Climate change

Current and future impacts on historic vessels and the UK maritime heritage sector

Volume Two: Mitigation and Adaptation

Image: Ian Kippax

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VOLUME TWO: MITIGATION AND ADAPTATION

INTRODUCTION

"If you're not prepared to take some risks then nothing would get done. We just have to be flexible and take each project as it comes." – Mike Hudson, National Trust Renewable Energy Programme Director.[1]

As demonstrated in *Volume One* of this paper, climate change is not simply an abstract issue for the future: it is happening now and is already impacting historic vessels and the maritime heritage sector. It is vital to think beyond the way in which things are normally done and to recognise the advantages and opportunities that increasing sustainability and reducing environmental impact brings. Flexibility is key: soon it will not be possible to predict and control every aspect of historic vessels and the environments they work in, as unprecedented changes which are difficult to foresee start to occur globally. It will be important to approach improving sustainability with an open mind, being aware of the complexity of the tasks ahead but also the opportunities they bring.[2] Above all, becoming more sustainable will bring us closer to the environment in which we work, and in which sailors have long lived and thrived.

There are actions which can be taken to *mitigate* climate change to lessen the likelihood of further damage. To avoid a significant increase in the average global surface temperature, greenhouse gas emissions need to be drastically reduced and renewable energy sources embraced. Non-renewable resources, like land, must be used sustainably with a greater consciousness of excess waste, such as single-use plastics. Historic vessels have a role to play in this fight for change, from making maintenance and conservation projects sustainable, to operating in more environmentally friendly ways.

Historic vessels and their stories teach us about our past, colouring the account of how modern Britain came to be. They also have the potential to teach us about our climate past and our climate future and as such can be a very important scientific tool, as the voyages and log books of HMS *Erebus* and USS *Jeannette* have demonstrated. It is no coincidence that boats have been employed as a key piece of imagery at climate change protests across the country. However, historic vessels do not exist purely as representatives of our past. They have a role to play as instruments of well-being in today's society, bringing an emotional connection, opportunities for learning and a sense of joy for all those engaged with them. For all these reasons, it is important to protect and prepare historic vessels for the environmental changes they are likely to face.

In studying the current impacts and the scientific evidence detailing what the future may hold, we are developing an evidence base which will be instrumental in determining how the maritime heritage sector should respond to climate change. This will involve taking

[1] https://www.nationaltrust.org.uk/features/our-response-to-climate-change
[2] Silvius, 2014, 79.

actions to both mitigate and adapt to climate change; that is, attempt to reduce any negative climate impacts, while at the same time protecting the heritage asset from current and future climate impacts. “It is human behaviour as much as the behaviour of physical remains which will be the key to a low-carbon future.”[3]

This volume sets out the recommended ways in which historic vessel custodians can respond to the climate crisis while simultaneously taking hold of and creating opportunities for their vessels. Case studies have been included throughout to demonstrate how some organisations have already successfully taken action. This report is aimed at the wide range of stakeholders which comprise the UK historic vessel sector, all of whom have differing needs, abilities and constraints. Not all climate targets will be appropriate for each vessel, responding to climate change involves building resilience and some outcomes will take time to achieve. There may be economic hurdles and practical challenges to overcome. It is important to find the best solutions for each aspect of our heritage and to remember that even small actions, cumulatively, can have a big effect.

Some recommendations are more tangible than others – for example, switching to a renewable energy provider feels like a direct response, whereas educating visitors on the climate and environment we work in may not feel so immediate. Nonetheless, both are important. A combination of tangible and intangible changes in all areas is a crucial part of tackling climate change. When adopting these recommendations, it will be important to find a balance between what is realistic and the need to take major action now. Heritage organisations in the UK, with large collections and estates, have recognised that “every aspect of the operation and management of the historic environment should be considered for its ability to mitigate and adapt to climate change. An overall improvement will be achieved because substantial improvements in any aspect will compensate for areas where few improvements are possible.” [4] It will help to embrace innovation and new ways of thinking: “the measures necessary to adapt to and combat climatic instability will also necessitate significant change in the historic environment, not all of which will conform to current thinking about heritage management.”[5]

All recommendations should be carefully researched and considered in the context of each individual historic vessel. Changes should be implemented in conjunction with the conservation principles listed in our guidance manual *Conserving Historic Vessels* (Vol. 3) to ensure that the vessel continues to be conserved according to its significance.

MANAGEMENT AND OPPORTUNITIES: RECOMMENDATIONS

CONSIDER SUSTAINABILITY AND MAKE ROBUST BUT REVERSIBLE CHANGES NOW

[3] Whimster, 2008, 22.

[4] Cassar, 2008c, 10.

[5] Impey, 2008, 2.

As set out in *Volume One*, the United Nations Sustainable Development Goals particularly highlight the need "to protect and safeguard the world's cultural and natural heritage."[6] In this context, sustainability means ensuring that all of our actions today meet the needs of the present without compromising the ability of future generations to meet their own needs.[7] Sustainability therefore ought to encompass every aspect of life, including economic, social, and environmental factors, and balance those different interests, managing economic, social, and environmental capital. [8] Sustainability has a wide geographic and temporal scope, covering short-, mid-, and long-term issues and impacts.[9] A further key aspect of sustainability is being transparent and accountable; for example, sharing details of your environmental impact with stakeholders, such as visitors to the vessel, crew or members of staff. Sustainability entails responsibility[10] and, as the climate crisis progresses, will inevitably become a much more normative concept, reflecting the values and ethics of society. [11]

When considering sustainability in relation to maritime heritage, it is important to look at every aspect of a historic vessel including its supporting infrastructure, services, suppliers, staff and personnel. This means not only looking at the energy consumption, water usage, waste, and carbon emissions of the vessel itself, but also those relating to supporting structures on land and the day-to-day operations on site, as well as the impact resulting from staff and visitor travel to site, or the energy consumption and waste resulting from procuring goods. All everyday aspects of associated life, such as printing paperwork, should be considered in sustainability measures. Some practical suggested changes to the organisation are set out later in this volume.

Although the future is unknown, this report has indicated that climate change is already affecting historic vessels in adverse ways which are likely to become more severe. Consequently, climate change mitigation and adaptation will *have* to be undertaken if these craft are to survive. Thinking of the bigger picture and making such changes now, even though they may be costly, will avert extreme economic pressures later or potential disaster events, such as flooding, fire or material destruction resulting from temperature rises. Long-term sustainability decisions must therefore be prioritised over short-term economic savings.

The one certainty of climate change is that it is uncertain, with the situation constantly changing as more data is uncovered.[12] We cannot wait for all research in this area to be completed before beginning to manage our assets in the face of climate change, so

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[6] There are 17 integrated SDGs. The fourth specific target of SDG11 (Target 11.4) is "Strengthen efforts to protect and safeguard the world's cultural and natural heritage". https://www.un.org/sustainabledevelopment/cities/

[7] World Commission on Environment and Development, Bruntland, 1987 in Silvius et al, 2014, 67

[8] Silvius et al, 2014, 70

[9] Silvius et al, 2014, 67-69

[10] Silvius et al, 2014, 69

[11] Silvius et al, 2014, 69

[12] Cassar, 2005e

preventative action must be taken as soon as possible. Nonetheless, any short-term actions should be well-researched and appropriate to the safety and significance of the vessel. If possible, actions which are reversible and do not affect the fabric of the vessel should be prioritised; for example, creating an emergency plan for an extreme weather event or taking part in scientific surveys. Such changes are robust but have minimum impact on significance.

CALCULATE YOUR CARBON FOOTPRINT AND STRIVE TO BECOME CARBON NEUTRAL

A 'carbon footprint' is "the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organisation or community",[13] and is therefore a measure of our individual and business levels of pollution. Nearly everything we do on a daily basis releases carbon into the atmosphere, meaning that once our footprint has been calculated, we can easily begin to decrease our carbon emissions by small changes to our everyday choices.[14] Carbon calculators exist to work out an individual or organisation's 'footprint' and these can equally be applied to an historic vessel and its ownership body. There are many of these available online for free, such as that provided by the World Wildlife Fund (https://footprint.wwf.org.uk/#/) or these, for individuals, small businesses, large businesses, and products, provided by Carbon Footprint (https://www.carbonfootprint.com/measure.html). After calculating your carbon footprint, you can then work to reduce and offset it. Measures to help with this can include reducing energy, material consumption and waste, lowering emissions, or setting specific targets, such as those recommended throughout this report.

Energy is consumed in every aspect of our lives, most of which comes from burning fossil fuels – the main anthropogenic cause of climate change. There are many simple ways to reduce energy consumption, including:[15]

- Turn off lights and electrical appliances when not in use.
- Keep outside doors closed during cold weather.
- Switch devices like photocopiers to 'standby' after use.
- Use LED light bulbs.
- Reduce paper use, by:
    - Printing and photocopying on both sides;
    - Using E-mail where appropriate;
    - Designing activity sheets to be reusable wherever appropriate (laminate and dry wipe pens).
- Use equipment that uses less electricity, including lights, heaters, air conditions, and refrigerators.
- Limit the use of air conditioning.

[13] https://www.goodenergy.co.uk/blog/2017/11/20/what-is-a-carbon-footprint/

[14] https://www.goodenergy.co.uk/blog/2017/11/20/what-is-a-carbon-footprint/

[15] These examples were taken from Wildside Activity Centre, Environmental Policy, 2019

- Install a programable thermostat.[16]
- Upgrade lighting,[17] for example, SS *Shieldhall* is gradually replacing its lamps with energy efficient types, while still maintaining a traditional look.
- Reduce waste.
    - A key principle of sustainability is eliminating waste[18] and in doing this a good deal of money will also be saved.
    - Toyota has identified 'The Seven Wastes' in its production system, which are: overproduction, waiting, transporting, inappropriate processing, unnecessary inventory, unnecessary or excess motion, and defects. [19] These principles could also be applied, on a smaller scale, to the maritime heritage sector.
    - Larger changes could include insulation projects, which can be more complex to undertake. In 2019, the tall ship *Glenlee* started to insulate the tween deck with rockwool insulation, which was the last major part of the hull that was bare. The lighting system was also changed to LED fittings.

All these actions, as well as being beneficial for the environment, will save money by reducing expenditure on energy.

There is a difference between reducing energy consumption and reducing emissions. Energy consumption refers to the total energy used by a historic vessel and its associated infrastructure, such as the energy used by heating and lighting, as well as the fuel used to run the vessel if operational. Reducing emissions refers solely to that fuel consumption and the emissions it produces while in use. Although both energy and fuel itself can be fossil fuels or come from fossil fuels, using fossil fuels directly on board the vessel produces harmful emissions locally, and these emissions then contribute directly to global warming and ocean acidification. Different mitigation measures in this area are suitable for different types of vessel, recognising that operational heritage craft have a special role to play in keeping alive traditional skills, educating the public and providing real-life experiences which would not be possible if their engines were no longer able to run.

A large portion of climate change mitigation focuses on reducing carbon emissions from power and energy generation, such as by using renewable resources. It will not always be possible for historic vessels to be fully carbon neutral or to reduce carbon emissions entirely, especially if their significance lies in their role as a coal-burning vessel, or if their business model relies on an engine and would not be viable under sail alone. However, there are other ways that vessels can be made more environmentally sustainable. This can include actions which offset the harmful emissions caused by travel, such as by undertaking sail cargo-carrying. Offsetting refers to balancing, counteracting, or compensating for

[16] https://www.epa.gov/nutrientpollution/sources-and-solutions-fossil-fuels
[17] Holborow, 2008, 28.
[18] Silvius, 2014, 70.
[19] Silvius, 2014, 70.

harmful, often unavoidable, actions. Other forms of carbon reduction involve implementing emission-free propulsion systems.

- **ELECTRIC ENGINES**

One way to reduce emissions is to use electric engines in historic vessels and this is particularly appropriate for those craft who were previously unpowered or whose original engine no longer survives. Research indicates that internal combustion engines (in cars) create 1.2 to 1.6 times more CO_2 emissions than electric battery vehicles. However, electric cars are not perfect as they still carry a large carbon footprint.[20] The environmental impact of electric engines in use can vary greatly because the electricity used to power these engines can be sourced from many different types of power, renewable or not. [21] There are also not many companies in the UK who currently produce and install electric engines, which can make this option more costly to pursue. Historic vessels also need to consider charging mechanisms and battery length against likely passage time.

CASE STUDY: *JOHN CONSTABLE*

John Constable, a Stour River Lighter, had two electric engines installed as part of National Lottery Heritage Fund conservation project.[22] The original Stour Lighters were towed in pairs by a single horse from 1705 to the early twentieth century, with one converted unsuccessfully to steam power in the 1930s. When the River Stour Trust decided to bring a Stour Lighter back into regular use, it was deemed impractical to tow it with a horse due to problems with the towpaths and modern field boundaries. They therefore opted to use an electric engine, which is silent, had minimal impact on aesthetics and fitted with their environmental aims.

The electric engine was installed by the Thames Electric Launch Company (TELCO).[23] To avoid impact on original fabric, the Heritage Lottery Fund opposed cutting any holes in the hull of the boat, so TELCO proposed using two electric outboards, mounted either side towards the stern of the boat, low down below the gunwale line, where they are almost invisible. The dual outboards make the boat easier to steer and gives additional security on the quickly flowing river, with one motor always being available in the case of a breakdown or weed on the propeller. At 2 mph, the motors deliver almost exactly 0.75kW, or one horsepower, which is equivalent to the original tow power of the boats, thereby allowing them to operate in keeping with their significance. They are also powerful enough to reach the modern-day speed limit of 4 mph or to stem currents in times of fast river flow if required. The engines are powered by a bank of batteries, which last for a day and are charged overnight using off peak electricity. It is also planned to install an array of solar panels at *John Constable's* regular mooring to enable recharging of the batteries.

[20] Nickischer, 2019, Abstract.
[21] Nickischer, 2019.
[22] http://pioneerck18.org/page8/page11/index.html
[23] http://www.thameselectric.com

- **FUEL ADAPTATIONS**

In some instances, historic vessels may be required to make changes to their current fuel systems in order to comply with new legislation or to make new types of fuel practicable for use. This should be done with the minimal intervention to avoid unnecessary impact on significance.

