31 MAI 2021

BDI-2021-ICE - CAST SEAWEEDS POTENTIAL VALORISATION ON ISLE OF WIGHT (UK)

SITUATION

JEAN-BAPTISTE WALLAERT
JBW CONSULTING
29200 BREST

TABLE OF CONTENTS

This report refers to project BDI-2021-ICE-IOW communicated on March 9th 2021 and attributed on march 30th 2021 to JBW Consulting.

Objective: Identify evaluate to potential of valorisation of seaweeds actually causing nuisances in several points of Isle of Wight.

Foreword to British fellows.
Let's historic figure guide our study and remember that Japanese celebrate every April 14th, the "mother of ocean", the British phycologist Kathleen Mary Drew-Baker (1901-1957). She discovered the reproduction cycle of Porphyra and allowed 10 billion nori sheets to be produced every year.
May your ancestor support your valorisation study.
The British Museum keeps an inventory of 600,000 species including some handwritten from her. The oldest is from XVIIth century.

I. PROBLEMATIC: CAST SEAWEEDS NUISANCES

Smell nuisance and cost of removal impact stakeholders on the island.
At local political level, it was decided to investigate wider possibilities to get a better use of this biomass enabling regular cleaning of the touristic places, reducing treatment cost for the community and improving the island autonomy to supply its own resource.

A. Methodology

The contractor offered to coordinate a project to assess the situation, contract experts in their transformation fields and explore together feasibility in order to propose by December 2021 ways to valorise collected seaweeds.
Prior to this assessment, this report is based on cooperation will between partners.

1. Long term nuisance

According to local newspapers, residents this issue appeared around 2005, one year after the breakwaters in Ventnor harbour. The source of the problem probably amplified (climatic phenomenon) as the consequences became also worst (tourism pressure, discomfort becoming public health). Some solutions have been initiated but encountering soon or later some barriers, could be regulatory or cost. Societal acceptance also creates a pressure not to accept any more public money spending without results and creates a demand in local circular economy.

2. Will to change

The long-term nuisance contributed to create a fertile environment to foresee alternate valorisation. Availability of EU funding was also an opportunity to launch the study prior to end of the 2021 year.
Findings to change are

- Fighting against nature is a lost fight – better to accept this biomass and make good use of it
- Spending operational costs seems an infinite expense – tackle the root is the solution
- Seaweeds are getting valorised worldwide – techniques, practices improve and can be copied

3. Team set up

Fields of investigation and contacts identified

Field	Who	What
Science & Technology	Gordon Watson (Portsmouth University)	○ Sampling ○ Lab analysis ○ characterization
Industry Cosmetic	Lizearle	○ Local sourcing evaluation ○ Potential of use
Agriculture	National Farmer Union	○ Tradition in fertilization ○ Local space availabilities
Fishery	Jeff Fisherman	○ Opinion on situation ○ Ability / interest to harvest seaweeds
Energy	Scania Anaerobic digestor	○ Best practice on Nottingham bus ○ Existing infrastructure ability
Regulatory & Administration	IoW Council: Jim Fawcett Ventnor council: Colm Harbour master: (?) Sandown Council Shanklin Council Ryde Council	
Services	Cheetah Marine Services (Sean) Inspiration Fabrication (Edward O'Kane)	○ Actual technique to remove seaweeds ○ 1st designer of a ventury pump in the 2010s

B. Situation in spring 2021

Prior to bringing external view, a good understanding of the situation based on facts is necessary. Best experts are local and a survey is organized to identify widely fields and contacts for this.

1. Sites of concern

	ownership	Total material qty (estimate)	Part of seaweed (estimate)
East Cowes			
Ryde	IoW Council	4,200 m^3	4,200 m^3
Sandown	IoW Council	1 m^3	1 m^3
Shanklin	IoW Council	1 m^3	1 m^3
Ventnor	IoW Council	50,000 m^3	20,000 m^3

a) *Ventnor harbour*

- Cascade gardens is a river that feeds Ventnor harbour in fresh water all year long.

The flow could be a part of a solution to prevent mud accumulation

- Harbour is 15 years old and became 3m shallower in the last 3 years due to sand + seaweed accumulation. It is oriented south with a containment wall, creating a hook with East entrance.

Figure 1: Ventnor -Gardens river

Figure 2: Ventnor Harbour

Observation from sky indicates seaweed field in dark blue

(1) History

2004: breakwaters construction
2011: seaweed removal operations start
2015-2017= hydrology study

(2) The sand bar

In 2004, the Haven was maintaining its original design depth. Thus, any Seaweed washed in would also ebb back out on the falling tide. Throughout 2005 a sandbar started to develop across the entrance, coupled with unseasonably summer gales, vast amounts of Seaweed were washed into the Haven & became trapped by the Sandbar. Hence this was the start of the ongoing & ridiculously expensive problem

(3) Seaweed entrance

Evaluation of seaweed arrival:

from May to January	BIG
from February to April	SMALL

Seaweeds are torn from rocky substrate with tide, storms, natural life cycle of these vegetal.

Seaweeds are drifted West to East carried by current and wind.

They rip the south containment wall and fill in twice a day with the tide.

Quickly with low tide, the gale sinks, mixes with sand and starts to rot once uncovered.

As tide also brings sediments, access is not accessible and limits mechanical action of collection.

Without regular removal, stock piles and creates a digestor showing bubbles of gas released. Gas includes sulphur (H2S), carbon dioxide (CO2) and probably methane (CH4).

The seaweed coming in to the Ventnor Haven generally mixes with the sand and decomposes, heavy gales will bring in large amounts which is less mixed up with the sand.
Smell affects tourism and more as rotten seaweeds stink.

Hydrology report produced in 2017 explains how this natural event is amplified by storms, wall refraction & diffraction, shallow waters & reduced speed near the shore.

(4) Seaweed removal

A dredger pumps about 100 cubic meter per hour and about 500 hours a year, this is about 50 000 cubic meters of sand, seaweed and water per year (source Cheetah Marine).
Cost to remove seaweeds and ensure access to mooring exceeds £70,000 per annum now with no long-term improvement. Since 2010, more than £500,000 have been paid by local council to clean the harbour. Despite investment cost for engineering the pumping, the operational spending appears as a bottomless well that will bring nothing positive in the long run.

Smell nuisance and cost of removal are 2 issues that impacts separate stakeholders on the islands but find roots in the same origin: massive biomass + sediment entrance in the recent harbour.

b) *Shanklin*

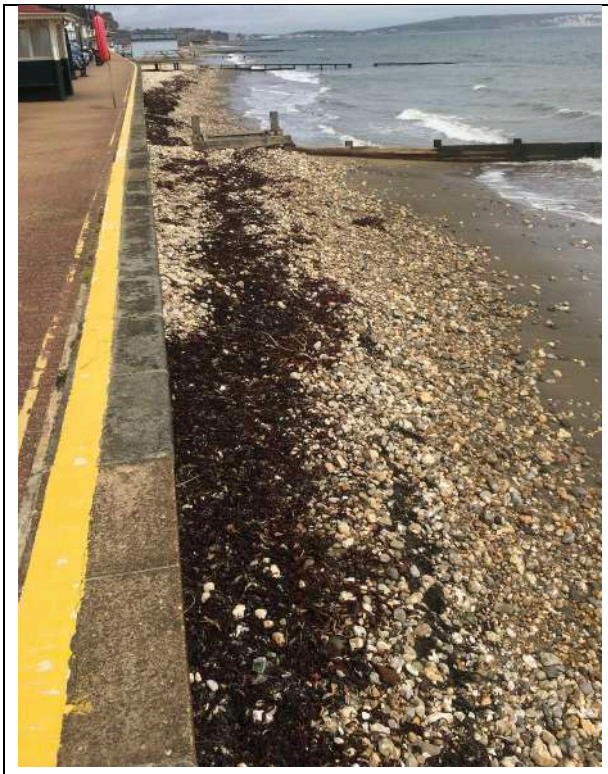


Figure 3 : Shanklin beach (high tide)

