World Animal Protection

Commissioned Report

Ghost gear in Cornwall, UK

2014 to 2015

(Final report November 2015)

Sue Sayer and Kate Williams

Juvenile grey seal entangled in ghost fishing gear on 25/04/15 (rescued by BDMLR) *Photo: S Sayer*

Report compiled November 2015

www.cornwallsealgroup.co.uk

Shag in a gill net on 11/11/14 (rescued by Bex Allen during a World Animal Protection funded boat survey) *Photo: S Sayer*

Contents

Preferred citation:

Sayer, S. and Williams, K. (2015) Ghost gear in Cornwall, UK 2014 to 2015 (Final Nov 2015). World Animal Protection Commissioned Report. pp56.

List of figures

Executive summary

A detailed summary of results can be found on pages 6 and 7.

Ghost fishing gear affects a range of marine life in Cornwall, including grey seals a species of conservation interest being a UK 'special responsibility' species under the EU Habitats Directive.

Between November 2014 and October 2015 26 systematic boat based coastal ghost gear survey transects were repeated covering the same 115km stretch of Cornwall's north coast (total survey distance 2990km).

360 additional opportunistic land based ghost gear surveys and sightings (almost one a day) were recorded around Cornwall and into north and south Devon by a large network of highly motivated volunteers.

A wide range of ghost gear items were photographed around most of Cornwall's 700km of coastline (north and south coasts), offshore islands and in the open sea with 4226 new items totalling 49917 litres (or 51 tonnes).

Whilst new ghost gear items were recorded in all months of the year, seasonal variations occurred.

58% (by item) and 73% (by volume) of all new ghost gear presented a possible or greater entanglement risk to marine life. On average 26% (by item) and 11% (by volume) of all new ghost gear was considered to pose a serious threat (interaction and entanglement risk possible/possible and above) to marine life and this increased to 47% (by item) and 30% (by volume) at established seal sites.

At least 52 individuals, and numerous mussels and pink sea fans, from 12 species of marine life (including seals, birds, crabs and fish) were photographed entangled in ghost gear.

Volunteers removed 14009 litres (or 14 tonnes) of ghost gear from the marine environment, considerably reducing the levels of risk posed by ghost gear to marine life (from 26% to 18%), particularly seals (from 47% to 24%).

Whilst much of the ghost gear could have been locally generated, an unknown proportion would have washed in from other locations or originated from fisheries effort by other nations. Three examples of marked gear linked Cornwall to the east coast of England, southwest Ireland and Maine in the USA reinforcing the need for global solutions to this issue.

Rescues conducted during this survey period demonstrated that even removing a small amount of looped net could save marine life from becoming entangled (Sayer and Allen, 2015).

Summary of results

Boat based systematic surveys:

Effort (surveys): 26 surveys

Ghost gear amounts (items, volume and types)

- 1398 items; 19560 litres; 20 tonnes and 1.1 items per km
- Most items were buoys/floats, monofilament net, trawl net and rope.

Ghost gear spatial distribution

- Ghost gear found at 46 locations across the entire survey transect
- Most ghost gear was in the north central standardised area
- Most ghost gear was found on coastline more perpendicular to the prevailing sea/wind conditions particularly on long northwest facing beaches
- Ghost gear was found in all types of marine habitat.

Ghost gear temporal distribution

- Greater ghost gear items and volumes were recorded in the summer
- Most trawl net was recorded in the winter
- Most rope was recorded in the spring
- Most monofilament net was recorded in the summer
- Ghost gear was recorded at twice as many sites in the summer compared to other seasons
- Monthly items peaked in July and volumes in June.

Land based surveys:

Effort (visits)

- 360 surveys; 1445 item records; 147 raw sites; 67 volunteers, 7 organisations and 4 photo ID teams.

Ghost gear amounts (items, volume and types)

- 2828 items; 30352 litres or 30 tonnes
- Most items were monofilament line and rope.

Ghost gear spatial distribution

- Ghost gear found at 46 standardised sites across the entire survey transect right around the Cornish coast and across the border into Devon
- A greater number of items were found on the south coast, but greater volumes of ghost gear were found on the north coast
- More monofilament line was found on the south coast and more rope and trawl net on the north coast
- More items per visit were found in south central standardised area of Cornwall (mostly small volume monofilament line) and in south Devon.

Ghost gear temporal distribution

- Most ghost gear items were recorded in the summer
- Greater ghost gear volumes were recorded in the winter.

Boat and land based surveys

Risk rating of ghost gear: Interaction risk

- 40% (by item) and 15% (by volume) of ghost gear posed a possible or greater risk of interaction
- These risks increased to 82% (by item) and 50% (by volume) at seal sites
- The most risky items by type were monofilament line, monofilament net and pots
- There was a slightly greater interaction risk in spring and autumn.

Risk rating of ghost gear: Entanglement risk

- 58% (by item) and 73% (by volume) of ghost gear posed a possible or greater risk of entanglement
- These risks decreased to 54% (by item) and 49% (by volume) at seal sites
- The most risky items by type were trawl net, monofilament net, rope and pots
- There was a slightly greater entanglement risk in spring

Risk rating of ghost gear: Interaction and entanglement combined risk.

- 26% (by item) and 11% (by volume) of ghost gear posed a possible or greater risk of interaction and entanglement (serious threat) at all sites
- 47% (by item) and 30% (by volume) of ghost gear posed a possible or greater risk of interaction and entanglement (serious threat) at established seal sites.

Witnessed entanglement

12 species (at least 52 individuals plus numerous mussels and pink sea fans) were witnessed as entangled – grey seals, cormorants, herring gulls, gannets, guillemots, shags, edible crabs, spider crabs, bass, catsharks, mussels and pink sea fans including:

- 15 live seals (eight were rescued by British Divers Marine Life Rescue) at seven locations
  - Mostly in monofilament net (but also trawl net)
  - Mostly in small quantities
  - Most were juveniles
  - 60% had deep serious resulting wounds.
- Two dead seals
- 3% of all seals observed at the West Cornwall haul out had some evidence of prior or current entanglement (up to 11 entangled individuals being sighted at any one time)
- Eight birds at six locations (two were rescued by boat survey team members)
- 18 crabs at two locations (several live ones were released by recorders)
- Nine individuals of two species of fish at five locations
- 64 live clumps of mussels at ten locations (several ghost gear items were removed by recorders)
- 179 dead pink sea fan fragments at eight locations.

Removal of ghost gear

1855 items (44%) and 14009 litres or 14 tonnes (28%) of ghost gear were removed by recorders reducing the risk of serious interaction and entanglement from 26% to 18% at all sites and from 47% to 24% at seal sites, making a very positive difference to levels of risk posed by ghost gear.

Origin of ghost gear

Not all ghost gear was locally generated and three items linked Cornwall to Yorkshire, southwest Ireland and Maine in the USA almost 4700km away.

Introduction

Grey seals

Grey seals (*Halichoerus grypus*) are amongst the least numerous seal species in the world, so appear in the International Union for Conservation of Nature 'Red List' (IUCN, 2014) and the European Union Habitat's Directive (Annexes II and V). With 38% of the world's population found across the UK (SMRU, 2013), grey seals are described as a UK 'special responsibility' species (JNCC, 2014).

Entanglement

Cornwall Seal Group Research Trust (CSGRT) volunteers have been intensively monitoring, recording and photo identifying grey seals in the southwest of England, UK since 2000. The first seal (juvenile female S3 'Lywans') caught in ghost gear was recorded in August that year and entanglement data has been recorded ever since. By 2010, there were 58 different entangled grey seals in CSGRT's photo identification catalogues of which 64% had injuries causing encircling constrictions, wounds or both and there was a significantly shorter ($p=0.045$) mean maximum capture period (MCP) for paired entangled seals compared to non-entangled controls (Allen, Jarvis, Sayer, & Mills, 2012). By the end of 2013, there were 262 different entangled grey seals in CSGRT's ID catalogues, mostly moderate or well nourished (97.3%) adults (61.8%) with an almost even split of males and females. Where visible ($n = 92$) all entangling items were fisheries related bar one and most were monofilament (72%). 31% of entangled seals had trailing materials, some in excess of a half body length (9.7%). Entangled seals with trailing material had significantly shorter MCPs than those without ($P=0.002$) suggesting a reduced survivorship for seals with larger quantities of entangling material. 79.4% of entangled seals had a serious open wound, constriction or both and of these 46% were judged to be deep constrictions. The distribution of MCPs for seals with deep constrictions was significantly shorter compared to non entangled seals ($P=0.014$) suggesting the more serious injuries affect survivorship (Sayer and Allen, 2015).

Ghost gear

Globally, 640,000 tonnes of fishing gear are lost in the oceans annually (Wilcox et al., 2014). Ghost gear is the term used for any fishing gear or fishing related litter that has been abandoned, lost or discarded that causes the bycatch of numerous species across international boundaries (Butler, 2013). It forms a significant component of marine debris - 11.4% (MCS, 2011). Ghost gear has many forms such as nets, ropes, lines, pots, hooks and other items that catch, injure and kill at least 136,000 seals, sea lions and large whales and an unknown number of birds, turtles, fish and other species worldwide (FANTARED2 2014.)

Data collection

World Animal Protection's Sea Change campaign inspired CSGRT to begin recording ghost gear systematically and a manageable, simple and user friendly system was designed for collecting data around Cornwall. This has proved popular with other coastal users who enthusiastically record and (where practical) remove ghost gear knowing that they are making a difference locally and providing evidence for a global campaign on the issue. This report summarises twelve months of data collected during boat and land based surveys between November 2014 and October 2015 inclusively. Results will be presented on the:

- Spatial distribution of ghost gear (items, volumes, type)
- Temporal distribution of ghost gear (items, volumes, type)
- Potential and witnessed interaction and entanglement risks posed to marine life
- Ghost gear removal and associated implications for marine life
- Origin of ghost gear

This report aims to provide evidence based insights to help inform effective actions for World Animal Protection's Sea Change Campaign and the Global Ghost Gear Initiative.

Method

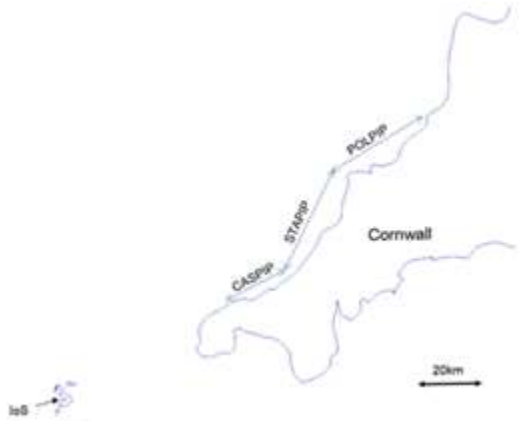
During September 2014, CSGRT contacted other organisations recording ghost gear around the world (such as the Commonwealth Scientific and Industrial Research Organisation, CSIRO) and locally (such as Rame Peninsular Beach Care) to inform survey and recording protocol design. By October 2014, CSGRT began trialling recording methods during boat and land based surveys and a single finalised survey protocol was agreed (see figure 1). On 22/10/14 CSGRT held a training evening attended by 20 key seal recorders to train them in the application of the new ghost gear survey protocols. Official ghost gear surveys began in November 2014 and were publicised in lots of ways using talk slots at local marine related conferences, in articles for local publications, by email through related marine networks and using social media sites.

Date		**Time**		**Recorder**	**Please take photos**		
Reference number (can mark numbers on map if drawing one)	**Location** (gear in sea give nearest land name and waypoint if you have one) Tick if **photo** taken and **photo number** if lots of items	Where specifics **Depth if in sea** - (surface, 1m, >1m) or **Part of beach** (N/E/S/W side; Top, Mid, Bottom or High Tide/Mid Tide/Low tide)	No. of items	**Type** of gear **B** Buoy **F** Float **L** Line **NM** Net monofilament **NT** Net trawl **P** Pot **RO** Rope **RU** Rubber **O** Other **Colour/Size/Shape/Materials**	**Size** **Length and width** (in cm/m); AND/OR **Volume** (Fist, head, arm, leg, torso, person, cow, box van, house) **Mesh** size in cm (pull knots tight to close mesh measure knot to knot) **Attached to gear** - hooks, lures, floats, animals? Has it been seen before? Y/N Retrieved/Removed? Y/N Where disposed of?	**Possibility of interaction** (U=Unlikely P=Possible L=Likely W=Witnessed) Risk assessment*	**Possibility of entanglement** if washed out (U=Unlikely P=Possible L=Likely W=Witnessed) Risk assessment*
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

* Interaction (**P** if seals use area routinely; **L** if seals seen within 5m of item; **W** if seal within touching distance of item otherwise **U**)
* Entanglement (**P** if looped/meshed/balled mass; **L** if seals seen within 5m of looped/meshed/balled item; **W** if seal seen entangled otherwise **U**)

Figure 1: Ghost gear recording form (above) Figure 2: Boat survey transect map (below)

Each month CSGRT organised three interlocking boat based coastal survey transects along the north coast of Cornwall (see figure 2) from west of St Ives (N50.211418; W-5.556078) to east of Boscastle (N50.715930; W-4.666100). During each of these surveys ghost gear at sea and on land was recorded along with sightings of all marine mega fauna, birds and human activities. Each boat survey or photo identification project (PIP) covered a different but systematically repeated stretch of coast:



1. CASPIP (Carracks to St Agnes)
2. STAPIP (St Agnes to Trevose)
3. POLPIP (Trevose to Boscastle east)

CASPIP was partly funded by Wave Hub and World Animal Protection whilst STAPIP and POLPIP were paid for by World Animal Protection subsidised by voluntary contributions from participants.

Surveying by boat was essential to ensure a range of coastal habitats were systematically surveyed as opposed to just accessible and popular beaches. The boat based coastal transect included beach, dune, cliff, estuarine and offshore island habitat much of which was inaccessible to the public. Boat surveys recorded ghost gear at sea and delivered systematic transect (as opposed to point) data. Each boat survey was facilitated by two local marine group coordinators who ensured the presence of key expert recording personnel for ghost gear, seals, birds and other marine life, as well as a team of volunteer spotters to ensure that any ghost gear present was seen, recorded and where possible photographed. Details of this rigorous survey process can be found in appendix A. At sea, dedicated recorders logged ghost gear on the standard form (figure 1) and each stretch of coast was intensively photographed to enable ghost gear records to be added to or amended for greater accuracy.

On land, volunteers photographed ghost gear during encounters ranging from systematic coastal transects to one off opportunistic finds. These were submitted to CSGRT and for each item of ghost gear (fist sized or above) the following data was recorded:

- Date, recorder and a photo reference number
- Location name, details and area code
- The number of items
- The size of the material – length and/or volume (compared to human body parts) as appropriate
- The type of ghost gear (buoys, floats, line, monofilament net, trawl net, pots, rope, rubber or other)
- Whether the item/s had been reported previously and/or removed
- Two risk ratings – firstly the likelihood of a seal/bird interacting with gear, This was recorded as 'possible' (P) if seals/birds used the area routinely; 'likely' (L) if seals/birds were within 5m of the item; 'witnessed' (W) if they were observed touching the item, otherwise the risk was assessed as 'unlikely' (U). Secondly, the likelihood of a seal/bird becoming entangled in the ghost gear was assessed. This was recorded as 'possible' (P) if the item was looped/meshed or a balled mass; 'likely' (L) if they were within 5m of a looped/meshed or balled item; 'witnessed' (W) if a seal/bird was seen entangled, otherwise the risk was assessed as 'unlikely' (U). The two risk ratings were combined into the following categories UU, UP, PU, PP, LU, LP, LL, LW, WL and WW. Categories PP+ (PP, LP, LL, LW, WL or WW) were considered to pose a serious threat to seals/birds.

Public participation levels on land and at sea were high right from the start. People were genuinely relieved that finally an organisation wanted data on the ghost gear that they were concerned about around their coastline. Even better that this data could be used by an international charity such as World Animal Protection as part of the global Sea Change campaign to inform action on this issue.

It was immediately clear from the number of records submitted that a dedicated data manager was required to input data for the project and one was swiftly appointed (Kate Williams). To encourage as many records as possible a single point of contact was used (sue@cornwallsealgroup.co.uk). To ensure quality control (through the consistent categorisation of ghost gear) standard survey forms (figure 1) were completed centrally by the data manager using the photographs, metadata and information submitted. All forms completed by the data manager were returned to the contributing volunteer to approve for rigorous data accuracy. As submitted, data was added to the master spreadsheet in MS Excel (figure 3). Details of the methodology employed can be found in appendix B.

Summaries of the data received were collated by the data manager monthly. Quantity (related to known human body part sizes, as advised by CSIRO) recorded in the field was transposed to litres using a conversion table (appendix C). Photos enabled the data manager to determine if items had been reported previously and these items were filtered out from the monthly data sets. Of the new ghost gear reported each month, calculations were made of the volumes removed from the coastline and that remaining. Data summaries were presented at monthly CSGRT meetings along with photographs taken by as many contributing volunteers as possible to sustain and grow interest in the project.