CASE STUDY: SS SHIELDHALL

In 2020, SS *Shieldhall* undertook a project to make adaptations to her fuel tanks and the type of fuel she used following changes in regulations relating to the burning of fuel with low sulphur dioxide content. These works were a direct result of the requirement to use diesel fuel (Marine Gas Oil MGO), to comply with current IMO environmental standards for sulphur contents of fuel oil for ships operating in defined areas, such as the English Channel and alongside in harbours. Previously, *Shieldhall* had used heavier grades of fuel oil without undue problems. However, these were no longer available locally from the beginning of 2018.

It had been noticed that, in 2018 after a passage to Falmouth for a scheduled drydocking, a number of rivets were weeping and allowing MGO to leak into the dry-dock. With the agreement of the local Maritime and Coastguard Agency surveyor, the offending rivets were ring welded externally and the problem resolved. The requirement to use MGO was expected to continue for an indefinite period and as a result, it was considered to be pro-active and prevent a possible reoccurrence to ring weld the remaining rivets inside the fuel tanks and also, to seam weld the hull frames to the hull plating, to prevent a possible leakage path from the insides of the fuel tanks to the outside with resulting pollution. Such repair work was considered to enhance the ship's construction, rather than diminish its strength.

- **COAL-BURNING VESSELS**

In some cases, it is not possible to reduce emissions without impairing the significance of the vessel. A traditional method of propulsion such as steam can be integral to a craft's heritage merit. It may also prove impractical to implement a new mechanism due to the historic configuration of the vessel or the cost involved in making such changes. The Heritage Fuels Alliance, formed by the Heritage Railway Association, the National Traction Engine Trust, the Federation of British Historic Vehicles Clubs, the Transport Trust and the Association of British Transport & Engineering Museums, has been lobbying Government on behalf of members who use coal in railway locomotives, road vehicles, pumping stations and more in the UK.[24] It is seeking an exemption to coal burning legislation for the heritage steam sector because there are tangible benefits to society which can be reaped from experiencing this type of machinery in action. However, should an exemption be

[24] https://www.theheritagealliance.org.uk/update/the-heritage-fuels-alliance-joins-the-heritage-alliance/

forthcoming, there remains a concern that supply will be an issue with the heritage sector too small to create the necessary demand on its own.

There are other ways for coal-burning vessels to reduce their emissions, such as by pre-heating their boilers with a 'warming fire' or operating for shorter periods of time. Many of these vessels only operate during the summer season (typically from March to October) and the number of times they sail is dependent on various factors, such as ticket prices, weather, shore-side infrastructure and the condition of the vessel. Some choose only to operate for special events such as museum open days and heritage boat festivals, the Queen's Diamond Jubilee Pageant, Bristol Harbour Festival, and the Thames Traditional Boat Festival. Occasions such as these allow the public to appreciate heritage in its true form with minimum emission output, while keeping the traditional skills of operating historic machinery alive.

- **USE OF BIO FUELS**

The Inland Waterways Association (IWA) has been carrying out research into a carbon neutral alternative for fossil fuel diesel. Earlier this century, a process was developed in Finland for converting animal fats and waste vegetable oil into diesel fuel, employing hydrogen. Today this alternative, known as second generation biofuel, is becoming readily available and is already in regular commercial marine use. Hydrotreated Vegetable Oil (HVO) carries a wide range of endorsements from Vetus to Volvo, Kubota to Yanmar. It is completely stable when stored (up to ten years), remains free-flowing down to at least -25°C and is not hygroscopic (attracts water). It is also 100% miscible, meaning that it mixes with all other diesel fuels and there is no need to flush the tank first.[25]

A recent (IWA) trial involved a narrowboat with a Bolinder 15 horse power single cylinder two stroke Crude Oil Engine which currently runs on red diesel. It was filled with HVO for the outbound journey and red diesel for the return, with the injector and fuel filter cleaned and reset before both runs. The trial looked at fuel consumption, exhaust smoke, emissions, reversibility, starting behaviour, engine stiffness and exhaust smell. Over the test distance of 18 miles, there was over a 20% saving in fuel consumption for HVO. When idling, some smoke was observed which then became impossible to see with HVO once the engine warmed up. The Bolinder is a direct reversing engine and HVO provided the most reliable reversing yet seen with the boat. There is some need for further learning as regards safety when kick starting these engines as HVO showed a tendency to 'kick back'. However, there was no stiffness observed in the engine when running on HVO and the odour was that of burning candles.

- **SAIL CARGO**

The Sail Cargo movement is a growing community interested in shipping ethical cargo under sail, reviving the maritime culture around cargo-carrying, sailing, and the communities they

[25] https://waterways.org.uk/about-us/news/fuel-for-thought-hvo-greener-boating

support. Sail cargo is collaborative (ship owners, producers, ports and brokers work together) and a means of adventure: opportunities also include sail training, ship building, and passenger travel. The popularity of the sail cargo market has grown exponentially in the past ten years, with companies and customers increasingly looking for green solutions, creating exciting possibilities for a commercial sail industry.[26] Sail cargo uses renewable energy in the form of the wind and its emissions and pollutants are close to zero. [27] Today there are over 10 sail cargo vessels operating, and more being built, expanded from only 3 in 2009.[28]

In 2020, new regulations from the International Maritime Organisation (IMO) further limited sulphur oxide emissions from ships.[29] The ambition is to reduce greenhouse gas emissions from shipping by at least half by 2050, reducing air pollution and creating low carbon shipping, through mandatory energy-efficiency measures and regulatory work.[30] Sail cargo is not in competition with the conventional shipping industry in terms of speed and price, but instead provides customers and consumers with an environmentally sustainable, economically viable, values-driven option.[31] While sail cargo is small compared to conventional shipping, there are several aspects which suggest the market will continue to grow: consumer demand, growing awareness, ethically-driven consumption, an increasing number of sail cargo vessels, which in turn leads to great port cooperation, and profitability.[32]

One of the biggest challenges for sail cargo is scale, as there are currently only a few small ships operating. The market for ethically-produced and transported commodities, however, is growing, with many companies seeking to make their practices greener, partly through taking part in alternative forms of shipping.[33] In response to this there is a rise in the number of sail cargo vessels being specially built or adapted. It is hoped that "the more dedicated sail cargo vessels there are, the more ports and authoritative bodies will understand how to work with them, and the more companies will use sail cargo to transport products." EcoClipper was set up in 2018 by one of the Fairtransport founders, Jorne Langelaan, to facilitate emission-free shipping worldwide. EcoClipper has assembled a team to develop a whole fleet of engineless sailing ships providing emission-free transport and travel worldwide[34] and is considering economies of scale, as the larger the operating ships, the cheaper the cargo. EcoClipper ships will sail on three shipping lines, Atlantic, Pacific, and Global, with fixed schedules, thereby creating a new shipping logistics system for sail cargo

[26] Langelaan in Hurford & Barker, 2020, 2
[27] Hurford & Barker, 2020, 3.
[28] Hurford & Barker, 2020, 6, 13.
[29] http://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx
[30] http://www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx
[31] Hurford & Barker, 2020, 6
[32] Hurford & Barker, 2020, 10-14
[33] Hurford & Barker, 2020, 4.
[34] https://raybelcharters.com/sailing-into-a-sustainable-future/

vessels.[35] The ships will hold 500 tonnes of cargo each, take 12 passengers and 36 trainees.

CASE STUDY: THE SAIL CARGO ALLIANCE

The Sail Cargo Alliance (SCA) is an international alliance of ship owners, brokers and producers. Within SCA are New Dawn Traders, Raybel Charters, Grayhound Lugger Sailing, *Bessie Ellen,* and the Sail Boat Project (a Shipshape Network South Project). Fairtransport are another such group. Our economy relies on international trade and international trade relies on ships, with nearly 95% of everything we use and own having travelled by ship at some point in its life.[36] There is a growing market for ethically-produced and transported commodities, with many companies seeking to make their practices greener, partly through taking part in alternative forms of shipping.[37] SCA is seeking to create a healthy transport culture with its ships undertaking sail-training and passenger travel as well as cargo transport under sail.[38] These sail cargo projects carry 5 to 50 tonnes, compared to the standard cargo ship which carries around 20,000 containers. [39] Fairtransport also aims to minimize the carbon footprint worldwide and to raise awareness of climate friendly transportation, with the transport of sustainable products.[40]

Several historic vessels are now part of the Sail Cargo Alliance: Brigantine *Tres Hombres*, built in 1943, was restored in 2007 and became operational as a sail cargo ship in 2009, and is now often regarded as the ambassador for modern sail cargo. She can carry 45 tonnes of cargo, 8 trainees, and 7 professional crew, and trades between Europe and the Caribbean in coffee, rum, and cocoa.[41] *Nordlys*, a 25-metre ketch, is possibly the world's oldest operational cargo ship, built in the Isle of Wight in 1873 as a fishing trawler. She now accommodates a crew of three professionals and six trainees and can carry a maximum of 25 tonnes of cargo between European ports. Her cargo is organic and traditionally crafted goods like wine, whisky, and olive oil.[42] She is engineless, transporting her cargo with the power of the wind and skilled seamanship. *Leenan Head*, too, is a historic vessel, built in 1906 and used for thirty years for fishing herring off the west coast of Ireland. She was then motorised in the 1950s. In 2001 she made her first voyage around the Atlantic and has since linked projects from Spitzbergen, Svalbard to Casamance, Senegal, from Brazil to the Newfoundland, the Caribbean and Western Europe.[43]

[35] https://raybelcharters.com/sailing-into-a-sustainable-future/
[36] https://www.maritimeuk.org/about/our-sector/shipping/
[37] Hurford & Barker, 2020, 4.
[38] https://www.newdawntraders.com/cargo-culture
[39] https://www.newdawntraders.com/cargo-culture
[40] https://fairtransport.eu/about/
[41] Hurford & Barker, 2020, 5.
[42] https://fairtransport.eu/nordlys/
[43] https://www.newdawntraders.com/cargo-culture/leenan-head

Bessie Ellen was built in Plymouth in 1904 and is one of the last surviving West Country trading ketches from a fleet that once stood at nearly 700.[44] She was one of the vessels involved at the beginning of the now growing trend in a return to sail power for carrying cargo and has a capacity of 50 tonnes. *Grayhound* is a 5/6th scale replica of a three-masted Customs Lugger built in 1776 in Cawsand, Cornwall, specifically to offer environment friendly charters, and minimal carbon footprint cargo shipping on a classic sailing ship. [45] She was launched in August 2012[46] and is on the UK Replica List. Grayhound Lugger Sailing has delivered cargoes of up to 4.5 tonnes of organic French wine and West Country ale under sail across the Channel.

Part of carrying cargo under sail has led to modifying conventional logistics, such as by establishing 'Port Allies' (part of the Voyage Co-Op system, established by New Dawn Traders). This is someone who collects orders locally from their community and facilitates the ship while in port by communicating with customers and harbour authorities. Systems like this have encouraged more vessels to get involved in sail cargo, such as the UK East Coast sailing barges, like *Raybel*, which are planning to transport cargo around England's East Coast and into cities like London.[47]

Raybel Charters is a Community Interest Company with three objectives: to reconstruct the historic Thames Sailing Barge *Raybel*; to return her to cargo delivery under sail; and to manage her as a newly revitalised heritage asset for community benefit.[48] *Raybel* was originally launched in 1920 and in the three following decades delivered many thousands of tons of cargo under sail, until diesel power became favoured.[49] Now that we understand the enormous damage which fossil fuels have had on our environment, vessels like *Raybel* offer the opportunity to learn from these lessons of the past and return to carrying cargo under sail, although *Raybel* will retain her engine to satisfy the port authority that she can maintain a specific speed, and although this increases emissions, it allows access to target markets.[50]

- **OTHER FORMS OF SAIL TRAVEL**

Until the mid-twentieth century, travelling over long-distances relied on ships, but this dependence disappeared as aviation technology advanced,[51] and now passenger travel by sail has been for several decades a recreational holiday option, firmly part of the tourism industry.[52] However, some people, particularly young generations, are now trying to travel without flying, in what is becoming known as 'slow travel' or 'adventure travel', as global

[44] https://bessie-ellen.com/about/history/
[45] https://grayhoundventures.com
[46] https://grayhoundventures.com/the-ship/
[47] Hurford & Barker, 2020, 7, 13.
[48] https://raybelcharters.com
[49] https://raybelcharters.com
[50] Hurford & Barker, 2020, 13.
[51] Hurford & Barker, 2020, 15.
[52] Hurford & Barker, 2020, 3se

awareness of how polluting air travel is increases. Air travel emits as much carbon dioxide annually as some of the world's major economies, and cruise ships are another significant emitter.[53] A survey of 6,000 people in the US, Germany, France and the UK found that 21% of passengers had reduced the number of flights they took in 2019 due to environmental concerns and a new concept known as 'flight shame'[54]

People are able to sail across oceans on sail training vessels, tall ships or privately owned yachts as crew and by sailboat hitchhiking, but these options do not have consistent routes or timetables that cater to those looking for alternatives to flight.[55] As a mode of transport for tourists, sail travel is currently very under-developed and it is therefore difficult to find information about it. Within Europe, slow travel typically takes place by train, but for trips further afield, people are beginning to explore sail travel as an option. Zero-emissions travel isn't easy with cross-continental boats often lacking amenities and sail transport is usually more expensive and time-consuming, so marketing will be required to raise awareness of this amongst consumers and passengers if they are to alter their behaviours and expectations away from conventional, cheaper, and quicker alternatives.[56]

Most famously, perhaps, Greta Thunberg, the young climate activist, travelled to the UN Climate Summit in New York by boat from the UK in 2019. She departed from Plymouth on *Malizia II*, a carbon-neutral racing yacht, powered by solar panels and an underwater turbine.[57] Similarly, the sailor and plastic pollution activist Emily Penn travelled from the UK to Australia by boat after graduating from university, recognising that slow travel could carry many environmental and personal benefits.[58] Simon Levelt,[59] a tea and coffee importer in the Netherlands, has also highlighted the opportunities available by offering customers the chance to sail as passengers along with their cargo.[60]

Fair Ferry is a sail ferry company undertaking trips from London to Rotterdam, Rotterdam to New York, Stralsund-Malmö to Copenhagen, and a 'North Sea Experience' from the Netherlands to England and back again. Their three ships are all historic: *Artemis* is a barque built for whaling in Norway in 1926, measuring 60m; *Twister* is a two-master built in 1902, measuring 35m, and is one of the fastest classic sailing ships in the region; and *Jantje* is a small tall ship, built in 1930.[61] Fair Ferry has also started collaborating with a train company to offer combined tickets for train and sail. [62]

[53] https://www.washingtonpost.com/world/2019/08/15/swedish-climate-activist-greta-thunberg-is-sailing-america-amid-storm-criticism/
[54] https://www.bbc.co.uk/news/business-49890057 in Hurford & Barker, 2020, 16
[55] Hurford & Barker, 2020, 15
[56] Hurford & Barker, 2020, 4
[57] https://www.washingtonpost.com/world/2019/08/15/swedish-climate-activist-greta-thunberg-is-sailing-america-amid-storm-criticism/
[58] Wardrobe Crisis Podcast, Episode 57, September 2018.
[59] https://www.simonlevelt.nl
[60] Hurford & Barker, 2020, 12
[61] https://www.fairferry.co.uk/the-ships
[62] Hurford & Barker, 2020, 12.