Figure 4 : Shanklin beach (low tide)

c) *Sandown*

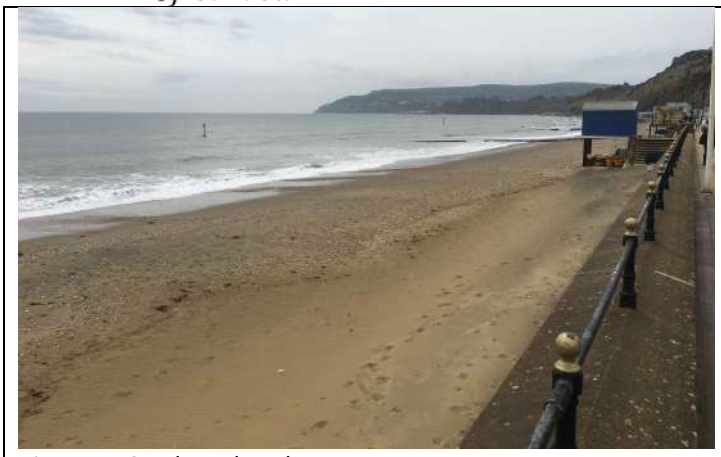


Figure 5 : Sandown beach

Figure 6 :Sandown pier

Quantity of biomass is neglectable at the time of this picture.

d) *Ryde*

Figure 7 : Ryde

Figure 8 : Ryde

Quantity of biomass is estimated a 1600 m long x 30 m wide x 10 cm thick= 4,800m^3
Period of accumulation estimated at 1 month

⇨ 57,600m^3 per annum to collect on Ryde beach.

Ryde operates a clearance at that stage.

e) *East Cowes*

Despite a said difficult access, this location provides the widest variety of species.
At this stage of the study, too few information are available to me for evaluation. Only neighbourhood statements confirm same nuisance of smell during hot season.

f) *Totland*

Figure 9: Totland Pier underwater

Figure 10: Totland Pier map (West)

2. Seaweeds

Identification is made from videos kindly shared by Andrew Hunt (Vectis Sustainable Engineering Ltd). Despite the good quality of the video, the pristine water quality, it is perceivable that cyanobacteria or anaerobic bacteria or spores also populate the environment creating a blur vision.

Completion is done by research on NBN Atlas (https://records.nbnatlas.org/) and taxonomy is detailed on http://www.eu-nomen.eu/
Information for each specie: https://www.marlin.ac.uk/species/

a) *Halidrys siliquosa*

ORDER: Chromista (Kingdom) Harosa (Subkingdom) Heterokonta (Infrakingdom) Ochrophyta (Phylum) Phaeista (Subphylum) Limnista (Infraphylum) Fucistia (Superclass) Phaeophyceae (Class) Fucophycidae

(Subclass) **Fucales** (Order) Sargassaceae (Family) Halidrys (Genus) Halidrys siliquosa (Species) - Common name: sea oak, pod weed
This specie is not mentioned in the atlas but is clearly present in the Isle of Wight area.

USE: used for alginate (a little) and soil fertilizing

GROWTH: 2cm/month
Moss & Lacey (1963) studied Northumberland populations of Halidrys siliquosa and reported:

- rapid growth and elongation of the axis between spring and the end of July;
- proliferation of new 'leafy' branches in spring, reaching a maximum in June -July;
- production of air bladders from Sept -November and again in Feb to peak in April that was highly variable, and
- development of receptacles starting in July, becoming fertile in November and releasing gametes from December to March, after which the receptacles disintegrate.

It appears, therefore, that growth and development follow a seasonal cycle of allocation of energy towards growth in spring, followed by allocation to reproduction later in the year.[i]
Source : https://www.marlin.ac.uk/species/detail/1450

ENVIRONMENT: Intertidal to 4 m. A distinctive and common rock pool seaweed from the middle to lower shore (may be found in upper littoral but only in rock pools). It may also form a zone in the sublittoral below the lower limit of Laminaria digitata.

b) *Grateloupia turuturu*

ORDER: Domain: Eukaryota > Kingdom: Plantae > Phylum: Rhodophyta > Class: Florideophyceae > Subclass: Rhodymeniophycidae > Order: **Halymeniales** > Family: Halymeniaceae > Genus: Grateloupia > Species: Grateloupia turuturu

USE : used for alginate (a little) and soil fertilizing

GROWTH: Grateloupia turuturu grows well in nutrient enriched waters, in 22 to 37 ppt salinity, and can survive 12-52 ppt and 4-29°C (Simon et al., 1999; 2001)[ii].

ENVIRONMENT: Deep-sea bed (A6 level 2) and Infralittoral rock and other hard substrata (A3 level 2). Entered the Global Register of Introduced and Invasive Species - Great Britain in October 2018 as this specie is native from North East Pacific Ocean (Asia Far East) and Northern Indian Ocean.[iii]

Figure 11: Halydris siliquosa (a) & Grateloupia turuturu (b)

c) *Dictyota dichotoma*

ORDER: Chromista (Kingdom) Harosa (Subkingdom) Heterokonta (Infrakingdom) Ochrophyta (Phylum) Phaeista (Subphylum) Limnista (Infraphylum) Fucistia (Superclass) Phaeophyceae (Class) Dictyotophycidae (Subclass) **Dictyotales** (Order) Dictyotaceae (Family) Dictyoteae (Tribe) Dictyota (Genus) Dictyota dichotoma (Species)

USE: No use known

GROWTH: Yearly seaweed developing in summer, very rare in winter

ENVIRONMENT: on rocks well enlightened, calm zone, infralittoral up to 30m deep.

Figure 12: Dictyota dichotoma (c), Callophyllis laciniata (f), Halydris siliquosa (a)

d) *Asparagopsis armata*

ORDER: kingdom (Plantae), phylum(Rhodophyta), class(Florideophyceae), order (**Bonnemaisoniales**), family (Bonnemaisoniaceae), genus(Asparagopsis), species (Asparagopsis armata) – Common name Harpoon weed

USE: Asparagopsis armata is used in the cosmetic industry for its antibacterial and fungicidal qualities, it is found in several aqueous solutions for the treatment of skin such as acne. Some studies go on its possible usage as enteric methane reduction for cows.

GROWTH: Asparagopsis armata is an annual specie, visible in the Mediterranean from winter to late spring while its development is summer on the coasts of the north-eastern Atlantic of Europe.

ENVIRONMENT: The sexual (gametophyte) plant is found in the shallow sublittoral or in deep littoral pools attached to other algae by its barbed axes. The asexual (tetrasporophyte) plant is typically found sublittorally and is epiphytic or sometimes free-living.
Outside of the British Isles this red alga extends to the Atlantic coast of France, Spain and Portugal into the Mediterranean. It originated in the Pacific and Indian oceans.[iv]

e) *Dilsea carnosa*

ORDER: Plantae (Kingdom) Biliphyta (Subkingdom) Rhodophyta (Phylum (Division)) Eurhodophytina (Subphylum (Subdivision)) Florideophyceae (Class) Rhodymeniophycidae (Subclass) **Gigartinales** (Order) Dumontiaceae (Family) Dilsea (Genus) Dilsea carnosa (Species) – Common name: Red rags

USE: In the past, in Ireland, it was used baked in the composition of seaweed breads. It would have a slight nutty taste.
In pharmacology, it has antifungal and antibacterial properties.