Date	Recorder	Area code	Ref	Location ID	Location	Location detail	Seal / Bird (B) site?	Lat	Long	No of items	B	F	L	N M	N T	P	R O	R U	O	Size Length 1=<1m; 2=1-5m; 3=5m+	Size Volume	Volume	Interacti on risk U,P,L,W	Entangl ement risk U,P,L,W	Photos	Seen before	Removed	Comments
02/11/14	Rob Wells	SE		Mevagissey Bay	Mevagissey Bay, Polstreath		N	50.236	-4.783	1						1				2	Torso	35	U	P	N	N	N	Dead crab pot
03/11/14	Sue Sayer Kate	NW	1	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	1		1								1	Fist	0.5	P	U	Y	N	N	Mainly white yellow red Maine float
03/11/14	Claire Wallerste	SE	1	Whitsand Bay East	Whitsand Bay East, Polhawn Cove		N	50.346	-4.2555	1							1			2	Torso	35	U	P	Y	N	Y	light coloured ropes
03/11/14	Claire Wallerste	SE	2	Whitsand Bay East	Whitsand Bay East, Polhawn Cove		N	50.346	-4.2555	1					1						Person	80	U	P	Y	N	Y	big clump of tangled net
03/11/14	Claire Wallerste	SE	3	Whitsand Bay East	Whitsand Bay East, Polhawn Cove		N	50.346	-4.2555	1					1						Arm	6	U	P	Y	N	Y	piece of green net
04/11/14	Rob Wells	SC	1	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	1							1				Arm	6	U	P	Y	N	Y	
04/11/14	Rob Wells	SC	2	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	8			8							1	3xFist	1.5	U	P	Y	N	Y	Other side of beach
04/11/14	Rob Wells	SC	3	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	1									1		Fist	0.5	U	P	Y	N	Y	
06/11/14	Newquay Beach	NC	1	Newquay	Newquay, Porth Beach		N	50.416	-5.078	1				1						3	Half/Per	40	U	P	Y	N	N	Huge! Whole gill net? NM
06/11/14	Newquay Beach	NC	2	Newquay	Newquay, Porth Beach		N	50.416	-5.078	1							1				Half/Per	40	U	P	Y	N	N	Huge! Whole gill net? RO
07/11/14	Rob Wells	SC		Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	1									1	2	Leg	12	U	P	Y	N	N	Fishing trousers
07/11/14	Pat May	SE		St Austell Bay	St Austell Bay, Par Beach		N	50.347	-4.6968	2							2			1	Arm	6	U	P	Y	N	Y	
08/11/14	Sue Sayer	NW	1	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	2								2			Arm in to	2	L	U	Y	N	N	
08/11/14	Sue Sayer	NW	2	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	1					1					1	Arm in to	2	L	P	Y	N	N	BIRD interaction witnessed with plastic hoo
08/11/14	Sue Sayer	NW	3	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	1							1				Arm in to	2	L	P	Y	N	N	
08/11/14	Alec and Enid F	SW	1a	Lizard	Lizard, Lizard Point SP		Y	49.959	-5.2063	1				1						2	Leg in to	4	P	P	Y	N	N	Gill net and rope and rubber
08/11/14	Alec and Enid F	SW	1b	Lizard	Lizard, Lizard Point SP		Y	49.959	-5.2063	1							1				Leg in to	7	P	P	Y	N	N	Gill net and rope and rubber
08/11/14	Alec and Enid F	SW	1c	Lizard	Lizard, Lizard Point SP		Y	49.959	-5.2063	1								1			Leg in to	1	P	P	Y	N	N	Gill net and rope and rubber
09/11/14	Jonathan Kersl	SW		Land's End	Land's End, Porthcurno		N	50.043	-5.6501	1									1	2	Torso	35	U	P	Y	N	Y	White rope like stuff
09/11/14	Rob Wells	SC	1	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	1						1					Head in	2	P	P	Y	N	Y	Black netting, orange Multifilament and gre
09/11/14	Rob Wells	SC	2	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	2							2			2	Head in	2	P	P	Y	N	Y	Black netting, orange Multifilament and gre
12/11/14	Charles Hood	SW	1	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	6									6		6xTorso	210	U	P	U	N	N	3 Fish boxes and 3 fish buckets
12/11/14	Charles Hood	SW	2	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	1									1		Fist	0.5	U	P	U	N	N	Cable tie
12/11/14	Charles Hood	SW	3	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	9						9					7xTorso	257	U	P	U	N	N	3 Pot metal and 4 pots and 2 pot parts
12/11/14	Charles Hood	SW	4	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	2	2										Head	4	U	P	U	N	N	Flat buff and a bullet buoy
12/11/14	Charles Hood	SW	5	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	5									5		Head	2.5	U	P	U	N	N	4 gloves and a welly
12/11/14	Charles Hood	SW	6	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	3								3			Arm	6	U	P	U	N	N	Rubber 3m
12/11/14	Charles Hood	SW	7	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	6							6				Leg	12	U	P	U	N	N	Rope, 6 lots in mixed bits up to and over 5r
12/11/14	Charles Hood	SW	8	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	3					3						Arm	6	U	P	U	N	N	NT x 3 in mixed bits up to 5m
12/11/14	Charles Hood	SW	9	Perranuthnoe	Perranuthnoe, Trebarvah Cliff Perra		N	50.112	-5.4408	4				4							Arm	6	U	P	U	N	N	NM x 4 in mixed bits up to 0.5m
13/11/14	Kate Hockley ai	NW	1	Godrevy	Godrevy, Kynance Cove		Y	50.24	-5.3848	1					1						Torso	35	P	P	Y	N	N	Net trawl
13/11/14	Kate Hockley ai	NW	2	Godrevy	Godrevy, Kynance Cove		Y	50.24	-5.3848	1									1	1	Head	1	P	P	Y	N	N	Ball and handle
13/11/14	Kate Hockley ai	NW	1	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	1				1							Fist	1	L	L	Y	N	N	Mono net ball
13/11/14	Kate Hockley ai	NW	2	Godrevy	Godrevy, Mutton Cove		Y	50.24	-5.3848	1								1		2	Head	2	L	L	Y	N	N	Rubber strip
13/11/14	Rob Wells	SC	1	Roseland	Roseland, Elwinick Cove	West of	Y	50.157	-4.9837	1						1					Torso in	5	P	L	Y	N	N	Blue trawl on rocks
13/11/14	Rob Wells	SC	2	Roseland	Roseland, Elwinick Cove	West of	Y	50.157	-4.9837	1								1			Torso in	10	P	L	Y	N	N	Rubber strip
13/11/14	Rob Wells	SC	3	Roseland	Roseland, Elwinick Cove	West of	Y	50.157	-4.9837	1							1				Torso in	20	P	L	Y	N	N	Line of trawl net apparently buried deep in s
13/11/14	Rob Wells	SC	1	Roseland	Roseland, Jack Sawle's Cove		Y	50.157	-4.9837	1						1					Torso in	23	L	P	Y	N	N	Home made pot metal spikes dangerous
13/11/14	Rob Wells	SC	2	Roseland	Roseland, Jack Sawle's Cove		Y	50.157	-4.9837	1							1				Torso in	4	L	P	Y	N	N	Home made pot metal spikes dangerous
13/11/14	Rob Wells	SC	3	Roseland	Roseland, Jack Sawle's Cove		Y	50.157	-4.9837	1								1			Torso in	8	L	P	Y	N	N	Home made pot metal spikes dangerous
16/11/14	Malcolm McKe	SW	1	Coverack	Coverack, Porthoustock	On shing	N	50.024	-5.0975	1		1									Head	4	U	U	P2	N	N	7 inch orange float
16/11/14	Malcolm McKe	SW	2	Coverack	Coverack, Porthoustock	On sand	N	50.024	-5.0975	1							1				3xFist	1.5	U	P	P3	N	N	RO: bundle of white rope with knots and loo
16/11/14	Malcolm McKe	SW	3	Coverack	Coverack, Porthoustock	On sand	N	50.024	-5.0975	1							1				3xFist	1.5	U	P	P4	N	N	Bundle of broken down white rope, green tr
16/11/14	Malcolm McKe	SW	4	Coverack	Coverack, Porthoustock	On sand	N	50.024	-5.0975	1							1				3xFist	1.5	U	P	P5	N	N	Bundle of broken down multi filament blue
16/11/14	Malcolm McKe	SW	5	Coverack	Coverack, Porthoustock	On shing	N	50.024	-5.0975	1				1							2xFist	1	U	P	P6	N	N	matted bundle of mono filament net, blue
16/11/14	Malcolm McKe	SW	6	Coverack	Coverack, Porthoustock	On shing	N	50.024	-5.0975	1							1				3xFist	1.5	U	P	P7	N	N	Line or rope? Bundle of orange line or brok
16/11/14	Malcolm McKe	SW	7	Coverack	Coverack, Porthoustock	On shing	N	50.024	-5.0975	1					1						3xFist	1.5	U	P	P8	N	N	Green trawl net, piece about 30cm square,
16/11/14	Rob Wells	SC		Mevagissey Bay	Mevagissey Bay, Gorran Haven - Va		N	50.236	-4.783	1									1	1	Fist	0.5	U	P	Y	N	Y	Angling line with 3 fish hooks and lures
16/11/14	Laura Workmar	NE		New Polzeath	New Polzeath, Baby Bay		N	50.577	-4.9204	1				1						3	Person	80	U	P	N	N	Y	75% of two bin bags was small net 2 to 6 inc
16/11/14	Zillah Robertso	SE	1	Whitsand Bay East	Whitsand Bay East, Freath	Beach c	N	50.346	-4.2555	2						2					Person	80	U	P	973	N	Y	2 lobster/crab type pots (records sent in in
16/11/14	Zillah Robertso	SE	2	Whitsand Bay East	Whitsand Bay East, Freath	Beach c	N	50.346	-4.2555	3					3						2xTorso	70	U	P	873	N	Y	some big bits of netting (records sent in in
16/11/14	Zillah Robertso	SE	3	Whitsand Bay East	Whitsand Bay East, Freath	Beach c	N	50.346	-4.2555	4									4		Person	80	U	U	873	N	Y	4 fishing boxes (records sent in in August)
17/11/14	Julie Hatcher	NC		Perranporth	Perranporth		N	50.35	-5.1539	1					1					3	4 Perso	320	U	P	Y	N	N	Massive clump of mixed gear
20/11/14	Kate Hockley ai	NW	1	Godrevy	Godrevy, Mutton Cove	West sid	Y	50.24	-5.3848	2	2										Head	4	P	U	Y	N	N	2 polystrene buoys (white and blue)
20/11/14	Kate Hockley ai	NW	2	Godrevy	Godrevy, Mutton Cove	West sid	Y	50.24	-5.3848	1					1					2	Arm	6	P	P	Y	N	N	Net 1-2m by 1 inch width
20/11/14	Kate Hockley ai	NW	3	Godrevy	Godrevy, Mutton Cove	West sid	Y	50.24	-5.3848	1						1					Head	4	P	P	Y	N	N	Top of pot, Blue
20/11/14	Kate Hockley ai	NW	4	Godrevy	Godrevy, Mutton Cove	North si	Y	50.24	-5.3848	1							1			1	Arm	6	P	P	Y	N	N	Rope Orange
20/11/14	Kate Hockley ai	NW	5	Godrevy	Godrevy, Mutton Cove	North si	Y	50.24	-5.3848	1								1		2	Leg	12	P	U	Y	N	N	Rubber Black 1.5 metres.
20/11/14	Terence Thirlaw	SW		Lizard	Lizard, Pentreath Beach		N	49.959	-5.2063	1							1			2	Person	80	U	P	Y	N	N	Braided tow rope 2 metres 150 mm dia to h
21/11/14	Lindsey Butterfi	SW	1	Land's End	Land's End, Porthcurno		N	50.043	-5.6501	1					1						Arm	6	U	P	Y	N	Y	National Trust. Blue net
21/11/14	Lindsey Butterfi	SW	2	Land's End	Land's End, Porthcurno		N	50.043	-5.6501	1									1		Head	4	U	U	Y	N	Y	Lump of palm oil
21/11/14	Rob Wells	SC	1	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	3				3							2xFist	1	P	P	Y	N	Y	3 bundles totalling 2 fists DSCF5564.jpg
21/11/14	Rob Wells	SC	2	Mevagissey Bay	Mevagissey Bay, Colona Beach		Y	50.236	-4.783	13			13								3xFist	1.5	P	P	Y	N	Y	13 small bundles totalling 3 fists DSCF557

Figure 3: Extract from the collated data file in MS Excel

Results and discussion

Boat based systematic surveys – spatial distribution

Survey effort (visits) – entire survey area

Between 01/11/14 and 31/10/15, 26 boat surveys were completed along systematically repeated coastal transects over 115km of the north Cornish coast from 8km west of St Ives to 13km east of Boscastle. The mean survey transect was 68km. Total travel distance including return journeys was just over 200km.

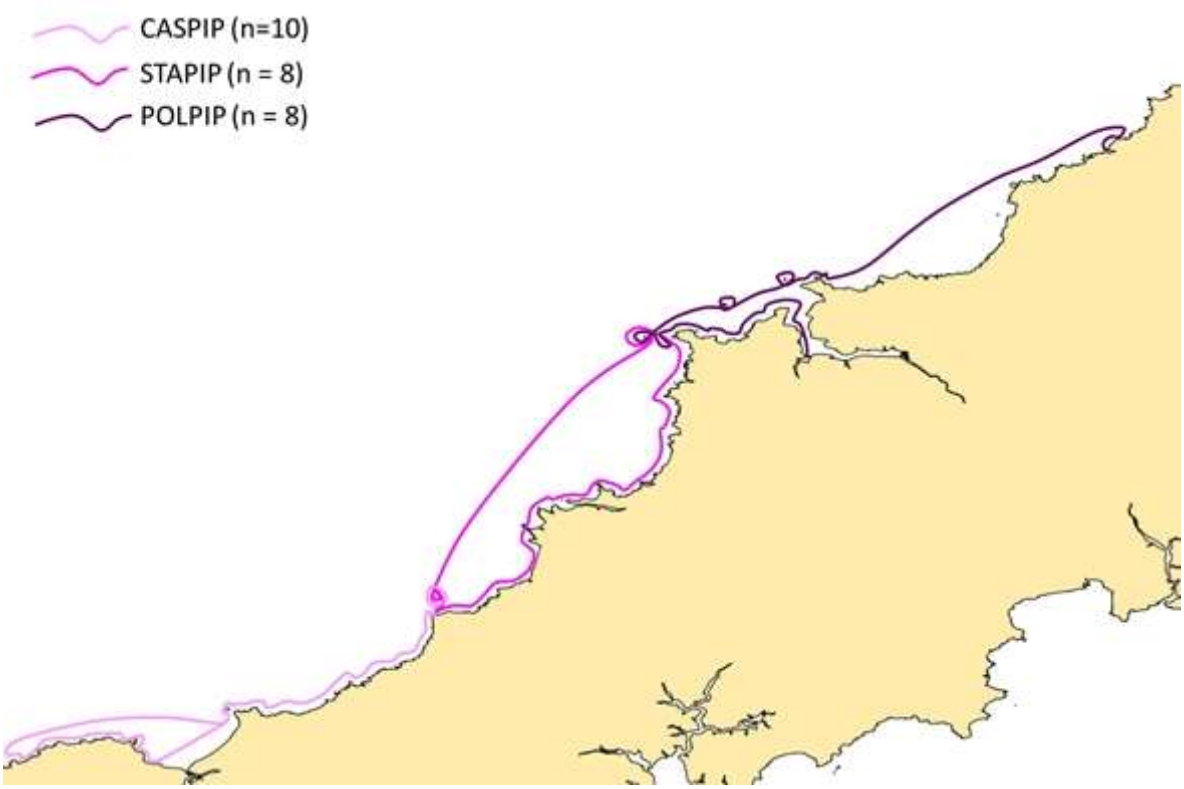


Figure 4: Boat survey coastal transect tracks (above) and Figure 5: Survey schedule (below)

	CASPIP	STAPIP	POLPIP	Quarterly total
Dec				
Jan	1		1	
Feb	1	1	1	5
Mar	1			
Apr	1	1	1	
May	1	1		6
Jun	1	1	1	
Jul	1	1	1	
Aug	1		1	8
Sep		1		
Oct	1	1	1	
Nov	1	1	1	7
Total	10	8	8	

These 26 surveys included:

- 10 CASPIP (NW) surveys
- 8 STAPIP (North central) surveys
- 8 POLPIP (NE) surveys.

Surveys were completed during every month of the year excluding December when weather and sea conditions prevented surveys taking place on health and safety grounds.

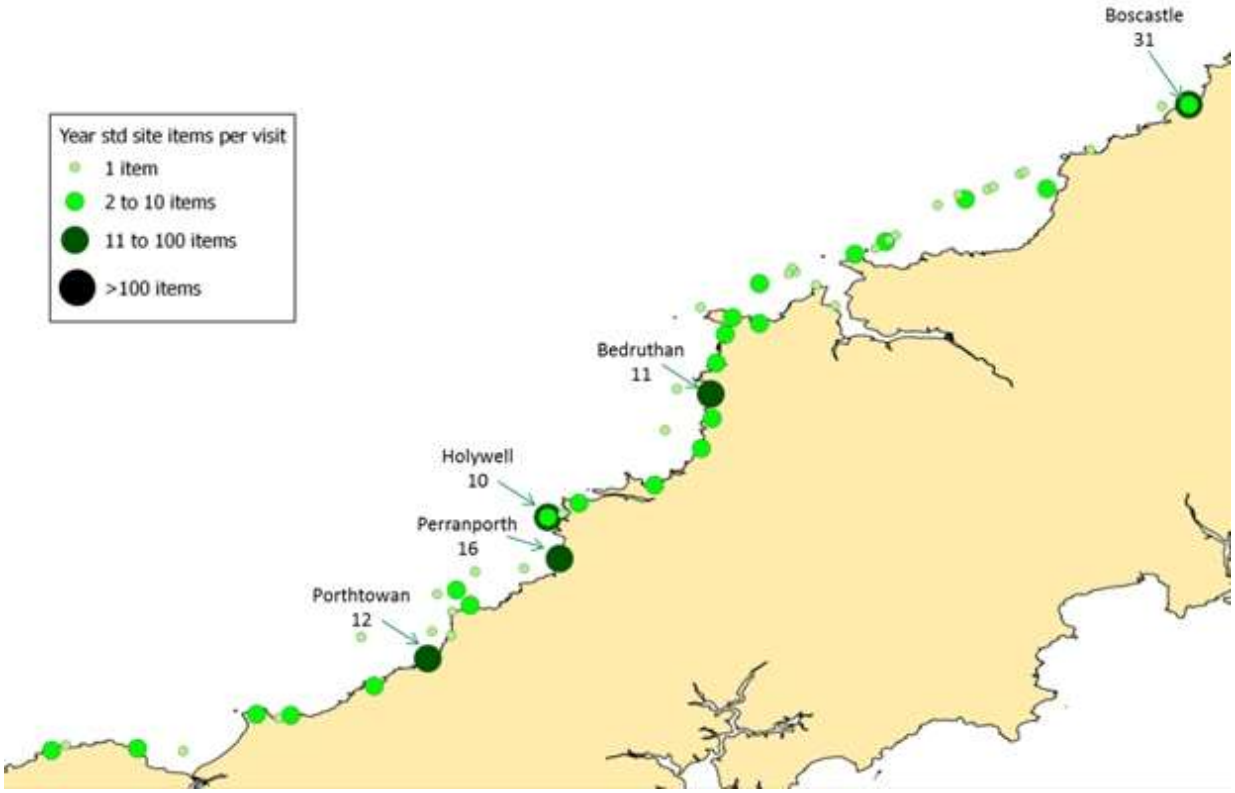
Each survey comprised a coastal section with fast sea sections to enable surveys to take place in optimum tide conditions.

St Ives Bay (CASPIP) and the Mouls to Pentargon (POLPIP) were only surveyed at speed.

Each survey pass of a location was considered a visit whether ghost gear was observed at that site or not.

Each survey included a range of mainland coastal habitats (beaches, cliff backed shores, dunes, estuarine) as well as rocky offshore islands, which were circumnavigated. A large range of marine megafauna were routinely observed within the survey area including: grey seals, common dolphins, bottlenose dolphins, harbour porpoise and ocean sunfish, along with four jellyfish species (barrel, blue, compass and moon) as well as up to 45 different bird species.

Number and volume of ghost gear items – entire survey area



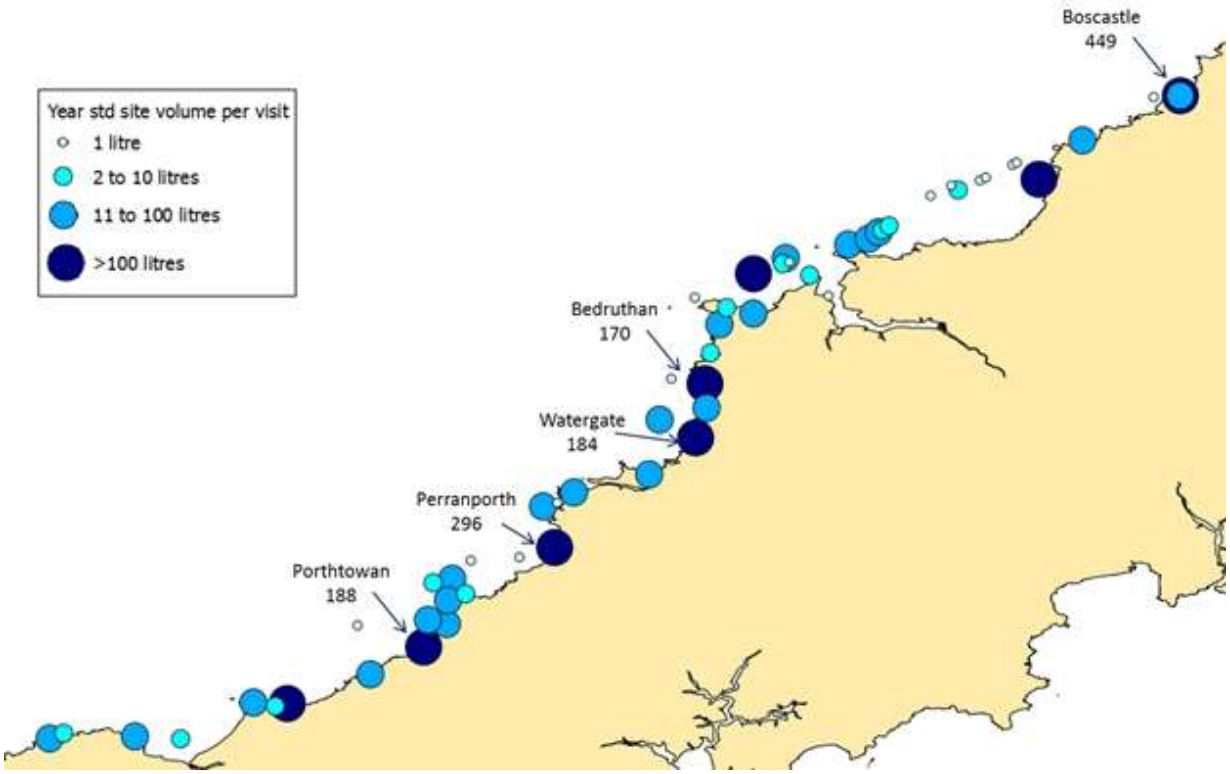


Figure 6: Number of new items per visit (above top). Figure 7: Volume per visit (above bottom)

As a slightly different number of surveys were completed along each repeated coastal transect, the number of new ghost gear items and their associated volumes in litres have been displayed as means per visit to correct for effort in figures 6 and 7. As many of the sites were very close together, records were combined into 23 standardised sites, effectively grouping nearby locations, plus 23 offshore locations. This provided a more meaningful overview of results and added clarity to otherwise considerably cluttered maps.

Ghost gear was recorded as a single item if it was physically joined together. For example a monofilament gill net with ropes and buoys attached was recorded as a single item, whilst two unlinked buoys at the same site were recorded as two items.

Following CSIRO's advice of referring to volumes of body parts known to all helped to standardise the quantification of item size by volunteers. Research, combined with experiments, enabled these sizes to be reliably converted from average known volumes into litres (appendix C). Describing volumes of ghost gear in litres was chosen in preference to tonnes as it was more suitable for smaller quantities, being accurately verifiable by experimentation and in the knowledge that different types of ghost gear items weigh considerably different amounts according to whether they are wet or dry. As a result, conversions to tonnes would have required means to be calculated from minimum (dry) and maximum (wet) weights, potentially adding an extra layer of error to calculations. Using litres proved to be considerably more accurate and meaningful for the purposes of this research. It would be possible to convert litres to mean tonnes using a conversion table developed for different types of ghost gear and this is something to be recommended for future research.