There is scope for historic vessels to develop this area and offer travel by sail as a new form of business venture. Cross-continental sailing is unlikely to become a viable mode of transportation in the near future but, within European waters the concept could develop, particularly in areas where eco cargo carrying is already taking place. EcoClipper has commented that "the exhilarating experience of travelling on a sailing ship puts it well within the booming adventure travel market, which was worth $586.3 billion in 2018.[63] Travelling by sail fulfils the desires of today's travellers to feel part of and experience the natural world without harming it in the process."[64]

- **CARBON OFFSETTING**

Earlier in this report**,** it was stated that "nearly everything we do on a daily basis releases carbon into the atmosphere, meaning that we can easily begin to decrease our carbon emissions by small changes to our everyday choices,[65] such as by choosing to purchase and eat locally produced food, which has emitted less carbon throughout its life as it has had less distance to travel." Despite this, it is not always so simple to reduce carbon – and even things which seem straight forward, such as purchasing locally grown food, can be difficult in some instances - if there is no local market, or if that food is considerably more expensive than imported alternatives.

Carbon offsetting schemes invest in environmental projects around the world, the idea being to make up for the carbon emitted by engaging in positive actions to make up for your personal of business carbon footprint. Such schemes can include planting trees, developing sustainable solutions in communities, and creating jobs in rural areas to deliver clean-energy solutions in the future.[66] Carbon offsetting techniques are believed to be effective, reducing emissions overall much faster than individuals or single companies can do.[67] However, this will not be a sustainable step for every vessel due to the cost involved. It is also important to be aware of greenwashing – the process of conveying a false impression as to how environmentally sound a company's products really are.

DEVELOP AN ENVIRONMENTAL POLICY AND EMBED GREEN PRINCIPLES WITHIN ALL PROJECTS AND PRACTICES

Developing and publishing a climate mitigation statement and/or an Environmental Policy involves systematically evaluating every aspect of work and life on and around the historic vessel in question. The statement, which may be published on the organisation's website, should simply acknowledge that the vessel recognises the climate issues affecting it, has areas to work on in regards to these and wishes to undertake that work. The Environmental

[63] https://www.alliedmarketresearch.com/adventure-tourism-market in Hurford & Barker, 2020, 18.
[64] Hurford & Barker, 2020, 18.
[65] https://www.goodenergy.co.uk/blog/2017/11/20/what-is-a-carbon-footprint/
[66] https://www.goodenergy.co.uk/blog/2017/11/20/what-is-a-carbon-footprint/
[67] https://www.carbonfootprint.com/carbonoffset.html

Policy, or a more detailed statement, should outline and expand upon the organisation's commitment to sustainability, detailing the ways in which this will be achieved.

Having an Environmental Policy can be highly beneficial, both for business and for the environment. For operational vessels, it can help you to stay within the law. For all vessels, it can also provide information for employees about their environmental roles and responsibility and improve cost control, including by conserving raw materials and energy. It can also help improve monitoring, which can aid efficiency in all areas.[68]

There is no standard content for an Environmental Policy, but it could include some of the things that are recommended throughout this report, such as reducing the use of single-use plastics. The statement or policy is a key opportunity to set targets to be evaluated later. An Environmental Policy could be split into different areas, for example:[69]

- Litter and Waste Management
- Energy Use
- Transport
- Water
- Purchasing policy
- Communication and Awareness
- Legislation

Your response to climate change should be built into the vessel's conservation management plan, its statement of significance and all associated projects and practices. This can include:

- Environmental risks, such as likelihood of catastrophic floods or the harmful effects of increased ocean acidification;
- Ensuring that all purchases and decisions are 'future-proofed' as far as possible given an uncertain climate and ongoing climate emergency;
- Reducing energy consumption in small ways, which can be as simple as turning lights off in rooms which are not in use or installing automatic lights.
- Reducing the amount of paperwork printed out and copies made;
- Reducing consumption of single-use plastics amongst all staff, crew and visitors.

Green conservation principles should be applied to any vessel project or related building works. Making conservation projects more sustainable can take many forms, from large changes like using sustainable timber, to smaller initiatives like encouraging workers to travel in environmentally friendly ways to the project site. For example, the latter could involve making use of government cycle-to-work schemes, which are already increasing in practical importance in a post-COVID 19 pandemic world. Additionally, safe areas to leave

[68] https://www.infoentrepreneurs.org/en/guides/how-to-write-an-environmental-policy/

[69] These examples were taken from Wildside Activity Centre, Environmental Policy, 2019.

bikes could be provided at the site, from simple bike racks to larger bike sheds, or lockers to store helmets and running gear. Some of the National Trust's properties and its headquarters at Heelis in Swindon have showers and lockers to encourage cyclists, walkers, and runners.[70]

Historic vessel conservation projects should apply sustainable approaches to material procurement. The HMS *Victory* conservation project, for example, is investigating a replanting regime of oak equivalent to three times the felling for the project, including nominated and dedicated trees and plantations, as part of a contribution to meeting the national aspiration of a threefold increase in annual planting as per 2050 climate change mitigation targets. There is also a commitment to demonstrate the use of the whole felled tree, by ensuring that the parts of the tree which do not yield timber suitable for *Victory* are used in secondary or tertiary projects, including biomass. The oak used will undertake up to four years of 'seasoning' in the rope walk in Portsmouth Naval Base so it is dry and strong enough to bear the strain of hundreds of thousands of people walking on it every year, aiming to make *Victory* as sustainable as possible for centuries to come.[71]

Museums across the UK are striving to become greener and many organisations have released guidelines on how to achieve this. The Ironbridge Gorge Museums Trust, for example, is "committed to the promotion of Green Tourism".[72] It has gone above and beyond simply becoming greener, stating that one of its strategic aims, in conjunction with its partners, is "to make Ironbridge Gorge World Heritage Site the greenest inhabited World Heritage Site in the World."[73] Similarly, the SS Great Britain Trust is striving to be as sustainable in possible in all areas of its museum operations, and has published a statement on its website to this effect.[74]

<u>Easy steps to becoming greener:</u>

- Recycling as much as possible, including scrap iron.
- Engaging in environmental education work.
- Having water butts and promoting the use of reusable water bottles.
- Using low-energy lighting.
- Using environmentally friendly cleaning materials.
- Creating and publishing an Environmental Policy available online.
- Re-using historic buildings.
- Reducing paper waste as much as possible.
- Using eco-friendly paper.
- Using sustainable sources for paper and printed materials.

[70] Rich et al, 2008, 35.
[71] https://www.royalnavy.mod.uk/news-and-latest-activity/news/2016/february/15/160215-scottish-timber-hms-victory
[72] https://www.ironbridge.org.uk/extras/green-museum/
[73] https://www.ironbridge.org.uk/extras/green-museum/
[74] https://www.ssgreatbritain.org/about-us/sustainability

- Offering staff training and involvement with green issues.[75]
- Promoting cycling or walking to work schemes, including through promoting bicycle hire and public transport.

Historic vessel organisations might consider joining the Green Tourism Business Scheme which aims to promote sustainable tourism across the globe. This scheme includes an awards certification programme, which recognises the commitment of tourism businesses actively working to become more sustainable.[76]

For operational vessels, compliance with current maritime legislation also means meeting the latest environmental standards. Maritime regulations originate from the International Maritime Organization (IMO) and other UN agencies, EU legislation, and UK legislation.[77] More information can be read here: https://www.gov.uk/guidance/shipping-industry-regulation.

CASE STUDY: SS SHIELDHALL

SS Shieldhall is the largest working steam ship in Britain and is a member of the National Historic Fleet.[78] She has included climate change in her conservation management plan since 2014. This document states that future proposals for the ship should pay special regard to solutions which will reduce the carbon footprint of the vessel by seeking to minimise energy usage.[79] The plan recognises that historic structures are often considered to be energy inefficient but suggests a number of improvements that can be made with minimal impact on the heritage asset. Improvement to energy efficiency can also provide savings in running costs in addition to being beneficial to the climate. Nonetheless, "any future mechanical or electrical proposals or suggestions to improve energy efficiency must be weighed against the negative impact they could have on the character of the vessel".

As a working craft, *Shieldhall* must comply with current maritime legislation and environmental standards. She is achieving this in a number of ways:

1. Exhaust emissions. *Shieldhall* must meet international regulations on exhaust emissions. Since 2017, she has used ultra-low fuel oil, with a sulphur dioxide level less than 0.1%, costing approximately £50/cubic metre. In a typical year, she consumes over 100 cubic metres.
2. Smoke emissions. *Shieldhall*'s smoke emissions are regulated through Port Health and those regulations have not changed for around 60 years. They are allowed to make dark smoke for 5 minutes per hour, while raising steam, although they actively

[75] Suggestions are taken from https://www.ironbridge.org.uk/extras/green-museum/ and https://www.ironbridge.org.uk/media/7752/enviro-visitor-charter.pdf
[76] https://www.green-tourism.com/about-us
[77] https://www.gov.uk/guidance/shipping-industry-regulation
[78] https://www.ss-shieldhall.co.uk
[79] Steamship Shieldhall. *Steamship Shieldhall: Conservation Management Plan*, 2014, 41.

try to avoid doing so, as it shows inefficient firing. Typically, she emits dark smoke for just a few seconds.

3. Bilge water. All bilge water is pumped to a holding tank and disposed of to a barge. This was a major part of the 2014 Heritage Lottery-funded works and preceded legislation by a couple of years, as today, pumping bilge water within the three-mile limit is not allowed.
4. Rubbish. All rubbish on board is sorted into paper and cardboard, glass, and passengers are advised accordingly. Nothing is thrown overboard. This is collected for further processing.
5. Sewage treatment. All sewage goes through *Shieldhall*'s aerobic treatment plant and what goes over the side is grey water that is biologically inert. Some sinks go straight overboard but most go via the treatment plant.
6. Capital works. When considering any capital works, *Shieldhall* does not use timber that is not from sustainable sources. Items such as paints and anti-fouling treatment are defined for use by the marine industry and come under their codes of practice.
7. Energy efficiency. The team on *Shieldhall* is gradually replacing lamps with energy efficient types, while trying to maintain a traditional look.

Shieldhall is therefore likely to be more environmentally friendly now than she was when she was first operated, but still maintains her traditional look, feel, and significance. It is interesting to note that *Shieldhall* does not simply comply with international regulations, but actively anticipates and exceeds them. This serves to show that historic ships can lead the way in sustainability, even when they still use fossil fuels and emit smoke.

Once a climate statement or Environmental Policy has been developed and embedded into all projects and practices of an organisation, it can be published to help develop positive relationships with external stakeholders, particularly customers and the local community.[80] In a time when more customers are being 'eco-aware' or looking for a 'feel-good factor' in the places they visit, this can be highly beneficial. Many groups and vessel owners have already created an Environmental Policy and ensured that it enjoys a high profile.

Wildside Activity Centre has communicated its Environmental Policy by:[81]

- Ensuring that staff are informed of their responsibilities in the staff handbook.
- Ensuring that volunteers know what is expected of them by training and information in volunteer induction pack.
- Including information within the Centre newsletter.
- Maintaining information/interpretation boards in the Centre grounds.

[80] https://www.infoentrepreneurs.org/en/guides/how-to-write-an-environmental-policy/
[81] Wildside Activity Centre, Environmental Policy, 2019.

- Developing activities for families/young people/community groups that promote sustainable lifestyles.
- And making use of local media and social media in informing others about the Centre's environmental aims and achievements.

Similarly, the Museums Association has recommended that museums embed their environmental policy across all aspects of their work, through operations, research, staff wellbeing, and learning programmes.[82]

The ss *Great Britain* Trust has published a sustainability statement on its website (https://www.ssgreatbritain.org/about-us/sustainability) in which it outlines its commitment to achieving and promoting sustainability and explains the steps it is taking to achieve this. Publishing such statements online is a simple step which others could relatively easily follow.

ENGAGE IN FORWARD PLANNING AND 'FUTURE-PROOFING'

"Proactive or anticipatory adaptation takes place before the occurrence of a climatic event and can be in response to projected changes in climate – thereby allowing more time for consultation, the discussion of alternatives, and long-term planning. It is also essential to increase resilience against future changes in climatic conditions, including extreme weather events."[83] HMS *Victory* is a good example of this with her Integrated Pest Management (IPM) system. This proactively reduces the chance of future infestations occurring on the ship and is monitored alongside a programme of research, with a current PHD thesis further examining the activity of Death Watch beetle on board. The Ironbridge Coracle Shed, covered in Direct Impacts in *Volume One* of this report, is another example of an organisation which took a proactive approach to 'future-proofing' by ensuring their shed's rotten support beams and struts were replaced before the annual flooding period. This turned out to be particularly important as the year they were replaced, 2020, brought significantly larger-than-usual floods.