GROWTH: Dilsea carnosa is fertile in winter, from December to January.

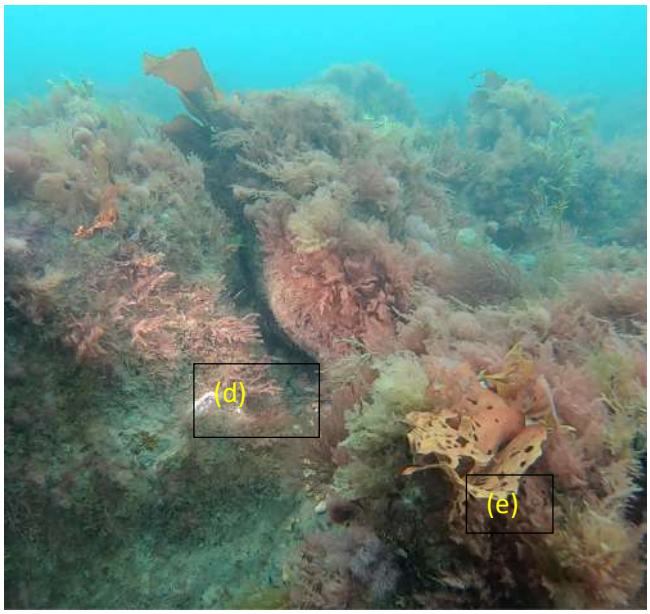


Figure 14: Asparagospis armata, Dilsea carnosa

ENVIRONMENT: Usually found from Russia Portugal in the lower littoral to shallow sublittoral attached to rocks. Widespread in the British Isles but more abundant in the south of England.

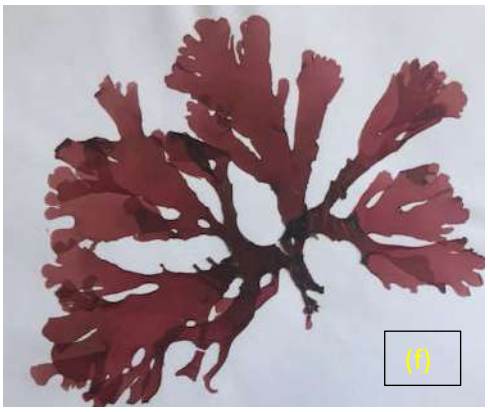


Figure 13: Callophyllis laciniata

f) *Callophyllis laciniata*

USE: unknown

GROWTH: usually in autumn.

ENVIRONMENT: infra littoral, on rocks, with very low tide to at least 30 m away from direct sun light;. It is also often found attached to kelp stipes and holdfasts on both sheltered and exposed shores. Recorded throughout the British Isles, but uncommon in the south east of England between Hampshire and Suffolk, probably due to lack of suitable substrata.

g) *Cladophora spp (or/and Ulva spp, previously Enteromorpha spp)*

USE: unknown for human but appreciated by goose

GROWTH: by spores and also by vegetative growth. Collecting it prevent from developing.

ENVIRONMENT: sanded rocks, in, sheltered zones of medio-coastal and infra-coastal beaten zone. Avoids direct sunlight, often mixes with Fucus. Found up to 20m-30m deep. Adapts to fresh water.

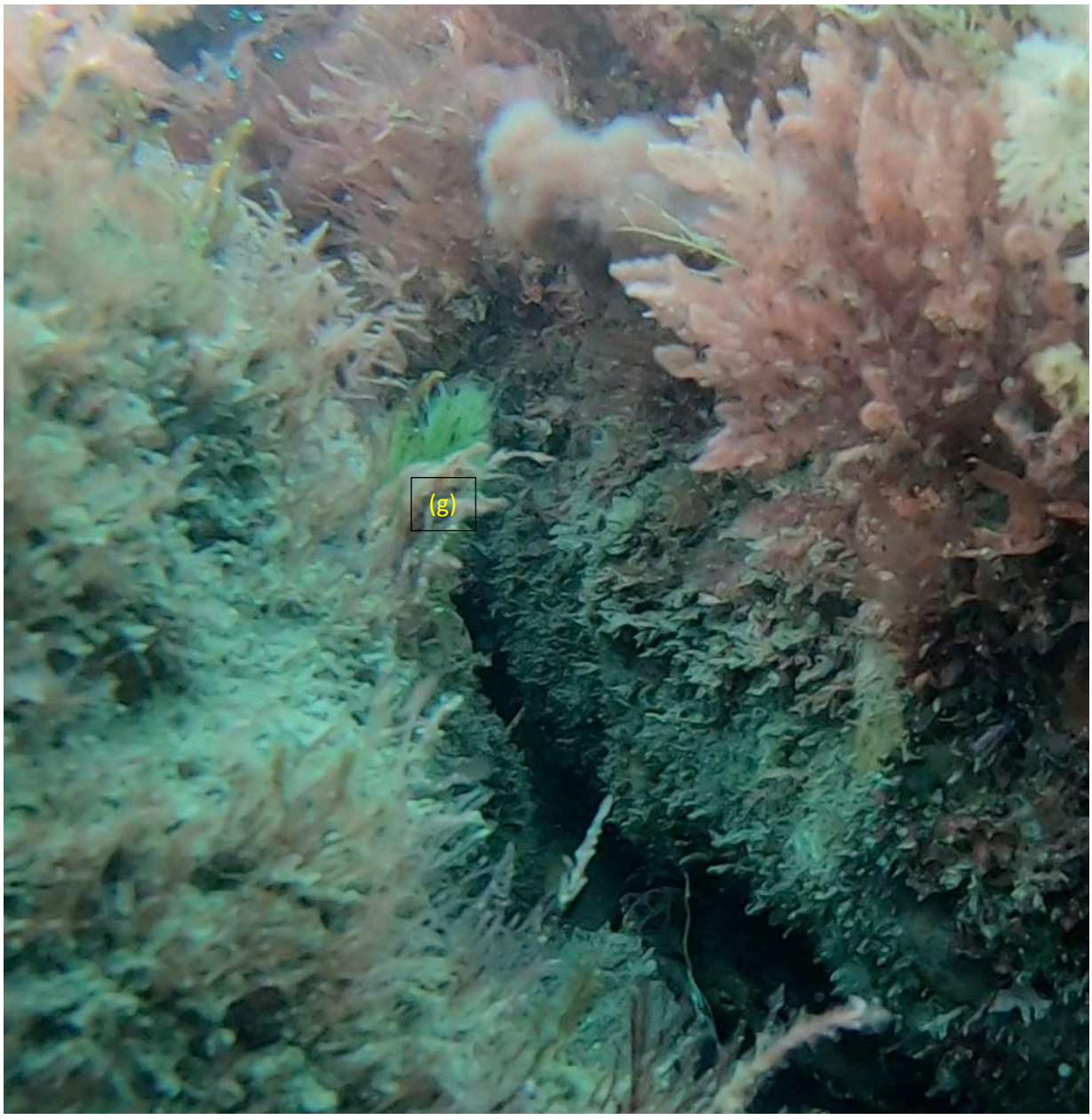


Figure 15 : Cladophora spp (g)

h) *Others*

A dense turf of foliose red seaweeds (including *Plocamium cartilagineum*, *Cryptopleura ramosa* and *Delesseria sanguinea*) on exposed or moderately exposed lower infralittoral rock, generally at or below the lower limit of the kelp

Many of the red seaweeds in this biotope have annual fronds, which typically die back in the autumn and regenerate in the spring. Consequently, a seasonal change occurs in the seaweed cover, which is substantially reduced over the winter and becomes most dense between April to September. For example, the perennial Delesseria sanguinea exhibits a strong seasonal pattern of growth and reproduction. New blades appear in February and grow to full size by May -June becoming increasing

battered or torn and the lamina are reduced to midribs by December (Maggs & Hommersand, 1993). Blade weight is maximal in midsummer, growth dropping in June and July and becoming zero in August (Kain, 1987).[v]

3. Collection solutions

a) *Venturi pump*

Inspiration Fabrication (Edward O'Kane) first used a Venturi to pump fresh seaweed above the wall. Conditions for work are:

- floating seaweed at high tide, not contaminated with sand
- rapid intervention prior to low tide and settlement of the seaweeds

b) *Dredging and pumping by boat*

Cheetah Marine (managed by Sean Strevens) won first contract to clean the harbour in 2010 and developed self-made boats to collect seaweeds.