Filtering out items that had been reported before was critically important (for example items in a bird's cliff nest) to give an indication of the new gear being added or washed in over time. Whilst there was likely to be some delay between ghost gear being washed into a site and recorded for the first time, this method enabled an indication of the new items lost or washed in over time.

After filtering out all the data for items that had previously been recorded, a total of 1398 ghost gear items were recorded in the field and subsequently in the office from photographs amounting to 19560 litres or 20 tonnes (appendices A and B for detailed methodologies) at 46 different locations. On average this is four new items (54 litres) a day, 26 new items (376 litres) a week or 116 new items (1630 litres) a month. These quantities are likely to represent a considerable underestimation given the challenge of surveying at sea: on a moving platform; holding binoculars steady; surveying from sea level with a low angle of view; wave motion and the low chance of encountering items within the small field of view close to the vessel. These challenges, along with surveying the coast from the sea at distance, make it very difficult to see small items.

Using the density of pure water at 4^{o}C (1000 kg/m^{3}) or sea water at 25^{o}C (1021.98 kg/m^{3}) a litreage of 19560 would represent 20 tonnes of ghost gear (Hazell and Walker 2015).

Ghost gear was distributed along the entire survey transect as shown in figures 6 and 7. Whilst most sites had between two and ten items of ghost gear per visit, five had over 10 items per visit and these have been labelled on the figure 6. Most sites had between two and ten litres of ghost gear per visit, with eight recorded as having over 100 litres per visit (the top five have been labelled on figure 7). Four of the top five sites appear on both maps suggesting that sites with a lot of items also built up the greatest volumes of ghost gear. All of the sites with the greatest number of items were long northwest facing beaches as opposed to headlands. Ocean processes tend to move material away from headlands and deposit it on beaches in bays. There was some difference in the west / east distribution of ghost gear items and their associated volumes. Most items per visit were found along the west or central areas of the coastline surveyed whilst more of the sites with the greatest volumes per visit were located in the eastern half of the

coastal transect. This contradicts the idea of sites with most ghost gear items also having the greatest build up of volume.

Type of ghost gear items – entire survey area

Ghost gear items were classified according to type into the following categories: Buoys (B) / floats (F), monofilament line (L), net monofilament (NM), net trawl (NT), pots (P) / rubber strips (RU), rope (RO) and other (O). For the purposes of this report buoys and floats were grouped together as were pots and rubber strips used within the pot structure.

Items that contained a mixture of different types of ghost gear were categorised according to the majority item, so for example a monofilament gill net tier with headline floaty rope / buoys and weighted bottom rope was classified as net monofilament.

Whilst all types of ghost gear were recorded, most were buoys followed by trawl net, monofilament net and rope.

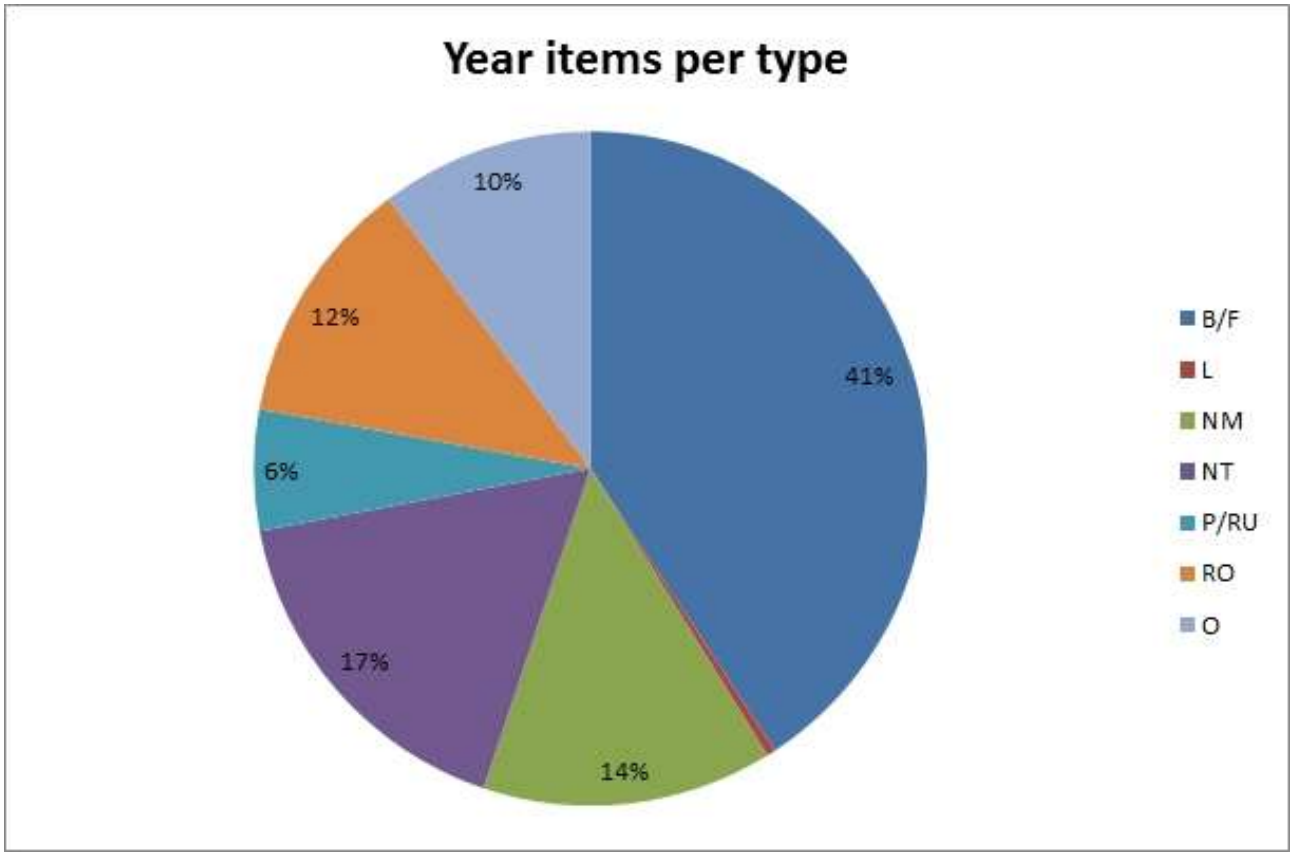
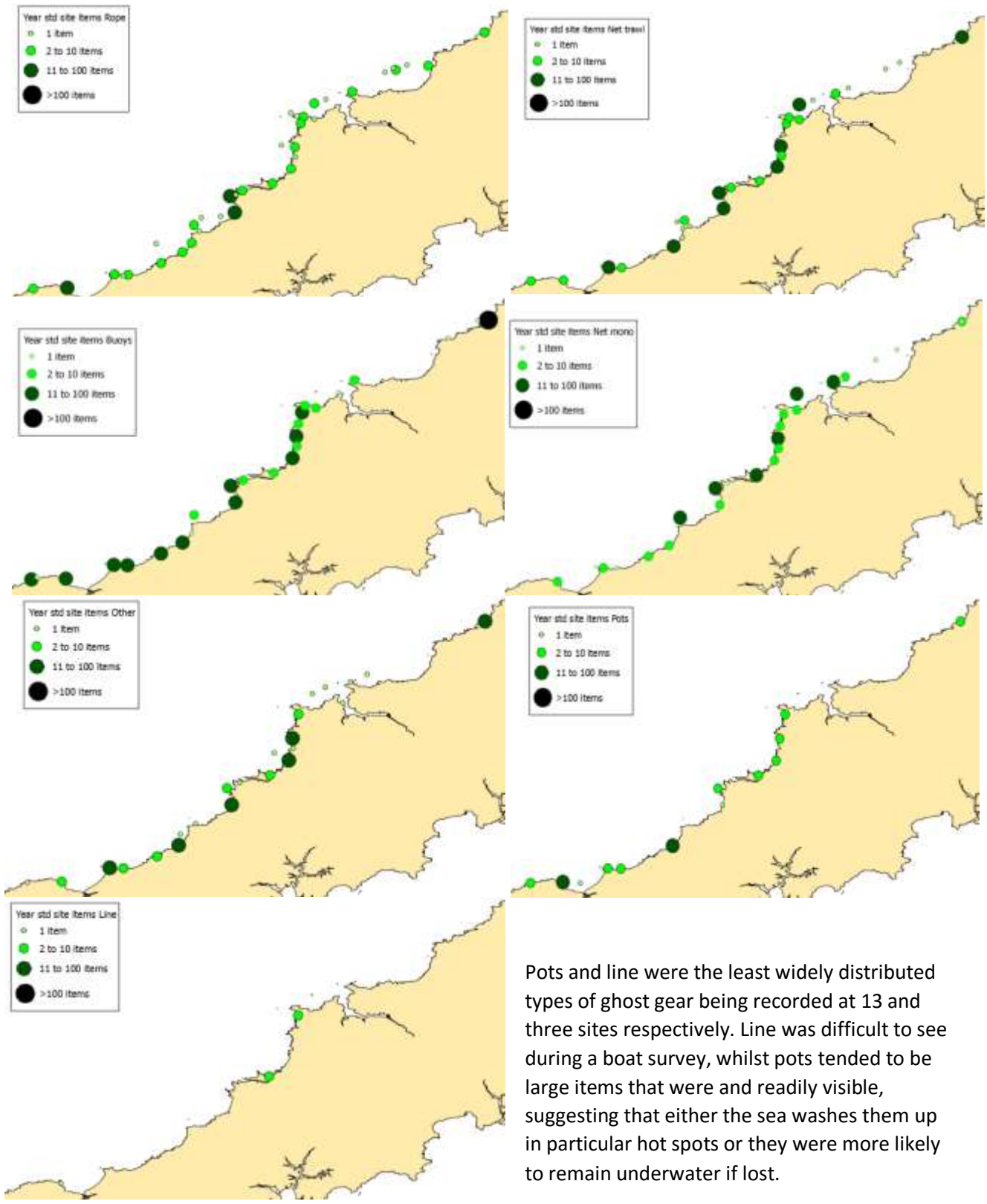


Figure 8: Total proportions of ghost gear classified by type

Each type of gear was distributed differently around the coastline with rope being most widespread - found at most sites (n = 36). Also widespread were:

- Trawl net at 30 sites
- Monofilament net and buoys at 25 sites and
- Other items at 23 sites.



Pots and line were the least widely distributed types of ghost gear being recorded at 13 and three sites respectively. Line was difficult to see during a boat survey, whilst pots tended to be large items that were and readily visible, suggesting that either the sea washes them up in particular hot spots or they were more likely to remain underwater if lost.

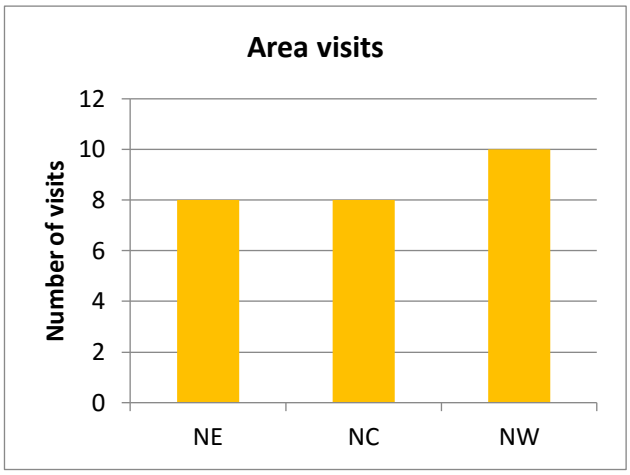
Figure 9: Distribution of ghost gear by type in order of the number locations where they were recorded

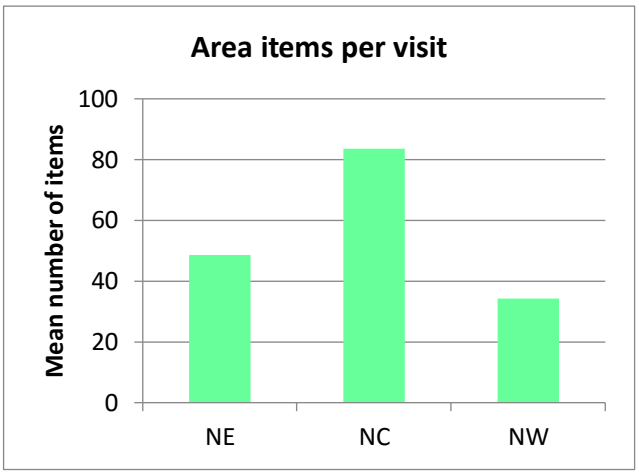
The shoreline in St Ives Bay and between the Mouls and Pentargon were not surveyed for ghost gear, but both locations presented the chance to survey more open water. Whilst only one item (pot gear) was observed in St Ives Bay, numerous items were observed in the sea between the Mouls and Pentargon.

Ghost gear was found in all types of marine habitat surveyed – beach, cliff backed, dune, estuarine and offshore islands as well as in the open sea.

Standardised area survey effort (visits), number of ghost gear items and volume

Each of CSGRT's survey transects covered a different standardised area of the north coast (appendix D) with overlapping islands at Bawden Rocks (off St Agnes Headland) and the Quies (off Trevose Headland).





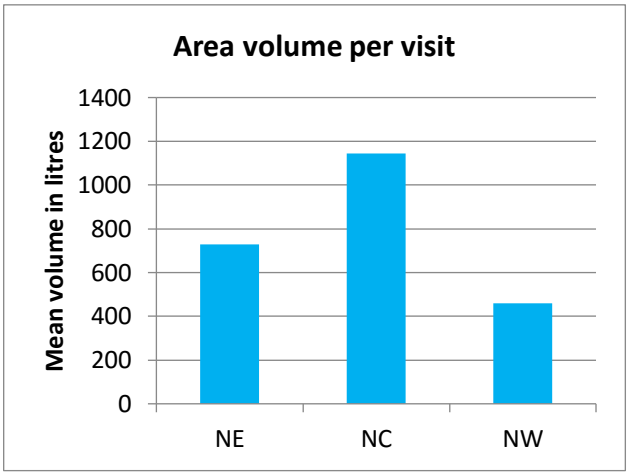


Figure 10: Survey effort, items and volume by area

As each of these three standardised areas were surveyed a slightly different number of times the number of ghost gear items and volumes were averaged per survey visit. For both these ghost gear parameters, the north central area of the Cornish coast had the most, with the northeast area having just under half that of the north central area and the northwest having least.

Figure 11: Distribution of ghost gear by area (below)

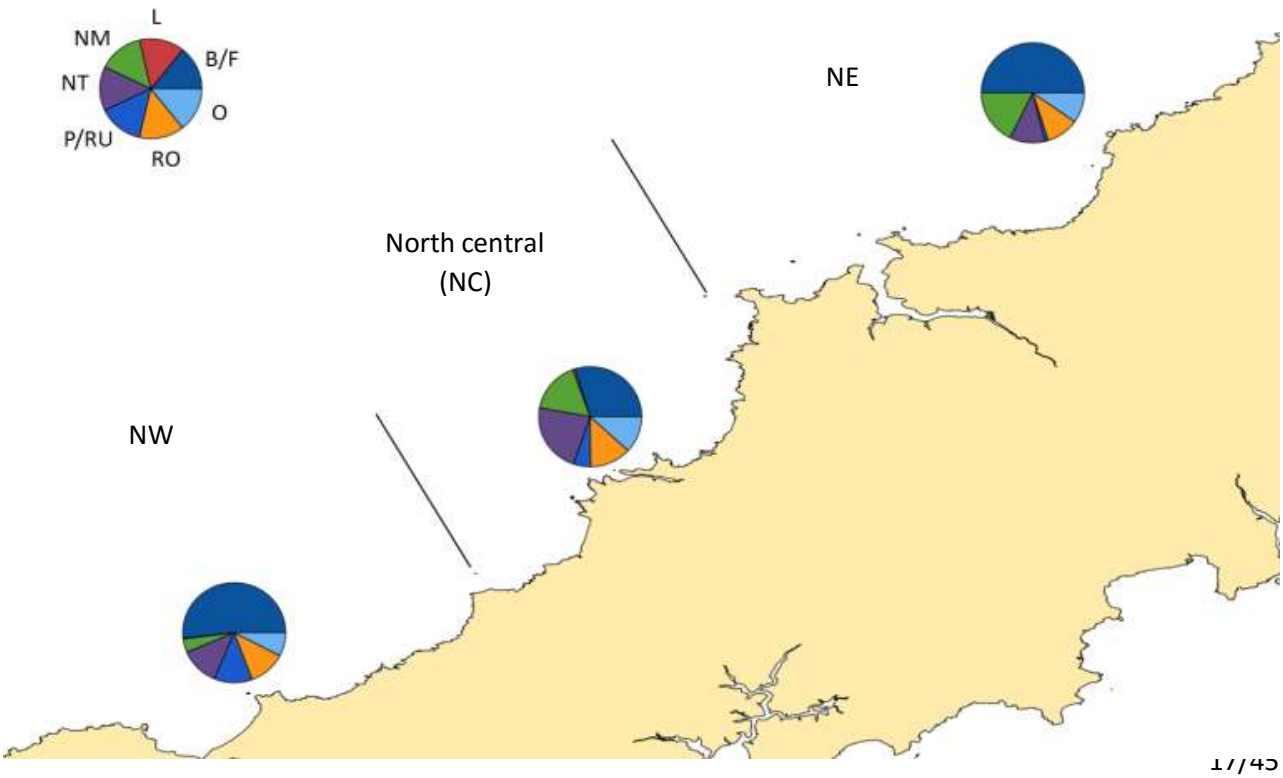


Figure 11 shows that buoys and floats were the predominant ghost gear item right across the north coast making up around half of the items found in the northwest and northeast standardised areas. Trawl net was found in reasonable proportions across the three areas but greatest in the central area. The proportions of monofilament net were high in the north central and northeast standardised areas. Higher proportions (albeit small ones) of pots were found in the northwest and central areas whilst being almost absent from the northeast area. Rope was distributed in fairly even proportions in all three areas, whilst line barely featured except in a miniscule proportion in the north central area. It seems likely that the more perpendicular angle of this central stretch of coastline (particularly between Perranporth and Trevose) is responsible for collecting more seaborne ghost gear items that blow or wash in from prevailing south westerly winds and waves, whilst the gentler angle of the other sections of the north coast trap less gear.

Boat based surveys: temporal distribution

Quarterly (seasonal) visits, items, volume and items by type

The entire survey period ran from 01/11/14 to 31/10/15. It made sense for the ghost gear data to be analysed seasonally, so for the rest of the temporal distribution data in this report, the initial month (November) was added to the end of the recording period allowing data to be presented in terms of winter (December, January and February); spring (March, April and May); summer (June, July and August) and autumn (September, October and November).