Proactive planning will reduce costs, as the effects of climate change result in an environment where preventing damage is cheaper and more effective than ameliorating it,[84] as has been shown by the recent Deepwater Horizon oil-spill disaster. Due to the pace of climate change, vessel owners should include climactic disaster events in their emergency plans (sometimes called business continuity planning), as the likelihood of these increases; for example, flash flooding, sudden fires, extreme heatwaves, and lightning strikes. This is already mandatory for most companies, following the Civil Contingencies Act 2004, but private and not-for-profit vessel custodians should also be encouraged to consider such

[82] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-communicating-environmental-impact-and-policies-to-audiences

[83] Sesana et al., 2019, 162

[84] Turner, 2010 in Silvius, 2014, 70

planning. Fires such as that at the old Thorneycroft sheds, Platts Eyott on the River Thames in 2021, where the Dunkirk Little ship *Lady Gay* was sadly destroyed, show the speed with which the flames can take control and the difficulties of any unplanned rescue attempts.

Emergency planning can be broken down into four basic stages:[85]

- Preparedness
    - Begins with the identification of the need for an emergency plan.
    - Gathering information.
    - Assessing the vulnerabilities.
    - Identifying risks.
    - Determining who will be involved in an emergency, including liaison with the emergency services (in particular the fire brigade).
    - Making links with conservators and local authority emergency planners.
    - Assembling contact lists of colleagues.
    - Assembling laminated site and room plans showing the location of utilities.
    - Assembling 'grab lists' of key items if there are collections within the vessel.
- Reaction
    - Discovery of the emergency.
    - Evacuation.
    - Liaison with emergency services, funders, insurers, and press.
    - Securing and weather proofing the remains and premises and undertaking emergency salvage.
    - Check on people-welfare.
- Recovery
    - Wherever possible use the disaster as an opportunity – e.g. by giving tours of the repair.
- Review
    - Learn from the disaster in case there is another.

One of the risks climate change poses is the damage or destruction of historic and archaeological archives and equipment.[86] Most libraries and archives will already have long-established emergency plans in place, as imposed by the Civil Contingencies Act 2004.[87] However, private vessel owners, small trusts or not-for-profit organisations may not have considered the risks posed by climate change to their documentary or photographic records. Consequently, the storage of archives, in some cases, may need to be rethought and any specialist equipment needed to move those archives should be considered and ideally sourced in advance.[88] The importance of archives and records is well-known in the

[85] As detailed and detailed by Cole, 2008, 38-39.
[86] https://historicengland.org.uk/research/current/threats/heritage-climate-change-environment/understanding-issues/
[87] Cole, 2008, 38.
[88] Fluck & Historic England, 2016, 12.

historic vessel sector, as shown by the work of the Society for Nautical Research (SNR)[89] in the 1930s, when they toured UK coasts, measuring, drawing, and photographing working boats. Many of the boat types they recorded have since disappeared.[90] The archive they created is now in the National Maritime Museum, Greenwich, with copy negatives kept in the Science Museum,[91] which illustrates the importance of holding particularly important archives and records in two separate locations.

INCREASE DATA COLLECTION, AVOID BACKLOGS AND SHARE INFORMATION

To tackle climate change, it is important to hold data which details what our climate and environment is already like. Monitoring can be used to:

1. Establish a baseline of what is considered a 'normal' environmental and climate conditions for historic vessels and their local areas.
2. Indicate what changes are already taking place when measured against the baseline, helping us to make informed decisions about what mitigation and adaptation methods to use now.
3. Predict what changes will occur in the future. Due to the high degree of uncertainty in climate change simulations, long-term monitoring of the actual impact of climate change is vital.[92]
4. Observe and analyse decay progress.[93]
5. Inform decisions on adaptative or corrective actions.[94]
6. Raise awareness with government, local authorities, property owners, heritage managers and the public.[95]
7. Gain political and economic support locally, regionally, and nationally.[96]
8. Facilitate more multidisciplinary approaches, by involving computer scientists, environmentalists, as well as sailors and marine specialists.[97]
9. Gather specialist data for our sector as there is currently very little concrete evidence relating specifically to historic vessels and climate change.
10. Evaluate how effective mitigation and adaptation actions are and have been.[98]

Advanced simulations, such as established by the Intergovernmental Panel on Climate Change and UK Climate Impacts Programme, can be used to predict the effects of future climate change on historic structures, but these simulations are very uncertain, and so "long-term monitoring of *actual* climate change impact is necessary to better understand

[89] https://snr.org.uk
[90] National Historic Ships, 2010 Vol. 3, 24
[91] National Historic Ships, 2010 Vol. 3, 24
[92] Bertolin, 2019, 5.
[93] Bertolin, 2019, 5.
[94] Bertolin, 2019, 5.
[95] Bertolin, 2019, 5.
[96] Bertolin, 2019, 5.
[97] Bertolin, 2019, ix.
[98] Anaf et al., 2019, 12.

the effects of climate change on historic buildings"[99] and other heritage assets, such as vessels.

Harvesting data is an example of a climate change related activity which should already be a normal part of preventative conservation and housekeeping. Although this may not seem important on a daily basis, over time this data will be vital. Consistently collecting and keeping data throughout the vessel on environmental parameters will help to highlight any major changes which could impact the safety of the vessel in the short-term, such as a sudden spike in humidity, and will also contribute to recording changes in the climate and weather local to the vessel in the long-term. Data should be collected at key points throughout the vessel on:

- Temperature
- Light radiation / uv-levels / illuminance
- Relative humidity (RH)

These 'key points' should cover the different areas of the ship, such as the bow, stern, decks and points throughout the hull. They should be both internal and external points. These measurements, taken daily or weekly, should always take place at the same key points to build up a consistent data picture. Consistency will allow any anomalies to be clearly seen. These measurements can then be converted into judgements: [100] they will contribute to future decision making about climate change mitigation and adaptation, ensuring that actions taken relate to the locality and specific conditions of the vessel. This will inform the introduction of any environmental controls and ensure that future decisions are a data-driven process. At a national level, being able to gather this information across a wide variety of vessel types from around the UK will help to inform the bigger picture about the impact of climate change on our sector.

"The development of an efficient and focused monitoring technique with results useful for the preventive conservation of cultural heritage depends, to a high degree, on a deep knowledge of the thresholds of decay that are acceptable or not acceptable to maintain the aesthetic, historic, and cultural values of aged and weathered materials."[101] Vessel custodians have a specialist understanding of the assets they care for, often gathered over many years or passed down through generations. These individuals will play a vital role in informing future recommendations on the conservation of historic vessels in a changing climate, based on their knowledge of what is acceptable or 'new' decay.

Although sometimes easier said than done, avoiding backlogs of work and keeping on top of maintenance can be another simple and effective way of reducing the adverse environmental impacts of a historic vessel, particularly when used alongside rigorous

[99] Haugen et al., 2019, 36.
[100] Anaf et al., 2019, 22.
[101] Haugen et al., 2019, 49

monitoring.[102] Organisations who have already advocated this as a way of mitigating impact and adapting to climate change include Historic England, English Heritage, and the Canal and River Trust. It is also simply part of good vessel care and conservation, although can be dependent on economic and time constraints. Historic England urges its stakeholders to invest more in maintenance[103] arguing that correcting maintenance backlogs, such as cleaning windows and light fittings, repairing doors and windows, and improving controls such as programmable thermostats and thermostatic radiator valves, can result in improved performance as well as a reduction in carbon emissions[104] with less energy needed to heat, light, and care for the asset. These are often very small changes, relatively easy to implement and achieve, which carry large benefits.

Sharing the methods we have used, as well as the information and data we have captured enables us to borrow and adapt good ideas from each other. This is a key part of National Historic Ships UK's remit, to connect individuals and organisations across the sector to work together and learn from each other. Lessons can be drawn from changing vessel conditions, conservation projects, disaster events of any size from insect infestations to flooding and from our successes and failures alike. While ownership details are subject to GDPR, National Historic Ships UK can make introductions to other custodians or vessel projects. We can share learning outcomes via our website, e-Newsletters and social media platforms. Our Facebook groups for vessel owners and Shipshape Network projects, set up during the 2020 pandemic, have proved an excellent way to boost sector communication. To find out more, email: info@nationalhistoricships.org.uk.

Develop a local Circular Economy, re-use materials and keep traditional skills alive

A circular economy "is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems,"[105] meaning that materials are reused over and over, as if in a circle, rather than in a linear mode of production, where materials are used once for one purpose and then discarded. Dame Ellen MacArthur was one of the original proponents of this approach. Local circular economies are highly beneficial to historic vessels, as they not only improve the environmental impact of the vessel, but can reduce material costs.

Salvaging or reusing materials reduces the amount of waste produced by a vessel or trust, which ultimately reduces the number of new items which need to be purchased, and reduces the emissions generated by creating new items. Reusing materials can also save money. This can include simple actions, such as saving envelopes, jiffy bags, and packaging material for reuse as appropriate, or more complex actions, such as salvaging historic timber, which can have conservation benefits by using wood traditionally associated with

[102] Colette; UNESCO, 2007, 30
[103] Fluck & Historic England, 2016, 19.
[104] Holborow, 2008, 28
[105] https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy

the ship. It is important to *re*-use traditional materials, as well as to seek out and use materials traditionally used on the historic ship in question. The Scottish Fisheries Museum has identified the timber it uses as typically having a higher carbon footprint as it has come from further away. Consequently, the Museum has taken steps to repair timber or use reclaimed wood for repairs whenever possible, for example by doing repairs with pieces reclaimed during pier works on Anstruther harbour.

Traditional shipbuilding and maritime craft skills typical to the UK can help in our efforts to apply more sustainable techniques and re-use materials for building and conservation work.[106] As the value of these skills becomes clear, the thirst for knowledge will grow. However, our ability to keep these type of skills alive in the UK with an aging specialist workforce has been described as a "demographic timebomb."[107] Training provision should be a top priority and should constantly be adapted and improved to the requirements of the current and incoming workforce. Educational opportunities need to be provided at all levels, with a strong focus on practical experience and skills should be recognised by accreditation.[108] To this end, National Historic Ships UK is already providing a distance learning course in Historic Vessel Conservation which hosts both UK and international students.

CASE STUDY: SHIPSHAPE HERITAGE TRAINING PARTNERSHIP PROJECT

From 2014 to 2016, National Historic Ships UK ran a scheme known as the Shipshape Heritage Training Partnership (SHTP) which delivered training in partnership with Trinity Sailing Foundation, Excelsior Trust, Scottish Fisheries Museum, Sea-Change Sailing Trust, and Dauntsey's School, funded by the Heritage Lottery Fund as part of its Skills for the Future programme.[109] The project aimed to help arrest the decline in the traditional seamanship skills that are integral to the future of the UK's operational historic sailing vessels, focusing on handling, maintaining, and conserving these craft.[110] The scheme provided ten 12-month training placements offering on-board specialist training in practical skills. The trainees also undertook a tailored course in historic vessel maintenance at the International Boatbuilding Training College Lowestoft and an interpretation placement at the Scottish Fisheries Museum.[111] The success of the initial project meant that SHTP 2 was launched in 2018, with an expanded offer providing sixteen full-time 12-month training placements at eight partner sites around the UK. Building on the outcomes of the first project, SHTP 2 offered two training routes - one focussed on the traditional seamanship skills necessary to operate and maintain historic vessels empathetically and effectively, the other on the practical skills required by museum ship-keepers in charge of vessel collections. The specific skills involved

[106] Whimster, 2008, 22.
[107] Whimster, 2008, 23.
[108] Cassar, 2005e, 64.
[109] National Historic Ships UK, *Shipshape Heritage Training Partnership Project* Leaflet
[110] National Historic Ships UK, *Shipshape Heritage Training Partnership Project* Leaflet
[111] https://www.nationalhistoricships.org.uk/page/nhs/shipshape-heritage-training-partnership-shtp-project

include traditional seamanship techniques, historic vessel maintenance and historic vessel conservation.[112] The National Lottery Heritage Fund awarded a grant of £409,000 towards a total project cost of £424,900, with a grant increase of £9,500 in 2020 to help offset the impact of the pandemic.[113]

CASE STUDY: *LYNHER BARGE*

The Lynher River Barge Community Interest Company, which acts as one of the South-West hubs for the Shipshape Network, is working to regenerate traditional shipbuilding and sailing skills. The company runs traditional boat training courses, family residential water-based activities, and team building days.[114]

The *Lynher* CIC has been working with a number of educational organisations and establishments, including the Plymouth School of Creative Arts, to educate children within their local community. The theme of 'Sustainability on the Water' has taught children how to use tools, source materials and plan the build or repair of a boat as a means of transporting both people and cargo. The ongoing conservation of the barge is enabling local children to learn the skills required to operate safely and enjoy the waterways while exploring their maritime heritage.[115]

The *Lynher CIC* aimed to engage parents together with their children in outdoor water-based activities, and partnered with other water-sports centres and the Plymouth School of Creative Arts to deliver the Sport England funded project 'Making Waves Together', which offers free water sports sessions for families in the St Peter and Waterfront Ward of Plymouth, or for anyone with a child at the Plymouth School of Creative Arts.[116]

Autumn 2015 saw the launch of The Firefly Project, an initiative seeking to establish a sailing club to benefit the Plymouth School of Creative Arts' students and their families.[117] A group of students in Years 8 and 9 (aged 12-14) restored two wooden Firefly dinghies within their school's technical department, launched them and learned to sail on the boats they had restored. A River School[118] expands the concept of education outside the classroom by providing educational packages to schools on the Plymouth waterways. The *Lynher* team also deliver 3- and 5-day traditional sailing courses, during which they teach people to manage a 30 tonne vessel and its crew using traditional skills, including river pilotage and gaff sailing in restricted waters.