Figure 16: first boat (2009)

Figure 17: second boat (2010)

Figure 18: tug propeller wash

Figure 19: third boat (2012)

Conditions for work are:

A basin is dredged in the middle of the existing harbour which makes the seaweed go into the middle of the Haven this has several advantages,

1. It stops the seaweed from collecting around the edges and rotting and smelling,
2. It concentrates it in one area which makes it easier to pump out,
3. It starts to rot which makes it easier to pump out and the deeper water keeps the smell from the atmosphere,
4. The deeper water helps reduce wave height in the harbour,

The dredger pumps about 100 cubic metre per hour and we pump about 500 hours a year, this is about 50 000 cubic metres of sand, seaweed and water per year.

Main disadvantage:
Dredging the Haven & dumping the spoils up to the East of the Haven proved a short-lived thing, with currents & tides washing all sediment straight back in through the entrance in a short period of time.

c) *Dredging, pumping and separating*

Dredging the Haven with Diggers & Dumpers in the same way, but this time hoping to separate the seaweed from the sand & transport it away. Of which the seaweed would be spread on farmers' fields & the sand was to be screened & rinsed then sold for use in Pony Schools.
This sadly, due to the situation being poorly managed in previous years proved to be an unrealistic contract for Cheverton Chalk to continue with.
The seaweed is contaminated with sand & the sand contaminated with rotting seaweed. This made it difficult to use the seaweed on the land & impossible to rinse the sand clean enough to enable it to be used for its planned purpose.
Solution: Had the Two of been collected before having the chance to contaminate one another, he could have dealt with a simple screening of the materials & offset some of his running costs by the sale of the sand to Pony School's. It could have been a win-win for all concerned.

d) *Beach collection*

So far, no collection is done from the beach.
Technically, some machines are designed to scrap the sand layer, sort the seaweeds from the sand and store them on a trailer that can be emptied in a truck.

- Systematic removal is essential for sanitary reasons with green seaweeds and toxic gas emission during decay
- Systematic removal serves the purpose but brings also concern regarding shore access, noise, workforce wages, biodiversity on the shore.
    - Sand sifter collects sand + gales + shells + worms although they initiate a self-cleaning action s they consist on a trophic pyramid base that birds appreciate.
    - Some seaweeds seem to structure the shore and retain the sand, preserving accelerated erosion.
- An occasional removal can be a wise solution for touristic places during the season and maintained after a storm and massive arrival of seaweeds.
- Manual cleaning can also be volunteered if debris mix with natural foreshore, which doesn't seem the case on Isle of Wight.

Human treats human, nature treats nature. Pedagogy should explain it. It will not happen naturally.

Figure 20: Beach-trotter

4. Treatment solution

(1) Fertilizer

Local farmers tried to collect it about 10/12 years ago but they had licensing issues and also wanted it delivered for free which was too expensive for the company that pimped the material.
Lorries were loaded up with it for disposal, some going to farms, but this was costly and the lorries drove through the town dropping smelly seaweed in the road, not very good for the town!

(2) Energy production

- A 2.5MW anaerobic digestion plant is set on a 24-acre site at Arreton near Newport. The facility is powered by a combined heat and power (CHP) plant. It was built in 2014.

It is able to process more than 50,000 tons of energy crops every year
It provides:
- 580 cubic meters per hour of biomethane to the grid
- 250kW of electrical generation capacity (1200 to 5000 homes equivalent)

The nutrient-rich biofertilizer is spread back onto arable farmland on the Isle of Wight

- On the Island, a gasification plant on Forest Road uses 30,000 tons of household waste to generate 2.3 MW of electricity. The plant consumes 500 kW of electricity on site so the net production is 1.8 MW.

(3) pumping out

The cheapest way so far is to dredge it and pump it out over the southern wall

Summary: Pros and Cons for these 4 techniques

Technique	Pros	Cons
1 - Fertilizer	- already done - traditional - no transformation	- strict regulation - need transportation
2 - Anaerobic digester	- 2 available on IoW - Mineralise organic matter - Extract nutrients ($NH4^+$, PO_4^{3-}).	- Salt + sand non digestible - Presence of methane inhibitor (Na, Cl) - Presence of sulphur causing H2S gaz.
3 - Pumping out	- no accumulation - fits for sand + water + seaweed	- cost… no limit of time

5. Document study

a) *Geography*

Source : https://www.nomisweb.co.uk/reports/localarea?compare=E06000046

The county of the Isle of Wight lies in the English Channel off the coast of Hampshire. It is the largest island in England, covers a geographical area of approximately 390 km^2 and is home to ca. 142,000 people.

(1) Population

65% of population aged 16-74 is active.

Tenure

Households

	Isle of Wight Local Authority	
	count	%
All households	61,085	100.0
Owned	42,817	70.1
Owned outright	25,091	41.1
Owned with a mortgage or loan	17,726	29.0
Shared ownership (part owned and part rented)	362	0.6
Social rented	6,523	10.7
Rented from council (Local Authority)	598	1.0
Other	5,925	9.7
Private rented	10,639	17.4
Private landlord or letting agency	9,663	15.8
Other	976	1.6
Living rent free	744	1.2

In order to protect against disclosure of personal information, records have been swapped between different geographic areas. Some counts will be affected, particularly small counts at the lowest geographies

Source: ONS - 2011 Census (KS402EW)

Figure 21: Tenure of land - IoW 2011

(2) Waste Water

In the Isle of Wight catchment, Southern Waters owns and operates 20 separate sewerage systems. Each of these collects wastewater over a geographical area known as a sewer catchment.

Each sewer catchment is drained by a complex sewerage system comprising a network of pipes, wastewater pumping stations (WPSs), and wastewater treatment works (WTWs). These combine to remove wastewater from homes and businesses and transport it to treatment facilities so that it can be recycled and safely discharged back into the environment.

Southern Waters sewer catchments generally cover urban centres and communities. Of the 384 km² of land serviced by their sewer catchments in this river basin, only 51 km2, or 13 %, of the land is covered by their drainage systems. However, of the 70,225 residential properties and 4,060 businesses within the Isle of Wight catchment, 95% of the homes and 89% of the businesses are connected to their sewerage system.

Remote rural properties are often not connected to sewerage systems and therefore rely upon a septic tank within their property to collect wastewater before it is periodically emptied by tankers and the wastewater is taken to a WTWs to be recycled.

87% of the equivalent population waste water is treated by Sandown WWTP which discharges up to 30,000m3/day into the environment.

Source : https://www.southernwater.co.uk/media/3904/isle-of-wight-dwmp-strategic-context.pdf

(3) Marine currents

South west current prevails and erode land mainly in Backlang and carries material up to Ryde at North Cost.