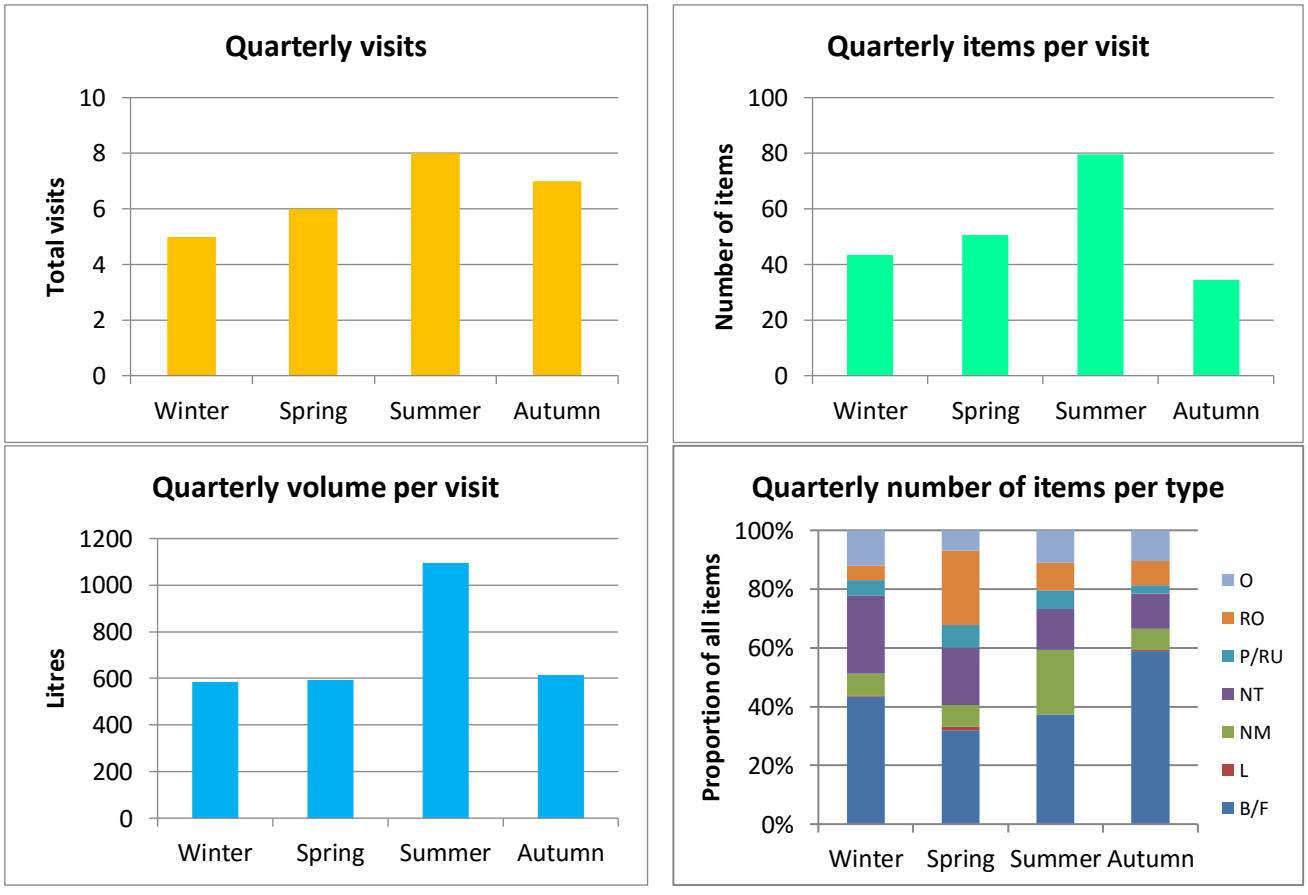


Figure 12: Survey effort (visits), items / volume per visit and ghost gear type by season

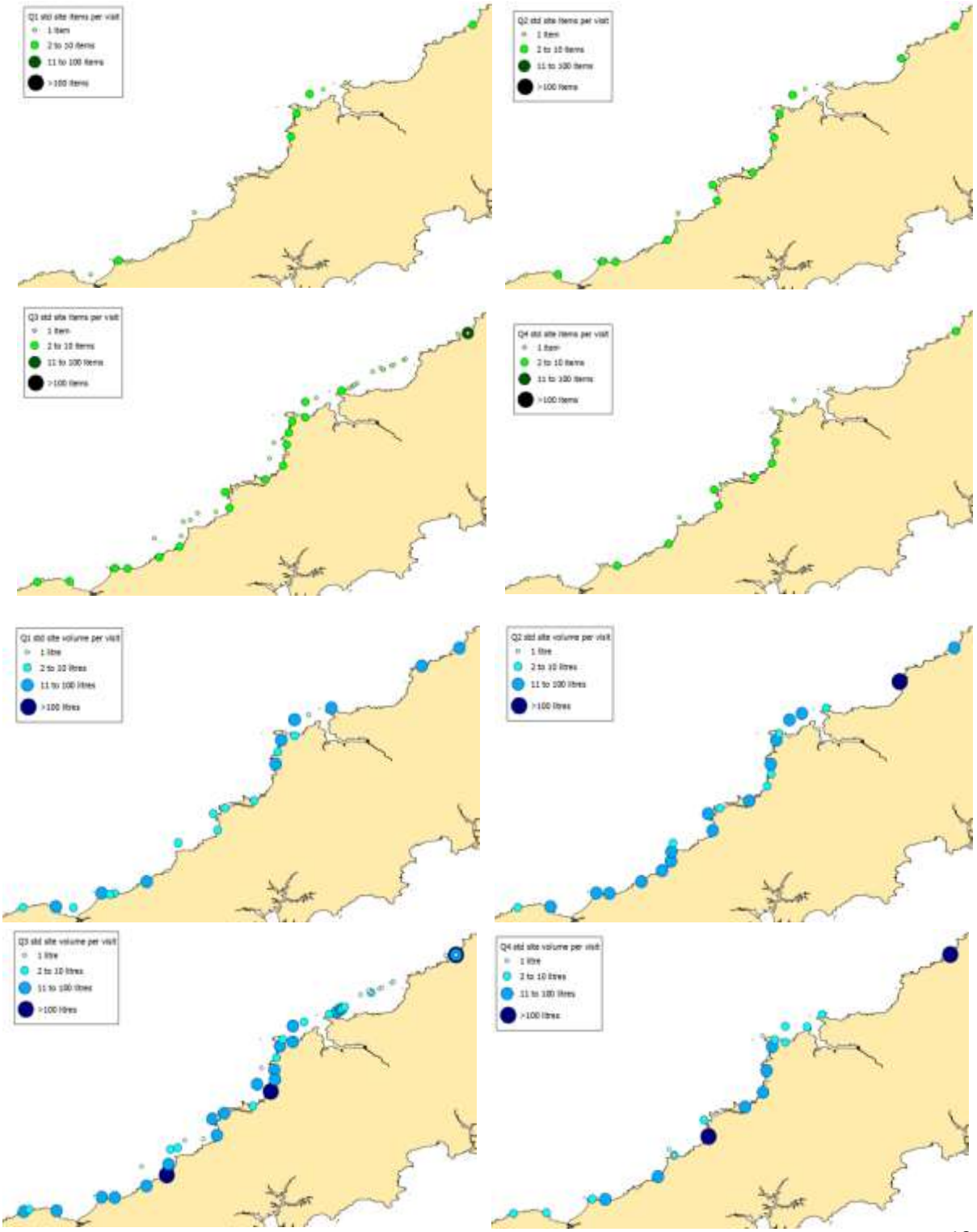
There was a lot of consistency about the mean number of items and volume of ghost gear per visit across the seasons with the exception of the summer when considerably more items and greater volumes were recorded. Whilst it is recognised elsewhere in this report that not all ghost gear is locally generated (see page 40) an obvious potential explanation of ghost gear peaks in the summer relates to gear loss associated with a peak in local fisheries effort.

Figure 12 shows there was an apparent variation in the number of ghost gear items being observed seasonally, with proportionally high quantities of trawl net being recorded in the winter, rope in the spring, monofilament net in the summer and buoys in the autumn and winter.

Quarterly (seasonal) spatial distribution

There appeared to be an additional spatial variation in the seasonal distribution of ghost gear observed. Not only were more items and volume per visit recorded during the summer (quarter 3), but these items were spread over around twice as many sites too (summer n = 50) compared to winter (n = 23), spring (n = 25) and autumn (n = 26).

Figure 13: Distribution of ghost gear by season (below)



Monthly boat based visits, items, volume and items by type

A further breakdown of the data into months enabled a more detailed analysis of patterns to be undertaken. The quarterly peaks in items and volume per visit were not driven by anomolous invididual months, indicating that the patterns observed were not driven by the sea ar weather conditions and associated visibility issues experienced during a particular monthly survey. Rather there were sustained similarities across the months for each season or trends of change within them.

Monthly items per visit clearly rose and then fell gradually from the peak recorded in July, whilst the peak of greater ghost gear volume was sustained through the summer before declining steadily during the autumn. Likewise the greater proportions of trawl net in the winter were sustained over more than one month, as was the greater proportion of rope in the spring. Monofilament net clearly progressively increased from April to August before suddenly dropping off again at the start of the autumn and buoys progressively increased from July to the peak in November, which was probably sustained until January.

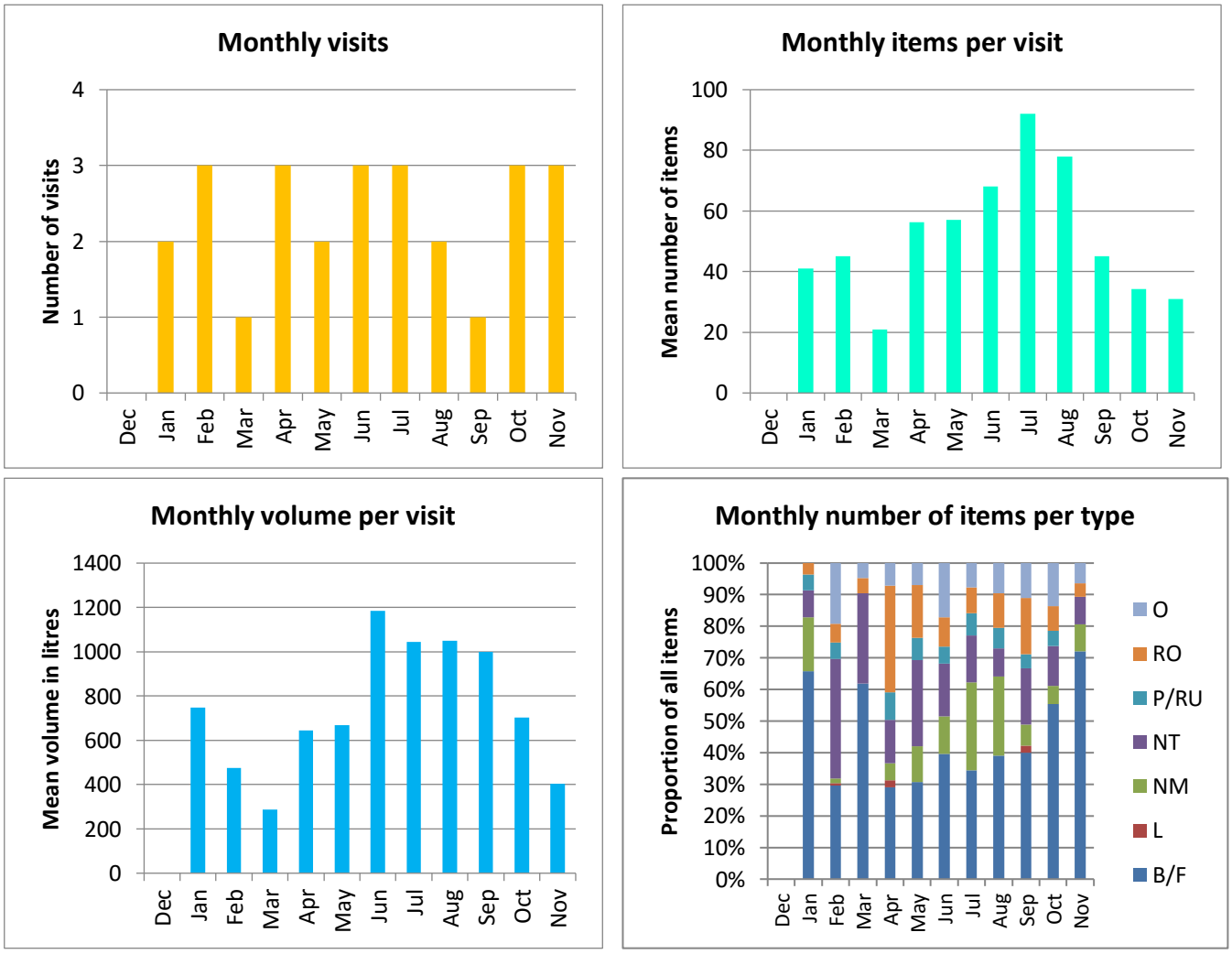


Figure 14: Survey effort (visits), items / volume per visit and ghost gear type by month

This monthly analysis adds validity to the conclusions being drawn about the temporal seasonal patterns of ghost gear abundance that were described on pages 18 and 19.

Results and discussion

Land based surveys: spatial distribution

Survey effort (visits) – entire survey area

Between 01/11/14 and 31/10/15, a total of 1445 records were generated from 360 surveys at 147 raw sites by 67 volunteers, seven different organisations and four photo ID teams. For a comprehensive list of voluntary contributors to this report, please see page 45.

As many of the sites were very close together, records were combined into standard sites (n = 46), effectively grouping nearby locations into one. This provided a more meaningful overview of results and added clarity to otherwise considerably cluttered maps.

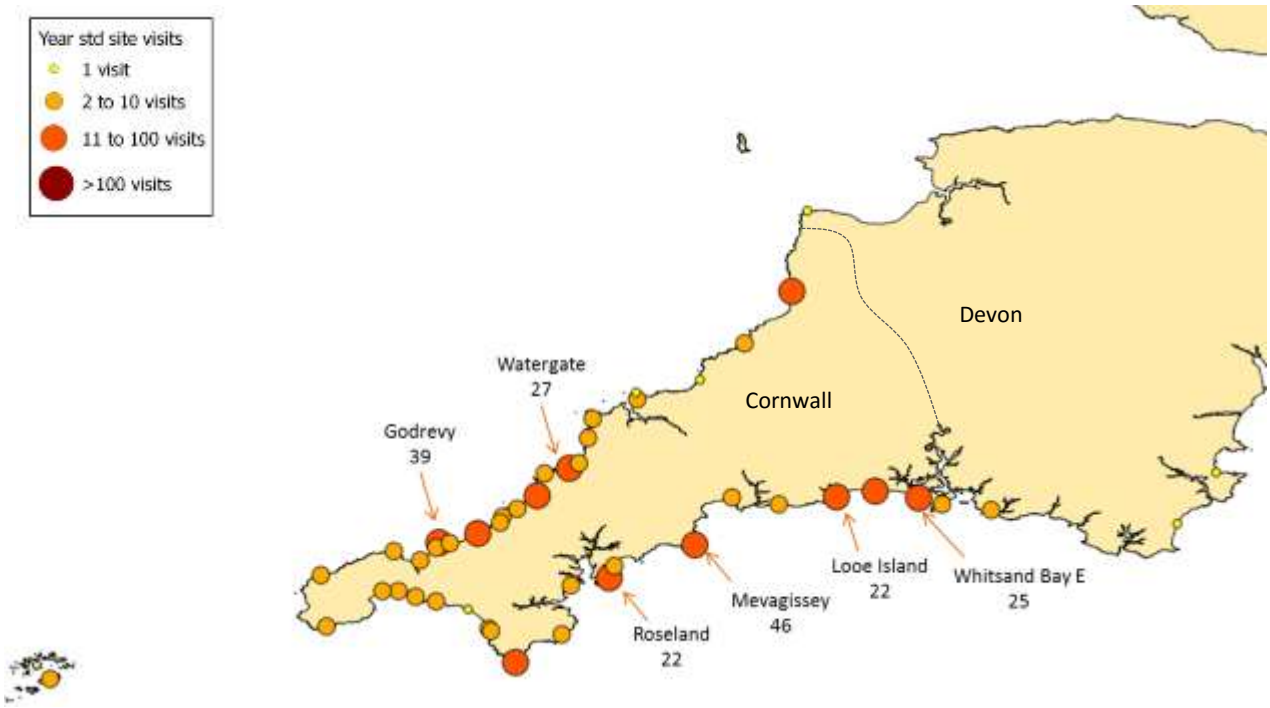


Figure 15: Number of visits made to standardised sites with positive ghost gear records

Figure 15 shows that ghost gear was surveyed at sites around the entire coastline of Cornwall and the Isles of Scilly, as well as across the borders into north and south Devon in SW England, UK.

The majority of these sites were surveyed more than once and some many times, up to a maximum of 46 visits. All the sites surveyed over 20 times have been labelled with their locations.

The number of visits displayed on the map represents a minimum number of visits, as some sites were routinely surveyed for seals (such as Godrevy, the Roseland, Mevagissey and Lizard Point) so will have been surveyed considerably more frequently than indicated on this map, as this map only shows visits where ghost gear items were observed (visits with nil records were not reliably reported).

Volunteer survey effort (as reflected by visits) was well distributed and provided effective coverage of the coast of Cornwall demonstrating the high level of commitment made by a large number of people. All of these individuals had sufficient interest in the issue of ghost gear to photograph its presence either opportunistically whilst they were out and about, or to conduct ghost gear specific walks along a particular stretch of coastline. Some volunteers became highly engaged in the project and conducted systematic surveys repeated throughout the entire survey period, routinely removing ghost gear items each time.

As land based records were collected opportunistically with a variable number of visits to each standardised site, resulting data has been presented as a mean per visit to correct for variations in effort and to enable comparisons to be made across sites. The Isles of Scilly are inset to maximize the map size.

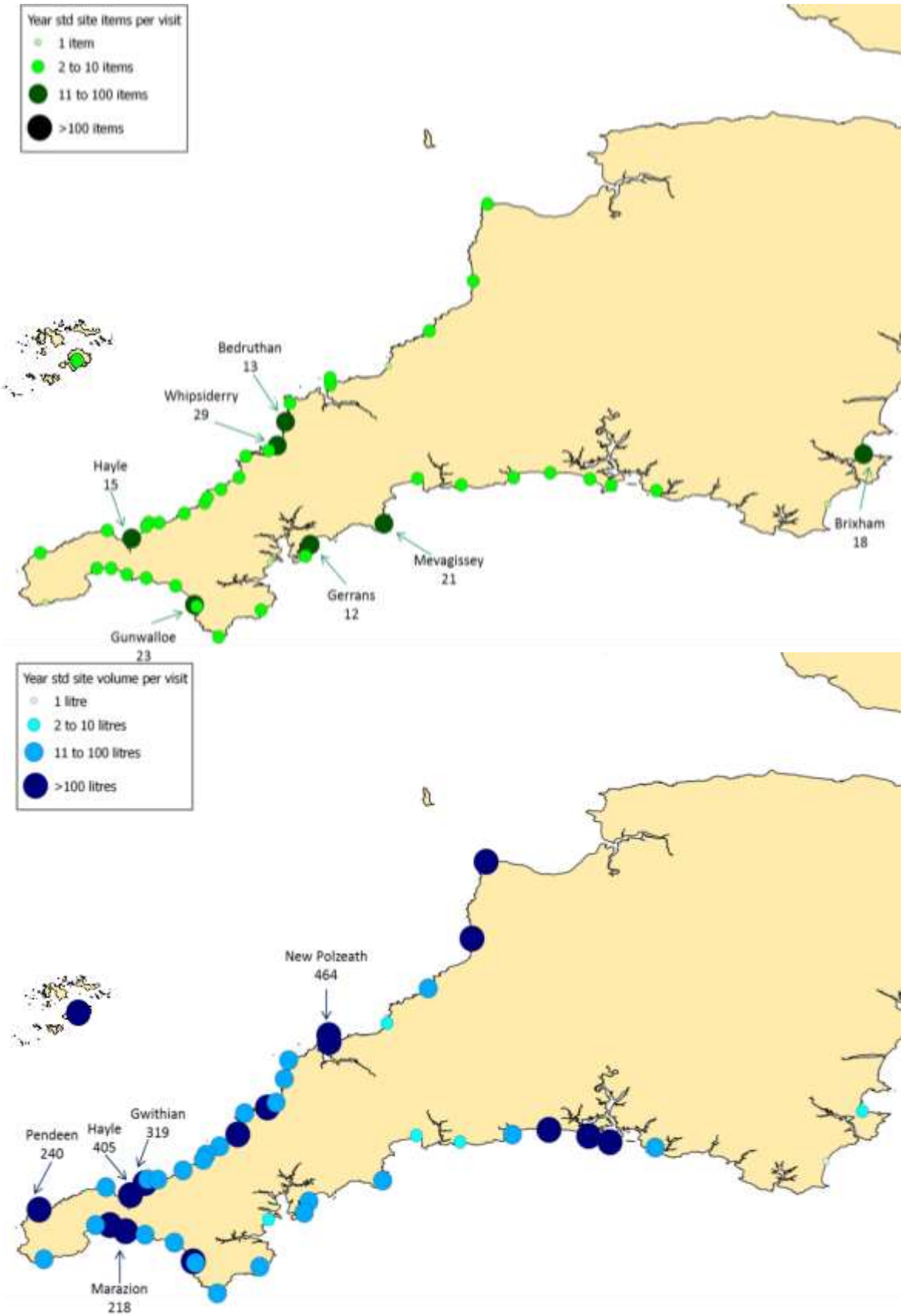


Figure 16: Number of new items per visit (top). Figure 17: Mean volume per visit (bottom)

Number and volume of ghost gear items – entire survey area

As on the boat surveys, ghost gear was recorded as a single item if it was physically joined together. For example a monofilament net with ropes and buoys attached was recorded as a single item, whilst two unlinked buoys at the same site were recorded as two items.

The same method was used by volunteers for recording the size of each item (using CSIRO's advice referring to the sizes of body parts known to all) to standardise the quantity and these were converted into litres.

Filtering out items that had been reported before remained critical (for example items trapped in rock, part buried in sand or just seen more than once) to give an indication of the new gear being washed in over time. Whilst there was likely to be some delay between ghost gear being washed into a site and recorded, for sites that were repeatedly visited throughout the entire survey period, this method enabled an indication of the new items lost or washed in over time.