USE OR GENERATE RENEWABLE ENERGY WHERE POSSIBLE

[112] https://www.nationalhistoricships.org.uk/SHTP2
[113] https://www.nationalhistoricships.org.uk/SHTP2
[114] https://www.nationalhistoricships.org.uk/register/1137/lynher
[115] https://www.nationalhistoricships.org.uk/page/shipshape/river-tamar-lynher-barge
[116] https://www.makingwavestogether.org.uk
[117] https://www.nationalhistoricships.org.uk/page/shipshape/river-tamar-lynher-barge
[118] https://www.nationalhistoricships.org.uk/page/shipshape/river-tamar-lynher-barge

'Renewable energy' refers to energy which comes from renewable sources, such as solar, wind, and hydro (rivers and tides) power, as well as geothermal energy and biomass,[119] as opposed to burning fossil fuels, which are finite. By using fossil fuels, we are actively harming the planet by contributing to global warming and other forms of pollution. Using renewable energy means that for every unit of energy you use, that unit is produced and put on the grid by a sustainable source.[120] Some renewable energy companies also engage in carbon offsetting. Renewable energy usually takes the form of sources, such as solar, wind, and hydro power which can be used to generate electricity. Gas is not renewable, as it is a fossil fuel, but many energy companies work to make the gas they supply 'carbon neutral' by offsetting the emissions through carbon reduction projects around the world. [121] There are a variety of regulatory bodies ensuring that renewable energy companies are in fact using the amount of renewable energy they say they are, including Ofgem. [122] Carbon offsetting is also verified by organisations such as the Gold Standard,[123] the Verified Carbon Standard,[124] or the United Nation's Framework Convention on Climate Change's Clean Development Mechanism.[125]

A number of companies supply renewable electricity, some of whom are 100% renewable, such as iSupply, Bristol Energy, Green Energy, Octopus, Tonik, Pureplanet, Outfox the Market, So Energy, Green Star Energy, Good Energy, Ecotricity, and Bulb.[126] Bulb is the UK's biggest green energy supplier.[127] They essentially act as a hub directing renewables to the grid and helping small and micro providers to make the best of their resources and stream the clean energy to people and businesses. Bulb has stated that their average member lowers their carbon impact by 3.4 tonnes of CO_2 a year, the same weight as an average Orca whale and the amount of carbon that would be absorbed by 1,689 trees in a year.[128]

Some of these energy providers are cheaper than traditional energy suppliers, including for business rates. For example, Bulb's business tariff, compared to the cheapest available alternative offered by the biggest business energy suppliers for a single site with a standard 1 rate meter in the East Midlands region, consuming 16,000 kWh per year, paying by direct debit with online billing, starting in August 2019, proved the cheapest product. It was £142 cheaper than the next cheapest, Engie, which is not 100% renewable, and was £1,017

[119] https://www.britannica.com/science/renewable-energy
[120] https://bulb.co.uk/energy/
[121] https://bulb.co.uk
[122] https://www.ofgem.gov.uk/regulating-energy-networks/networks-explained
[123] https://www.goldstandard.org
[124] https://verra.org
[125] https://unfccc.int/process-and-meetings/the-kyoto-protocol/mechanisms-under-the-kyoto-protocol/the-clean-development-mechanism
[126] https://electricityinfo.org/fuel-mix-of-uk-domestic-electricity-suppliers/
[127] https://bulb.co.uk/energy/
[128] https://bulb.co.uk/carbon-tracker/#carbon-impact

cheaper than British Gas, which is also not 100% renewable.[129] Overall, Bulb's prices are 18% cheaper than standard Big Six deals.[130]

In terms of heritage and historic assets, many in the sector are already converting to renewable energy. The National Trust, for example, set up a Renewable Energy Investment programme in 2015.[131] For some places, such as Gibson Mill at Hardcastle Crags,[132] this has involved using renewable energy and making new technology fit listed buildings with their own conservation needs. Elsewhere, the Trust has made a commitment to go from around 0 to 50% renewable energy *generation* in a decade, building its own renewable energy generation systems, such as a hydro turbine weir near Sticklebarn pub in the Lake District.[133] Money saved by the scheme will be invested straight back into its conservation work and special places.[134] Historic England, too, has recognised the importance of using renewable energy, alongside reducing fuel consumption and increasing energy efficiency.[135]

The Lynher Barge CIC has switched to Bulb as its workshop provider. Bulb prioritises providing energy for charities and not-for-profits as part of its ethos and will provide at a lower cost to these organisations. Classic Sailing, which manages adventure sailing holidays on historic vessels advocates renewable ways of generating electricity on board, highlighting *Tecla,* which has a prop shaft generator to recharge her batteries when sailing, thus minimising use of diesel generators.[136] Tall Ship *Glenlee* fitted a green heating system in 2010, taking heat energy out of the River Clyde by using pumps to run a conventional central heating system, as part of a wider plan to become more green in the face of climate change.

Of course, many historic vessels are engineless, relying solely on renewable energy, namely, wind power – for example, the Thames sailing barge *Cambria*, built in 1906 or *Saturn*, a Shropshire Union Canal Fly Boat, which was traditionally pulled by horses[137] and is the last surviving example of this type of vessel. *Saturn* is still able to be pulled by a horse and the Saturn Trust use a horse when possible. However, horse-boating has become difficult in recent years due to the increase in activity along the towpaths, which are used by cyclists, walkers and fishermen, making walking a horse down a narrow busy towpath potentially dangerous. The canal towpaths also have boats tied along them so it is essential for the towline to be lifted across the boat's roof which is tricky and not efficient. It would not be financially viable for the Trust to own a horse, although they do sometimes hire a horse and horse-boat on the quieter canals. Horse-boating *Saturn* is quiet, fast, and efficient, and it

[129] https://bulb.co.uk/business/
[130] https://bulb.co.uk/moving-in/?src=nav
[131] https://www.nationaltrust.org.uk/profiles/profile-mike-hudson
[132] https://www.nationaltrust.org.uk/hardcastle-crags/features/renewable-energy-at-hardcastle-crags
[133] https://www.nationaltrust.org.uk/features/our-response-to-climate-change
[134] https://www.nationaltrust.org.uk/profiles/profile-mike-hudson
[135] https://historicengland.org.uk/advice/planning/infrastructure/renewable-energy/
[136] https://classic-sailing.co.uk/article/classic-sailing-climate-change-draft-strategy
[137] http://www.saturnflyboat.org.uk/about-saturn.html

also demands very different skills to working a motor boat. *Saturn* is frequently towed instead of horse-boated, and in these situations the Trust believes it is important to use another historic narrowboat and work the boats using traditional methods as a motor and butty.

There is some scope for those in the heritage sector to generate their own renewable energy. As well as having the benefit of being carbon-free and reducing your own energy bills, surplus energy can be sold on, generating revenue for the vessel. This will not be suitable for everyone. Renewable energy schemes can only be installed where they do not compromise the special qualities of a space[138] or vessel. However, using the technology in the right way can actually make certain places look more beautiful and create ways for them to be useful in a new part of their history. The return time of investments must also be given careful consideration.

CASE STUDY: DIFFERENT FORMS OF ENERGY GENERATION

The new Windermere Jetty buildings utilise their proximity to Lake Windermere to benefit from a lake source heat pump to deliver heating and hot water. The heat pump draws water from the lake, whose water remains at an almost constant 6ºC, even in winter,[139] and circulates it through three large radiator panels installed below the main jetty within the lake.

Camas Tuath is an inlet bay on the Ross of Mull and is the home to Camas, an outdoor activity centre. The activity centre itself is housed in 200-year-old fishing cottages. Due to the remoteness of the centre, it is completely off-grid, powered by renewable energy, including solar panels and a wind turbine. It also has its own organic garden which supplies salads, fruits and vegetables.[140]

Lynher CIC intends to generate its own hot water at the marine hub by using a simple system of hose pipes snaked on a large tin roof, which heats up quickly when exposed to sunlight. This is an example of solar thermal power, where the heat from the sun heats a cold liquid in a closed pipe loop, which circulates within a hot water storage tank. It does not need to be a sunny day for this to work, but the brightness of the sun does increase the efficiency of the system on any given day.[141] Lynher CIC is also working on creating renewable energy on shore, from solar, wind, and tide energy and is researching how to make this commercially viable.

The ss Great Britain Trust is aiming to reduce the carbon footprint of the *SS Great Britain*, and the Trust's operations at large, by installing solar panels wherever possible.

IMPLEMENT PRACTICAL INWARD AND OUTWARD FACING CHANGES TO YOUR ORGANISATION

[138] https://www.nationaltrust.org.uk/lists/our-guide-to-renewable-energy
[139] https://www.architectsjournal.co.uk/buildings/all-aboard-carmody-groarkes-windermere-jetty-museum/10041181.article
[140] https://iona.org.uk/island-centres/camas-the-outdoor-centre-with-a-difference/
[141] https://www.nationaltrust.org.uk/features/solar-thermal

There are a number of practical ways to make your organisation more sustainable and climate friendly, both from an inward and outward facing viewpoint. Encouraging visitors, crew, staff, volunteers, clients and passengers to travel sustainably to the site or when joining, working at or visiting a historic vessel is important. Measures can be put in place to aid this, such as by providing places to securely lock up a bike or by lobbying local councils for public transport routes, cycle lanes, and safe footpaths to the site. This can form part of your climate change strategy as in the case study below.

In the aftermath of the 2020 pandemic, a hybrid work policy which offers robust support for flexible, home and mobile working will ultimately help to create a more resilient workforce.[142] As the climate crisis progresses and events like heatwaves make travelling difficult or impossible in some instances, as highlighted in *Direct Impacts*, this will become an essential form of survival and will be particularly relevant for administration or office based roles.

Catering and events offer another key way to reduce waste and associated carbon footprints. ss G*reat Britain* is a good example of a vessel owning organisation which has already made many changes in this area.[143] Ideas to try include:

- When hosting weddings, conferences, or banquets, try to reduce the plastic in table decorations – wood, feathers, and leaves make good alternatives, as used by the Ironbridge Gorge Museums Trust.[144]
- Minimise food miles. Food miles refer to the distance that food has had to travel before it is consumed. DEFRA estimates that food transport is responsible for 25% of all miles covered by heavy goods traffic in the UK.[145]
    - Food miles can be decreased by using food which is grown in Britain seasonally. Cafes and restaurants based around historic vessel attractions could begin to introduce seasonal produce, for example, by offering one seasonal food item on their menu per month.
    - Food miles can also be decreased by buying food from local suppliers, although this is not always possible and may prove more expensive. Customers may particularly enjoy the purchase of locally-produced 'craft' items, such as craft beers, rather than big brands produced nationally and internationally.
- Increase recycling.
    - For example, at the Ironbridge Gorge Museum the "catering team are on-board with ensuring as much recycling is achieved as possible and rather than have bins inside the café, visitors are encouraged to leave all their recycling

[142] Fluck & Historic England, 2016, 14.
[143] https://www.ssgreatbritain.org/about-us/sustainability
[144] https://www.ironbridge.org.uk/media/7598/green-info-for-website.pdf
[145] http://www.i-sis.org.uk/FMAS.php

on the tables to enable the catering staff to clear everything away and take care of the recycling."[146]

- Other ways to increase recycling can include providing clearly labelled and segregated recycling bins for customers to use throughout the site.

- Reduce single-use plastic use in order to reduce plastic pollution.
  - Install water fountains and encourage visitors to bring their own bottles to reduce sales of single-use plastic drinks. While this may appear likely to reduce profit in a key area, there are viable alternatives with canned drinks being much more easily recyclable than plastic bottles. This is now widespread in many cultural institutions including the Horniman Museum and Gardens in London[147] and at various University of Oxford colleges, such as Christ Church.
  - Use 'Vegware' products as a plastic replacement, as demonstrated by ss *Great Britain* and the National Trust. Vegware is a plant-based compostable foodservice packaging and the company manufactures more than 300 plant-based catering disposables, all designed to be commercially composted with food waste, including cutlery, tableware, hot and cold drinks cups and takeaway packaging.[148] Remember when switching to sustainable materials not to simply discard the old products, but to ensure that they are used first.
  - According to the UN, plastic bags and foamed plastic products, commonly known by the brand name 'styrofoam', are particularly problematic plastic products, as they can take thousands of years to decompose, contaminating soil and water.[149] These can very easily be removed from catering. The most common single-use plastics found during international coastal clean-ups are, in order of magnitude: cigarette butts, plastic drinking bottles, plastic bottle caps, food wrappers, plastic grocery bags, plastic lids, straws and stirrers, other types of plastic bags, and styrofoam take-away containers.[150] Many of these can be relatively easily removed from catering and commerce connected to historic vessels.
  - Catering venues could offer incentives for customers using their own takeaway containers. For example, many coffee shops offer a 10p discount for customers bringing their own takeaway coffee cup, in partnership with a 10p increase for the use of a disposable coffee cup. This helps the coffee shop to recover costs from the use of disposable cups. Other coffee shops offer a 50p discount to customers who bring their own takeaway cup. Some vendors who offer takeaway food also give discounts to customers who bring

[146] https://www.ironbridge.org.uk/media/7598/green-info-for-website.pdf

[147] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-climate-change-communication-where-to-start

[148] https://www.vegware.com/uk/catalogue/

[149] UNEP, 2018, vi

[150] UNEP, 2018, 10

their own containers. Financial incentives are crucial in changing the habits of consumers.[151]

A really simple climate change mitigation action can be to use an eco-friendly search engine, such as Ecosia, when completing desk-based research or office-based work. Ecosia uses the ad revenue from your searches to plant trees where they are needed the most.[152] By searching with Ecosia, you actively contribute to reforestation without making any large personal changes. This approach can be applied across whole teams and organisations.

CASE STUDY: CLASSIC SAILING

Classic Sailing has developed a climate change strategy, part of which looks at the impact of customers taking flights to join their paid voyages and how best to offset this, including by partnering with a reforestation organisation. The goal is to grow a Classic Sailing Forest and a fundraiser has been set up to support this. They are encouraging their customers to fly less:[153]

- By asking vessel owners to publish their programmes as many years in advance as possible, thereby allowing customers to "plan a big trip less frequently and enjoy the anticipation, while squeezing in more local adventures."
- By continuing to market worldwide; advocating island hopping from the mainland;
- By advocating staying longer in order to make the most of flying, for which they are encouraging vessel owners to offer discounts for sailing more than one leg at a time.
- By advocating using a sailing experience within existing travel plans, in order to use the sailing experience to travel to another destination responsibly.
- By advertising 'lookalike' destinations – for example, rural Norway is similar to New Zealand's Milford Sound, and the Outer Hebrides is a good substitute for the Falklands.
- By introducing 'no fly' voyages that start or finish in the same country or region and that can be travelled to by public transport.
- By advocating being a 'sailing purist' by only using engineless boats and rowing boats.
- By choosing windy places where as much wind-powered sail as possible can be undertaken.