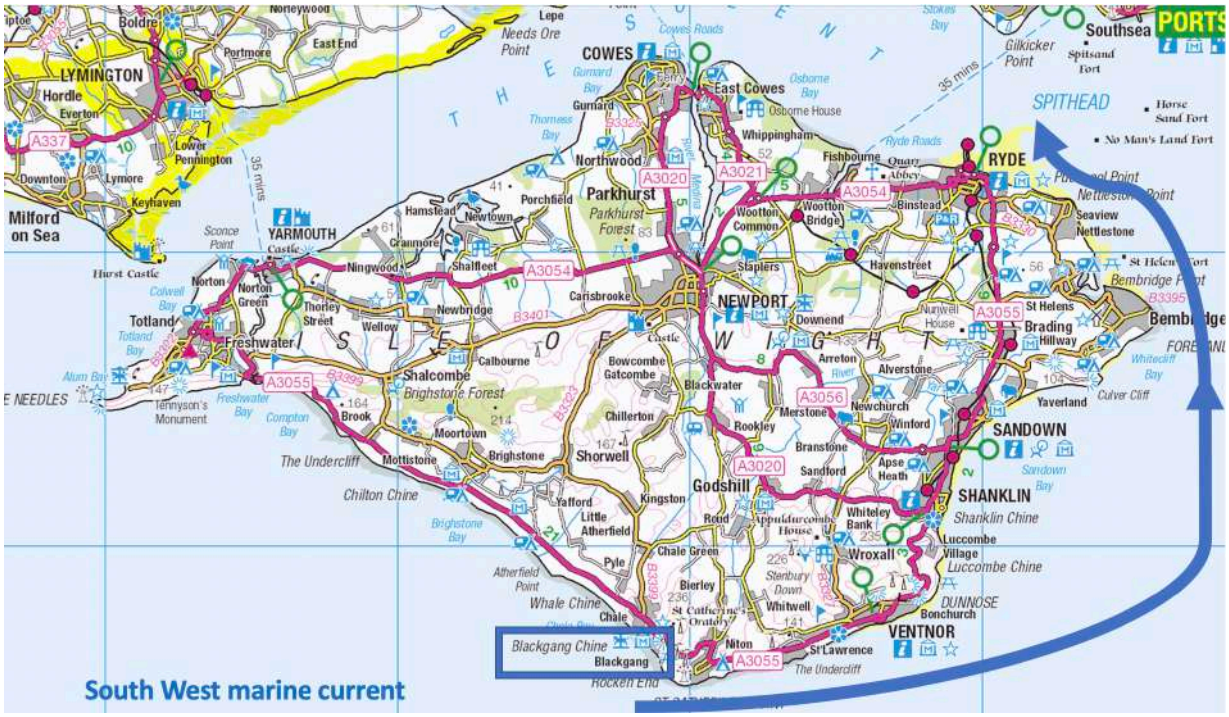


Figure 22- Map of Isle of Wight

With gyre phenomenon, massive inlets of sediments are carried along the cost and settle when speed and depth reduce. Biomass tends to agglomerate, decay and form a mud that can be the cradle of sickness. A recent patent was issued for cracking sediment.

b) *Regulatory*

(1) At sea

There is no specific legislation covering seaweed harvesting in the UK. Regulation is undertaken through general legislation (e.g. UK Food and Environment Protection Act, Town and Country Planning Act, Marine and Coastal Access Act 2009, The Marine Scotland Act 2010, EU legislation).

(2) Land and sea shore

To begin harvesting it is necessary to contact the landlord of the coastline. This will be: i) The Crown Estate, which usually manages the shoreline from MHSW to 12 nautical miles offshore on behalf of the UK government, or ii) A private landlord who may own the coastline between MHSW and MLSW.

(3) For harvesting

Reference document listed as of July 2014 are:
Wildlife and Countryside Act 1981 as amended by the Countryside and Rights of Way Act 2000 and the Natural Environment and Rural Communities Act 2006
Marine and Coastal Access Act 2009
Marine Licensing (Exempted Activities) Order 2011
The Conservation of Habitats and Species Regulations 2010 (as amended) and The Offshore Marine Conservation (Natural Habitats, & C.) Regulations 2007 (as amended)
Natural Environment and Rural Communities (NERC) Act (2006)
UK Biodiversity Action Plan (2007)

Source: https://www.westgateonsea.gov.uk/
Source : http://marineagronomy.org/ - Netalgae report

When preferred solution will be identified, this regulatory update will be detailed.

c) *Local economy*

Tourism and its supporting services, such as hospitality and retail, provide the bulk of the island's economy. It also has a significant agricultural heritage, including sheep, dairy, arable farming and, increasingly, salad crops. Its maritime heritage has also supported various economic activities including boat-building, sailcloth manufacturing and other maritime industries. Other major industrial sectors include the manufacturing of composite materials.

Considering stable pattern from a local economic assessment in December 2010, 10% of populations works in services for tourism, 10% in manufacturing but only 1,2% in farming and fishing.
Social and retail hold the largest contingent with 31% of the active population.

Industry

Persons

	Isle of Wight Local Authority	
	count	%
All usual residents aged 16 to 74 in employment the week before the census	59,299	100.0
A Agriculture, forestry and fishing	735	1.2
B Mining and quarrying	70	0.1
C Manufacturing	5,335	9.0
D Electricity, gas, steam and air conditioning supply	227	0.4
E Water supply; sewerage, waste management and remediation activities	351	0.6
F Construction	5,034	8.5
G Wholesale and retail trade; repair of motor vehicles and motor cycles	9,379	15.8
H Transport and storage	2,380	4.0
I Accommodation and food service activities	5,393	9.1
J Information and communication	1,090	1.8
K Financial and insurance activities	888	1.5
L Real estate activities	927	1.6
M Professional, scientific and technical activities	2,568	4.3
N Administrative and support service activities	2,266	3.8
O Public administration and defence; compulsory social security	4,047	6.8
P Education	5,831	9.8
Q Human health and social work activities	9,277	15.6
R, S, T, U Other	3,501	5.9

In order to protect against disclosure of personal information, records have been swapped between different geographic areas. Some counts will be affected, particularly small counts at the lowest geographies

Source: ONS - 2011 Census (KS605EW)

Figure 23: Industry jobs repartition (ONS-2011)

(1) Farming

In 2002 there was a total of 24,231 hectares of farmland on the Isle of Wight and 610 registered farm holdings. Trend goes to smaller farms.

Land ownership: Unlike other habitats of importance for biodiversity, there have been no nature reserves or sites created specifically for farmland habitats or species on the Isle of Wight. However,

despite this there are a number of SSSI (Site of Specific Scientific Interest) and nature reserves on the Island that contain farmland habitats.

