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Pilot Scottish Beach Litter Performance Indicators (SBLPI)

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W R Turrell



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Pilot Scottish Beach Litter Performance Indicators (SBLPI)

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Summary

A range of pilot Scottish Beach Litter Performance Indicators (SBLPIs) are proposed which aim to allow the Scottish Government to monitor the state of litter on its beaches, as well as judge the success of its policies in reducing sources of marine plastics and litter. The SGLPIs will form the basis of adding aspects of beach litter assessment to the 2019 update of Scotland's Marine Atlas and the Marine Scotland MAPS NMPi (National Marine Plan interactive) interactive tool, part of the Marine Scotland Open Data Network, which has been designed to assist in the development of national and regional marine planning. The pilot indicators were initially prepared for the Scottish Government Litter Evidence and Analysis Group, November 2018.

The SGLPIs are generated using data generously provided by the Marine Conservation Society (MCS) Beachwatch programme. This extensive citizen-science programme is a fundamentally important monitoring activity needed to understand man's impact on our marine environment. More details of the programme can be found at <https://www.mcsuk.org/beachwatch/>. Many thanks to MCS and all the volunteers who have painstakingly collected the data over the last decade.

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1. Pilot Scottish Beach Litter Performance Indicators (SBLPI)

A range of pilot Performance Indicators are proposed which aim to allow the Scottish Government to monitor the state of litter on its beaches, as well as judge the success of its policies in reducing sources of marine plastics and litter.

The pilot Scottish Beach Litter Performance Indicators (SBLPIs) utilise the Marine Conservation Society (MCS) Beachwatch citizen-science foreshore surveys (Marine Conservation Society, 2018). These surveys use a standard method, agreed with OSPAR, to count all the visible pieces of plastic and non-plastic litter on a beach and to put these into one of 118 different categories.

Using the MSC surveys, pilot SBLPIs were selected based on:

- Availability of data in the MSC/OSPAR beach survey protocols;
- Relevance to industry sectors which the Scottish Government may influence through dialogue/legislation;
- Relevance to specific litter items which the Scottish Government may influence through policies/legislation/publicity campaigns;
- Relevance to specific litter items of concern to the Scottish public;

There are two types of pilot SBLPI, sub-totals that sum a range of litter categories together and specific items, which target individual marine litter items.

Inclusion or exclusion of litter categories in the performance indicators which use sub-totals is somewhat arbitrary. For example, in the sub-total category “Marine”, which tries to capture litter from marine sources (Shipping, offshore industries, fishing vessels) other than identifiable fishing gear includes the litter category “8 Engine oil containers and drums <50 cm”. Obviously these could also come from land-based sources. However, a judgment has been made based on the likelihood of land versus marine sources.

The MSC/OSPAR protocols impose some further restrictions on the performance indicators that can be used. For example, during MSC/OSPAR beach surveys, plastic straws are not counted separately. They are recorded within the category “22 Cutlery/trays/straws”. Full descriptions of each indicator are provided in Appendix 1.

Coastal Sub-Regions

Pilot SBLPIs have been calculated for specific sub-regions around the Scottish coast. Sub-regions cannot be based on Scottish Marine Regions owing to the scarcity of surveys in some SMRs. In addition, the coastal sub-regions used here have been based on oceanographic processes that influence the deposition of beach litter, and these processes also do not follow SMRs. Figure 1 shows the coastal sub-regions used to calculate the pilot SBLPIs, while a table in the Appendix provides a cross reference between coastal sub-regions used here and SMRs.

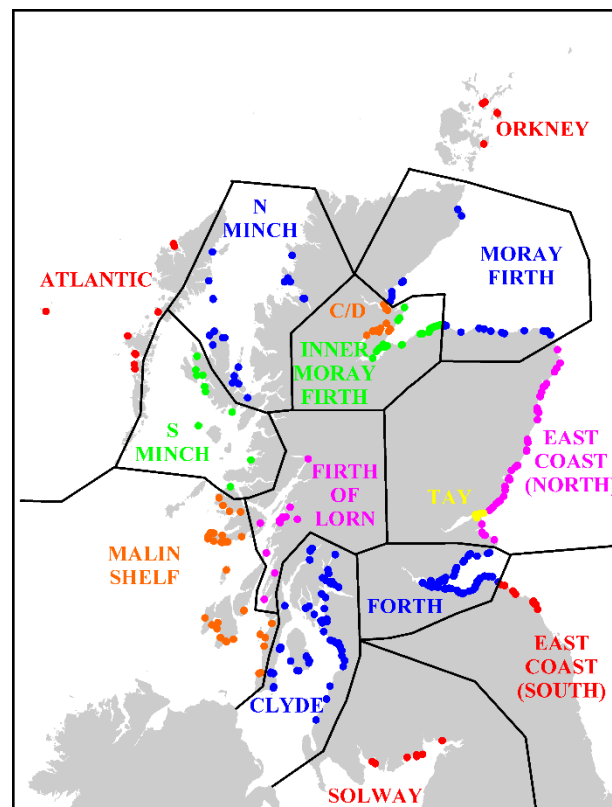


Figure 1: Map showing location of All MSC foreshore surveys used (coloured symbols), arranged in 15 sub-regions (indicated by different colours). The last section of this brief lists all 15 sub-regions and how they have been used to develop pilot SBLPIs. There is currently no data available from Shetland.

Understanding Beach Litter in Scotland

In Scotland we have very active tides, winds and coastal currents. The combination of these has resulted in some effects which alter the average loadings of litter on our beaches. The oceanographic effects mean that average beach loadings increase up the west coast of Scotland, reset to a base value north of Scotland, and then increase again down the east coast. These effects, for example, result in beaches in

the North Minch area having some of the highest loadings in Scotland. This is not because there are more sources of marine litter there, just that oceanographic processes result in more enhancement of beach litter in that region.

The oceanographic processes are influenced by the direction of the prevailing wind relative to the beach in question, as well as by the nature of the water body the beach is located within. The technical analysis that supports the pilot SBLPIs (Turrell, 2018; Turrell, 2019) suggested that beaches within harbours, sea lochs, estuaries and embayments have different litter loadings than beaches lying along open coasts. For this reason SBLPIs have been estimated using surveys only from open coast foreshores, unless stated otherwise (i.e. Firth of Forth harbours).

Owing to the complex effect of natural processes, total beach loadings must be viewed in the context of where a particular beach lies along our coasts. Hence the pilot SBLPIs proposed here look at trends within a sub-region of our coasts rather than absolute values. They also use a relative scale that is the same for all litter categories and for all sub-regions (i.e. values normalised to have a mean of zero, and a standard deviation of one over the period 2008-2017).

September/All Year

Finally, two sets of Pilot SBLPIs have been trialled. One uses just the months of September, as this is when the MCS, Great British Beach Clean takes place. However, at some locations data is also available throughout the year.

Pilot SBLPIs – Further Warnings

Be aware of certain limitations to the pilot SBLPIs:

- The natural variability of the amount and composition of beach litter described above can also result in large day to day, month to month and even year to year variations. The trends presented here in pilot SBLPIs are influenced not just by the size of the source of the items entering the sea, but also this natural variability. Hence use the pilot SBLPIs as a general guide rather than looking at the fine details.
- The selection of the traffic light scheme is purely subjective – use with some caution.
- The pilot SBLPI OT-03 Plastic Cups is potentially “red” in all areas. This is most likely because of a limitation in the data (i.e. plastic cups seem to be only recorded after 2015 – TBC with MCS). Hence shading has been removed (grey inserted).
- Remember that the pilot SBLPIs have been estimated for the decade 2008 to 2017

Pilot Key Messages

Abundance of plastic bags and plastic bottles are decreasing in all areas with records
The total amount of litter in Firth of Forth Harbours is high (five times higher than elsewhere in Scotland) and is increasing
The proportion of sanitary items in the Clyde and Forth is (about ten times) higher than elsewhere in Scotland
Sanitary items are on the increase in the Clyde and in Firth of Forth harbours
Debris associated with fishing and shipping are on the increase in Firth of Forth Harbours and in the Moray Firth
Wet wipes are increasing in the Clyde, Forth and east of Scotland
Angling related debris is increasing on east coast and Forth beaches
Smoking related debris is increasing on beaches on the east coast and in the Firth of Forth

Pilot Scottish Beach Litter Performance Indicators – SUMMARY

	Increasing by 2 or more standard deviations* per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

*Note: the greater the number, positive/negative, the greater the increase/decrease in litter

Priority One

Type	SBLPI		Cly	Ork	Mor	EC(N)	For	For(H)
Individual Items	Plastic – Bottles*	P1-01	-1.5	-1.9	-1.9	-2.0	-1.8	-1.1
	Plastic – Shopping Bags*	P1-02	-2.5	-1.2	-1.9	-1.6	-1.6	+0.1
	Plastic – Straws*	P1-03	+1.1	RARE	-1.5	-1.9	-0.9	-2.9
	Sanitary – Cotton Buds	P1-04	+1.7	RARE	-1.6	-1.2	-1.5	+0.5
	Sanitary – Wet Wipes	P1-05	+2.7	RARE	+0.7	+2.2	+1.9	+2.9
	Paper – Coffee Cups*	P1-06	+0.6	RARE	-1.8	-0.6	+0.7	-0.7
Totals	All Plastic	P1-07	+0.1	-1.5	+0.2	-1.6	-0.9	-1.4
	All Sanitary	P1-08	+2.0	RARE	-0.4	-0.7	+0.3	+3.0
	All Litter	P1-09	+0.6	-1.5	-1.0	-1.5	-0.1	+1.2
<i>Average Total Litter Loading (np/100m)</i>			670	40	320	250	341	

N.B. Indicators marked by an asterix can include additional (but similar) litter items as well as the target item owing to the nature of the MCS survey recording protocols.

Industry

Type	SBLPI		Cly	Ork	Mor	EC(N)	For	For(H)
Totals	Plastic – Fishing Related	IN-01	+0.8	-1.2	+1.6	+0.3	-0.3	+1.3
	Plastic – Marine Related	IN-02	+1.8	-0.9	+1.1	+0.8	+0.7	+2.2
	Plastic – Aqua. Related	IN-03	RARE	RARE	RARE	RARE	RARE	RARE
	Plastic – Farm Related	IN-04	RARE	RARE	RARE	RARE	RARE	RARE
	Total – Angling Related	IN-05	+0.7	RARE	+0.3	+2.7	-0.6	+1.8
	Total – Fishing Related	IN-06	+0.8	-1.2	+1.6	+0.3	-0.3	+1.3
	Total – Marine Related	IN-07	+1.7	-0.9	+1.1	+0.8	+0.7	+2.2
	Total – Old Plastic	IN-08	-1.2	-1.4	+0.2	-1.6	+0.1	-1.8

Other

Type	SBLPI		Cly	Ork	Mor	EC(N)	For	For(H)
Individual Items	Metal – Drinks Cans	OT-01	-1.7	-1.7	-0.9	-2.2	+0.9	-1.6
	Plastic – Sweets/Crisps	OT-02	+0.1	-1.7	-1.8	-0.6	-1.9	-0.9
	Plastic – Cups (see p.4)	OT-03	+2.5	RARE	+2.4	+2.2	+2.3	+2.3
	Plastic – Food Packaging	OT-04	-1.8	RARE	-1.5	-2.1	-1.3	-1.1
	Paper – Smoking Related	OT-05	+1.7	RARE	-2.3	+2.6	+2.1	+0.9
	Medical – Syringes	OT-06	+0.4	RARE	RARE	-2.3	-1.1	+0.8
	Plastic – 4/6 Pack Yokes	OT-07	-0.7	RARE	RARE	-0.1	-1.1	-0.4
	Rubber – Balloons	OT-08	-1.0	RARE	-1.2	-2.2	+0.1	+1.4

Percentage Composition of Marine Litter (2017)

Item	Clyde	Orkney	Moray Firth	East Coast (North)	Firth of Forth (Beaches)	Firth of Forth (Harbours)
Plastic	58	94	67	72	43	37
Rubber	1	6	3	1	1	1
Cloth	1	0	4	2	2	4
Paper	4	0	7	9	5	4
Wood	1	0	2	1	1	<1
Metal	3	0	10	6	6	2
Glass	3	0	2	2	2	5
Pottery	<1	0	1	1	1	<1
Sanitary	30	0	2	5	40	46
Medical	<1	0	<1	<1	<1	<1
Pollution	<1	0	1	1	1	<1
<i>Total (np/100m)</i>	<i>670</i>	<i>40</i>	<i>320</i>	<i>250</i>	<i>300</i>	<i>1,600</i>

Note: Harbours surveyed in the Firth of Forth were Blackness, Bo'ness (Grangeans), Cramond, Granton, Portobello, North Queensferry, South Queensferry and Wardie Bay.