They are also undertaking eco trading under sail, where sail holidays are accompanied by carrying cargo, such as on board *Grayhound*.[154]

USE HISTORIC VESSELS TO COMBAT MARINE DEGRADATION AND CLEAN THE ENVIRONMENT

[151] UNEP, 2018, vii
[152] https://www.ecosia.org
[153] https://classic-sailing.co.uk/article/classic-sailing-climate-change-draft-strategy
[154] https://classic-sailing.co.uk/inspiration/cargoes-under-sail-green-transport-revolution

Marine degradation includes a variety of forms of harm to the marine environment, from overfishing to damage of the seabed. Marine degradation is not always a direct result of climate change but can arise from unsustainable practices, often economically motivated. Historic vessels have the ability to redress this by demonstrating the use of non-invasive techniques. They can be used to collect and dispose of waste in their local environment as a means of addressing the global issue around plastics and litter. As well as making the local environment safer for wildlife, litter cleans can make the area more appealing for boat users and visitors. It is very important to ensure that litter collected is then correctly disposed of, such as by being placed in the correct recycling bins. If not disposed of correctly, the litter can simply once again become polluting.

There is scope for recording the litter and pollution found; for example, Plastic Patrol, which describes itself as "an international movement sitting at the intersection of wellbeing and environment",[155] has built a smartphone app which allows users around the world to record plastic litter they have found in nature. Plastic Patrol mobilises volunteers globally to take part in clean-ups or to independently create their own. [156] The data is then shared with partner scientists at University of Nottingham and University of Glasgow who analyse it and gather a true understanding of the extent of litter recorded in the UK, broken down by brands, types and distribution.[157] This data and its accompanying report have informed recommendations to the Government, which could be reflected in the upcoming Environment Bill, including, for example, a Deposit Return Scheme for certain 'on-the-go' items and a plastic bag charge for all types of plastic bags sold.[158] This kind of data tracking and analysis is crucial for assessing the adequacy of policy interventions and industry sustainability commitments.[159] Plastic Patrol adds that "crowdsourced data on polluting materials will be essential to monitor progress towards a circular economy, allowing citizens to 'police' the system and help develop a set of ambitious targets to eliminate single use materials in nature."[160]

The Great Nurdle Hunt is a citizen science project recording and collecting plastic. Specifically, it aims to record and collect nurdles, which are small plastic pellets about the size of a lentil. They are used in plastic production. Countless billions of nurdles are produced each year and the vast majority of these end up in the oceans, with many washing up on the shores.[161] This website contains detailed information about how to take part in 'Nurdle Hunts' on the beach, including safety guidelines: https://www.nurdlehunt.org.uk/take-part.html. Many historic vessels are already involved in cleaning their local environments and organisations devoted to the waterways or oceans

[155] Plastic Patrol, 2020, 1
[156] Plastic Patrol, 2020, 1
[157] https://plasticpatrol.co.uk/plastic-patrol-2019-report/
[158] Plastic Patrol, 2020, 20-21
[159] https://plasticpatrol.co.uk/plastic-patrol-2019-report/
[160] Plastic Patrol, 2020, 2
[161] https://www.nurdlehunt.org.uk/the-problem.html

are also promoting this. Raising social awareness and education, alongside public pressure, is essential to encourage changes in consumer behaviour[162] and historic vessels are well-placed to contribute to this work.

Another environmental approach is 'Rewilding' – a land management method where the land's natural processes are allowed to take place, encouraging repair to damaged ecosystems and restoring degraded habitats and wildlife populations.[163] Some historic vessels such as Lynher CIC are already supporting rewilding and have adopted this technique as a way to keep the nature around their workshop thriving. Mount Edgcumbe Park, on the opposite side of the road to the Lynher CIC base, has a large colony of Cornish black bees, whose importance cannot be understated, as the British native honeybee is now an endangered species. In rewilding the local environment, Lynher CIC is therefore contributing to the protection of the biodiversity of the local area and consequently the UK as a whole.

CASE STUDY: GAMECOCK

Gamecock is one of the few remaining oyster smacks which were constructed and worked in Whitstable, built to meet the specific requirements of oyster dredging in inshore waters. She is a rare non-modified type and so represents over 110 years of Whitstable history. The intention is to return her to oyster dredging once her conservation is complete. The Whitstable Oyster Company has already agreed to employ *Gamecock* for dredging on their private oyster beds as the power dredgers damage the seabed. At present, the local company has changed to farming the oysters on racks, which has its own difficulties. The use of *Gamecock* in this traditional way could bring huge demand from universities, schools, and tourists, as, in the words of Whitstable Oyster Company, "there is nothing more interesting than seeing the contents of a dredge for the first time".

Gamecock performs well in light winds, as was reflected in her historic victory in the Oyster Smack Race of 1914. The change within the dredging industry from sail to power originated because it enabled one man to undertake the work of a crew of four, as was standard practice on craft such as *Gamecock*. If legislation were passed to protect the seabed from power-dredging by penalising power, dredging by sail would once again become economical. For many years, for example, fishing on the river Fal has been sustainable because power dredging is forbidden as it destroys the seabed.

Gamecock will be able to promote commercial environmentally sustainable dredging by sail in partnership with Whitstable Oyster Company. There is also a potential luxury market for wind-dredged oysters, as there is already for line-caught fish. Returning her to dredging under sail will offer scope for educational purposes, enhanced tourism, provide practical experience of shipwright's artisan skills, and celebrate the town's coastal connections, as well as offering sail and adventure training for local groups. *Gamecock* will once again

[162] UNEP, 2018, 19

[163] https://rewildingeurope.com/what-is-rewilding/

become part of oyster fishing in the traditional manner, which, although requiring more manpower, is much less harmful to the marine environment, helping to preserve it for the future economy and fishing markets.

CASE STUDY: THE *RATHO PRINCESS*

The *Ratho Princess* was originally built as a passenger boat in 1923 and is now part of the National Historic Fleet. She is based in Ratho, Scotland and was used when the first sod was cut in the Union Canal as part of the restoration work to reopen the lowland canals of Scotland under the Millennium Link Project.[164] The Union Canal had long been a dumping ground for rubbish and was little more than a derelict eyesore. Ronnie Rusack, the owner of the Bridge Inn, a pub and restaurant on the banks of the Union Canal in the village of Ratho near Edinburgh airport, took a close interest in the dilapidated 68-mile waterway that once connected Edinburgh to Glasgow. Using a small rowing boat fitted with an outboard motor, he began taking trips on the stretches of canal that were still navigable, finding many beautiful areas. An acquaintance told him that the best way to clear the canal was to simply use it, which stayed with him and impacted his conservation and environmental work. He recognised that the public, too, needed to love the canal again and so organised various events along the stretch, launching a restaurant boat in 1974 so as to use the canal even more. A second restaurant boat was later set up and voluntary organisations began to form around the canal, including the Forth and Clyde, Falkirk Canal Society, Linlithgow Union Canals Society, 1940s group in Broxburn and the Edinburgh Canal Society, meaning that even more canal restoration activities took place. Because of the state of the canal and its various closed bridges and areas, none of the voluntary groups could sail into each other's areas, so they formed an amalgamated group called the Scottish Waterways Association.

Ronnie then invested in another boat, *The Ratho Princess,* built by the famous Graham Bunn in 1923. The idea was to take the *Princess* to each of the blockages to the east and west and show the public why they couldn't go any further, making the people of Scotland realise that this area was actually an underused asset. In 1985 the government set aside funds for the Millennium and the group eventually received £85 million to completely restore the canal and open up all of its sections. *The Ratho Princess* played a great part in this, as she led flotillas of boats at the opening of each section of the canal. For 15 years after the Millennium link opened, *the Princess* pioneered routes from Edinburgh to Stirling, Edinburgh to Leith, Edinburgh to the Clyde and up into the city of Glasgow.

The Scottish Waterways Association has now restored a Scottish Canals workboat to teach boat handling skills to volunteers. *The Princess* constantly goes up and down the canal organising clean ups, cutting back vegetation, and generally maintaining the local environment, which, as well as being vital for the local ecology, has helped many unemployed people get back into a work ethic and has reformed the lives of numerous

[164] https://www.nationalhistoricships.org.uk/register/389/ratho-princess

disabled and disadvantaged people every year. The complete restoration of the Scottish Lowland Canals has, firstly, shown the huge importance of volunteers in cleaning the local environment of all forms of anthropogenic pollution. Secondly, it has illustrated the powerful role that historic vessels can play, enabling people to get closer to their local environments and sparking their interest.

CASE STUDY: BEACH CLEANS AND LITTER PICKS

In 2019 the Lynher Barge CIC and Rame Peninsula Beach Care created the Fair Shores project,[165] when the team started collecting litter from the shores of the River Tamar with underprivileged families on board *Lynher*. They mapped areas of the waterways where litter collects or is fly tipped and used *Lynher* to bring community groups out to clean the river shores. An application to Tevi, a support programme for Cornwall and the Isles of Sicily for business and enhancing the natural environment,[166] was made for a new landing boat constructed from recyclable plastic to access any type of shore, while Rame Peninsula Beach Care contributed a kayak made out of recycled fishing nets. Cornwall Council provided litter-picking equipment and appropriate rubbish disposal via Biffa. As well as simply cleaning the river foreshore, the *Lynher* team recorded its findings and passed them on to Exeter University as a contribution to their research into pollution among the waterways. This project demonstrates the unique way historic vessels can help with the litter pollution problem, as *Lynher* was used to reach areas that others cannot, and, furthermore, provided a conduit to help community groups contribute to keeping their locality clean.

The Thames Sailing Barge *Thalatta* was built in 1906 and rigged as a boomie.[167] During the 2019 sailing season, she also embarked on beach cleans, concentrating on collecting plastic rubbish. The team decided to begin doing this as they realised the extent of the plastic pollution problem from media stories and a lifetime spent at sea. They wanted to show the children and youth groups on their five-day educational trips what an issue this is and so, with permission from parents and group leaders and after purchasing some 'litter pickers', they sailed to beaches not accessible by cars, thus proving that a large percentage of the plastic on beaches was brought by tidal streams. All the plastic collected was brought on board and put in recycling ashore. The children and parents were very enthusiastic about the project, photographing it for inclusion on social media. *Thalatta* plans to continue beach plastic collections during the 2021 sailing season.

The Canal and River Trust has created a number of initiatives aimed at cleaning plastics and litter from UK waterways. The Trust has found that every year an estimated 14 million pieces of plastic end up in and around our canals and rivers, including plastic bottles, food wrappers and bags. The Trust alone cannot clear this, resulting in enough plastic to fill

[165] https://www.nationalhistoricships.org.uk/page/shipshape/river-tamar-lynher-barge

[166] https://tevi.co.uk

[167] https://thamesbarge.org.uk/boats/thalatta/

20,000 bin bags which is washed from our waterways out into the ocean each year.[168] However, if everyone who visited one of the Trust's canals or rivers picked up just one piece of plastic, the water and towpaths would be clear within a year. Consequently, the Trust is encouraging all visitors to take part in litter picks as part of a Plastics Challenge.[169] It is offering safety tips for this, such as always using gloves and litter pickers; educating young children about river safety; and not reaching into or entering the water to pick up litter.[170]

Working with the Norfolk Museum Service and young people's groups, the Lowestoft smack *Excelsior* developed a twelve-month long education programme, 'Oceans of Waste', looking at man's environmental impact on our oceans. Oceans of Waste delivered short educational workshops held at the Time and Tide Museum, involving at local maritime history; a visit to Lowestoft's Maritime Museum; and a beach clean at Lowestoft beach. The beach clean was carried out in conjunction with Cefas (Centre for Environment, Fisheries and Aquaculture Science) https://www.cefas.co.uk/. The programme culminated in a day sail on *Excelsior*, which enabled young people to learn team-building skills, take responsibility under the guidance of crew, and develop new confidence in their abilities in an unfamiliar environment. The project combined educating young people on ocean waste, actively cleaning that waste in an area local to the ship and using a historic vessel to build soft skills in young people via sail training. This project demonstrates the benefits of developing a programme where wider learning complements sailing.

The group's leader feedback indicated that the young people enjoyed the beach clean, found it interesting to hear from Cefas about the pollution around our shores and the effect it can have on marine life, and that the students were surprised at the vast array of items that were found on the beach when they were searching. The young people enjoyed being able to tally it all up to see what they had found and who had found the most, the largest, and the most unusual items. They said that they look differently at the beach now that they have an understanding of the harm that our waste can have on the environment.

Waste Free Oceans collects plastic in the oceans and transforms it into new, innovative products.[171] The organisation offers simple solutions to collecting plastic from the oceans, by using a trawl that can be attached to regular fishing posts. Using this trawl, fishermen can fish for ocean plastic on their idle fishing days, collecting between 2 and 8 tonnes of marine litter on each journey.[172] Only collecting floating litter minimises the extent to which aquatic fauna will be caught or otherwise adversely affected. For example, The Thomsea trawl net extends only 70 cm into the water column (with the rest supported above the water line),

[168] https://canalrivertrust.org.uk/news-and-views/features/plastic-and-litter-in-our-canals?utm_source=facebook&utm_medium=social&utm_campaign=plasticschallenge_2020
[169] https://canalrivertrust.org.uk/news-and-views/features/plastic-and-litter-in-our-canals?utm_source=facebook&utm_medium=social&utm_campaign=plasticschallenge_2020
[170] https://canalrivertrust.org.uk/refresh/media/original/41959-plastics-challenge-safety-tips.pdf
[171] https://www.wastefreeoceans.org/about
[172] https://www.wastefreeoceans.org/collecting

ensuring environmental care.[173] Additionally, in undertaking litter collection on fishing vessels, the consumption of fuel is reduced as those trips would already have been taking place.[174] WFO's Trash Catcher can either be leased or purchased at contact@wastefreeoceans.org.