Crops: Lesser Snapdragon Prickly Poppy Rough Poppy Corn Buttercup Small-flowered Catchfly Night-flowered Catchfly Spreading Hedge Parsley Narrow-fruited Corn Salad Broad-fruited Corn Salad Green Field Speedwell Corn Chamomile Lesser Quaking-grass Cornflower Broad-leaved Spurge (source

Table 1: Main farming land-uses on the Isle of Wight (2000-2002)

Land-use	Area (ha)				
	1990	1995	2000	2001	2002
Rough grazing	1,640	1,799	1,055	1,307	1,569
Permanent grass	8,801	9,075	8,934	9,474	8,492
Temporary grass	3,146	2,348	2,284	2,214	2,380
Wheat	5,505	4,393	5,424	3,796	4,975
Winter barley	1,369	1,061	327	337	394
Spring barley	704	438	358	922	429
Oats	247	262	127	273	311
Set aside	-	1,466	1226	1874	1299
	21,412	20,842	17,451	17,983	17,469
Total farmland	26,240	25,858	24,847	25,544	24,231

Figure 24: Main farming land-uses on IoW (2000-2002)

Table 2: Changes in livestock numbers on the Isle of Wight (2000-2001)

	1990	1995	2000	2001	2002
Total sheep	35,406	36,565	35,083	33,096	30,738
Total cattle	23,087	20,025	16,981	17,073	14,839
Dairy cattle	7,311	5,650	4,636	4,741	4,333

Figure 25: changes in livestock numbers on the IoW (2000-2001)

Decline in livestock may have consequences for seaweeds co-products:
☺: less cattle means less competition for organic waste to digestor and therefore opportunity for treatment.
☹: less cattle means less opportunity to develop seaweed fed animal!

(2) Fishing

The United Kingdom fishing vessel list (excluding islands) as at 1st May 2021 indicates:

- 17 boats <10m are registered in Isle of Wight. Total capacity tonnage = 46Tons
- 0 boat >10m

Source: https://www.gov.uk/government/statistical-data-sets/

(3) Hatchery: mussel / shellfish farmers

Neither mussels nor oysters are raised on Isle of Wight for the moment.
A pioneering project shows interest to hatch oysters in the strait with mainland providing water quality improves. If water quality may be responsible for seaweeds blooming (especially green seaweeds), it is to notice that seaweed can also contribute to improving water quality as they're part of natural regulation of nutrients concentration.

(4) Tourism

Pilgrimage

Island is mainly catholic. Quarr Abbey welcomes pilgrims all year long.

Holidays

45% of >2 million visit trips are holidays.

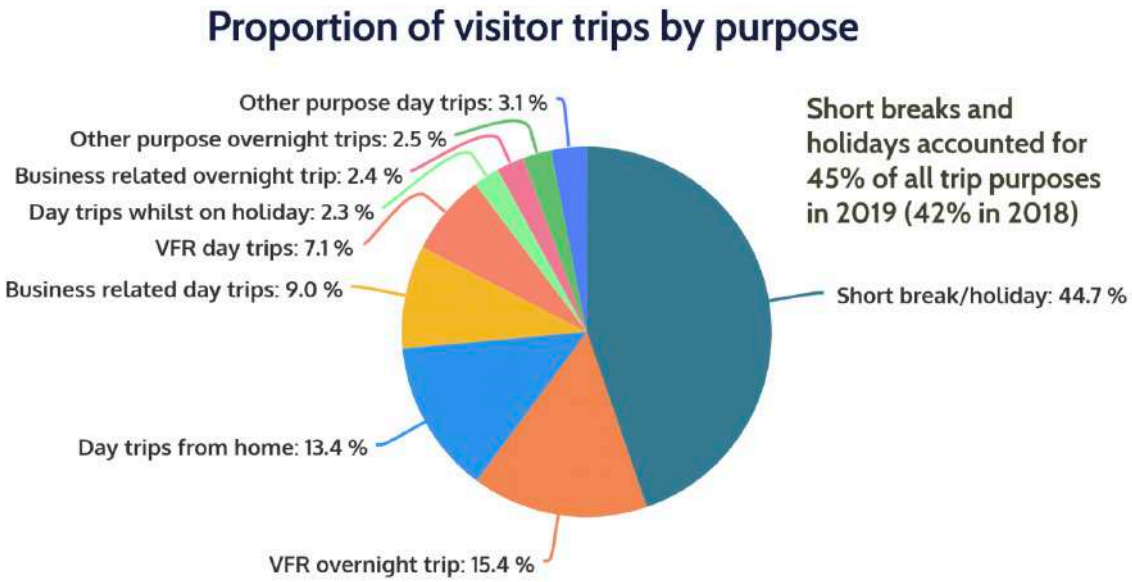


Figure 26: Proportion of visitor trips 2019

Source : https://visitwightpro.com/wp-content/uploads/2020/03/Dashboard-2019-year-page1-1.pdf

(5) Racing - Sailing

Island sailing club organize every year a famous sailing competition. Last edition attracted 300 boats to support Ellen Mc Arthur cancer charity trust
See next edition on July 3rd: http://www.roundtheisland.org.uk

(6) Navy and Rescue

3 Coast guards rescue team are on-call in Ventnor, Bembridge, Needles.
For this report, we received help from one of the coast guard volunteer who shared his diving pictures.

(7) Transformation

Additional to this report I can only recommend the reading of Cefas contract report FC002I available here: https://assets.publishing.service.gov.uk/

(8) Transportation - energy

Island Transport Strategic plan to 2038 announces will to:

- Embrace new vehicle technology and fuels
- Purchase its electricity from renewable sources
- Seek to promote net gains in relation the local Biodiversity Action Plan targets and where possible contribute to the enhancements afforded by the Biodiversity Opportunity Areas which offer the opportunity to link fragmented and isolated sites.

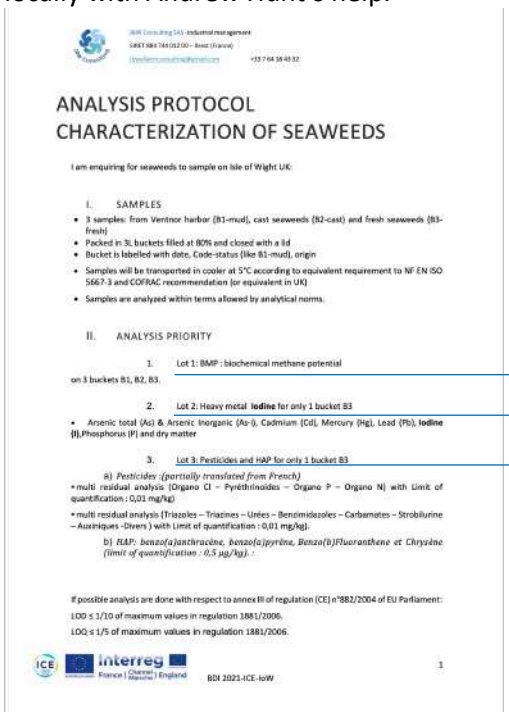
Scania's model of biogas-fuelled buses in Nottingham is an example to be followed considering technology now offers possibilities to develop such network at wider scale.

Source: https://www.iow.gov.uk/azservices/documents/2782-FG1-Island-Transport-Plan.pdf

d) *Seaweed analysis (chemical and biomethane potential)*

(1) Sampling

A sampling protocol based on Iab capability was shared with Colm Watling who kindly managed to lead locally with Andrew Hunt's help.



ANALYSIS PROTOCOL
CHARACTERIZATION OF SEAWEEDS

I am enquiring for seaweeds to sample on Isle of Wight UK:

I. SAMPLES

- 3 samples: from Ventnor harbor (B1-mud), cast seaweeds (B2-cast) and fresh seaweeds (B3-fresh)
- Packed in 3L buckets filled at 80% and closed with a lid
- Bucket is labelled with date, Code-status (like B1-mud), origin
- Samples will be transported in cooler at 5°C according to equivalent requirement to NF EN ISO 5667-3 and COFRAC recommendation (or equivalent in UK)
- Samples are analyzed within terms allowed by analytical norms.

II. ANALYSIS PRIORITY

1. Lot 1: BMP : biochemical methane potential

on 3 buckets B1, B2, B3.