Sub-Region Summaries

Going anti-clockwise around Scotland:

Solway

- Not enough surveys to estimate SBLPIs.

Clyde

- The Clyde sub-region has the second highest average beach litter loading in Scotland.
- The proportion of the total litter loading that is made up of sanitary items is the highest in Scotland.
- The Clyde has the highest number of pilot SBLPIs showing increasing trends, particularly within sanitary items and those related to angling, fishing and shipping.

Malin Shelf, Firth of Lorn, Atlantic, South Minch, North Minch

- Not enough surveys to estimate SBLPIs.

Orkney

- Orkney has the lowest average beach litter loadings in Scotland.
- Beach litter in Orkney may reveal the true “background” litter conditions in Scottish waters before other effects enhance litter concentrations.
- Because local sources of non-plastic litter items are so low (i.e. wood, paper, cloth, glass, metal, sanitary and medical items), plastic makes up by far the greatest proportion of Orkney beach litter, probably most originating out-with Orkney.
- Overall, the pilot SBLPIs reveal relatively clean beaches in Orkney, with an overall improving trend.

Moray Firth

- Although indicators for this sub-region have been calculated, several years are missing owing to too few surveys being available.

- In general most pilot SBLPIs are showing decreasing trends, apart from those related to the marine industries of shipping and fishing, which are showing gradual increasing trends.

Inner Moray Firth, Cromarty/Dornoch

- Not enough surveys to estimate SBLPIs.

East Coast (North)

- Apart from indicators associated with wet wipes, angling and smoking, most other pilot SBLPIs suggest improving beach conditions in this sub-region.
- For some indicators, however, this may be partly caused by very high values estimated from 2008 surveys.

Firth of Tay

- Not enough surveys to estimate SBLPIs.

Firth of Forth

- As with the Clyde, this sub-region has a high proportion of sanitary items.
- However, the total beach litter loadings are not particularly high. This is most likely due to the effect of wind, tides and currents along the Scottish east coast.
- In general, apart from those associated with wet wipes and smoking waste, all pilot SBLPIs in the Firth of Forth are suggestive of static or improving litter conditions.

Firth of Forth (Harbours)

- Harbours in the Firth of Forth have the highest total litter loading of any Scottish Sub-Region where SBLPIs have been calculated – i.e. 1,600 np/100m.
- They also have the highest proportion of sanitary items (nearly 50%), and this proportion is increasing at the fastest rate of any SBLPIs.
- All SBLPIs associated with industries are increasing

East Coast (South)

- Not enough surveys to estimate SBLPIs.

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Marine Scotland Science
25 October 2018

2. Full Sub-Region Assessment – Clyde

Pilot - Scottish Beach Litter Performance Indicators - Clyde Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
Clyde	All	-1.5	-2.5	+1.1	+1.7	+2.7	+0.6	+0.1	+2.0	+0.6
	Sept	-0.6	-1.9	+1.7	+1.8	+2.3	+1.5	+1.1	+1.9	+1.4

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
Clyde	All	+0.8	+1.8	RARE	RARE	+0.7	+0.8	+1.7	-1.2
	Sept	+2.0	+2.3	RARE	RARE	+1.8	+2.0	+2.3	+0.7

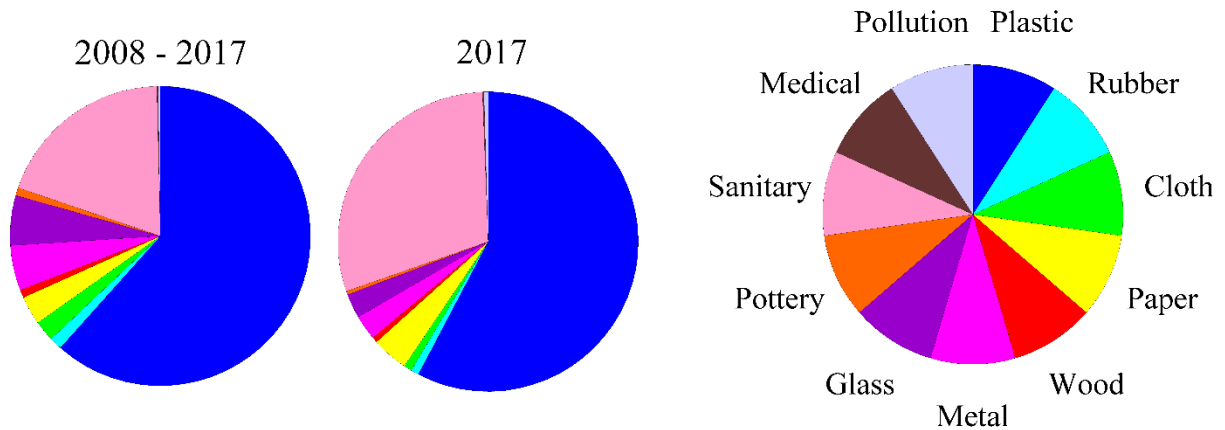
Other

Reg	Prd.								
		OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
Clyde	All	-1.7	+0.1	+2.5	-1.8	+1.7	+0.4	-0.7	-1.0
	Sept	-0.9	+0.5	+2.2	-2.0	+1.6	+1.5	-0.8	+0.9

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01	24.8	21.6
		Plastic – Shopping Bags*	P1-02	15.5	16.3
		Plastic – Straws*	P1-03	13.6	15.5
		Sanitary – Cotton Buds	P1-04	82.3	85.3
		Sanitary – Wet Wipes	P1-05	13.4	17.1
		Paper – Coffee Cups*	P1-06	1.5	1.3
	Totals	All Plastic	P1-07	370.0	409.0
		All Sanitary	P1-08	104.7	125.0
		All Litter	P1-09	582.7	670.4
Industry	Totals	Plastic – Fishing Related	IN-01	9.9	11.8
		Plastic – Marine Related	IN-02	9.9	11.7
		Plastic – Aquaculture Related	IN-03	RARE	RARE
		Plastic – Farm Related	IN-04	RARE	RARE
		Total – Angling Related	IN-05	3.2	5.5
		Total – Fishing Related	IN-06	10.0	11.8
		Total – Marine Related	IN-07	10.1	11.9
		Total – Old Plastic	IN-08	127.9	126.1
Other	Individual Items	Metal – Drinks Cans	OT-01	12.8	9.4
		Plastic – Sweets/Crisps	OT-02	55.9	65.9
		Plastic – Cups	OT-03	2.7	1.6
		Plastic – Food Packaging	OT-04	8.3	9.8
		Paper – Smoking Related	OT-05	8.5	6.4
		Medical - Syringes	OT-06	0.4	0.3
		Plastic – 4/6 Pack Yokes	OT-07	0.6	0.7
		Rubber - Balloons	OT-08	0.2	0.1

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	407	488	61.6	57.7
Rubber	9	7	1.4	0.8
Cloth	15	7	2.2	0.9
Paper	20	33	3.1	3.9
Wood	6	5	0.9	0.6
Metal	32	23	4.9	2.7
Glass	36	22	5.4	2.7
Pottery	5	3	0.8	0.4
Sanitary	128	252	19.4	29.8
Medical	1	1	0.1	0.2
Pollution	2	4	0.2	0.4
<i>Total</i>	<i>670</i>	<i>846</i>		



Sub-Region Summary

- The Clyde sub-region has the second highest average beach litter loading in Scotland.
- The proportion of the total litter loading that is made up of sanitary items is the highest in Scotland.
- The Clyde has the highest number of pilot SBLPIs showing increasing trends, particularly within sanitary items and those related to angling, fishing and shipping.

SBLPI Summary

Priority One Indicators

- Indicators relating to plastic bags and plastic bottles are both on the decline in the Clyde, and were low and constant after 2013.
- However, all indicators related to sanitary items (total number of items, cotton buds and wet wipes) show increasing trends.

Industry-Related Indicators

- There was too few litter items in the Clyde related to aquaculture or farming to allow indicators to be estimated.
- All other industrial-related beach litter indicators (related to fishing, general shipping and angling) are on the increase, shown more by the September-only indicators than the indicators calculated using any month.
- The plastic pieces September indicator, indicative of old plastic from remote sources, is decreasing, although the any-month indicator is small and increasing.

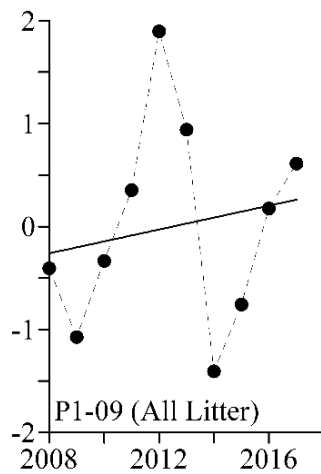
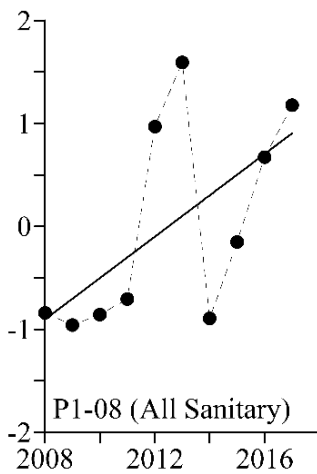
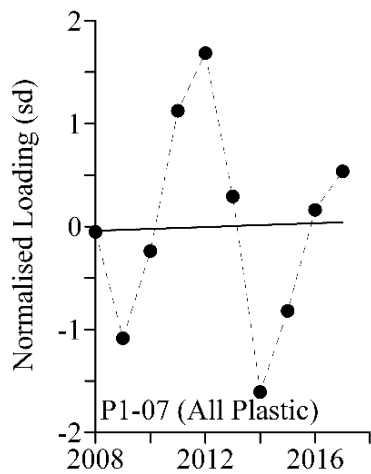
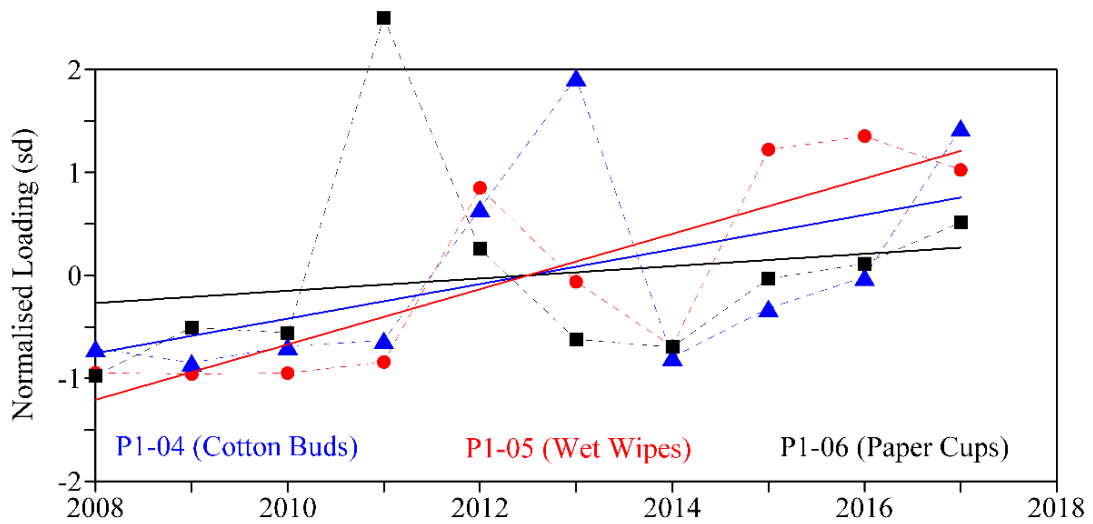
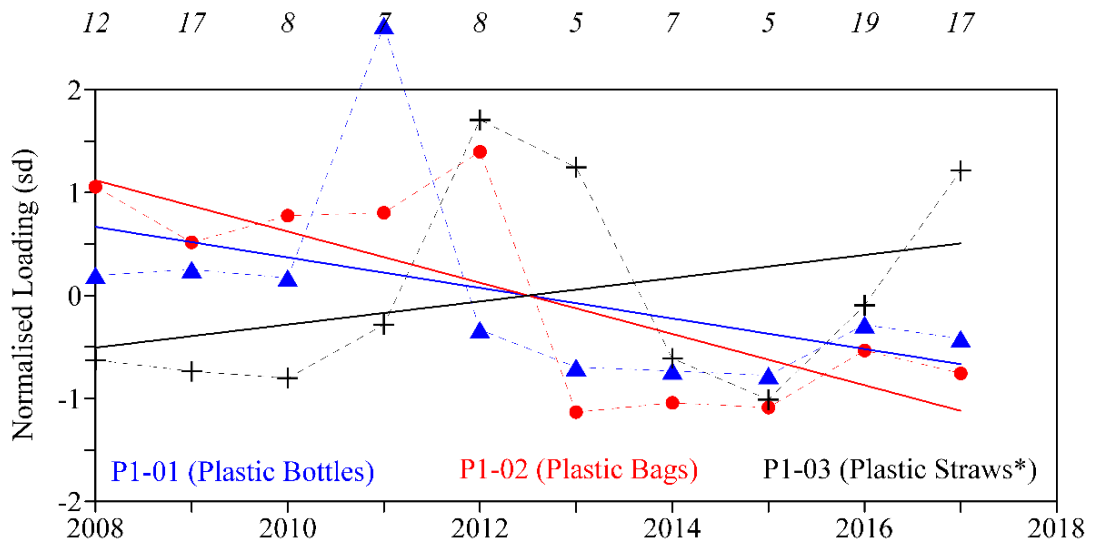
Other Specific Litter Items