At the other end of the spectrum, some organisations are advocating for plastic reduction by the consumer. The Marine Conservation Society, for example, has created a Plastic Challenge for July 2020 which encourages consumers to switch out single-use plastics in order to reduce plastic pollution in the ocean. Their website features a counter recording how many tonnes of plastic have been dumped into the ocean so far in a given year.[175]

USE HISTORIC VESSELS TO COLLECT AND CONTRIBUTE TO DATA ON CLIMATE CHANGE

Vessels have always had connections with science; notably, HMS *Beagle* was the brig-sloop in which Charles Darwin sailed around the world from 1831 to 1836 documenting numerous animal and plant species which ultimately led to the development of his theory of evolution by natural selection.[176] Other ships, too, collected climatological data in their logbooks, and often carried people specifically interested in gathering information on natural history alongside their naval crews, as was the case with HMS *Erebus*.

Today, historic vessels of all types, both static and operational, can still contribute to science. This can take many different forms, from taking part in scientific surveys to using the history of the vessel and its logbooks to illuminate climactic changes in its lifetime. 'Science' is a very broad field, including studying climate data, ecology, geomorphology, archaeology, and many more. Once operational again, the oyster smack *Gamecock* hopes to provide opportunities for ecological, archaeological and geomorphological micro-studies in the Swale. The journeys of many historic vessels can be used to gather data on changing weather over time and to predict further changes, most famously, the voyage of HMS *Erebus*, which encountered huge ice sheets in the Arctic circle which no longer exist[177], as well as the logs of various other ships.[178] Ships which hold log books of pertinent local and/or global weather data should make this available to climate change research groups.

In New Zealand too, climate scientists are using logbooks of voyages around New Zealand and into Antarctica from the late-1800s to the mid-1900s for this purpose,[179] as part of the Southern Weather Discovery Project.[180] Logbooks used include those from Robert Falcon Scott's 1910 to 1912 expedition of the South Pole, where measurements of temperature

[173] https://www.wastefreeoceans.org/collecting
[174] https://www.wastefreeoceans.org/collecting
[175] https://www.mcsuk.org/campaigns/plastic-challenge-home
[176] http://hmsbeagle.com
[177] Palin, 2019, Chapter 13
[178] https://graphics.reuters.com/CLIMATE-CHANGE-ICE-SHIPLOGS/0100B4QE2FC/index.html; https://www.theverge.com/2019/5/3/18528638/southern-weather-discovery-ship-logs-climate-change
[179] https://www.theverge.com/2019/5/3/18528638/southern-weather-discovery-ship-logs-climate-change
[180] https://www.zooniverse.org/projects/drewdeepsouth/southern-weather-discovery/about/research

and barometric pressure were taken until they died on their return journey.[181] Although the climate scientists working on these logbooks are from New Zealand, Scott was Royal Navy officer and explorer and this voyage left from Cardiff in June 1910 aboard the former whaling ship *Terra Nova*.[182] The Old Weather project uses volunteers to explore, mark, and transcribe historic ship's logs from the nineteenth and early twentieth centuries, passing this data about past weather and sea-ice conditions to climate scientists.[183]

The work of eXXpedition also demonstrates the impact ships can have in scientific research. eXXpedition is a Community Interest Company and not-for-profit organisation that runs pioneering all-female sailing research expeditions to investigate the causes of and solutions to ocean plastic pollution, with previous expeditions highlighting the endemic nature of microplastics within our global ocean.[184] Although eXXpedition's research projects do not take place on a historic vessel, the same principles of collecting scientific data and evidence could be applied in a heritage setting. This could be as simple as collecting and logging the plastic found on a voyage or trip, alongside the details of the time, place, and duration of that voyage; recording the wildlife seen locally to the ship at different times of year and how this changes over time; or transcribing historic logbooks and the climatological data they record and passing this information onto institutes researching in that area.

Community involvement in climate change data collection can be increased through local projects recording and monitoring the historic environment. For example, the project CITiZAN48, the Coastal and Intertidal Zone Archaeological Network,[185] tackles threats to England's coastal archaeology by promoting a standardised survey and monitoring methodology that a network of volunteers can then undertake.[186] This can broaden interest and access to heritage as well as aiding the heritage organisations themselves.

Similarly, Southern Weather Discovery, based in New Zealand and operated through Zooniverse, uses community members to read and transcribe the weather logs from nineteenth and twentieth century ships sailing across the Southern Ocean.[187] In many instances, the volunteers are called 'citizen scientists' and the process as a whole is known as 'crowdsourcing', the practice of using a group of people or 'crowd' for a common goal, sharing ideas, resources, and services,[188] often online.

USE HISTORIC VESSELS TO IMPROVE OCEAN LITERACY AND EDUCATE THE PUBLIC ABOUT CLIMATE CHANGE

[181] https://www.theverge.com/2019/5/3/18528638/southern-weather-discovery-ship-logs-climate-change
[182] http://www.bbc.co.uk/history/historic_figures/scott_of_antarctic.shtml
[183] https://www.oldweather.org/about.html
[184] https://exxpedition.com/about/about-us/
[185] https://www.citizan.org.uk
[186] https://www.citizan.org.uk/about-us/who-we-are/
[187] https://www.zooniverse.org/projects/drewdeepsouth/southern-weather-discovery/about/research
[188] https://crowdsourcingweek.com/what-is-crowdsourcing/

"We have one ocean. That's all we've got… We have to look after it, otherwise it's curtains. It's as simple as that." – John Hepburn, The Island Trust Ocean Discoverability Programme.[189]

'Ocean literacy' refers to educating people about the sea itself, what lives in it, what people do with it, and how we mutually affect each other. Improving ocean literacy is vital as it allows sailors to pass on their love of the ocean to future generations. Loving the ocean entails having respect for it and wanting to protect it – both from environmental pollution and from the bigger threat of climate change. Hepburn, of the Island Trust, has argued that the government will only undertake major environmental commitments if their electorates insist that they do so, and that consequently sailors have a duty to educate the public about the ocean where possible. If the public understand the ocean and its mutual impact, they will be more inclined to want to protect it.

Improving ocean literacy is in peoples' best interests not just environmentally, but socially and economically, too. The Island Trust has found that engaging in ocean literacy attracts more customers and often more funding. Such schemes and voyages can help encourage young people into the maritime sector,[190] which has already been identified elsewhere in this report as a climate change mitigation. The schemes are used to educate participants about merchant shipping, fishing, and maritime industry, helping to de-demonise the industry. Ocean literacy holds the belief that if we want to get people interested in maritime careers, we must get them engaged with the sea first. It is easy to inspire children, especially when watching sea life: they just have to be given the opportunity. Those children will then carry their experiences of the sea with them for the rest of their lives, knowing that the sea is good because they have felt it and been excited by it.

Participants in ocean literacy voyages can record the wildlife they find; for example, the Ocean Discoverability programme uses iNaturalist,[191] an international citizen science programme, as Ocean Discoverability participants do. UK recordings that are logged on iNaturalist can now be captured by the UK Biodiversity Network. Additionally, iNaturalist has the scope to set up a collection project, which can record everything from one voyage in one place. This can be beneficial as it can bring an extra element to voyages, such as friendly competition about which individual saw the most, although it does have implications in sail training about people having their phones on deck. An alternative is for one person to record everything through the ship's single account and there are plenty of solar based phone charging stations available commercially. Recording will not only help educate the people taking part in ocean literacy programmes but will also increase the amount of data available from the historic vessel sector about the ways our local environments are

[189] Hepburn, Sea Tales Podcast, 'Seeing the sea differently with John Hepburn from the Island Trust,' 2019.

[190] https://www.theislandtrust.org.uk/wp-content/uploads/2020/01/Ocean-Literacy-for-Sail-Trainers-Course-Evaluation.pdf

[191] https://www.inaturalist.org

changing. This will show us the changes that are taking place in the areas where we work and sail.

Addressing the challenges presented by climate change will require collaboration, including sharing knowledge and expertise, as is already achieved through the work of National Historic Ships UK and the Shipshape Network. It will be important to learn from others, both nationally and internally, and share data and mitigation and adaptation techniques.[192] The Island Trust has established a network of people interested in taking part in ocean literacy and becoming On Board Ocean Educators (OBOEs). They have set up a Facebook group for people who want to be part of this: https://www.facebook.com/groups/883900518674129. Part of becoming involved in ocean literacy and marine education is learning from others, and so groups like this will be crucial, with opportunities to meet up with other educators being advertised. A file sharing group, hosted on Wakelet, has also been established to share a selection of websites for citizen science, ocean literacy, and sail training projects.[193]

The European Marine Science Educators Association (EMSEA) is a network of marine science educators which aims to act as one voice across Europe and beyond in order to promote and deliver ocean literacy. They work with scientists, teachers, policy makers, and the public. They support their members by sharing good practice and training opportunities, as well as by working on grant-funded projects which their members can benefit from. They organise events and host digital platforms, allowing for networking and collaboration.[194] In a similar vein, the Marine Conservation Society hosts Sea Champions,[195] a nationwide volunteer programme. The volunteers support marine conservation in a variety of ways, such as by organising beach cleans, giving local talks, or by promoting sustainable seafood choices in their local communities. Becoming a Sea Champion gives access to resources, such as action packs and beach cleaning resources,[196] and an introduction to a network of like-minded people, including an online community.[197]

Ocean Youth Trust (OYT) UK offers sail training and adventure under sail. This is a youth work charity which uses its vessels to introduce disadvantaged young people to sailing and the marine environment, developing skills to help them succeed in life. It operates in four areas of the UK through four registered charities: OYT Scotland, OYT North, OTY South, and OYT Ireland.[198] OYT South's flagship, *Prolific,* was built in 2005 and modelled on the historic design of the herring-fishing vessels in operation along the Norwegian coast during the 19th century.[199] OYT's significant contribution is that it uses sailing to show young people that

[192] Fluck & Historic England, 2016, 44
[193] See: https://wakelet.com/i/invite?code=99faed8
[194] http://www.emsea.eu/info.php?pnum=2
[195] https://www.mcsuk.org/seachampions/
[196] https://www.mcsuk.org/seachampions/seachampion-resources
[197] https://www.mcsuk.org/seachampions/seachampion-social-media
[198] https://oyt.org.uk
[199] http://www.oytsouth.org/prolific.asp

they can succeed in life, and in doing so uses minimal emissions and also encourages young people to respect and care for their environment, and to see sailing as a viable alternative to travelling and working with fossil fuels.

Sail Boat Project is another initiative which widens access to the sea through sail training and transport developing individuals' and communities' skills for positive social and environmental change. It is a Community Interest Company providing a range of activities based around sailing, building relationships with individuals and organisations who are, or who work with marginalised people, helping them to get the most out of activities and opportunities by building confidence, developing employability skills, improving decision-making ability, and working towards nationally-recognised qualifications.[200] It advocates the use of sail cargo, connecting coastal communities, reducing CO2 emissions, future-proofing work skills, and raising awareness.[201]

The Blue Flag scheme was first introduced by the Foundation for Environmental Education (FEE) to promote clean beaches and marinas. Sail Training International now offers a version of the Blue Flag scheme to training vessels, whereby vessels can apply to be recognised as having green policies provided they abide by the code of conduct. Vessel owners must be members of their National Sail Training Organisations, the Sail Training International Ships Council, or participate in events run by Sail Training International. Blue Flag accredited vessels must comply with the following agreement:[202]

- Not throw garbage into the sea or along the coast. (Vessels undertaking a long passage and needing to dispose of some bio waste appropriately will need to attach their waste management plan for approval by FEE).
- Not discharge black water (sewage) holding tanks in coastal waters, sensitive sea areas or harbours. Vessels arrange to discharge any black water tanks in the reception facilities provided by the port authority or marina. (Only applicable for vessels with holding tanks).
- Not release toilet water in the sea in near coastal waters and sensitive areas. (Only applicable for vessels without holding tanks).
- Not release poisonous or toxic waste (oil, paint, used batteries, cleaning agents, etc) in the sea. Vessels commit to deliver these types of waste to the containers at the appropriate reception facilities provided by the port authority or marina.
- Undertake and promote recycling and the use of recycling facilities.
  Use the most environmentally friendly products among paints, anti-foulings, paint remover, detergents, etc, that are available and work efficiently.
  Report pollution or other violations of environmental regulations to the appropriate authorities.

[200] https://sailboatproject.org/about-sail-boat-project/

[201] https://sailboatproject.org

[202] https://sailtraininginternational.org/app/uploads/2018/01/Blue-Flag-Scheme-application-form.pdf

- Not engage in forbidden fishing practices.
- Respect time periods when fishing is prohibited.
- Protect animals and plants in the sea, including not disturbing breeding birds, seals or other marine animals.
- Respect vulnerable and protected areas.
- Avoid damage of the sea bottom; for example, in the way that vessels anchor.
- Avoid disturbing fishing activities or fishing gear.
- Not buy or use objects made from protected species or from archaeological underwater findings.
- Encourage other sailors to take care of the environment.

The full code of conduct and details of how to join can be found here: https://sailtraininginternational.org/app/uploads/2018/01/Blue-Flag-Scheme-application-form.pdf. Joining entails an active commitment to reducing the detrimental environmental impact of sail training vessels.

The Green Blue is a joint environmental awareness programme created by the Royal Yachting Association and British Marine, established in 2005. It gives practical advice on how to increase sustainability while maintaining freedom of access and rights of navigation for recreational boaters. It offers boat owners the opportunity to become involved with its projects and campaigns through shared resources on social media, websites, newsletters and emails, the display of which will help raise awareness of various issues, including 'Green Guides to Boating'.[203] Projects and initiatives raise awareness of the impacts of boating on wildlife, stopping the spread of invasive species, reducing water pollution, and advocating for antifouling best practice. [204] By increasing knowledge, there are clear positive impacts; for example, the guidance on water pollution protection actively reduces pollution by promoting best practice.