2. Lot 2: Heavy metal **Iodine** for only 1 bucket B3

- Arsenic total (As) & Arsenic Inorganic (As-i), Cadmium (Cd), Mercury (Hg), Lead (Pb), **Iodine (I)**,Phosphorus (P) and dry matter

3. Lot 3: Pesticides and HAP for only 1 bucket B3

a) *Pesticides :(partially translated from French)*

• multi residual analysis (Organo Cl – Pyréthrinoïdes – Organo P – Organo N) with Limit of quantification : 0,01 mg/kg).

• multi residual analysis (Triazoles – Triazines – Urées – Benzimidazoles – Carbamates – Strobilurine – Auxiniques -Divers) with Limit of quantification : 0,01 mg/kg).

b) *HAP: benzo(a)anthracène, benzo(a)pyrène, Benzo(b)Fluoranthene et Chrysène (limit of quantification : 0,5 µg/kg) :*

If possible analysis are done with respect to annex III of regulation (CE) n°882/2004 of EU Parliament:

LOD ≤ 1/10 of maximum values in regulation 1881/2006.

LOQ ≤ 1/5 of maximum values in regulation 1881/2006.

BDI 2021-ICE-IoW 1

Objective :

(1) Identify potential organic energy avaialble

(2) Identify potential risk to be used as fertilizer as food or cosmetic ingredient

BMP
Heavy metals + Iodine
Pesticides

SAMPLING COLLECTION

Approximate collection point suggestion In the red square

Bucket 1	MUD	
	Picture	Sean Strevens (Cheetah) Report
		Ventnor Harbor
Bucket 2	CAST	
	Picture	0263 from Andrew Hunt
	location	Ryde

BDI 2021-ICE-IoW 2

Bucket 3	FRESH	
	Picture	5114 from Andrew Hunt
	location	Ventnor area - Horsebay
	Comment	I assume similar to 0270 in Ryde

BDI 2021-ICE-IoW 3

(2) Analysis

Chemical and BMP results are expected within 3 months.

Samples have been confirmed received by Inovalys lab in Nantes on 26th may 2021. This lab was selected among 2 as their analysis capacity for chemicals was meeting Cofrac requirements and has already tested BMP on seaweeds in the past.

II. ANNEX

A. Cheetah marine report (Sean April 21st 2021)

VENTNOR HAVEN

SEAWEED REMOVAL

H2S Hydrogen Sulphide

Digging out the seaweed

First seaweed removal boat May 2009

Second boat attempt June 2010

Tug propeller wash

Hydraulic power pack

Pump trial

Pump boat build

Pump Boat design

Pump Boat Sept 2012

Pump Working

Pump maintenance

Hydraulic pump breakdown

Stormy weather

Fully developed pump boat

B. Map of Isle of Wight

C. Table of figures

D. List of seaweed species (VENTNOR)

Taxon ID	Species Name	Phylum	Class	Order	Family	Genus	Species
NHMSYS0021059938	Osmundea	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Osmundea	
NHMSYS0021059474	Corallinaceae	Rhodophyta	Florideophyceae	Corallinales	Corallinaceae		
NBNSYS0000177687	Rhodophyceae	Rhodophyta	Rhodophyceae				
NHMSYS0021059479	Corallina officinalis	Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Corallina	Corallina officinalis
NHMSYS0021060129	Calliblepharis ciliata	Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Calliblepharis	Calliblepharis ciliata
NHMSYS0021060295	Plocamium cartilagineum	Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	Plocamium cartilagineum
NHMSYS0021059455	Porphyra umbilicalis	Rhodophyta	Bangiophyceae	Bangiales	Bangiaceae	Porphyra	Porphyra umbilicalis
NHMSYS0021059580	Lithothamnion	Rhodophyta	Florideophyceae	Corallinales	Hapalidiaceae	Lithothamnion	
NHMSYS0021059781	Ceramium	Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	
NHMSYS0001500745	Ulva	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	
NHMSYS0021059359	Ulva lactuca	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	Ulva lactuca
NHMSYS0021059450	Porphyra linearis	Rhodophyta	Bangiophyceae	Bangiales	Bangiaceae	Porphyra	Porphyra linearis
NHMSYS0021059473	Corallinales	Rhodophyta	Florideophyceae	Corallinales			
NHMSYS0021059854	Delesseria sanguinea	Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Delesseria	Delesseria sanguinea
NHMSYS0021059900	Drachiella spectabilis	Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Drachiella	Drachiella spectabilis
NHMSYS0021059944	Osmundea pinnatifida	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Osmundea	Osmundea pinnatifida
NHMSYS0021060140	Dilsea carnosa	Rhodophyta	Florideophyceae	Gigartinales	Dumontiaceae	Dilsea	Dilsea carnosa
NHMSYS0021060157	Chondrus crispus	Rhodophyta	Florideophyceae	Gigartinales	Gigartinaceae	Chondrus	Chondrus crispus
NHMSYS0021060280	Rhodothamniella floridula	Rhodophyta	Florideophyceae	Palmariales	Rhodothamniellaceae	Rhodothamniella	Rhodothamniella floridula
Source	https://records.nbnatlas.org/						

E.List of seaweed species (EAST COWES)

Taxon ID	Species Name	Phylum	Class	Order	Family	Genus	Species
NHMSYS0001500745	Ulva	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	
NHMSYS0021060157	Chondrus crispus	Rhodophyta	Florideophyceae	Gigartinales	Gigartinaceae	Chondrus	Chondrus crispus
NHMSYS0021060219	Gracilaria	Rhodophyta	Florideophyceae	Gracilariales	Gracilariaceae	Gracilaria	
NHMSYS0021059781	Ceramium	Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	
NHMSYS0021059210	Cladophora	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	
NHMSYS0021059822	Pterothamnion plumula	Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Pterothamnion	Pterothamnion plumula
NHMSYS0021059967	Polysiphonia	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	
NHMSYS0021060028	Halurus flosculosus	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Halurus	Halurus flosculosus
NHMSYS0021060093	Gelidium pusillum	Rhodophyta	Florideophyceae	Gelidiales	Gelidiaceae	Gelidium	Gelidium pusillum
NHMSYS0021060205	Polyides rotunda	Rhodophyta	Florideophyceae	Gigartinales	Polyidaceae	Polyides	Polyides rotunda
NHMSYS0021060268	Palmaria palmata	Rhodophyta	Florideophyceae	Palmariales	Palmariaceae	Palmaria	Palmaria palmata
NHMSYS0021059359	Ulva lactuca	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	Ulva lactuca
NHMSYS0021059479	Corallina officinalis	Rhodophyta	Florideophyceae	Corallinales	Corallinaceae	Corallina	Corallina officinalis
NHMSYS0021059706	Audouinella	Rhodophyta	Florideophyceae		Acrochaetiaceae	Audouinella	
NHMSYS0021059843	Heterosiphonia plumosa	Rhodophyta	Florideophyceae	Ceramiales	Dasyaceae	Heterosiphonia	Heterosiphonia plumosa
NHMSYS0021059165	Bryopsis plumosa	Chlorophyta	Ulvophyceae	Bryopsidales	Bryopsidaceae	Bryopsis	Bryopsis plumosa
NHMSYS0021059366	Ulva prolifera	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	Ulva prolifera
NHMSYS0021059474	Corallinaceae	Rhodophyta	Florideophyceae	Corallinales	Corallinaceae		
NHMSYS0021059806	Ceramium virgatum	Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae	Ceramium	Ceramium virgatum
NHMSYS0021059855	Membranoptera alata	Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Membranoptera	Membranoptera alata
NHMSYS0021059858	Hypoglossum hypoglossoides	Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Hypoglossum	Hypoglossum hypoglossoides
NHMSYS0021059873	Cryptopleura ramosa	Rhodophyta	Florideophyceae	Ceramiales	Delesseriaceae	Cryptopleura	Cryptopleura ramosa