- Indicators related to drinks cans, food packaging and balloons are all decreasing.
- Indicators related to syringes and smoking related debris are slowly increasing.

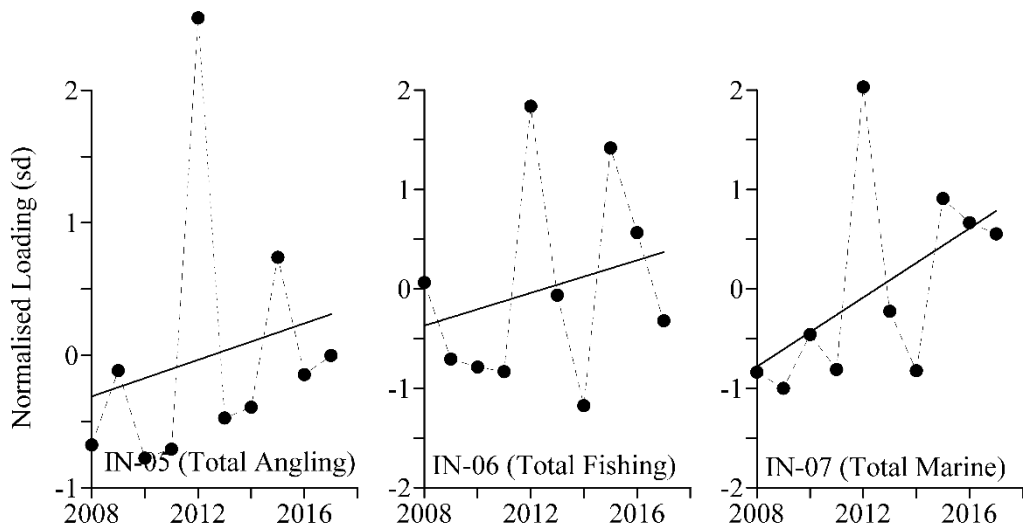
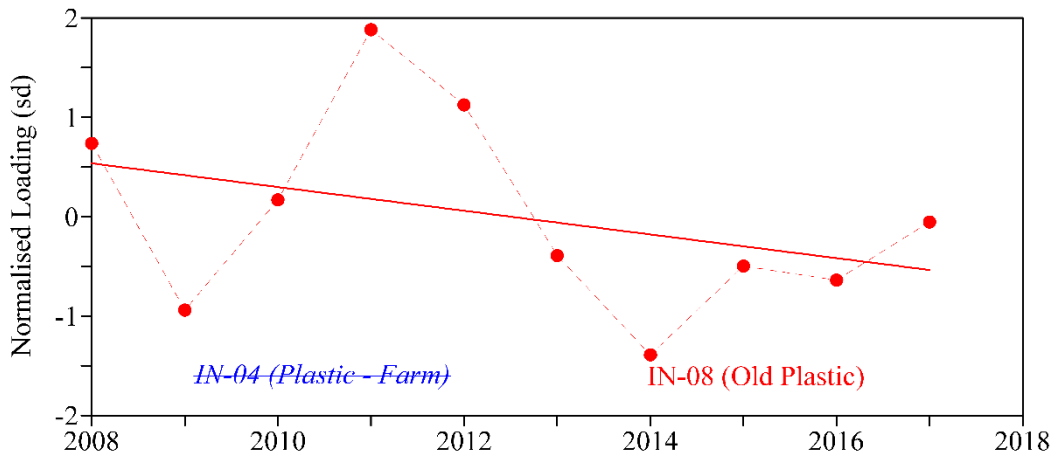
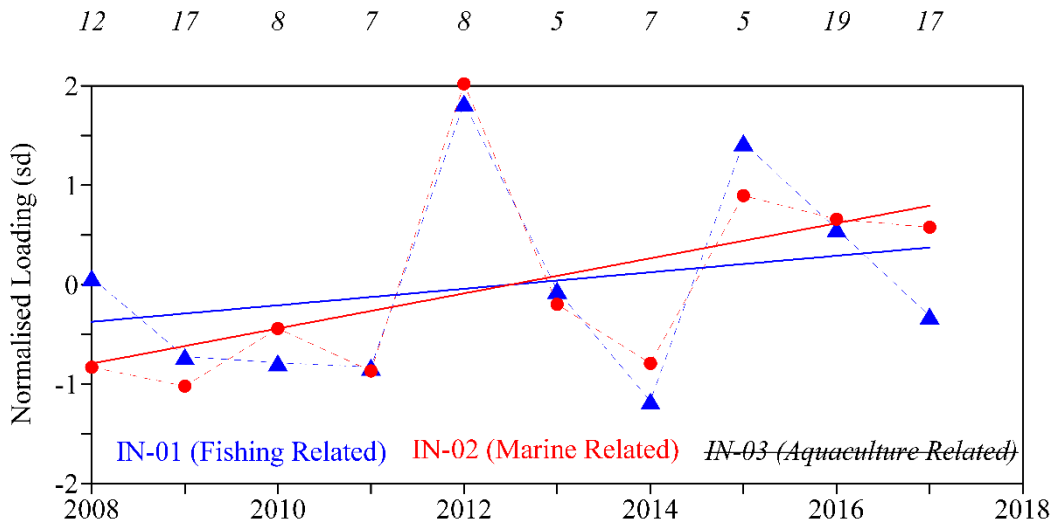
Technical Notes

1. Good data coverage.
2. All wind exposure directions included as within the Clyde there is a complex shoreline.
3. Only "Open Coast" water body type used.
4. Litter category indicators IN-03 (Aquaculture Related) and IN-04 (Farm Related) have too little observed occurrences to develop an indicator.
5. Litter category indicators OT-03 (Plastic Cups) and OT-08 (Balloons) have data but in only a few years.

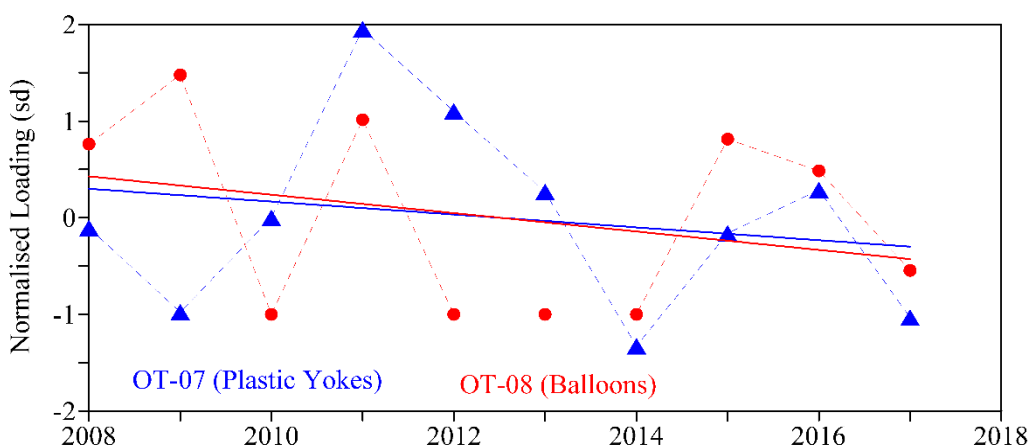
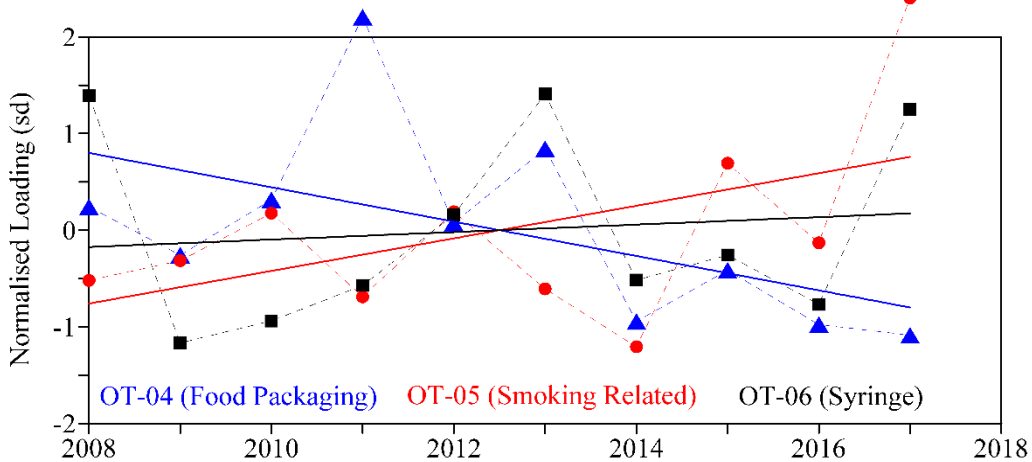
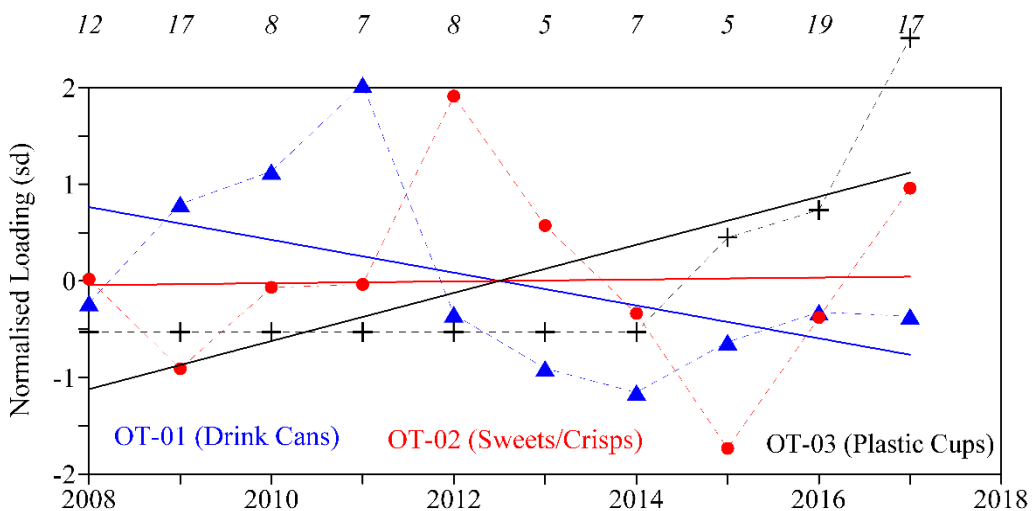
Clyde, All Months – PRIORITY 1