After filtering out all the data for items that had previously been recorded, a total of 2828 different items were recorded amounting to 30,352 litres or 30 tonnes of ghost gear right around the coast of Cornwall, the Isles of Scilly and Devon. This represented an average of eight new items (83 litres) a day or 54 items (584 litres) a week up to 236 items (2529 litres) a month being washed in.

Using the density of pure water at 4°C (1000 kg/m^3) or sea water at 25°C (1021.98 kg/m^3) a litreage of 19560 would represent 20 tonnes of ghost gear (Hazell and Walker 2015).

Ghost gear was distributed around the entire coastline of the area surveyed with most sites having a mean of between two and ten new items per visit. Seven sites had a mean of over ten new items per visit and these have been labelled on figure 16. These sites were on the central and western sections of both north and south coasts in Cornwall and at the eastern limit of the survey area in south Devon. Interestingly four of the beaches with the highest incidents of new ghost gear per visit were west facing – three on the north coast – Hayle, Whipsiderry and Bedruthan and one on the south coast – Gunwalloe. The three other sites on the south coast were all east facing beaches – Gerrans, Mevagissey and Brixham. This may be an indication that the number of ghost gear items washing ashore has less to do with potential wind direction (Cornwall's prevailing wind direction being from the SW) and more to do with ocean processes.

Whilst most sites had between 11 and 100 litres of ghost gear per visit, many sites had more than this. Of the sites with the greatest volume of new ghost gear, all but six were located on the north coast. The six exceptions were at the west and east ends of the south coast of Cornwall. All of the sites with the greatest volume of gear were west facing suggesting that perhaps wind has more to do with the incidence of large volumes of ghost gear, which perhaps are caught more by surface air flows. Five sites in particular had more than 200 litres of ghost gear per visit and all of these are labelled on figure 17.

In contrast to the data from the systematic boat survey data, there was a marked difference between the number of new ghost gear items washing in and their volume. Only one site appeared on both figures 16 and 17 as having a large number of ghost gear items and large volumes of ghost gear too – this was Hayle beach in St Ives Bay and the considerable differences displayed by these two maps shows the importance of quantifying ghost gear using more than one parameter.

Examples of large volume ghost gear items recorded are shown in figure 19 (monofilament net), figure 20 (trawl net) and figure 21 (pots and rope) on pages 25 to 27.

Type of ghost gear items – entire survey area

For consistency with the boat surveys, ghost gear items were classified according to type into the same categories: Buoys (B) / floats (F), monofilament line (L), net monofilament (NM), net trawl (NT), pots (P) / rubber strips (RU), rope (RO) and other (O). Buoys and floats were again grouped together as were pots and rubber strips.

Similarly, mixed material items were classified according to the majority item.

Of all the items recorded most were monofilament line, followed by rope (figure 18). Interestingly these ghost gear types were two of the bottom four items recorded during the boat surveys. It seems likely that line could easily be missed during a boat survey being generally small items coloured for minimal visibility. The greater prominence of rope is harder to explain.

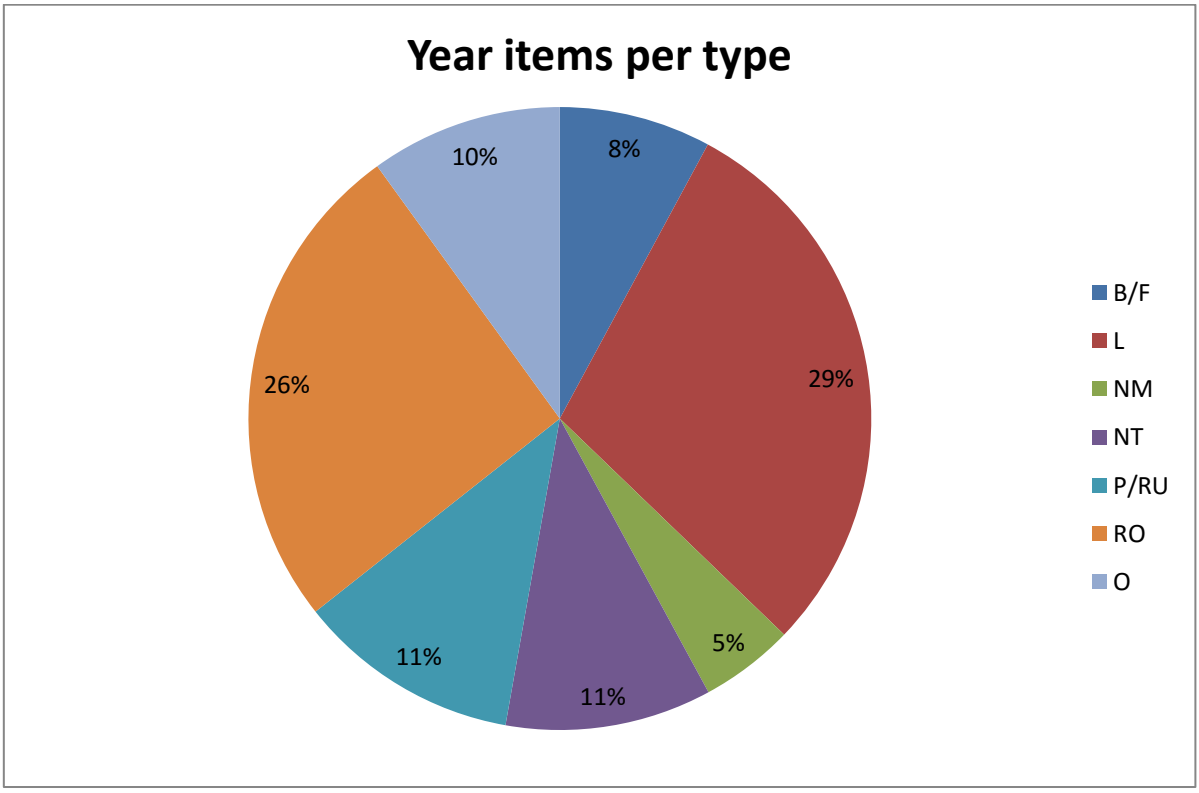


Figure 18: Number of new items according to gear type

Each type of gear was distributed differently around the coastline (figure 22). As on the boat surveys, rope was the most widely recorded at 40 sites, followed by trawl net at 38 sites. The consistency across boat and land based surveying suggests this could be a genuine pattern, but it is worth noting that these items tend to be larger and so more easily visible, found and recorded, although the absence of rope and only small numbers of trawl net items being recorded in the far west of the county may suggest the distribution may be related to fisheries effort. In contrast to the boat survey results, pots were the next most widely recorded ghost gear type at 33 sites. All other land based ghost gear items appeared to have gaps in their distribution for example:

- Buoys and floats (n = 28 sites) – few were recorded either side of the Camel Estuary on the north coast
- Other items (n = 27 sites) – little was recorded either side of the Camel Estuary on the north coast
- Net monofilament (n = 26 sites) – little was recorded in the far west of Cornwall, northeast Cornwall and either side of St Austell Bay
- Line (n = 22 sites) – little was recorded in the far west and along the northeast coast of Cornwall.

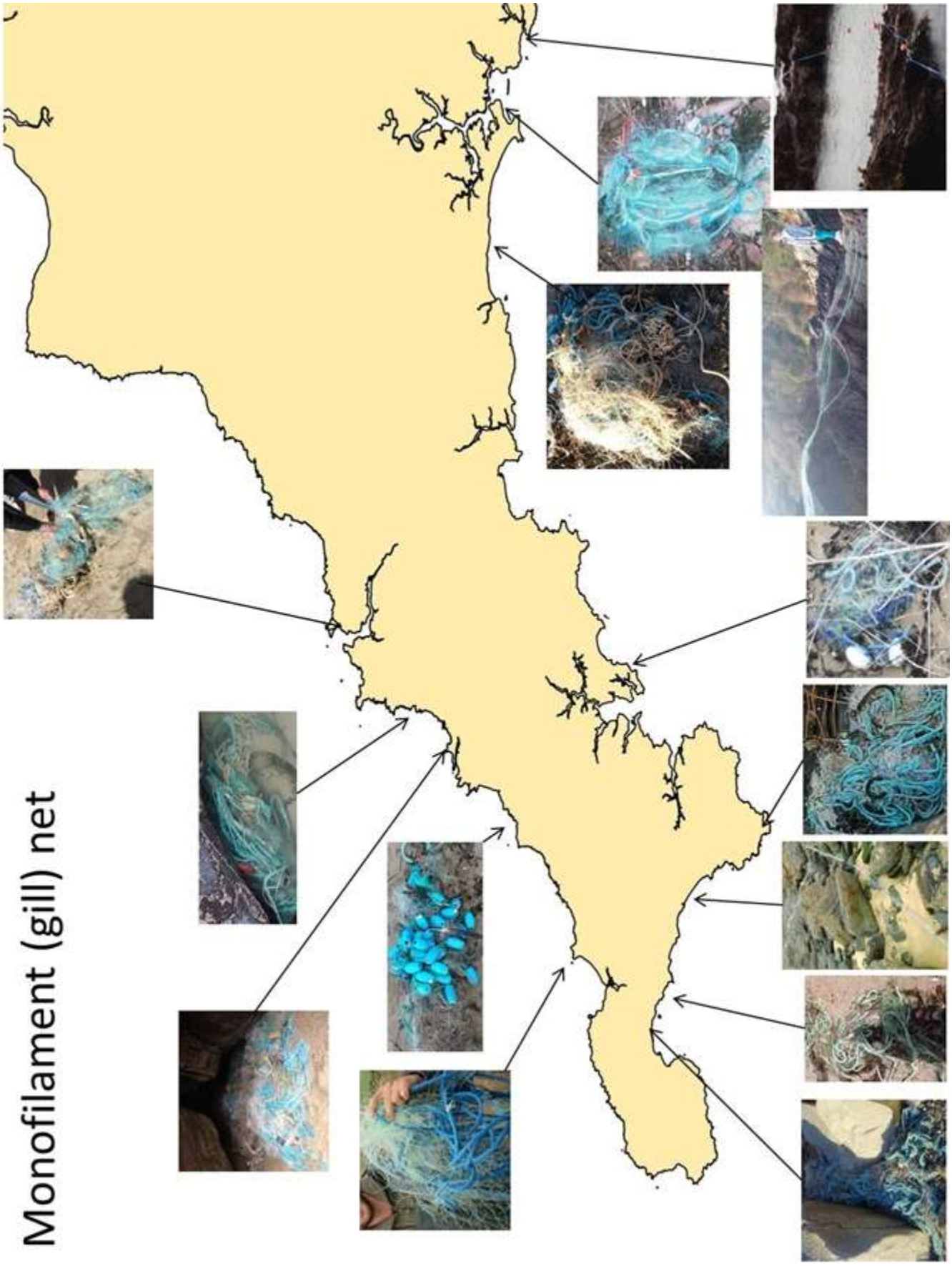


Figure 19: Examples of monofilament net

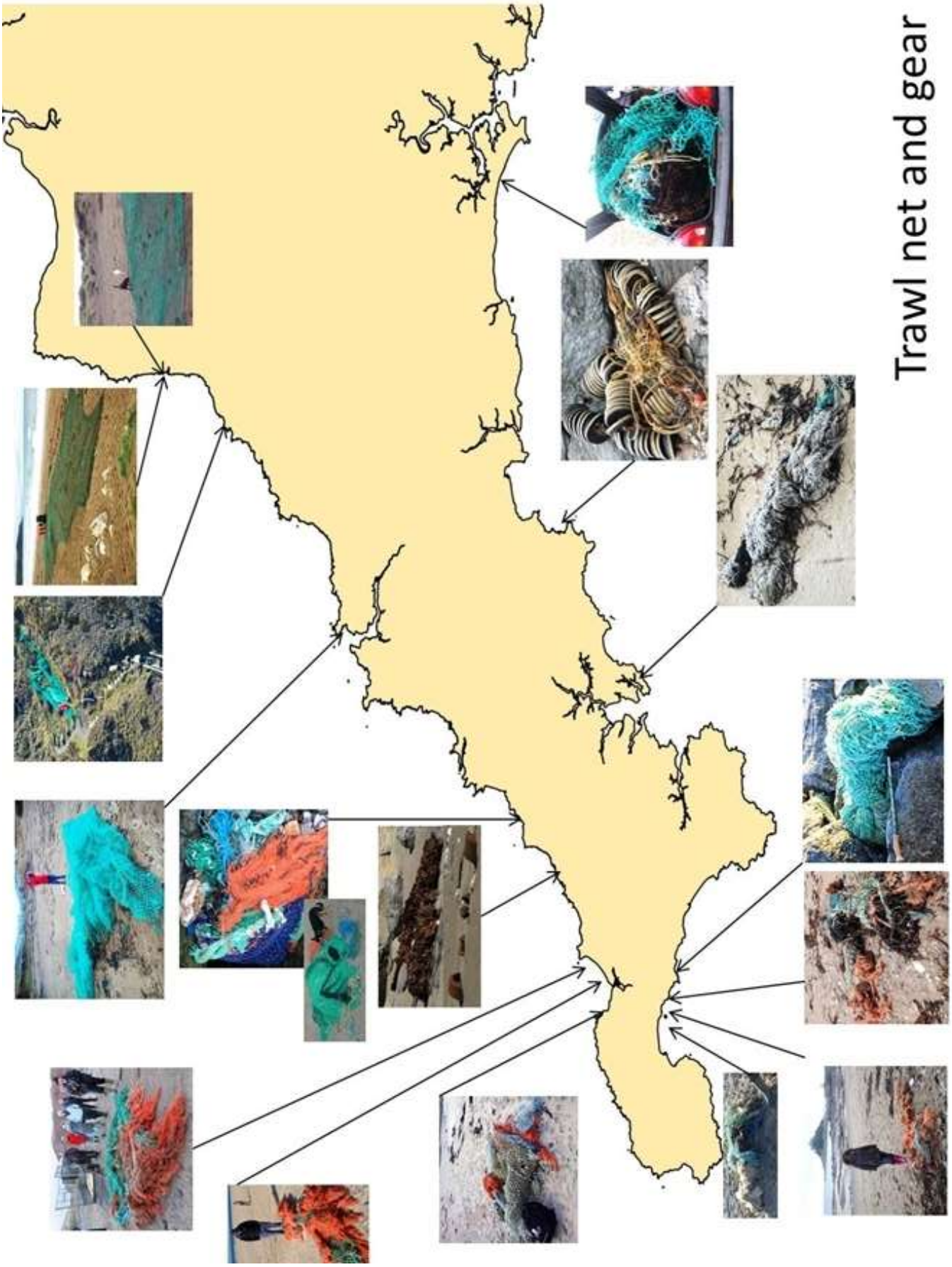


Figure 20: Examples of trawl net and gear

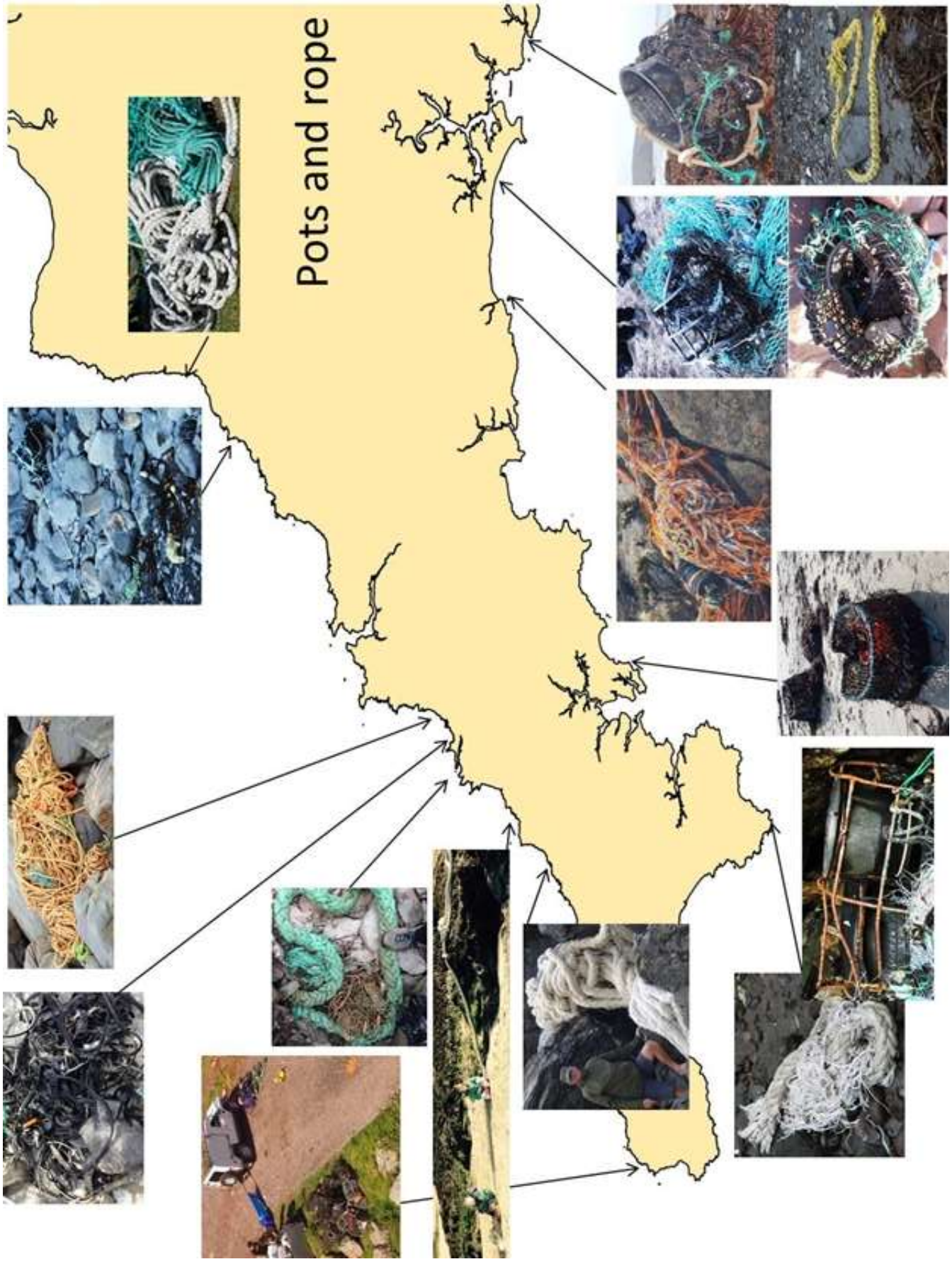


Figure 21: Examples of pots and rope

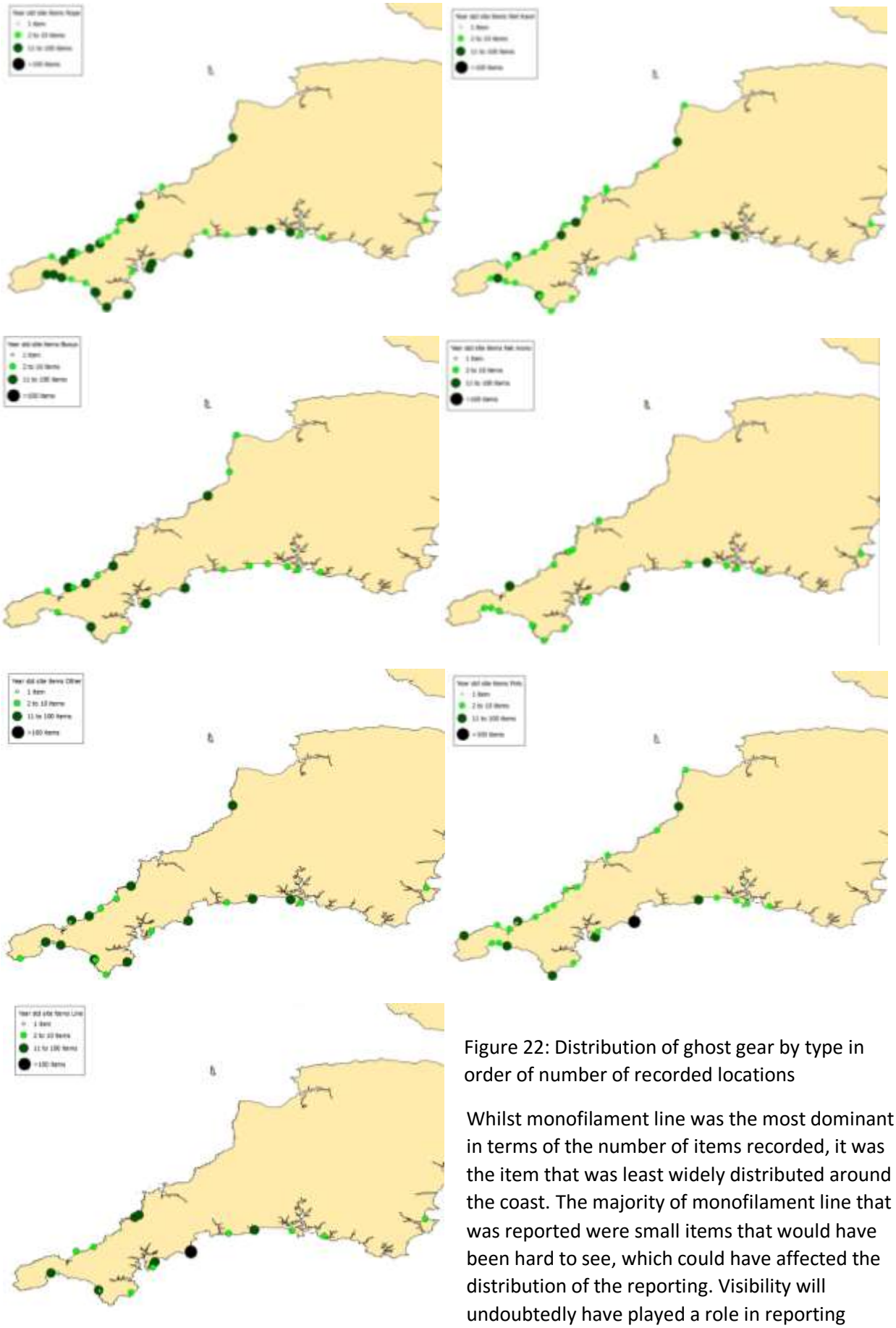


Figure 22: Distribution of ghost gear by type in order of number of recorded locations