NHMSYS0021059997	Vertebrata lanosa	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Vertebrata	Vertebrata lanosa
NHMSYS0021060046	Sphondylothamnion multifidum	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Sphondylothamnion	Sphondylothamnion multifidum
NHMSYS0021060132	Cystoclonium purpureum	Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Cystoclonium	Cystoclonium purpureum
NHMSYS0021060140	Dilsea carnosa	Rhodophyta	Florideophyceae	Gigartinales	Dumontiaceae	Dilsea	Dilsea carnosa
NHMSYS0021060236	Grateloupia doryphora	Rhodophyta	Florideophyceae	Halymeniales	Halymeniaceae	Grateloupia	Grateloupia doryphora
NHMSYS0021060242	Grateloupia turuturu	Rhodophyta	Florideophyceae	Halymeniales	Halymeniaceae	Grateloupia	Grateloupia turuturu
NHMSYS0021060295	Plocamium cartilagineum	Rhodophyta	Florideophyceae	Plocamiales	Plocamiaceae	Plocamium	Plocamium cartilagineum
NHMSYS0021060323	Rhodymenia pseudopalmata	Rhodophyta	Florideophyceae	Rhodymeniales	Rhodymeniaceae	Rhodymenia	Rhodymenia pseudopalmata
NHMSYS0000602386	Enteromorpha	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Enteromorpha	
NHMSYS0021059198	Chaetomorpha	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Chaetomorpha	
NHMSYS0021059208	Chaetomorpha melagonium	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Chaetomorpha	Chaetomorpha melagonium
NHMSYS0021059229	Cladophora rupestris	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	Cladophora rupestris
NHMSYS0021059230	Cladophora sericea	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Cladophora	Cladophora sericea
NHMSYS0021059239	Rhizoclonium tortuosum	Chlorophyta	Ulvophyceae	Cladophorales	Cladophoraceae	Rhizoclonium	Rhizoclonium tortuosum
NHMSYS0021059276	Ulothrix	Chlorophyta	Ulvophyceae	Ulotrichales	Ulotrichaceae	Ulothrix	
NHMSYS0021059321	Ochlochaete hystrix	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ochlochaete	Ochlochaete hystrix
NHMSYS0021059353	Ulva intestinalis	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva	Ulva intestinalis
NHMSYS0021059452	Porphyra purpurea	Rhodophyta	Bangiophyceae	Bangiales	Bangiaceae	Porphyra	Porphyra purpurea
NHMSYS0021059633	Scinaia furcellata	Rhodophyta	Florideophyceae	Nemaliales	Scinaiaceae	Scinaia	Scinaia furcellata
NHMSYS0021059758	Callithamnion corymbosum	Rhodophyta	Florideophyceae	Ceramiales	Callithamniaceae	Callithamnion	Callithamnion corymbosum
NHMSYS0021059769	Ceramiaceae	Rhodophyta	Florideophyceae	Ceramiales	Ceramiaceae		
NHMSYS0021059919	Chondria capillaris	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	Chondria capillaris

NHMSYS0021059922	Chondria dasyphylla	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Chondria	Chondria dasyphylla
NHMSYS0021059936	Laurencia obtusa	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Laurencia	Laurencia obtusa
NHMSYS0021059944	Osmundea pinnatifida	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Osmundea	Osmundea pinnatifida
NHMSYS0021059993	Polysiphonia stricta	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Polysiphonia	Polysiphonia stricta
NHMSYS0021060025	Griffithsia corallinoides	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Griffithsia	Griffithsia corallinoides
NHMSYS0021060027	Halurus equisetifolius	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Halurus	Halurus equisetifolius
NHMSYS0021060030	Monosporus pedicellatus	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Monosporus	Monosporus pedicellatus
NHMSYS0021060033	Plumaria plumosa	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Plumaria	Plumaria plumosa
NHMSYS0021060043	Spermothamnion repens	Rhodophyta	Florideophyceae	Ceramiales	Wrangeliaceae	Spermothamnion	Spermothamnion repens
NHMSYS0021060073	Colaconema daviesii	Rhodophyta	Florideophyceae	Colaconematales	Colaconemataceae	Colaconema	Colaconema daviesii
NHMSYS0021060119	Catenella caespitosa	Rhodophyta	Florideophyceae	Gigartinales	Caulacanthaceae	Catenella	Catenella caespitosa
NHMSYS0021060129	Calliblepharis ciliata	Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Calliblepharis	Calliblepharis ciliata
NHMSYS0021060136	Rhodophyllis divaricata	Rhodophyta	Florideophyceae	Gigartinales	Cystocloniaceae	Rhodophyllis	Rhodophyllis divaricata
NHMSYS0021060198	Phyllophora pseudoceranoides	Rhodophyta	Florideophyceae	Gigartinales	Phyllophoraceae	Phyllophora	Phyllophora pseudoceranoides
NHMSYS0021060221	Gracilaria gracilis	Rhodophyta	Florideophyceae	Gracilariales	Gracilariaceae	Gracilaria	Gracilaria gracilis
NHMSYS0021060223	Gracilariopsis	Rhodophyta	Florideophyceae	Gracilariales	Gracilariaceae	Gracilariopsis	
NHMSYS0021060224	Gracilariopsis longissima	Rhodophyta	Florideophyceae	Gracilariales	Gracilariaceae	Gracilariopsis	Gracilariopsis longissima
NHMSYS0021060280	Rhodothamniella floridula	Rhodophyta	Florideophyceae	Palmariales	Rhodothamniellaceae	Rhodothamniella	Rhodothamniella floridula
NHMSYS0021060303	Chylocladia verticillata	Rhodophyta	Florideophyceae	Rhodymeniales	Champiaceae	Chylocladia	Chylocladia verticillata
NHMSYS0021060308	Lomentaria articulata	Rhodophyta	Florideophyceae	Rhodymeniales	Lomentariaceae	Lomentaria	Lomentaria articulata
NHMSYS0021060309	Lomentaria clavellosa	Rhodophyta	Florideophyceae	Rhodymeniales	Lomentariaceae	Lomentaria	Lomentaria clavellosa

NHMSYS0021060330	Erythrotrichia carnea	Rhodophyta	Compsopogonophyceae	Erythropeltidales	Erythrotrichiaceae	Erythrotrichia	Erythrotrichia carnea
NHMSYS0021185175	Vertebrata fucoides	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Vertebrata	Vertebrata fucoides
NHMSYS0021185292	Umbraulva dangeardii	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Umbraulva	Umbraulva dangeardii
NHMSYS0021185544	Vertebrata nigra	Rhodophyta	Florideophyceae	Ceramiales	Rhodomelaceae	Vertebrata	Vertebrata nigra

Source https://records.nbnatlas.org/

F.Notes

[i] *Tyler-Walters, H. & Pizzolla, P., 2008. Halidrys siliquosa Sea oak. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-05-2021]. Available from: https://www.marlin.ac.uk/species/detail/1450*

[ii] *https://www.cabi.org/isc/datasheet/109142*

[iii] *https://www.gbif.org/species/159517193*

[iv] *Skewes, M. 2003. Asparagopsis armata Harpoon weed. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-05-2021]. Available from: https://www.marlin.ac.uk/species/detail/1619*

[v] *Tillin, H.M. & Budd, G., 2002. Foliose red seaweeds on exposed lower infralittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-05-2021]. Available from: https://www.marlin.ac.uk/habitat/detail/65*