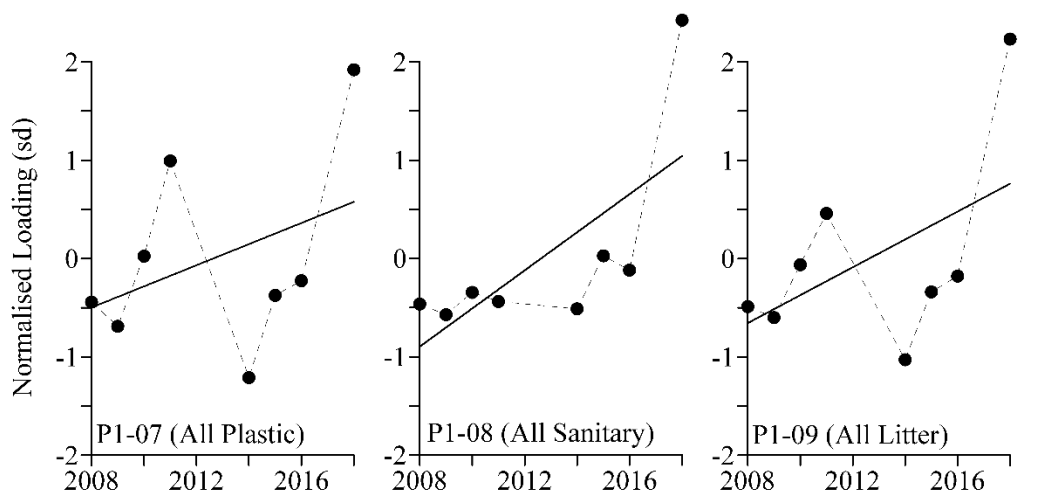
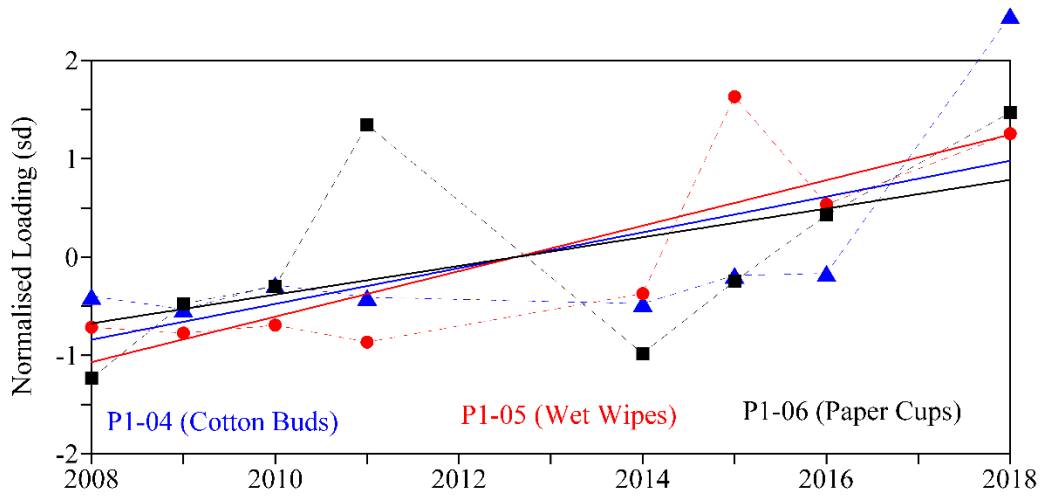
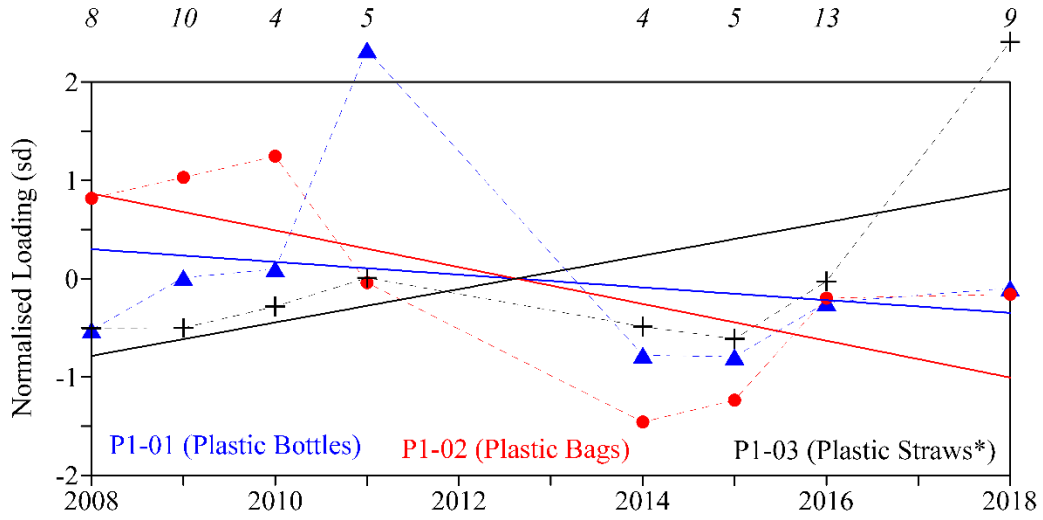
Clyde, All Months – INDUSTRY



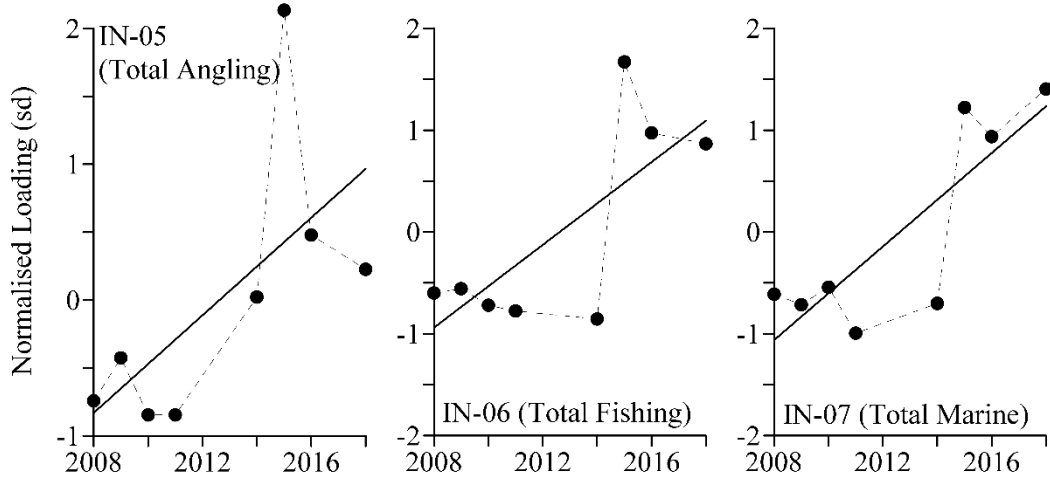
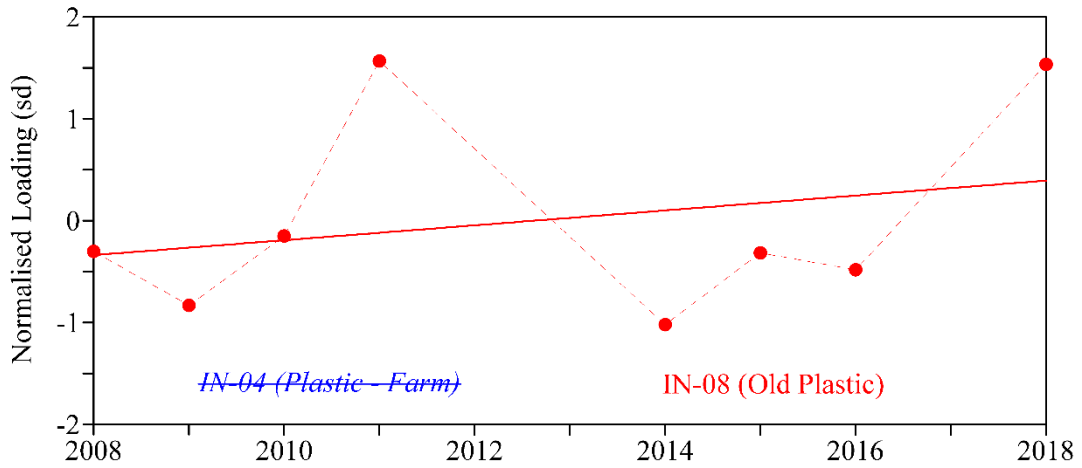
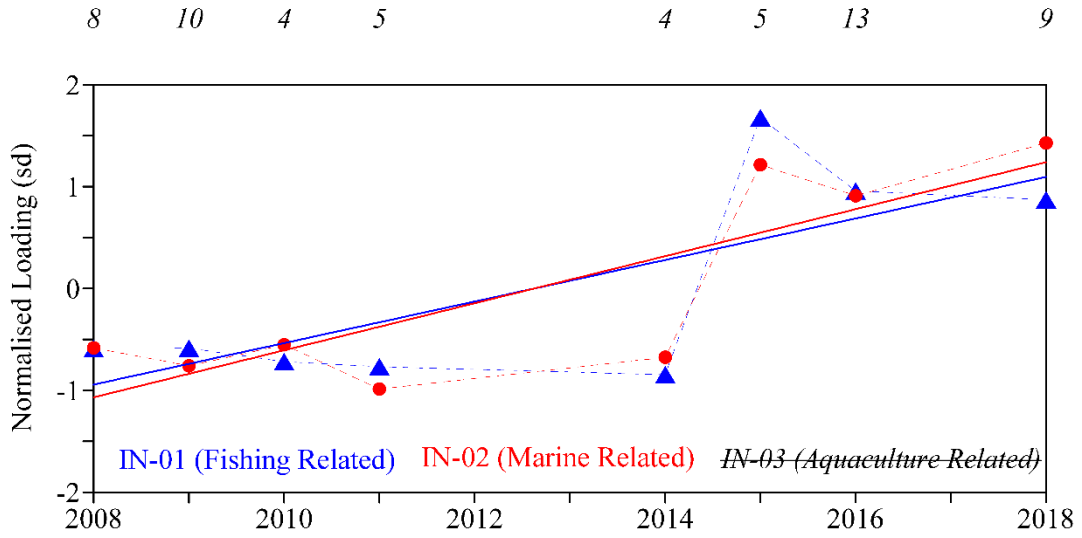
Clyde, All Months – OTHER