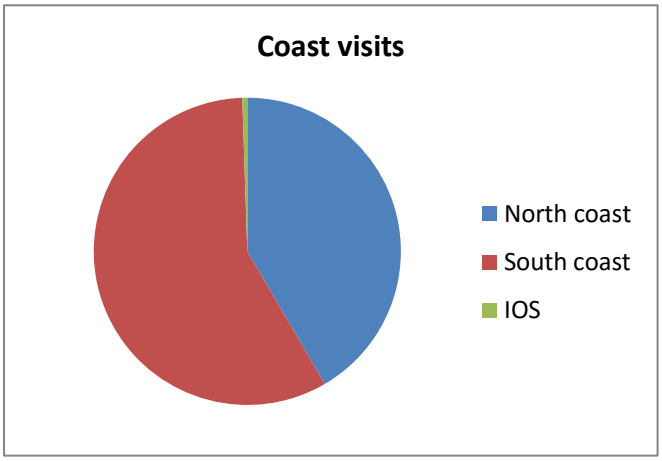
Whilst monofilament line was the most dominant in terms of the number of items recorded, it was the item that was least widely distributed around the coast. The majority of monofilament line that was reported were small items that would have been hard to see, which could have affected the distribution of the reporting. Visibility will undoubtedly have played a role in reporting frequency, along with another factor – that of

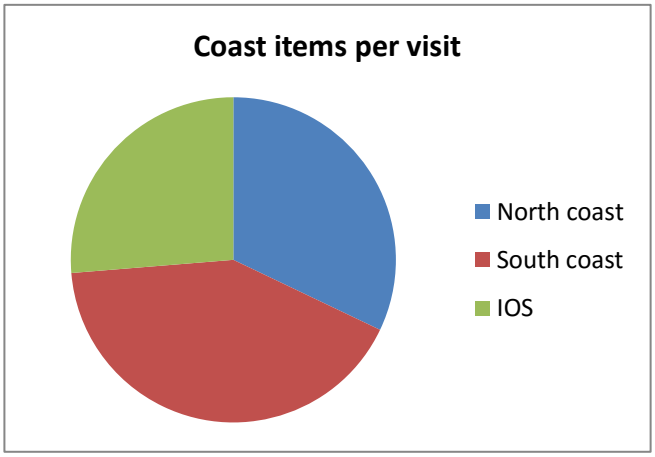
coastal accessibility. Much of Cornwall's west and northeast coasts are high, cliff backed shorelines making them considerably less accessible to the public. Whilst parts are visible from the coast path, many beaches in these areas cannot be easily reached, if at all. Lack of access will have resulted in less ghost gear being seen (particularly smaller items) and so under reported.

To gain a greater understanding of the spatial distribution of ghost gear in Cornwall it was necessary to look at the data at progressively smaller scales – first by coast and then by standardised areas.

Coastal survey effort (visits), number of ghost gear items and volume

Despite surveys being undertaken on an entirely voluntary basis over 12 months, there was a relatively even split of visits across the two coasts of Cornwall with slightly more taking place on the south, rather than the north coast and fewest surveys taking place in the Isles of Scilly. Whist the effort was relatively consistent across both coasts, the number of ghost gear items and their volume were not. Despite the smaller number of records from the Isles of Scilly, each had a considerable number and volume of items recorded (but with such a small sample these findings could be misleading). More ghost gear items per visit were recorded on the south coast, whilst greater volumes per visit were recorded on the north coast.





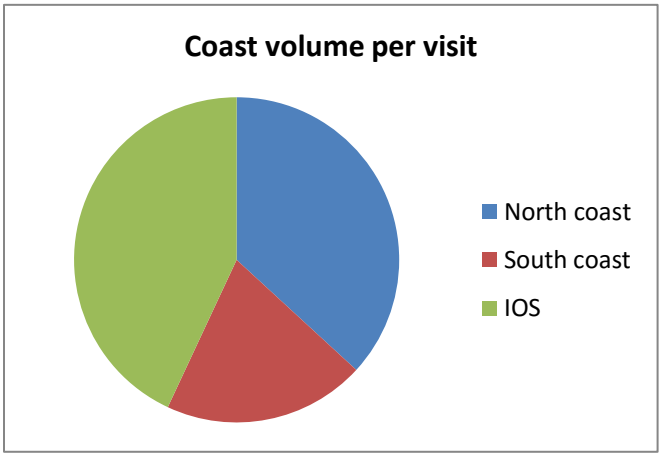


Figure 23: Survey effort, ghost gear items and volume per visit by coast

Cornwall's south coast is relatively lower lying and more accessible than the north coast, which is much more exposed as it faces the Atlantic Ocean. Accessibility could account for the greater number of ghost gear items being reported on the south coast, whilst winter storms may account for the larger volume of ghost gear being washed up and recorded on the north coast.

An analysis of the types of ghost gear items revealed that all types of ghost gear items were found on both coast but there were some obvious differences (figure 24). Proportionally more monofilament line was found on the south coast whilst proportionally more rope and trawl net was found on the north coast. This could reflect an underlying difference in the way the ocean processes sort materials or could be a consequence of differences in fisheries activities. Equally it could result from the visibility and accessibility factors discussed previously.

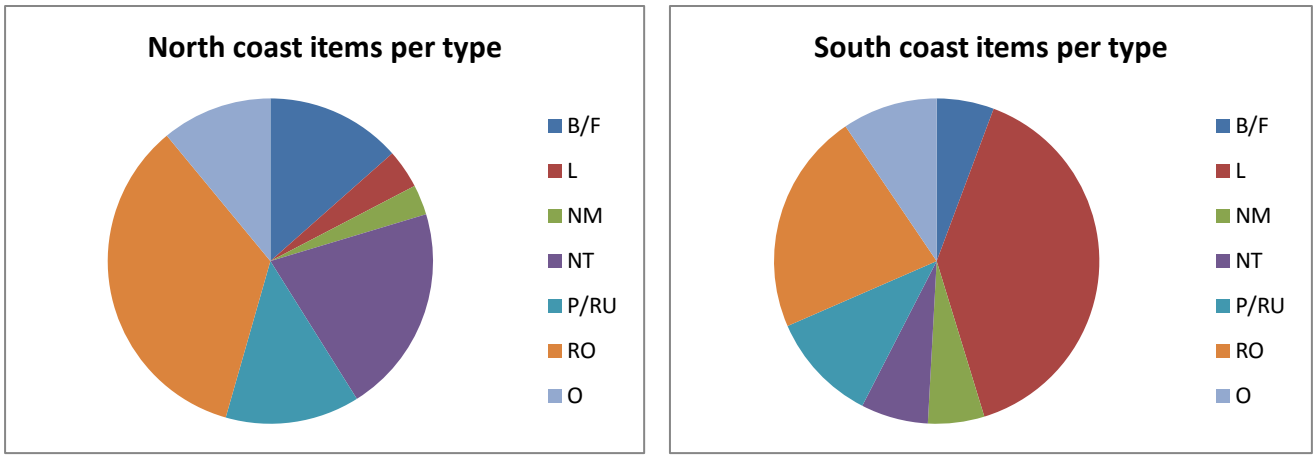


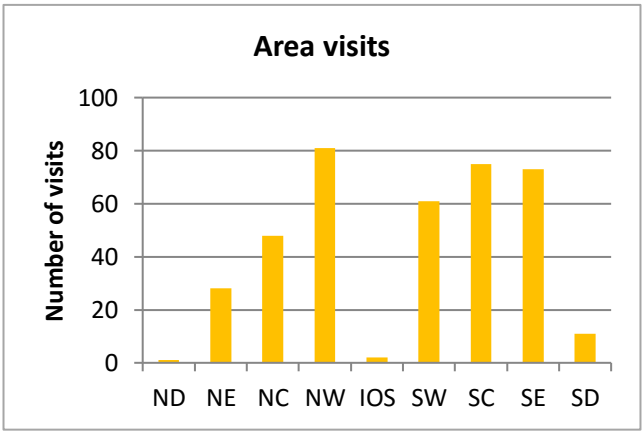
Figure 24: Types of ghost gear items by coast

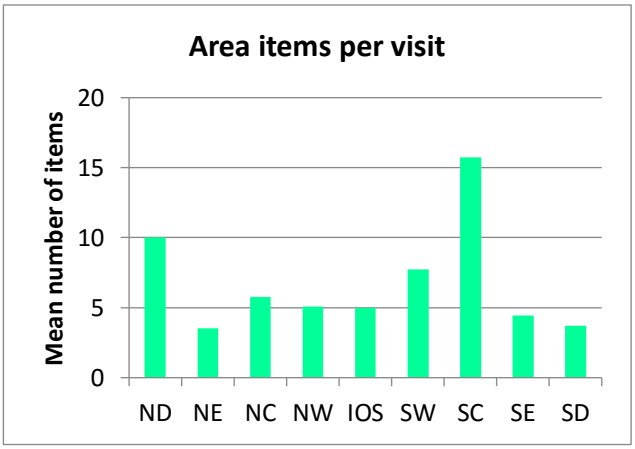
Standardised area survey effort (visits), number of ghost gear items and volume

CSGRT routinely splits the southwest coast into nine standardised areas for the purposes of reporting (appendix D) and as with the boat data, these have been used to further investigate the ghost gear data.

From north to south these are:

- North Devon (ND)
- NE Cornwall: Welcombe mouth to Trevose (NE)
- North central Cornwall: Trevose to St Agnes (NC)
- NW Cornwall: St Agnes to Lands End (NW)
- The Isles of Scilly (IOS)
- SW Cornwall: Lands End to Falmouth (SW)
- South central Cornwall: Falmouth to Mevagissey
- SE Cornwall: Mevagissey to Tamar (SE)
- South Devon (SD)





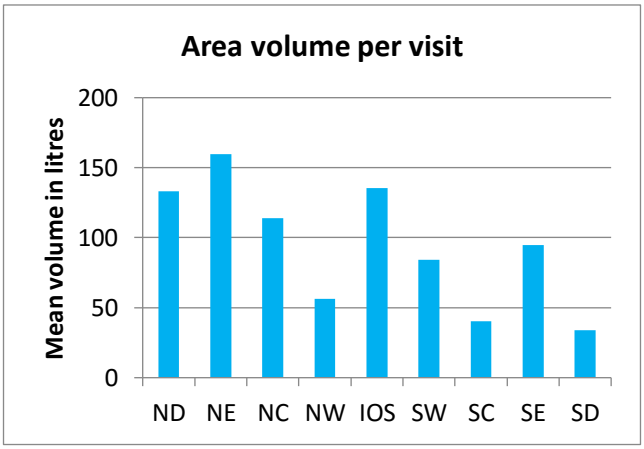


Figure 25: Survey effort, ghost gear items and volume per visit by standardised area

The greatest number of survey visits were undertaken across mainland Cornwall. Little can be deduced from the Isles of Scilly and Devon data due the relatively small survey effort. As a result of the considerable variations in survey effort across the standardised areas, ghost gear items and volume were once again calculated per visit for comparability.

Compared to the systematic boat based survey results there was a surprisingly consistency about the number of ghost gear items per visit across the standardised areas with two exceptions – north Devon and south central Cornwall, the latter of which had over 15 new items per visit. It would be easy to dismiss this as a reflection of one volunteer's considerable efforts in this area (Rob Wells), but as Rob repeatedly removed ghost gear items each visit, these were replaced with new items each time. In contrast, the south central area had one of the lowest volumes of ghost gear per visit, so not only were there lots more items here, these were generally smaller than those found in other areas. The opposite was true in north central, northeast and southeast Cornwall all of which had fewer numbers of ghost gear items reported, but in proportional larger volumes.

Building upon the boat based survey work in figures 9 and 10, these land based surveys have served to demonstrate that ghost gear is an issue all around the coast. Not surprisingly with multiple sites being visited on each boat survey, the scale of the number of items and associated volume of ghost gear were considerably higher than in these land based results from the north coast for each area. Differences did exist in the proportions of gear found across the standardised areas on the south coast.

Figure 26 shows the distribution of ghost gear items by standardised area. Another difference between the south central area and all the other areas – the ghost gear was mostly made up of monofilament line. This accounts for the large number of small items found in this area. Again it would be easy to put this down to Rob's individual recording effort, but in addition to him repeatedly removing it and it being routinely replaced, monofilament line occurred in generally greater proportions right along the south coast, whereas it was only really recorded in the north central area (and a tiny proportion in the northwest area). Whilst it is entirely possible that the lack of accessibility in the northeast area of Cornwall resulted in the lack of monofilament line reporting, it seems likely that there is something about the way the ocean processes operate or fisheries effort that cause this variation in monofilament line distribution.

Rope was reported in all standardised areas and was the greatest ghost gear type in terms of the number of items reported in six of these areas. Pots were recorded in all areas except for the Isles of Scilly with proportionally more being found along the north coasts of Cornwall and Devon (with the exception of the central area) and in greater proportions particularly in the north east compared to the boat survey results.

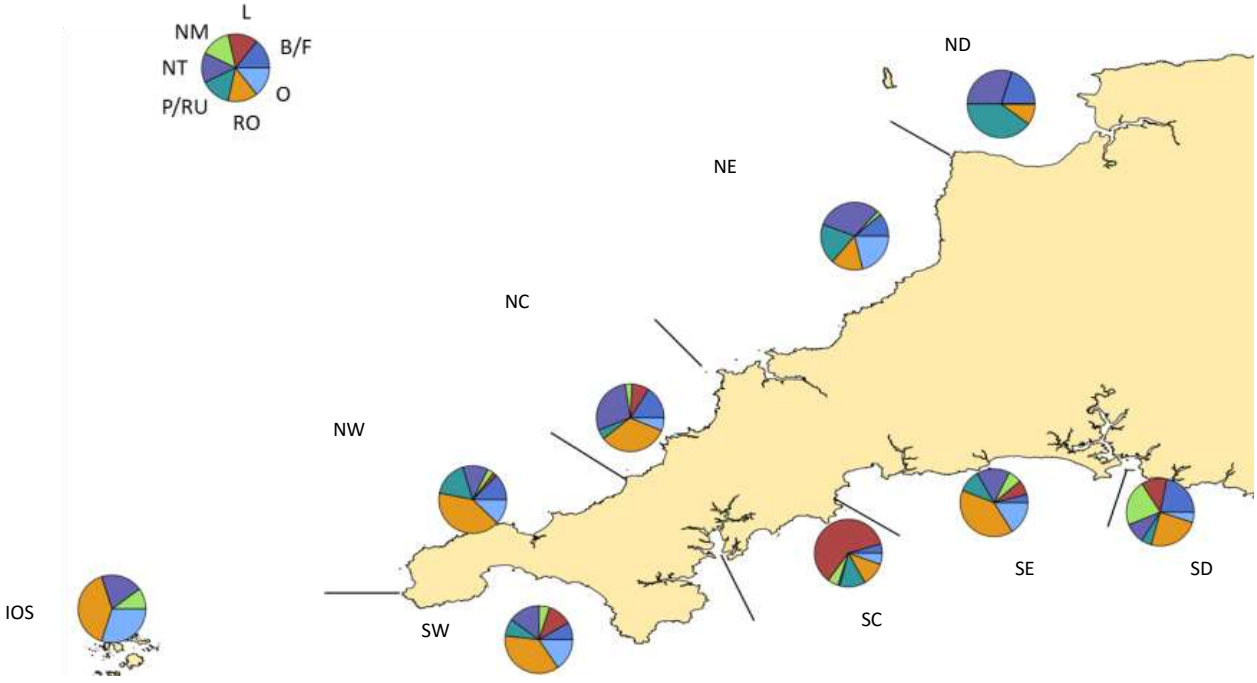


Figure 26: Distribution of ghost gear by standardised area

Trawl net was recorded in all standardised areas although in proportionally greater quantities along the north coast east of St Agnes (consistent with the boat survey results) and in southeast Cornwall. Perhaps trawl net, which tended to constitute larger items, capable of floating at the surface, were affected more by the wind and travelled further east, pushed along by Cornwall's prevailing southwesterly winds.

Buoys and floats were found in all standardised areas apart from the Isles of Scilly and similar to trawl net, proportionally greater quantities were reported on the north Cornish coast and in south Devon. Accessibility must play a part in the number of items of this gear type being reported. Buoys and floats are routinely recycled by fisheries and are collectable items with the general public. As a result buoys and floats are often removed from accessible beaches and so only the others from inaccessible coves and cliff backed shore lines remained to be reported by our volunteers.

Despite being found in all standardised areas (apart from north Devon) and in proportionally greater quantities in the north coast boat survey results, monofilament net was only seen in small proportions with the exception of in south Devon where 22% of reported items fell into this category.

It is interesting that monofilament line and net were both apparently dominant items along the south coast of Cornwall, whilst trawl net and pots were more dominant along the north coast.

Other ghost gear items related to fishing (for example fish boxes, fish buckets, beam trawl rollers) were recorded in all areas (apart from north Devon).

Land based surveys: temporal distribution

Quarterly (seasonal) visits, items, volume and items by type

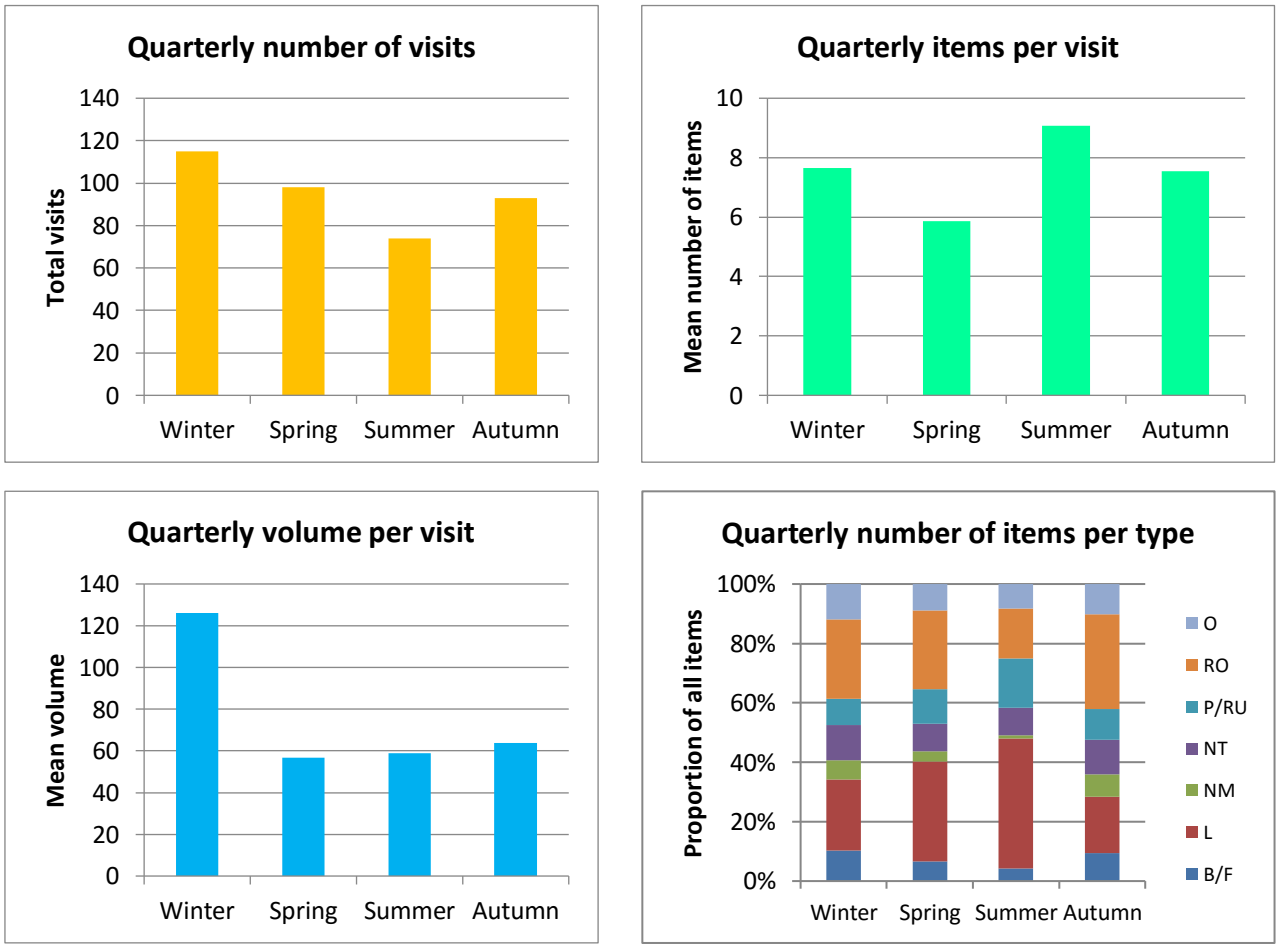


Figure 27: Survey effort (visits), items / volume per visit and ghost gear type by season

Whilst there was a good survey effort in terms of the number of visits across all seasons (figure 27), there was sufficient variation to require the mean number of items and volume of ghost gear per visit to be calculated (figure 27) to enable comparisons to be made. Although the differences were small, most items per visit were reported in the summer (consistent with the boat based surveys), followed by the winter and autumn. As a lot of ghost gear (total 1855 items and 14009 litres) was removed by volunteers and data was filtered to include only new items in these calculations, there will still have been a lag time between ghost gear items being lost by fisheries vessels and it washing ashore. Perhaps the summer and autumn 'peaks' could be attributable to the periods of greatest fisheries effort, whilst the autumn/winter 'peak' is more a reflection of winter storms bringing long lost and perhaps distant items ashore.

