable sneakers brand that has experimented with the use of a semi-transparent material based on algae for the capsule collection in collaboration with the Israeli designer Daniel Elkayam fig. 06. Inspired by biophilic values, the line was born as a continuation of the designer's *SEAmathy* project, which experiments and reflects on the life and death of organic matter – specifically algae. The focus is on the transition of the plant from the natural habitat to the role it assumes as a support for fashion activating a new life cycle.

### **Wearing Seaweeds**

The cited case studies illustrate fashion experimentations applying seaweeds that are nurturing research practices intertwining design and science. Unlike traditional vegetal fibres, such as cotton and linen, seaweeds are characterised not only for evoking an exotic and yet unfamiliar imaginary, but also a low-impact production system: they are abundant in nature; they do not require irrigation; only their regenerative part is being used; they do not consume arable land neither require pesticides or fertilisers; they biodegrade quickly; they are naturally fire resistant reducing the need to add toxic flame retardants to clothing; they are processed in plants already oriented towards energy optimization (Bak et al., 2019). However, the possible criticalities of seaweed application should not be overlooked. For example the emissions and costs related to transport, since most of the production is located in Iceland. As well as the loss of centrality of territories historically used for the cultivation of traditional fibres. Nonetheless the risks of a colonisation of new marine areas for the development of intensive cultivation of seaweeds with possible future imbalances for the ecosystem. This essay does not consider algae-based materials exclusively as environmental alternatives for sustainable practices, but rather addresses these plants as a means for establishing possible connections between human and non-human. They are “vibrant”, alive materials that evolve over time and which require care. They redefine the concepts and temporalities of fabric and fashion. This is encouraged by the intrinsic properties of the fibre that generates an effect of physical well-being, keeping its characteristics unaltered along the transformation process. Even after several washing cycles, the seaweed fibre is able to activate cell regeneration and reduce skin inflammation thanks to the active ingredients of the sea like amino acids, iodine and mineral salts<sup>7</sup>.

By applying a plant metaphor to fashion (Moradei, 2022 in press), seaweeds transformed into fabric and placed next to the human body seem to reconfigure a new natural environment. Thus, they symbolically resume life in a multispecies landscape, representing a possibility of progressive change in the relationship between humans and the planet.

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PhD, his research interests include the environmental and social sustainability in fashion design and production; the education of fashion designers and the role of the fashion portfolio in the construction of a professional identity; the places of Made in Italy and the new configurations of industrial districts.

#### **Clizia Moradei**

PhD student in sustainable fashion at Università Iuav di Venezia. Her research themes include sustainable fashion practices with a focus on biomaterials at the intersection with botany and biology, the relationship between design, craftsmanship and industrial production.

#### **7**

These reasons are the basis of the initial success of this product for textile application in the medical field (Janarthanan & Senthil Kumar, 2017).

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