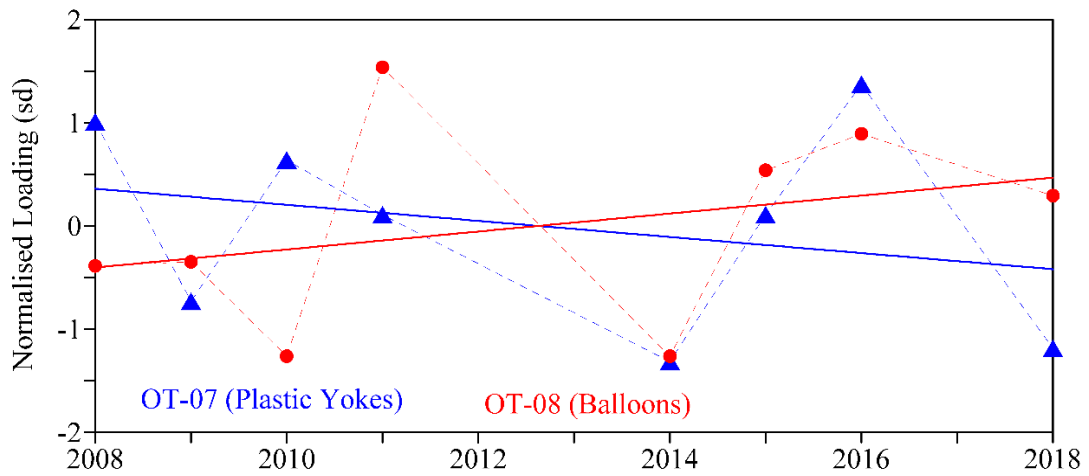
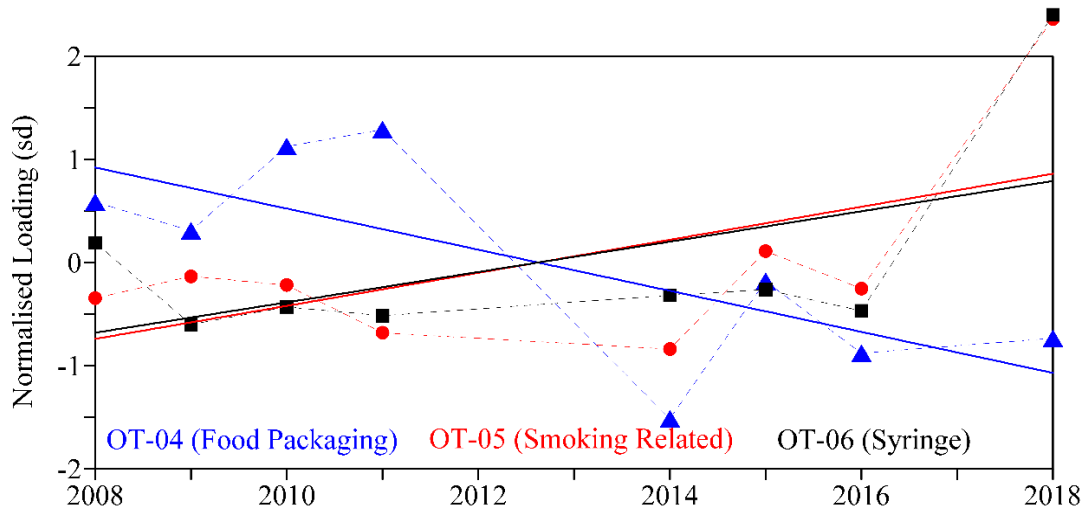
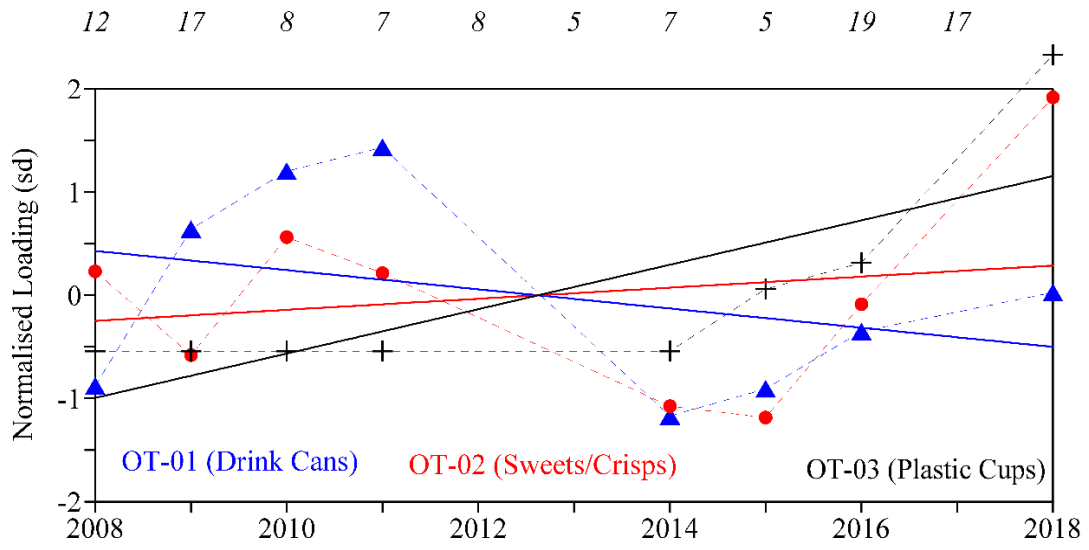
Clyde, September – PRIORITY 1



Clyde, September – INDUSTRY



Clyde, September – OTHER



3. Full Sub-Region Assessment – Orkney

Pilot - Scottish Beach Litter Performance Indicators - Orkney Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
Orkney	All	-1.9	-1.2	RARE	RARE	RARE	RARE	-1.5	RARE	-1.5
	Sept	x	x	x	x	x	x	x	X	X

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
Orkney	All	-1.2	-0.9	RARE	RARE	RARE	-1.2	-0.9	-1.4
	Sept	x	x	x	x	x	x	x	X

Other

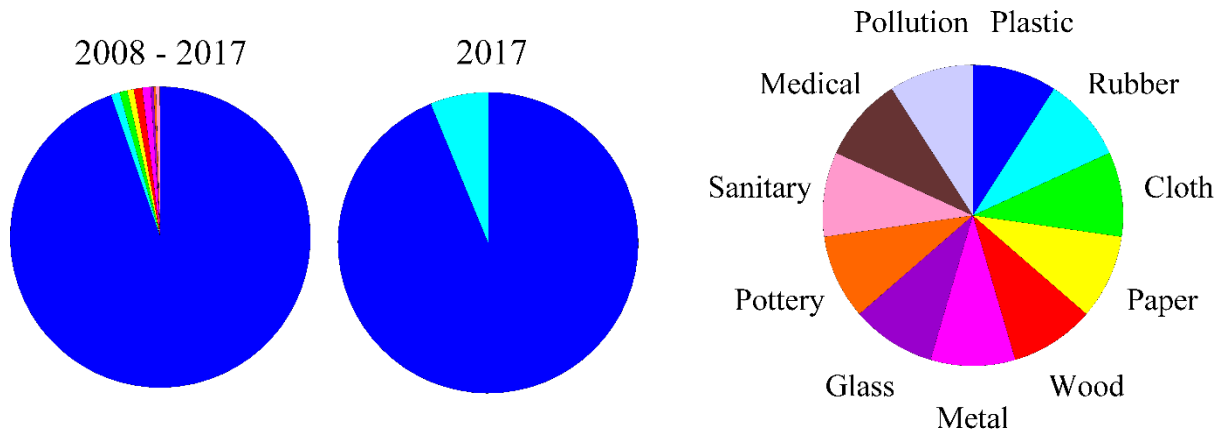
Reg	Prd.	OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
		Orkney	All	-1.7	-1.7	RARE	RARE	RARE	RARE
Sept	x		x	x	x	x	x	x	X

Absolute Average Foreshore Loadings

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01	X	2.4
		Plastic – Shopping Bags*	P1-02	X	0.8
		Plastic – Straws*	P1-03	RARE	RARE
		Sanitary – Cotton Buds	P1-04	RARE	RARE
		Sanitary – Wet Wipes	P1-05	RARE	RARE
		Paper – Coffee Cups*	P1-06	RARE	RARE
	Totals	All Plastic	P1-07	X	40.4
		All Sanitary	P1-08	RARE	
		All Litter	P1-09	X	42.5
Industry	Totals	Plastic – Fishing Related	IN-01	X	2.5
		Plastic – Marine Related	IN-02	X	3.0
		Plastic – Aquaculture Related	IN-03	RARE	RARE
		Plastic – Farm Related	IN-04	RARE	RARE
		Total – Angling Related	IN-05	RARE	RARE
		Total – Fishing Related	IN-06	X	2.5
		Total – Marine Related	IN-07	X	3.0
		Total – Old Plastic	IN-08	X	11.4
Other	Individual Items	Metal – Drinks Cans	OT-01	X	0.1
		Plastic – Sweets/Crisps	OT-02	X	0.8
		Plastic – Cups	OT-03	RARE	RARE
		Plastic – Food Packaging	OT-04	RARE	RARE
		Paper – Smoking Related	OT-05	RARE	RARE
		Medical - Syringes	OT-06	RARE	RARE
		Plastic – 4/6 Pack Yokes	OT-07	RARE	RARE
		Rubber - Balloons	OT-08	RARE	RARE

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	41.4	3.8	94.7	93.8
Rubber	0.4	0.3	0.9	6.3
Cloth	0.4	0.0	0.9	0.0
Paper	0.3	0.0	0.7	0.0
Wood	0.4	0.0	0.9	0.0
Metal	0.4	0.0	0.9	0.0
Glass	0.1	0.0	0.3	0.0
Pottery	0.1	0.0	0.2	0.0
Sanitary	0.2	0.0	0.4	0.0
Medical	0.0	0.0	0.0	0.0
Pollution	0.0	0.0	0.0	0.0
<i>Total</i>	<i>43</i>	<i>4</i>		



Sub-Region Summary

- Orkney has the lowest average beach litter loadings in Scotland.
- Beach litter in Orkney may reveal the true “background” litter conditions in Scottish waters before other effects enhance litter concentrations.
- Because local sources of non-plastic litter items are so low (i.e. wood, paper, cloth, glass, metal, sanitary and medical items), plastic makes up by far the greatest proportion of Orkney beach litter, probably most originating out-with Orkney.
- Overall, the pilot SBLPIs reveal relatively clean beaches in Orkney, with an overall improving trend.

SBLPI Summary

Priority One Indicators

- The plastic bag and plastic bottle indicators are both on the decline in Orkney, and both seem low and constant after 2014.
- Plastic straws (cutlery), cotton buds, wet wipes and plastic cups are too rare on Orkney beaches to allow indicators to be estimated.

Industry- related Indicators

- Plastics and total litter indicators linked to fishing and marine industries are on the decline.
- The indicator related to plastic pieces, possibly related to old plastic and from remote sources, is also decreasing.