The UK's most famous historic vessels and maritime assets are ideally suited to build public awareness and support through sharing of information and effective communication on the subject, given their high-profile nature. Less well-known ships, too, can be used to improve public awareness about the risks posed to the environments we operate in and the changes that have occurred in those places in the past few decades. If the public become more aware of the true dangers and risks of climate change, as well as of the urgency of the climate emergency, this should help contribute to changing government policy and galvanise support for climate change mitigation and adaptation initiatives.

Exhibitions and events can also provide a useful mechanism for highlighting to the public the importance of climate change and the impacts it will bring. The National Maritime Museum Greenwich's Polar Worlds exhibition, which opened in 2018, encourages visitors to consider

[203] https://thegreenblue.org.uk/resources/club-centres-association-resources/awareness-raising-toolkit/
[204] https://thegreenblue.org.uk/get-involved/campaigns/

the impacts of climate change in the globe's polar regions through the histories of ships such as the *Terra Nova,* HMS *Endurance*, the *Aurora* and RRS *Discovery*.[205,206] In 2020, *Polly Higgins*, one of the boats used in the Extinction Rebellion demonstrations, was put on display outside the museum, as a way of telling the story of the ocean and indicating that "we're fundamentally altering how the planet distributes heat."[207] The Natural History Museum has a section of its website dedicated to blog posts and articles explaining climate change and the effects on areas relating directly to its collections.[208] Throughout this area of the website, there are references to historic vessels instrumental in collecting environmental data which is now being used to inform approaches to climate change, such as HMS *Challenger*.[209]

The Museums Association has published guidance on communicating environmental impact and policies to audiences, as well as on using collections to raise awareness of the climate crisis.[210] These highlight the way in which public concern about the climate and ecological emergency has risen hugely in the past few years, meaning that museums can now help people to think about how the future might look and encourage them to build a more sustainable world.[211] Visitors want to know that museums are acting responsibly and sustainably. Some of the changes museums can make to let their audiences know about sustainability could be simple, such as giving information on energy use and waste recycling next to light switches and bins.[212] Not all of these changes cost huge amounts: approaches could involve integrating the communication of environmental policies and values into displays which already exist.[213] For example, educating visitors about the history of a vessel and how it previously navigated in climates and landscapes which are now rapidly changing, or have already changed. Increasing digital and social media output is also a quick and affordable way to start reaching young people and engage them in issues related to the climate crisis.[214]

Historic vessels and their sites are often used to host events, some of which could raise awareness of climate change as well as heighten the profile of the ship itself. There is the potential for vessels to associate themselves with climate events held near them and to benefit from the publicity to reach new audiences. Tall Ship *Glenlee*, is moored in close

[205] http://geographical.co.uk/reviews/exhibitions/item/2930-new-galleries-at-national-maritime-museum
[206] https://www.rmg.co.uk/see-do/we-recommend/attractions/polar-worlds
[207] https://www.standard.co.uk/go/london/arts/royal-museums-greenwich-paddy-rodgers-interview-a4483001.html?
[208] https://www.nhm.ac.uk/discover/climate-change.html
[209] https://www.nhm.ac.uk/discover/news/2020/january/how-150-year-old-samples-are-teaching-us-about-climate-change.html
[210] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis
[211] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-communicating-environmental-impact-and-policies-to-audiences
[212] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-communicating-environmental-impact-and-policies-to-audiences
[213] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-museum-learning-and-climate-crisis
[214] https://www.museumsassociation.org/museum-practice/communicating-the-climate-crisis/15102019-museum-learning-and-climate-crisis

proximity to the Glasgow site which will host COP 26 - the 26th UN Climate Change Conference of the Parties – in Autumn 2021. As a ship built to carry bulk cargo under sail, she has a vital story to tell. COP 26 is intended to be the biggest international summit the UK has ever hosted, bringing together over 30,000 delegates including heads of state, climate experts and campaigners to agree coordinated action to tackle climate change. [215]

Case Study: The Island Trust's Ocean Discoverability Programme

Originally, the Ocean Discoverability project took children with life-limiting disabilities from Devon and Cornwall day sailing, with ocean literacy forming a key element of the educational component of the day. They learnt about sailing alongside touching, feeling, and examining marine life in the water and on the seabed. Those who wished to do so could help hoist the sails before entering Plymouth Sound and were given the chance to steer. In Plymouth Sound they gained an appreciation of the geography, marine life and other ships and boats. On the return journey they helped collect samples of plankton for microscopic examination.[216] The project is now continuing the work done on *Cornubia*[217] under the Bristol Channel Pilot Cutter Trust from 2010 to 2016. [218]

Young people have always enjoyed the experience, with testimonials reading things like "lots of really cool things about being out at sea," "on the water he forgets all his worries," and "I feel like I've come home."[219] The scheme has now expanded, offering trips for home-educated children[220] and running an Ocean Literacy for Sail Trainers course in 2019.[221] The sail training and ocean literacy takes place onboard *Pegasus* and *Johanna Lucretia*.[222] *Pegasus* is the youngest vessel at The Island Trust: she is a modern boat based on the designs of the famous Bristol Channel Pilot Cutters, designed by Ed Burnett and built by The Bristol Classic Boat Co. in 2008. *Pegasus* is successful as a medium for youth work and for groups requiring slightly more private accommodation: she has the simplest rig of The Island Trust vessels and as such is easier for younger crew members to handle safely under sail and motor.[223] *Johanna Lucretia* is The Island Trust's largest vessel. She is currently the only UK flagged topsail schooner in sail training. She is traditionally rigged and was built in 1945 at the Rhoose shipyard in Ghent, Belgium as a fishing vessel. She was never used for this purpose and lay as a completed hull and deck for several years before being sold in 1952, when she was converted for recreational use. She is well-suited to sail training due to her rig and because of her spacious decks and accommodation, with a variety of cabin sizes.[224]

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[215] https://www.ukcop26.org

[216] https://www.theislandtrust.org.uk/the-island-trust/ocean-discoverability/

[217] https://www.nationalhistoricships.org.uk/register/467/cornubia

[218] https://www.theislandtrust.org.uk/the-island-trust/ocean-discoverability/

[219] https://www.theislandtrust.org.uk/testimonials/

[220] https://www.theislandtrust.org.uk/ocean-literacy-voyage/

[221] https://www.theislandtrust.org.uk/wp-content/uploads/2020/01/Ocean-Literacy-for-Sail-Trainers-Course-Evaluation.pdf

[222] https://www.theislandtrust.org.uk/ocean-discoverability-2019-end-of-season-report/

[223] https://www.theislandtrust.org.uk/boats/pegasus/

[224] https://www.theislandtrust.org.uk/boats/johanna-lucretia/

Case Study: Other ocean literacy programmes

The Island Trust's Ocean Discoverability programme is not the only way of delivering ocean literacy. Hepburn, the Director of the programme, has suggested that sail trainers could become On Board Ocean Educators (OBOEs) or that specialist OBOES can be brought on board. Ocean literacy does not only have to target young people: it can benefit adults, too. Merseyside Adventure Sail Trust (MAST), based in Liverpool, and the Brixham trawler *Vigilance* are both independently looking at offering ocean literacy voyages.

Brixham Fish Market hosts a guided tour for members of the public, sometimes taking people out on a sailing trip afterwards. Ocean literacy has been incorporated into this tour by encouraging people to consider the 'life beneath their feet' and by undertaking plankton trawling while out at sea, later inspecting the plankton under microscopes. This is an activity provided for both adults and children.

Widening Horizons, developed by the Millfields Trust and delivered by Millfields Inspired,[225] is a project aimed at engaging primary school children in the Stonehouse area of Plymouth with the world of work. The area is particularly deprived and unemployment is high, so often they have no family in work to give them an idea of what a career is like. Widening Horizons takes them to visit various places of work, such as a solicitor's office, and places of education, like the local college construction school and the school of dentistry. John Hepburn of The Island Trust helped to establish a maritime module which includes a visit to the local yacht marina. Split into three groups they rotate around the marina manager talking about all the jobs needed to keep yachts yachting. This includes Coast Clean whose owner not only removes rubbish from local marinas, but makes works of art from the driftwood and Sonardyne which offers precision positioning, taking people out in their training boat to look for sunken treasure using the sonar. Hepburn also provided a 'Life Beneath the Keel' session, which was designed to emulate being a marine biologist for half an hour and this proved popular.

Sailing Tectona[226] is another sail training organisation undertaking ocean literacy youth voyages with historic vessels, including *Tectona*, built in 1928,[227] and *Olga*, a Bristol Channel Pilot Cutter built in 1909.[228]

CASE STUDY: *TREBALISA*, WILDSIDE ACTIVITY CENTRE

Wildside Activity Centre, situated alongside the canal in Smestow Valley Local Nature Reserve, Wolverhampton, aims to reconnect people with nature and provide enjoyment of

[225] https://millfieldsinspired.com/widening-horizons/
[226] https://www.sailingtectona.co.uk
[227] https://www.sailingtectona.co.uk/the-boat
[228] https://www.sailingtectona.co.uk/olga

the outdoors through adventurous and environmental activities.[229] The centre actively promotes sustainability issues and has created its own Environmental policy.[230]

As part of the aim to reconnect people with nature, the centre has a narrowboat, the *Trebalisa*, purpose-built in 1993 with Urban Programme funding. The narrowboat was designed to be a 'floating classroom', equipped with wheelchair access.[231] She operates on the Staffordshire and Worcestershire Canal, between Autherley Junction and Stourton, and Autherley Junction and Great Haywood Junction; on the Shropshire Union Canal between Autherley Junction and Norbury Junction; and on the Birmingham Main Canal to Tipton.[232] The boat is used to enable people of all ages and abilities to have access to the canal networks and learn about the wildlife and operational life there, from seeing kingfishers, herons, swans, and water voles, to operating the locks.[233] The youngest visitors are babies and the oldest are over 90 years old.[234] Although the *Trebalisa* is not a historic vessel and was purpose-built, she is a good example of the ways in which narrowboats, including historic narrowboats, can be used to educate victors about both their local environment and the boats themselves. Narrowboats which are already open to visitors for trips could adopt a similar principle of educating visitors about the environment they are in and explaining how important that environment's survival is for the future of the boat itself.

Declare a Climate Emergency

Some maritime heritage organisations or historic vessel custodians may find it impactful to declare a climate emergency. This recognises the United Nations' assertion in 2018 that there was only until 2030 left to limit a climate change catastrophe,[235] and that action must be taken now. The ss Great Britain Trust, for example, declared a climate emergency in October 2019, which highlighted that it "recognises environmental breakdown, based on scientific evidence, and believes that heritage and cultural organisations must both make a difference directly as well as inspire and advocate for change" and that, as a leading maritime museum which undertakes major conservation, it is well-placed to pledge to pioneer energy efficiencies and share new best practice globally.[236] For some vessel organisations, declaring a climate emergency can be a step in holding themselves and their climate impacts accountable, and may then encourage other historic vessels, modern craft and museums to recognise their own climate impacts, too. Declaring a climate emergency is about creating wider awareness of the climate issue and beginning to pave the way for system change.

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[229] https://www.wildsideac.co.uk/aims-and-objectives-2/
[230] https://www.wildsideac.co.uk/conservation-volunteer-group/
[231] https://www.wildsideac.co.uk/narrowboatb-2/
[232] https://www.wildsideac.co.uk/narrowboatb-2/
[233] https://www.wildsideac.co.uk/narrowboatb-2/
[234] https://www.wildsideac.co.uk/narrowboatb-2/
[235] https://www.bbc.co.uk/news/science-environment-45775309
[236] https://www.ssgreatbritain.org/about-us/sustainability

CONCLUSIONS

The findings of this report indicate that we must make changes now. Our love for historic vessels and the oceans and waterways they sail upon should focus the sector to take the decisive and appropriate action necessary to begin adapting to and mitigating climate change. In addition to identifying the likely areas of impact, this report has set out a wide range of recommendations aimed at different stakeholders from museum ships to operational vessels, private owners to commercial operators, or small trusts and charities. Case studies and examples have shown the steps already being taken by some to address the issues and give ideas of practical as well as academic or theoretical steps which can be taken. Many funders now require sustainable approaches to be built into any application and there are also dedicated grant programmes available for projects which focus on environmental outcomes.

While this report highlights a wide range of ways in which individual vessels can play a part in mitigating climate change, it also demonstrates that some of the issues are far too large and complex to be tackled by single organisations alone, even if a combined approach is taken. The necessary infrastructure for managing climate change needs to be introduced at government level and leading sector bodies, such as National Historic Ships UK, have a role to play in giving evidence to this effect and in related advocacy work. National Historic Ships UK sits on the Mobile Heritage Advocacy Group run by the Heritage Alliance and has regular meetings with the Department of Digital, Culture, Media and Sport as its sponsoring body. It will use its Shipshape Network, which connects organisations and individuals across the historic vessel sector, to facilitate the sharing of data and ideas and develop best practice as we learn how best to adapt and mitigate in the face of climate change.

Going forwards, National Historic Ships UK will maintain a watching brief on behalf of the sector, as climate change modelling can change quite dramatically in a short period of time, evidenced by the projections between the 2001 assessment report (TAR Climate Change 2001) and AR5, where the 2001 projections, stemming from data from 1990, were found to have been under-modelled, specifically in relation to sea level, which had, in only 16 years, risen faster than projected, and to global mean surface temperature, which was in the upper part of the range projected by the Intergovernmental Panel on Climate Change.[237] What we know about climate change is constantly changing as time progresses, increasing data and allowing more effects to become apparent, and as scientific modelling improves. Any new information we observe will be used to assess the likely impact upon historic vessels and their associated infrastructure and disseminated across our wide range of stakeholders.

Safeguarding against the adverse threats brought by climate change, through adapting, mitigating, and conserving, is a huge undertaking but also a real opportunity. Tackling these

[237] Street, 2008, 5.

threats will bring costs and other challenges – but equally, not adapting to and mitigating these issues will have serious implications from which the sector may struggle to recover, both financially and in terms of the permanent loss of maritime heritage. It is therefore necessary to think long-term and to try to see any changes made in a positive light. We recognise that changes are often not easy to implement, but, cumulatively, even small steps can make a huge difference. Historic vessels will not be battling climate change alone – we are all in this together and will benefit from the collective knowledge of the wider UK heritage sector and related industries in the years ahead.