In terms of ghost gear volume per visit, there was a remarkable consistency between all seasons apart from the winter when there was a more than two fold increase in the volume per visit being reported. It seems likely that ocean processes played a role here and this winter increase in ghost gear volume per visit may have resulted from winter storms aggregating multiple ghost gear items at sea and then washing them ashore. A similar winter peak in ghost gear volume was not found from the systematic boat based surveys.

All types of gear were reported in all seasons. For buoys and floats, monofilament net, trawl net and other ghost gear items there was little variation in the proportions of these being reported seasonally. There was an increase in the proportion of pots and rubber as well as monofilament line being reported during the summer, perhaps when these fisheries are most active.

Maps of the spatial distribution of items and volume per visit reported each season are in appendix E.

Monthly land based visits, items, volume and items by type

A further breakdown of the data into months enabled a more detailed analysis to be undertaken.

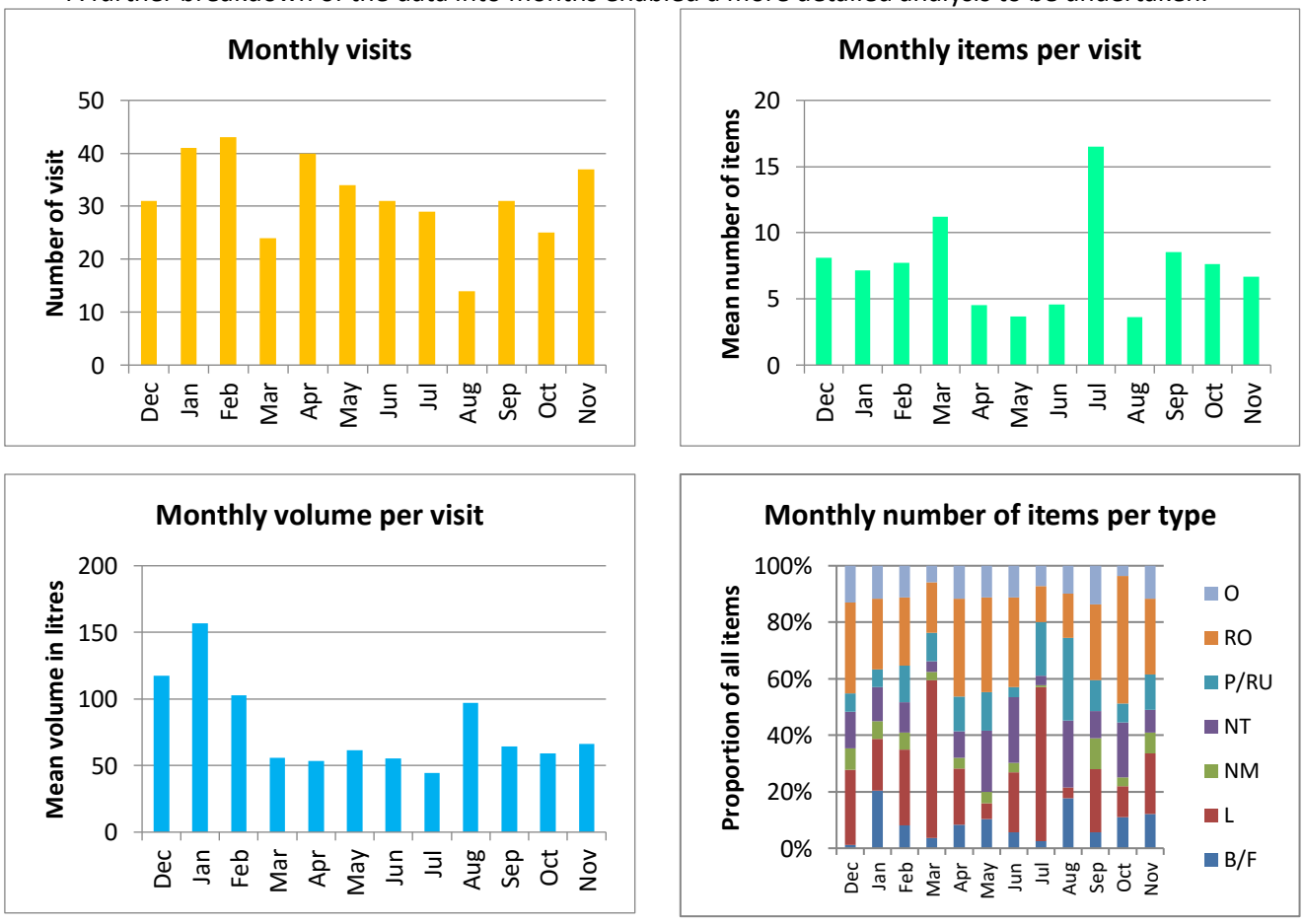


Figure 28: Survey effort (visits), items / volume per visit and ghost gear type by month

There was more monthly variation in survey effort (visits) than seasonally, but once this had been accounted for by calculating the number of items and volume per visit, the data revealed a surprising level of consistency between most months for both parameters with some exceptions.

It seems that the seasonal items per visit 'peaks' in winter and autumn (figure 27) were created by consistent monthly patterns (figure 28), whilst the summer 'peak' described above was driven by data from one exceptionally high month – July. It should be noted that March was also a high month for the number of items per visit reported. Both these months had very high proportions of monofilament line recorded (see figure 28). The high number of monofilament line items per visit in July can be attributable to one volunteer – Rob Wells who was less active in the two preceding months and had a big clear up in July. The March peak in monofilament line arose from both Rob Wells' efforts in the Mevagissey area and Kath Wherry's visits to Gerran's Bay. Whilst CSGRT widely publicised about small bits of line still being responsible for entangling seals, it is not known whether other recorders saw and recorded these items as frequently as Rob and Kath. It is worth noting that July was not exceptionally high in terms of volume per visit being reported, remembering that monofilament line often occurred in very small fist size volumes.

The winter seasonal peak in volumes per visit seen in figure 27 resulted from consistently high reported volumes in all three months (figure 28), suggesting this is much less likely to have resulted from variations in reporting by individual volunteers and much more likely to have resulted from ocean processes.

The peak in volume per visit in August appears to have arisen as a result of four reported items - three very large piles of rope and a line of pots reported by Kate and Dave Williams, Rob Arnold, Widemouth Task Force and the Friends of Portheras/Carbis Bay Crew respectively.

The monthly ghost gear items, volume per visit and type results appear to be inversely proportional to those recorded during the boat based surveys. This suggests that the two marine and coastal environments are acting in combination with some time delay in operation between gear loss, appearance around and then on the coast, perhaps as a result of the different open ocean and coastal processes in operation.

Results and discussion

Risks posed to marine life by ghost gear recorded on boat and land based surveys

As marine species had been observed entangled in ghost gear prior to the start of the survey year, all the ghost gear observed was risk assessed according to the likelihood of marine life interacting with it, as well as the likelihood of marine life becoming entangled in it (see details of the protocol used on page 10).

All sites	No of items	B/F	L	NM	NT	P/RU	RO	O	Volume
Grand total	4226	793	835	333	539	408	893	425	49917.5
Interaction P> (PU, LU, WU, PP> + W)	1688	206	604	215	126	190	231	116	7268.25
Percentage risk of interaction	40%	26%	72%	65%	23%	47%	26%	27%	15%
Entanglement P> (UP, PP> + W)	2454	125	714	296	494	179	559	87	36653.25
Percentage risk of entanglement	58%	16%	86%	89%	92%	44%	63%	20%	73%
Interaction & Entanglement PP> + W	1096	55	537	190	111	58	119	26	5379.5
Serious risk of interaction and entanglement	26%	7%	64%	57%	21%	14%	13%	6%	11%

Figure 29: Ghost gear risks across all sites and all species

Seal sites	No of items	B/F	L	NM	NT	P/RU	RO	O	Volume
Seal site total	1594	304	625	76	66	199	185	139	8528.75
Interaction P> (PU, LU, WU, PP> + W)	1307	176	572	68	50	183	156	102	4249.75
Percentage risk of interaction	82%	58%	92%	89%	76%	92%	84%	73%	50%
Entanglement P> (UP, PP> + W)	853	42	555	51	48	58	74	25	4184
Percentage risk of entanglement	54%	14%	89%	67%	73%	29%	40%	18%	49%
Interaction & Entanglement PP> + W	747	33	505	43	35	53	56	22	2564
Serious risk of interaction and entanglement	47%	11%	81%	57%	53%	27%	30%	16%	30%

Figure 30: Ghost gear risks at seal sites for seals

It should be noted that most ghost gear will not likely remain in situ for long. Whilst on land, with Cornwall's large tidal range much of the ghost gear was thought likely to re-enter the sea and become re-mobilised increasing threat levels to all marine life. Whilst the interaction rating was calculated for the gear in situ, the entanglement risk rating was calculated according the risk posed if the ghost gear was re-mobilised.

Interaction risks

Of all new ghost gear observed at all sites, 40% (by items) and 15% (by volume) was assessed to pose a possible or greater interaction risk to marine life with monofilament line, net and pots posing a greater proportional risk. At established seals sites this increased to 82% (by items) and 50% (by volume) of ghost gear posing an interaction risk.

The temporal dimension of interaction risk was analysed and whilst this may be a reflection of survey effort or ghost gear quantities, there may have been a greater proportional risk during the spring and autumn.

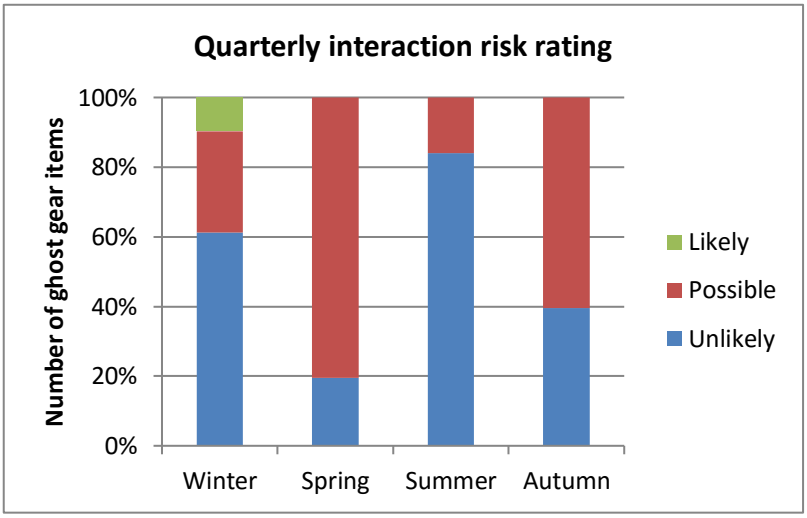
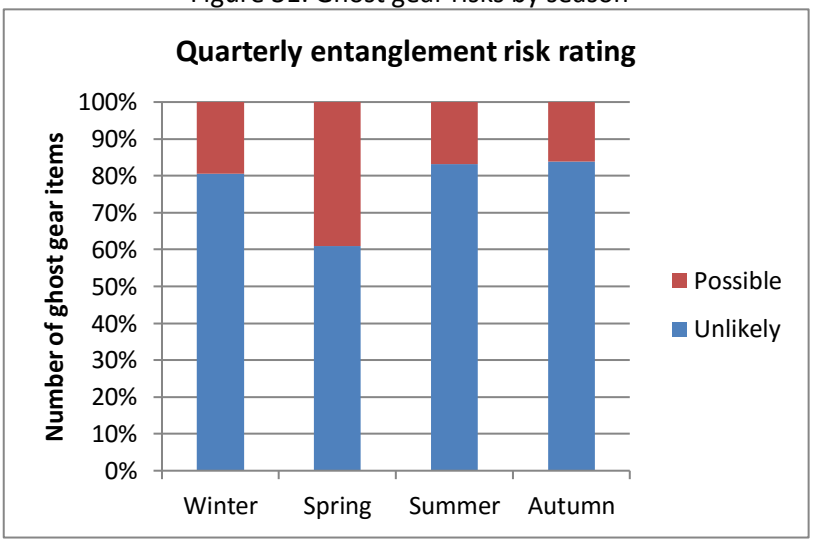


Figure 31: Ghost gear risks by season



Entanglement risks

Of all new ghost gear observed at all sites, 58% (by items) and 73% (by volume) was assessed to pose a possible or greater entanglement risk to marine life with trawl net, monofilament net and line, rope and pots posing a greater proportional risk. At seal sites these assessed entanglement risks decreased to 54% (by items) and 49% (by volume) presumably because a lot of the items were buoys and floats (which were not meshed, looped or balled) or because seals stayed more than 5m way from the ghost gear. The former explanation seems most likely as buoys and floats were relatively benign in terms of the entanglement risk they posed to marine life, but the 11% serious risk for buoys and floats arose because

football floats were encased in trawl net. Pots presented a considerably higher risk prior to data being combined with their associated and more benign rubber strips (87% for pots alone and 29% for pots when combined rubber).

The temporal dimension of entanglement risk was analysed suggesting that there may have been a slightly greater proportional risk of marine life becoming entangled during the spring.

Combined interaction and entanglement risks

Risks assessed as possible or greater for both interaction and entanglement (PP>) were deemed serious.

At all sites, 26% (by items) and 11% (by volume) of all the new ghost gear recorded was considered to pose a serious threat to marine life, seals and birds in particular.

At established seal sites these figures increased with 47% (by items) and 30% (by volume) of ghost gear being assessed as posing a serious risk to marine life seals in particular. Overall, a third to a half of all ghost gear that was washed into the vicinity of seal haul sites posed a serious combined risk of interaction and entanglement.

Witnessed entanglement

12 different species of six different types of marine creature were witnessed entangled in ghost gear including seals, birds, crabs, fish, mussels and pink sea fans:

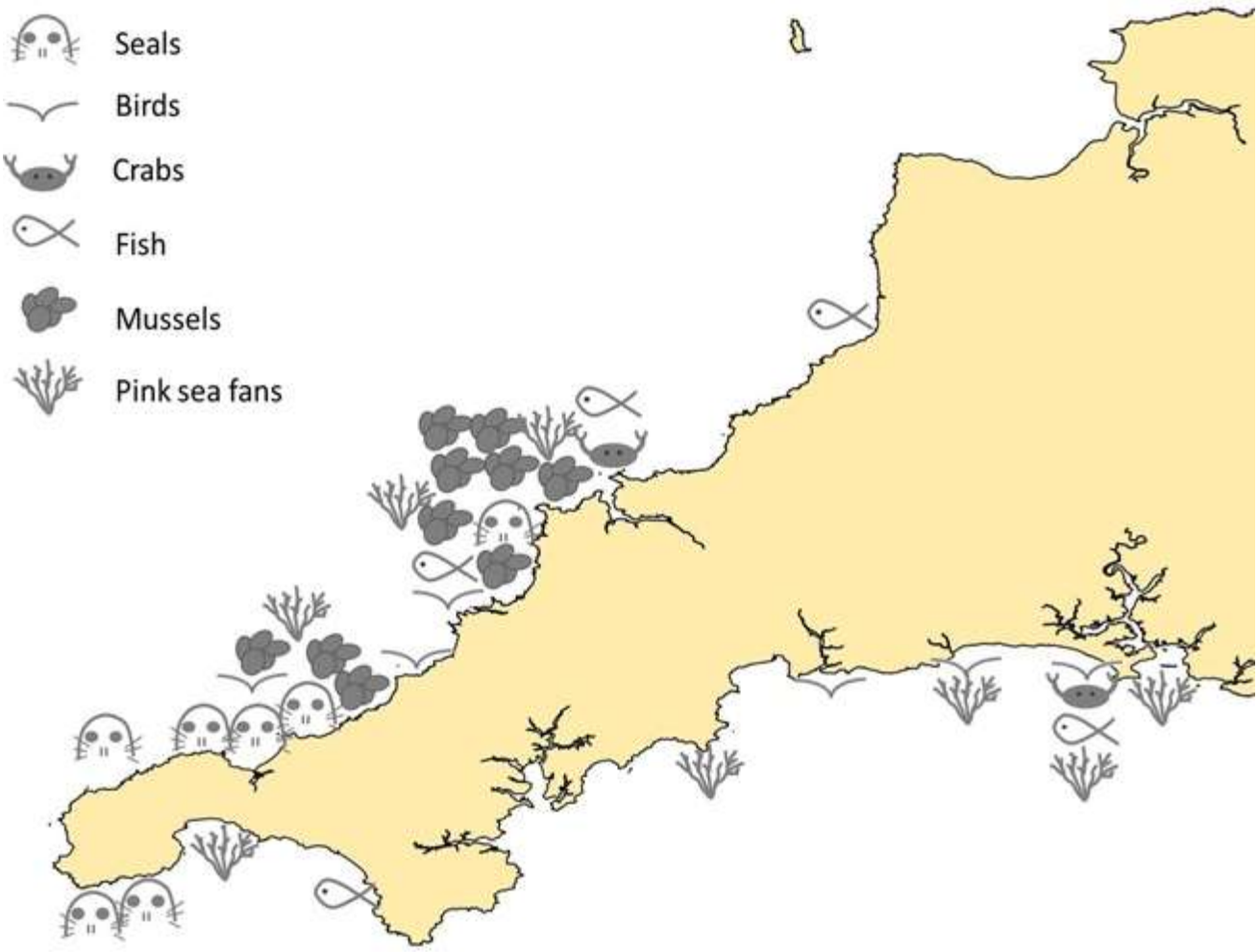


Figure 32: Spatial distribution of marine life witnessed entangled in ghost gear

Seals – 15 different live individuals were photo identified with visible ghost gear entanglement at seven different locations on the north and south coasts during the survey period. Eight of these were successfully rescued by British Divers Marine Life Rescue within 138 days after 24/12/14.

Of the 15 seals witnessed with visible entangling material, most were observed with monofilament net and the rest were entangled in trawl net. The majority of the 15 seals had only small amounts of monofilament net but five were trapped in large amounts of ghost gear – the biggest measured 9m by 1.2m of trawl net (these five were all successfully rescued). Most of the entangled seals were juveniles and on most of the 15 seals (60%) the entangling material had cut deeply through their skin, blubber and flesh causing a wound that was assessed to be serious.