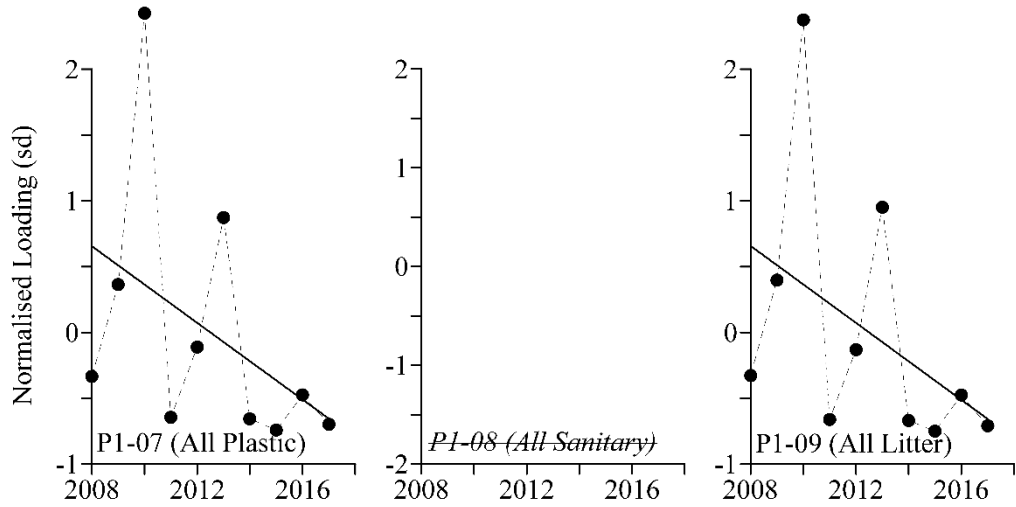
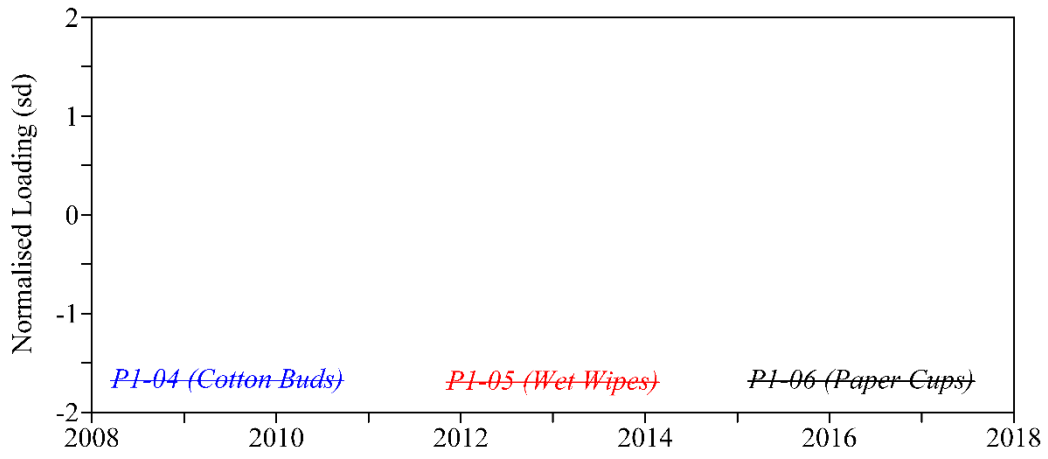
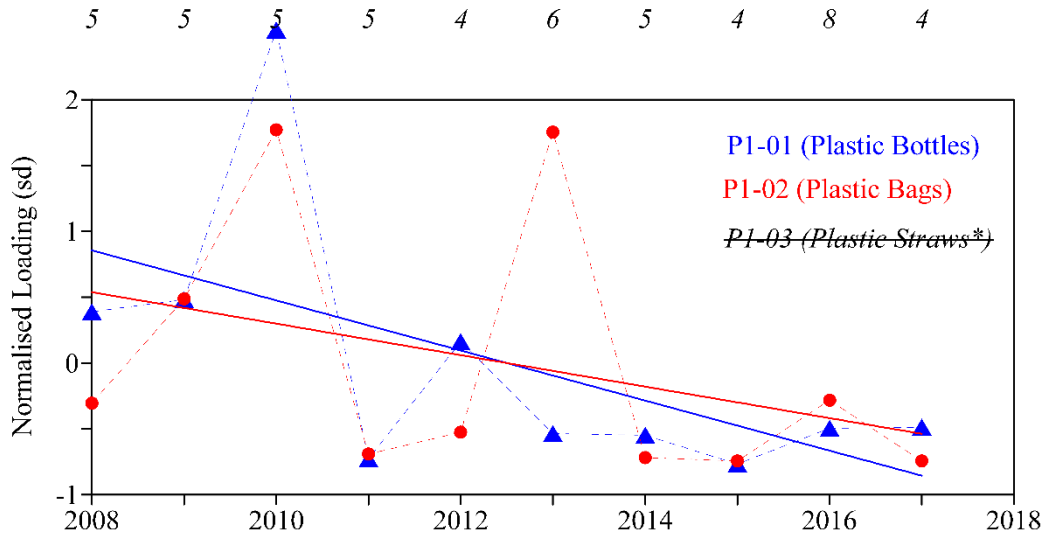
Other Specific Litter Items

- All other specific litter items are too rare to allow indicators to be estimated, apart from drinks cans and sweet/crisp wrappers whose indicators are both decreasing.

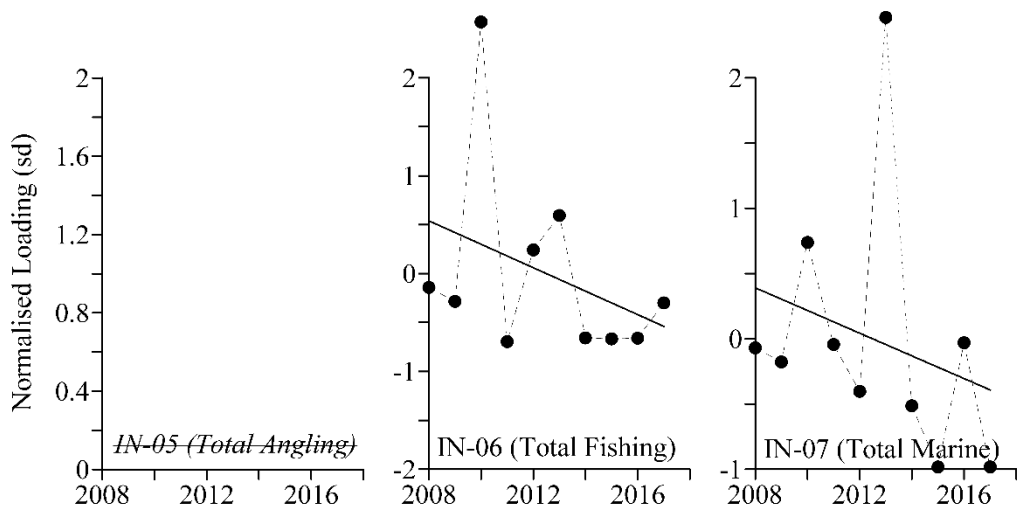
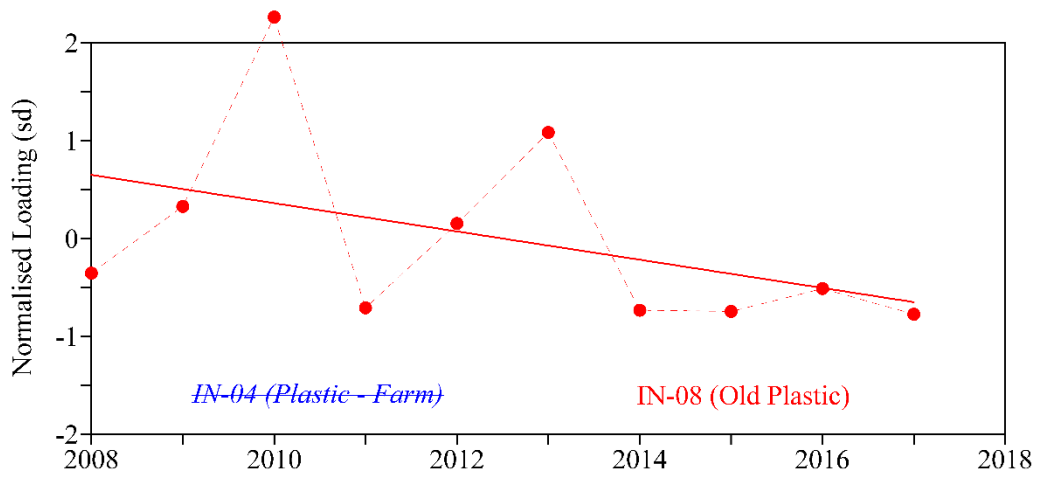
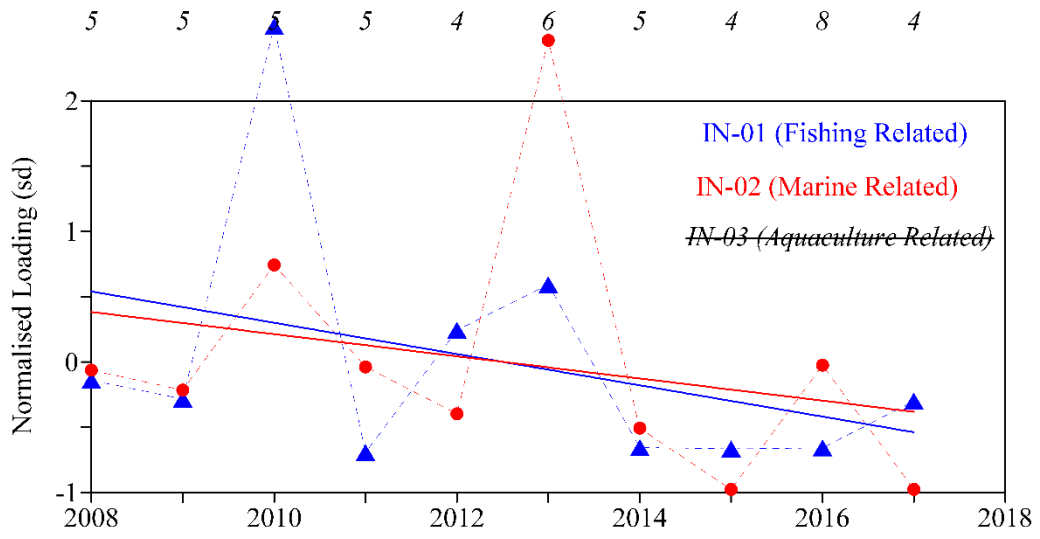
Technical Notes

1. Only “Open Coast” foreshores had enough surveys to use.
2. On the east coast, as winds are predominantly offshore, wind exposure direction not relevant (see Turrell, 2019).

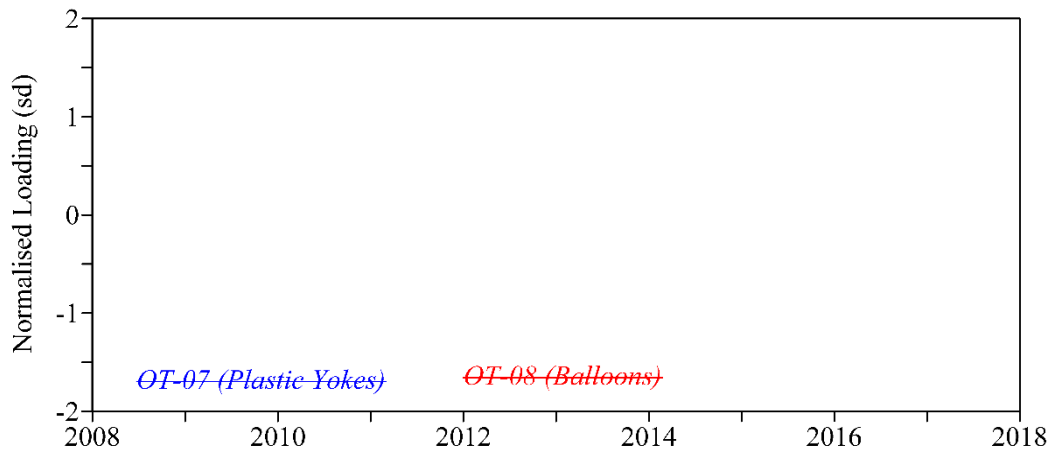
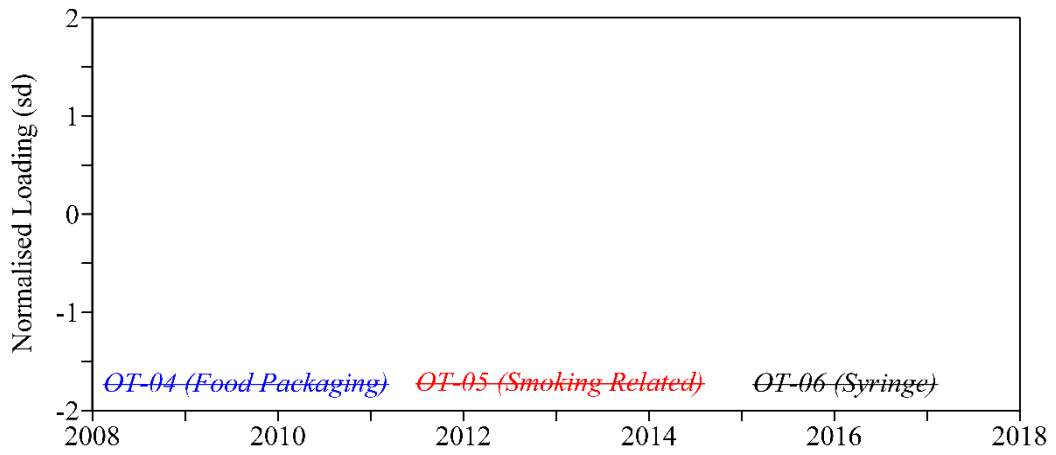
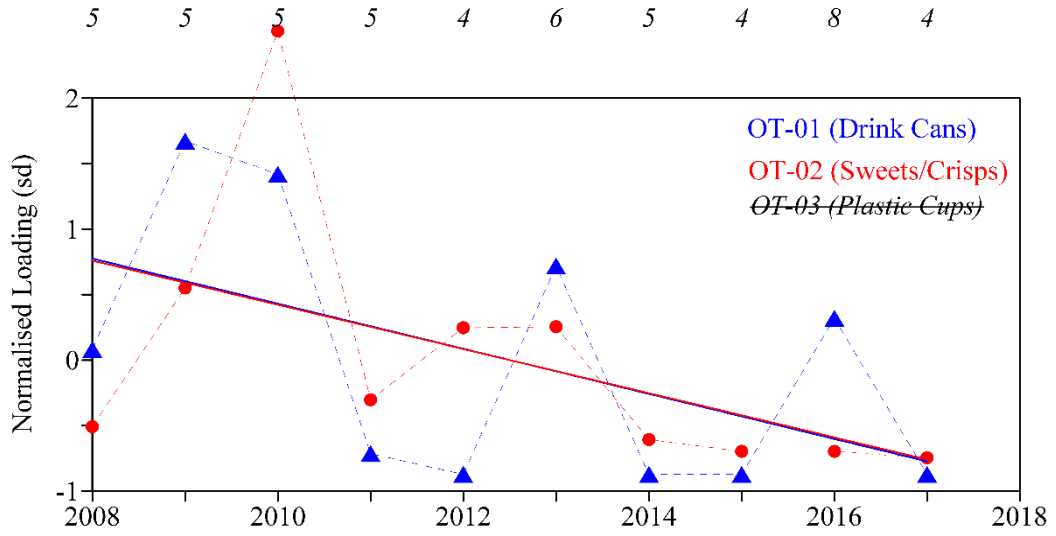
Orkney, All Months – PRIORITY 1



Orkney, All Months – INDUSTRY



Orkney, All Months – OTHER



Full Sub-region Assessment – Moray Firth

Pilot - Scottish Beach Litter Performance Indicators - Moray Firth Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
Moray Firth	All	-1.9	-1.9	-1.5	-1.6	+0.7	-1.8	+0.2	-0.4	-1.0
	Sept	x	x	x	x	x	x	x	x	X

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
Moray Firth	All	+1.6	+1.1	RARE	RARE	+0.3	+1.6	+1.1	+0.2
	Sept	x	x	x	x	x	x	x	x

Other

Reg	Prd.	OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
		Moray Firth	All	-0.9	-1.8	+2.4	-1.5	-2.3	RARE
Sept	x		x	x	x	x	x	x	X

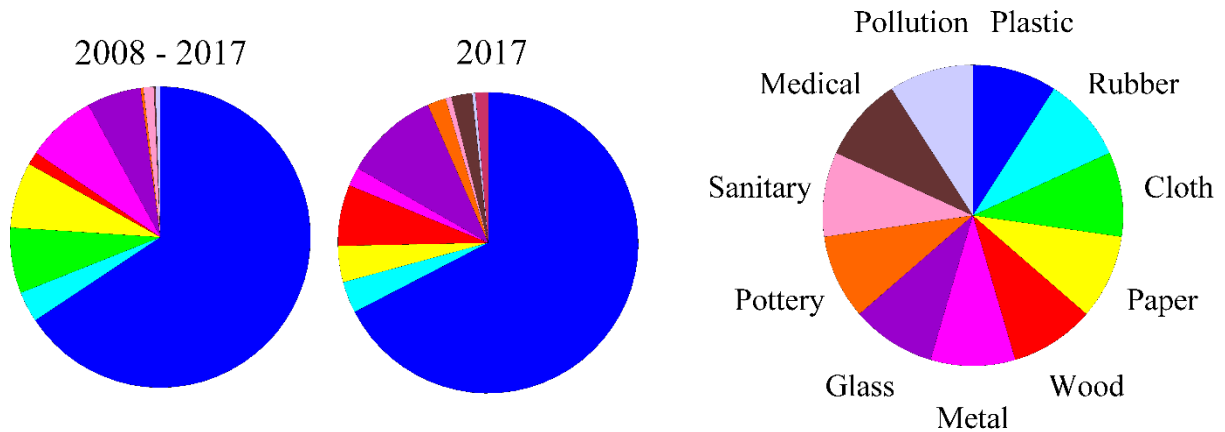
Absolute Average Foreshore Loadings

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01		9.5
		Plastic – Shopping Bags*	P1-02		3.9
		Plastic – Straws*	P1-03		3.5
		Sanitary – Cotton Buds	P1-04		0.3
		Sanitary – Wet Wipes	P1-05		2.7
		Paper – Coffee Cups*	P1-06		0.5
	Totals	All Plastic	P1-07		135.1
		All Sanitary	P1-08		3.9
		All Litter	P1-09		261.6
Industry	Totals	Plastic – Fishing Related	IN-01		7.7
		Plastic – Marine Related	IN-02		8.8
		Plastic – Aquaculture Related	IN-03	rare	rare
		Plastic – Farm Related	IN-04	rare	rare
		Total – Angling Related	IN-05		1.0
		Total – Fishing Related	IN-06		8.0
		Total – Marine Related	IN-07		9.0
		Total – Old Plastic	IN-08		50.2
Other	Individual Items	Metal – Drinks Cans	OT-01		8.9
		Plastic – Sweets/Crisps	OT-02		9.6
		Plastic – Cups	OT-03		0.7
		Plastic – Food Packaging	OT-04		3.1
		Paper – Smoking Related	OT-05		26.2
		Medical - Syringes	OT-06	rare	rare
		Plastic – 4/6 Pack Yokes	OT-07	rare	rare
		Rubber - Balloons	OT-08		0.3

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	207.3	98.9	65.7	67.4
Rubber	10.4	4.9	3.3	3.4
Cloth	22.3	5.7	7.1	3.9
Paper	22.3	9.6	7.1	6.6
Wood	4.4	2.9	1.4	2.0
Metal	23.9	14.9	7.6	10.2
Glass	18.4	2.9	5.8	2.0
Pottery	1.0	0.9	0.3	0.6
Sanitary	3.5	3.3	1.1	2.2
Medical	0.5	0.5	0.2	0.3
Pollution	1.7	2.0	0.5	1.4
<i>Total</i>	<i>315.7</i>	<i>146.6</i>		

Note: Total differs from previous table as years with less than four surveys dropped from calculations for SBLPIs (Total =261 np/100 m), but not from table above (Total = 316 np/100 m). For consistency the total in the table above is used.



Sub-Region Summary

- Although indicators for this sub-region have been estimated, several years are missing owing to too few surveys being available.
- In general most pilot SBLPIs are showing decreasing trends, apart from those related to the marine industries of shipping and fishing, which are showing gradual increasing trends.

SBLPI Summary

Priority One Indicators

- Indicators related to plastic bags and plastic bottles are both on the decline in Moray Firth, although the years just following the plastic bag charging introduction are missing.
- Almost all other Priority One indicators are declining.

Industry- related Indicators

- Plastics and total litter from fishing and marine industries are on the decline.
- Old plastic, possibly from remote sources, is also decreasing.

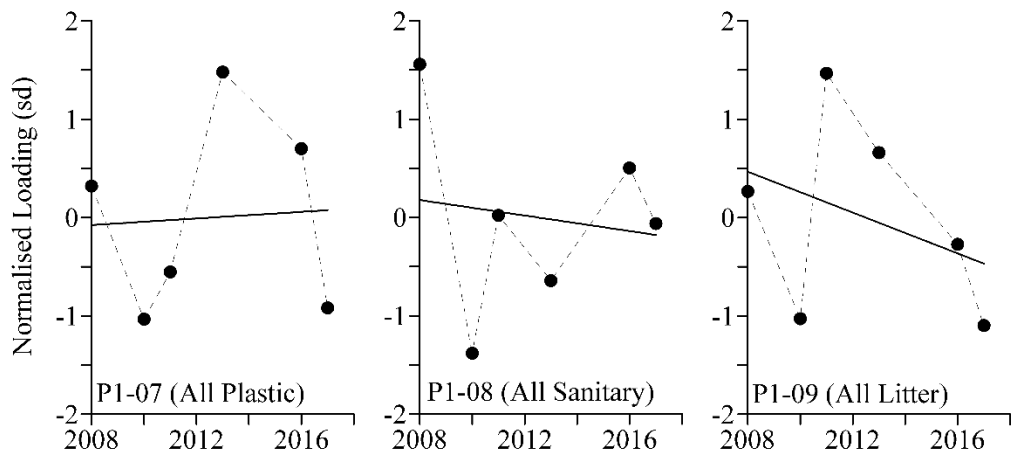
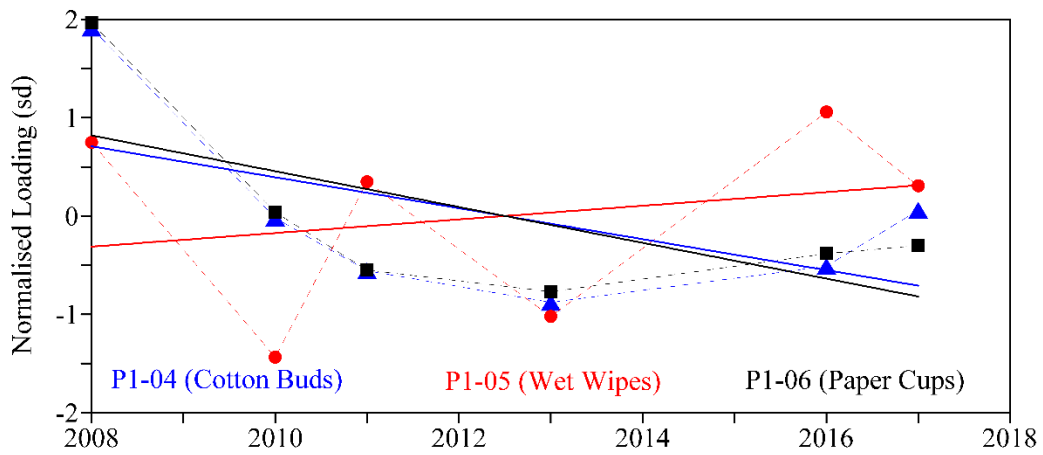
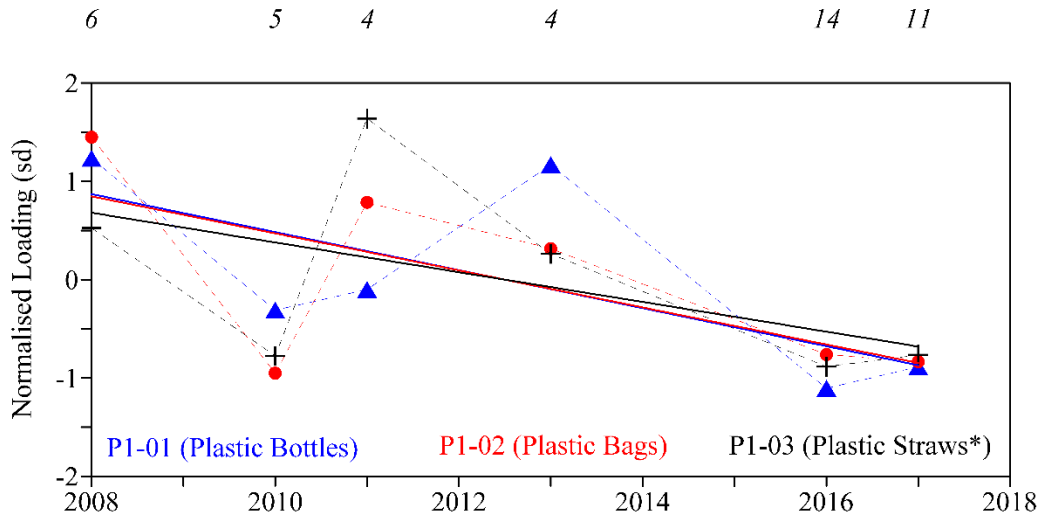
Other Specific Litter Items

- Apart from the indicator related to plastic cups, which is probably flawed owing to missing record years, all specific litter item indicators are declining.
- Yokes from 4/6 packs and syringes are too rare in the Moray Firth to allow an indicator to be estimated.