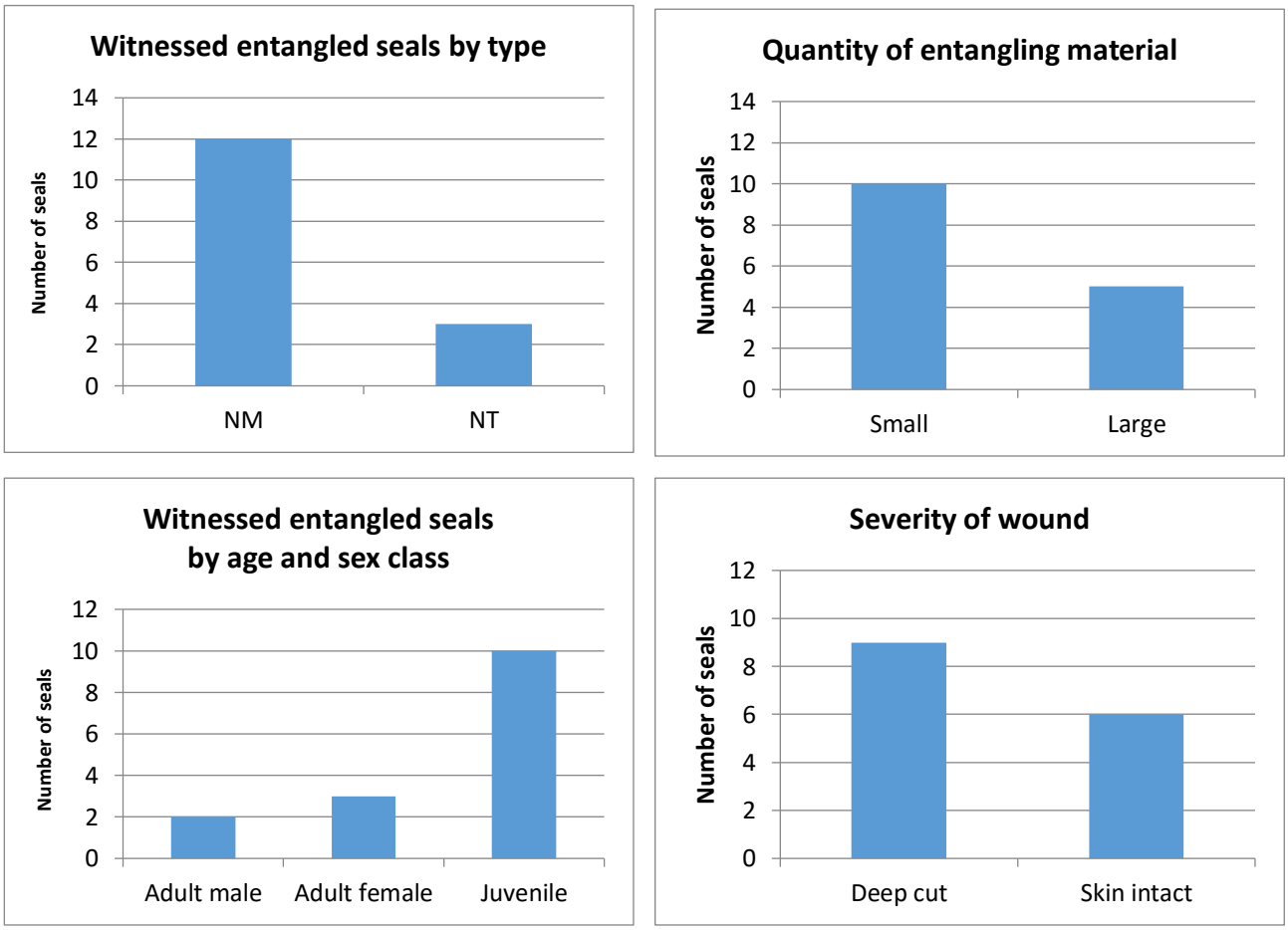


Figure 33: Witnessed entangled seals data

Two additional entangled seals died during the survey period – one had been successfully rescued by British Divers Marine Life Rescue, taken for rehabilitation at the Cornish Seal Sanctuary where this adult female had died a few days later. Post mortem examination showed she had previously been severely injured by entanglement in some form of marine debris, most likely monofilament net, that was no longer present in her wound (see appendix G for Sandy's story). The other dead entangled seal was stranded at Booby's Bay on 11/01/15 and photographed by Liz Clarke. Please see appendix F for more information about this seal and what this says about the role ghost gear plays in the entanglement of seals.

From CSGRT's long term research monitoring and identification project at West Cornwall it is clear that these 15 seals are not the only live seals that have previously been or are still currently entangled. A much larger number of entangled seals had obvious injuries or apparent encircling marks but no material visible. During the survey period all entangled seals comprised a mean of 3% of all seals sighted (minimum 0% and maximum on any one survey day 13% - 23/02/15). A maximum of 11 different entangled seals were observed at one time on 22/01/15.

Birds – Eight individuals – one cormorant, two herring gulls, one gannet, two guillemots and two shags were photographed at six different locations including in open sea, on the north and south coast. Two of these (a shag and a gannet) were successfully rescued by members of the CSGRT boat survey team.

Crabs – At least 18 individuals of dead spider and edible crab were reported and photographed in full gill nets at two different locations on the south coast. Several additional live crabs were rescued and released by Rame Peninsular Beach Care.

Fish – Nine individuals of two species (bass and catshark) were photographed in ghost gear – both in full monofilament gill nets or hooked at five different locations on the north and south coasts. One catshark was successful freed from its entangling hook and released back into the sea.

Mussels – 64 different clumps were photographed at ten different locations – all on the north coast. The impact of ghost gear on the success of mussel growth and productivity are unknown.

Several volunteers were concerned about line and rope filaments tangled in mussel beds. Mussels attach themselves to rocks using byssal threads (strong silky fibres produced from a gland in their foot) and move by extending a byssal thread, anchoring it and then shortening it. If removed from the rocks, mussels should be able to reattach themselves if left to do so. After taking expert advice, it was found that with a knife or scissors the loops of the line or rope could be cut and the filaments successfully pulled through the mussel beds without too much disturbance.

Figure 34: Entangled fish and mussels

Pink sea fans – The pink sea fan is a nationally important species and has a species action plan which guides its conservation. Whilst it is impossible to establish the exact number of pink sea fans found in nets, recorders reported at least 179 different pink sea fan fragments at eight different locations on both the south and north coasts. It is not known whether ghost gear pulls pink sea fans off the sea bed effectively killing them, or whether already dead pink sea fan fragments get caught up in drifting ghost gear.

Between 2005 and 2008 (CWT, 2008), Cornwall Wildlife Trust carried out a diver survey of pink sea fan reefs to record the size and density of these corals in Cornish waters. Priority survey areas included St Agnes and Newquay Bay on the north coast; east of the Lizard Peninsula and Dodman Point to Gorran Haven on the south coast.

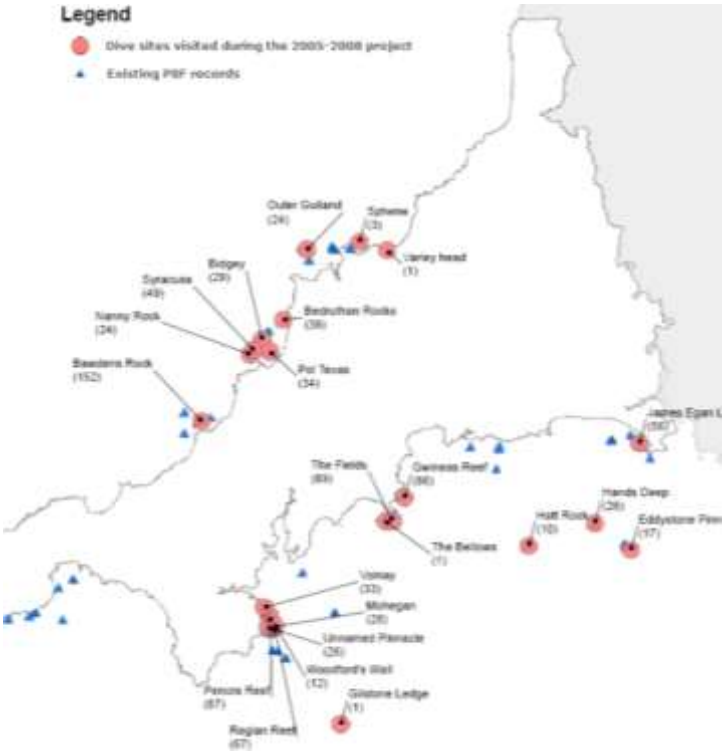


Figure 35: CWT map of known pink sea fan sites

CSGRT volunteers found pink sea fans washed up tangled in ghost gear on beaches in similar areas to their known presence offshore. In contrast to the evidence presented in this report, CWT diver surveys showed little evidence of anthropogenic damage to pink sea fans. Perhaps as the majority of the dives were on rocky reefs, these sites had less potting, mobile gear fishing and dredging activities to impact on the pink sea fans?

Figure 36: Ghost gear (left) that when unravelled contained numerous pink sea fan fragments (right)

Whilst non looped, meshed or balled items are apparently benign in terms of entanglement, they are often plastic, absorb toxins, break into small fragments and pose an additional risk of ingestion to marine life.

Results and discussion

Ghost gear removed by surveyors during land and boat based surveys

Opportunities for the removal of ghost gear were variable. For boat surveys it was only possible to remove ghost gear encountered at sea, but where it was safe to do so, ghost gear was successfully removed by the survey teams. At seal sites, recorders were rarely able to remove ghost gear as doing so would have resulted in undesirable seal disturbance. At other sites, volunteer ability to remove ghost gear depended on the characteristics of the ghost gear in terms of its size, weight and hygiene safety, as well as the accessibility of the site and the distance between the ghost gear and transport. Despite there being no expectation for recorders to remove ghost gear, in many cases they did. In total from land based surveys an incredible 1855 items (44% of the original number of items) amounting to 14009 litres (28% of the original volume) were successfully removed from the marine environment (including 971 items or 908 litres from seal sites when they were not occupied by seals.)

Ghost gear removal lowered the levels of risk posed by ghost gear to all marine life.

At all sites the levels of serious risk of interaction and entanglement fell from 26% to 18% (by items).

At seal sites, the levels of serious risk of interaction and entanglement fell from 47% to 24% (by items).

This data demonstrates that CSGRT volunteers efforts to remove ghost gear made a very positive difference to the levels of risk ghost gear posed to all marine life and particularly seals.

Results and discussion

Origin of ghost gear

Whilst the source of most ghost gear in Cornwall cannot be identified due the lack of gear marking by the fishing industry, the origins of three items found on the north and south coasts were traceable as originating from outside Cornwall, confirming that not all ghost gear in Cornwall is locally generated:

1. Castletownbere in southwest Ireland – a black fish box photographed (below) at Gunwalloe by Paul Harry on 25/10/14 (during survey protocol trials for this project which started a week after this find).

Figure 37: Ghost gear from southwest Ireland

2. A blue fish box from Fishgate fish market, Albert Dock, Hull, East Yorkshire photographed on 07/03/15 at Whipsiderry, Newquay by Liz Clark.

Figure 38: Ghost gear from Yorkshire

3. A buoy from the lobster fisheries in Harrington Maine on the east coast of the USA identified by Cathy Fetterman from the US licensing authorities (please see infographic below).

Figure 39: Ghost gear from Maine USA

Despite finding ghost gear from distant sources, much will have been locally generated too. The south coast of Cornwall and Devon are home to two major fishing ports – that of Newlyn in southwest Cornwall and Brixham In south Devon. Whilst the inshore fleets from these harbours are likely to contribute gear around these areas, many fisheries from these ports operate far offshore and so will have an unknown impact across the southwest coast. Fisheries effort at sea might help to explain the distributions of ghost gear found.

Recommendations

More years of data will be required to build upon this baseline data to assess the levels of inter annual variation in the amount and types of ghost gear as well as the associated risks they pose and to assess any trends arising from the actions taken to reduce and resolve the issue of ghost gear in the marine environment.

CSGRT are currently actively seeking the £40480 funding required to repeat another 12 months of boat based surveys from a variety of private and voluntary sources. This will effectively be match funded by CSGRT volunteer effort to the equivalent of £15120 for the boat surveys alone, in addition to all the land based surveys that are undertaken for free by CSGRT's amazing ghost gear volunteers who have sent in records alongside all those from a large number of partner organisations. There were 360 different land based surveys of ghost gear undertaken representing a huge additional volunteer effort. Considering the scale and duration of this project, this research represents excellent value for money.

From early work being undertaken by CSGRT in the Global Ghost Gear Initiative's (GGGI) Building Evidence (BE) working group, it is clear that data collection could become increasingly aligned to their aims alongside the research being done by other organisations globally, for example additional data could be collected in terms of the ghost gear materials, knots and mesh sizes to try and establish more information about the sources of lost fisheries equipment.

To ensure comparability between researchers across the globe, experiments could be done to enable different ghost gear size units to be converted for different specific gear types such as litres to tonnes.

Gear marking trials in local fisheries would enable the origin of gear to be identified and hugely enhance the possibilities of finding solutions to the issue of ghost gear informing attempts to minimise the input of ghost gear lost into the marine environment.

The production of a fisheries gear ID guide similar to those available in the USA and Australia would go a long way to help with sourcing the lost gear around our coastline.

CSGRT's continued participation in the GGGI BE working group can help inform other global partners about practical, realistic, effective and successful ghost gear data collection protocols for sustainable citizen science projects over large areas and long time scales.

Conclusion

A detailed summary of results can be found on pages 6 and 7.

The ghost gear survey protocols adopted have successfully enabled research findings to be presented on the following:

- Quantity of ghost gear in terms of items, volumes and type
- Spatial distribution of ghost gear
- Temporal distribution of ghost gear

The research findings have revealed:

- Spatial variations and patterns in the amounts, volumes and types of ghost gear
- Temporal variations and patterns in the amounts, volumes and types of ghost gear
- The number of species impacted by ghost gear sub lethally and fatally
- The risk levels posed by ghost gear to grey seals (a UK 'special responsibility' species at the southern end of their range and an important sentinel indicator of change).

It proved important to quantify ghost gear by more than one parameter (items and volume) to understand the complexity of the issue. Measuring ghost gear in litres was more practical, accurate, suitable and meaningful for the purposes of this research.

Results have demonstrated that the method of surveying from land and sea were complimentary and both were required over a regional scale, throughout all seasons of the calendar year, to build a big picture of ghost gear in the marine and coastal environment.

This project has raised awareness about the issue of ghost gear with the public (locals and visitors) in this region and engaged a motivated network of volunteers to successfully record 49917 litres (51 tonnes) and remove 14009 litres (14 tonnes) of ghost gear from the shores around Cornwall. The removal of ghost gear by recorders made a very positive difference to the levels of risk posed by ghost gear to all marine life, particularly seals, helping long term conservation efforts for this species in this region.

This report forms a thorough baseline quantifying the scale of the ghost gear issue in Cornwall, SW England at the southwest approaches of the first landfall of the Gulf Stream in the UK. Further years of research will be required assess the persistence of the intra annual spatial and temporal variations observed and the levels of inter annual variation should they exist.

References

Allen, R., Jarvis, D., Sayer, S., & Mills, C. (2012). Entanglement of grey seals (Halichoerus grypus) at a haul out site in Cornwall, UK. *Marine Pollution Bulletin*, *64*(12), 2815–2819.

Butler, J. R. (2013). A value chain analysis of ghost nets in the Arafura Sea. *Journal of Environmental Management*.

Cornwall Wildlife Trust (2008). Pink sea fan survey report. http://www.cornwallwildlifetrust.org.uk/Resources/Cornwall%20Wildlife%20Trust/PDF%20Documents/Cornwall_Wildlife_Trust_Pink_Sea_Fan_survey_report_2005_2008.pdf

MacMullen, P. et al (2014). FANTARED2. *Commission of the European Communities report*.

IUCN (2015). http://www.iucn.org

Hazell and Walker (2015). Conversion of liquid litres to metric tonnes http://www.thecalculatorsite.com/conversions/common/liters-to-metric-tons.php

JNCC. (n.d.). 1364 Grey seal Halichoerus grypus - SAC selection species account. Retrieved August 09, 2014, from http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=s1364

Marine Conservation Society. (2011). Beachwatch Big Weekend.

Sayer, S. and Allen, R. Cornwall Seal Group. (2015). Entanglement and its effects on grey seals (Halichoerus grypus) 2000 to 2013. *World Animal Protection Commissioned Report*.

SMRU (2013). Scientific Advice on Matters Related to the Management of Seal Populations. *SCOS*.

Wilcox, C., Heathcote, G., Goldberg, J., Gunn, R., Peel, D., & Hardesty, B. D. (2014). Understanding the Sources and Effects of Abandoned, Lost, and Discarded Fishing Gear on Marine Turtles in Northern Australia. *Conservation Biology : The Journal of the Society for Conservation Biology*, *00*(0), 1–9. doi:10.1111/cobi.12355.

Acknowledgements

Volunteers eagerly joined a rapidly expanding network of 'ghost gear recorders' enabling land based survey coverage of most of Cornwall's 700km of coastline. Hardy souls also volunteered to brave long days at sea especially during the winter months to record ghost gear! Without them, this project would not have been possible.

Rebecca Allen, Annie, Rob Arnold, Kelly Astley, Louise Austin, Tim Bain, Catherine Barry, Eliane Bastos, Gemma Beckett, Lynda Bolding, Ian Boreham, Mike Boyse, Steve Brodawel, Danielle Bussell, Lindsey Butterfield, Pippa Burrows, Caitlin, Michaela Channings, Chrissie, Christine, Claire, Liz Clark, Niki Clear, Sandie Coombes, Amy Copping, Chrissie Corbett, Zoe Courchene, Abby Crosby, Ann Davies, Sarah Deere-Jones, Lauren Delacy, Christina Dixon, Simon Dolphin, Katie Drake, Paula Evans, Alec Farr, Enid Farr, Mike Fletcher, Geoff Gamble, Margaret Gardner, Gabi Gilkes, Jasmina Goodair, Mark Grantham, Tony Greenbank, Laura Guy, Elliot Hall, Earnest Hall, Vic Hall, Mary Hallett, Joanne Harris, Paul Harry, Julie Hatcher, Neil Hembrow, Jes Hirons, Kate Hockley, John Hepburn, Charles Hood, Gus Horsley, Rebecca Hughes, Edd Hurst, Ian Illingworth, Nigel Ingram, Elise Neve, Dan Jarvis, Dave Jarvis, Lesley Jarvis, Annie Jenkin, Amy Jones, Julie, Lyn Kent, Jonathan Kersley, Kyle, Adrian Langdon, Cat Lee, Claire Lewis, Annabelle Lowe, Ben Lowe, Chris Lowe, Jan Loveridge, Jeff Loveridge, Abigail Maiden, Anne Matthews, Pat May, John Meakin, Dave McBride, Libby McBride, Malcolm McKenzie, Kev Metcalfe, Matt Mitchell, Taliesyn Mitchell, Richard Morton, Sue Morton, Jocelyn Murgatroyd, Mark Nason, Bob Nicholls, Ellie Nuthall, Nigel, Andrea O'Shaughnessy, Annette Petersson, Nick Pickles, Jane Pickles, Sarah Pilgrim, Pippa, Paul Pocock, Emma Porter, Zillah Robertson, Rory, Ross, Anne Rundle, Becky Sandelson, Lynda Small, Wendy Sargeant, Christine Spooner, Mike Stephens, Terry Thirlaway, Dave Thomas, Steve Trewhella, Alice Trevail, Jen Tyler, Shan Uglow, Nick Upton, Mo Usher, Caz Waddell, Claire Wallerstein, Rob Wells, Peter Welsh, Heidi Westbrook, Kath Wherry, Justin Whitehouse, Faye Whitman, Tracey Williams, Joanne Wilson, Kyle Wingfield, Jane Wiltshire, Steve Woods, Laura Workman and Inge Wusterhausen.

Atlantic Diving / Newquay Sea Safaris – for providing boats at a heavily subsidised rate and at short notice to make the most of short weather and sea condition windows!

Rebecca Allen and Mike Taylor – STAPIP coordinators

Sarah Millward and Tina Robinson – POLPIP coordinators

Martin Gregory and Derek Spooner – LISPIP coordinators

Dave Williams for providing expertise and recording bird life

Carbis Bay Crew, Cornwall Wildlife Trust, Friends of Fowey Estuary, Friends of Par Beach, Friends of Portheras, Helford Marine Conservation Group, Looe Marine Conservation Group, Newquay Beachcombing, Newquay Marine Group, Polzeath Marine Conservation Group, Rame Peninsula Beach Care, St Agnes Marine Conservation Group, Wembury Marine Centre, Widemouth Task Force

Cornwall College for subsidizing some of the STAPIP surveys

Wave Hub for funding most of the CASPIP surveys

Special thanks to World Animal Protection for core funding all of the STAPIP and POLPIP surveys and some CASPIP surveys and for commissioning this report

Huge thanks to everyone who contributed to this project whether listed above or not. You have helped to make our coastline cleaner and safer for marine life.