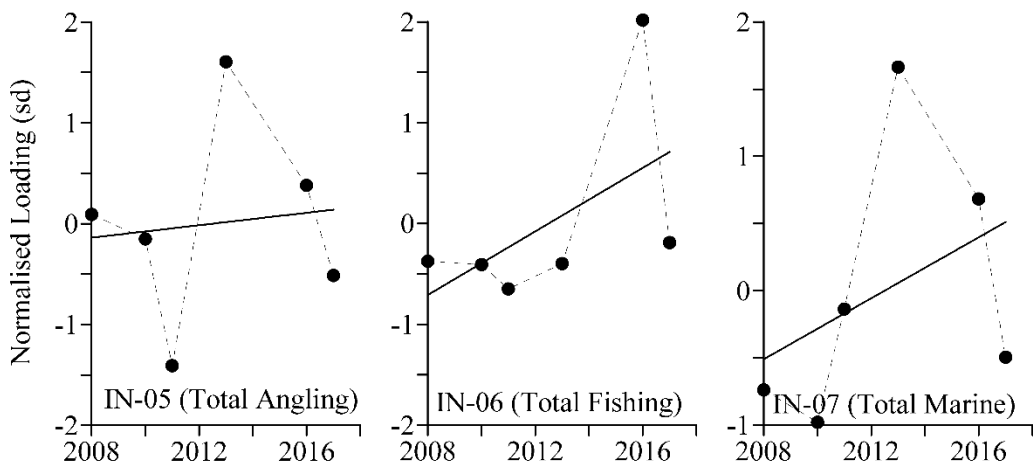
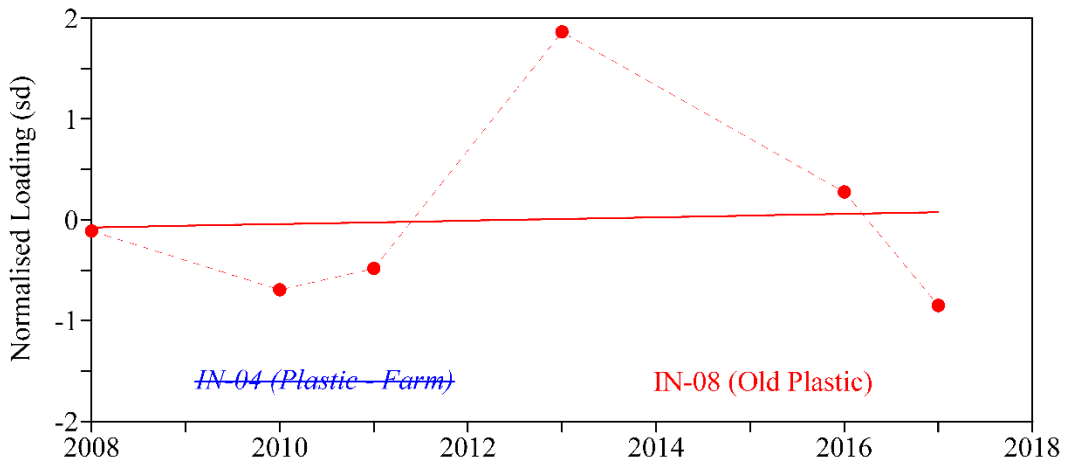
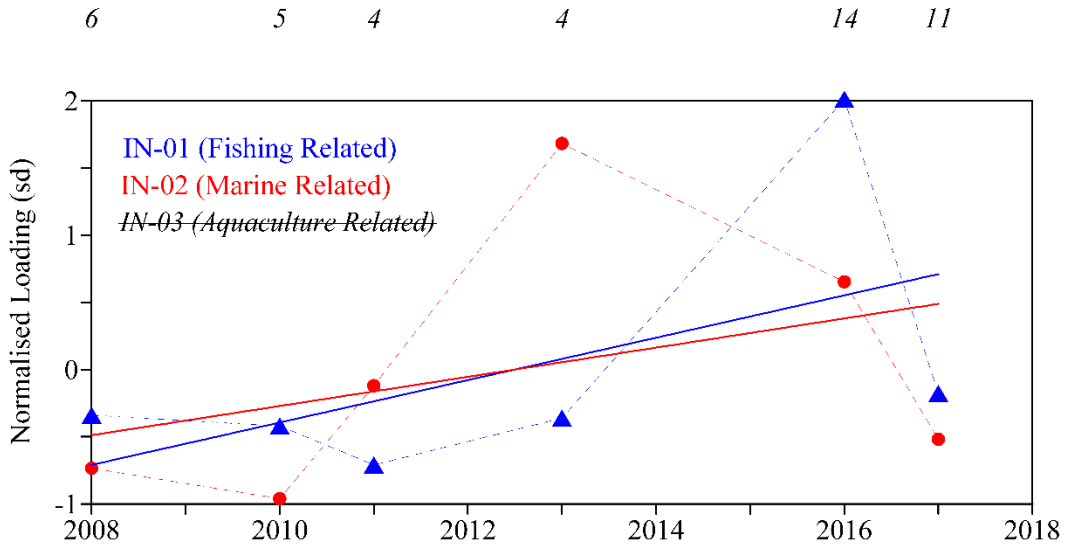
Technical Notes

1. Only "Open Coast" foreshores had enough surveys to use.
2. On the east coast, as winds are predominantly offshore, wind exposure direction not relevant (see Turrell, 2019).
3. Not enough surveys to calculate indicators for 2009, 2012, 2014, 2015.
4. There were too few observations in the IN-03 (Aquaculture Related), IN-04 (Farm Related), OT-06 (Syringes) and OT-07 (Yokes) categories to calculate indicators (i.e. these were rare items in the Moray Firth).

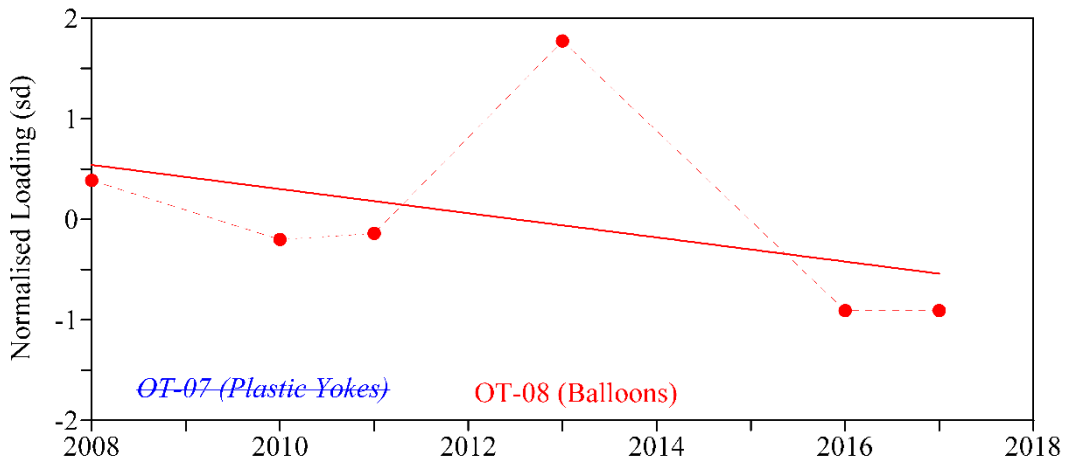
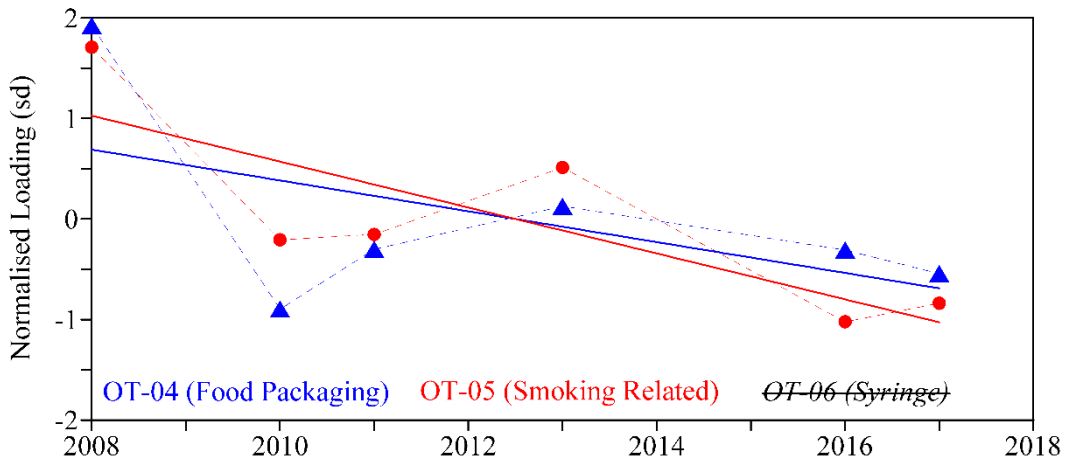
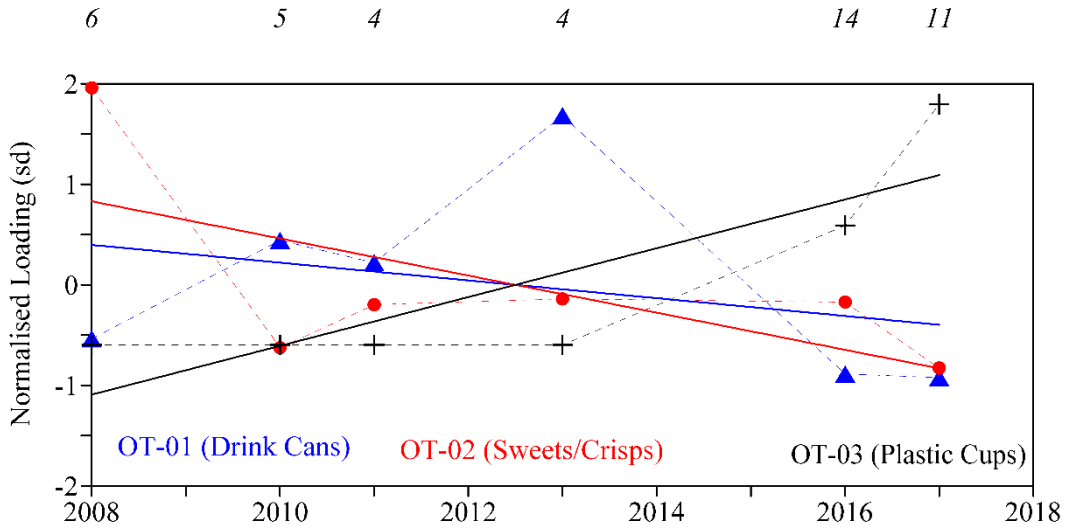
Moray Firth, All Months – PRIORITY 1



Moray Firth, All Months – INDUSTRY



Moray Firth, All Months – OTHER



4. Full Sub-Region Assessment – East Coast (North)

Pilot - Scottish Beach Litter Performance Indicators - East Coast (N) Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
ECoast (N)	All	-2.0	-1.6	-1.9	-1.2	+2.2	-0.6	-1.6	-0.7	-1.5
	Sept	-2.1	-1.4	-2.1	+1.0	+1.7	-1.2	-2.0	0.0	-1.9

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
ECoast (N)	All	+0.3	+0.8	RARE	RARE	+2.7	+0.3	+0.8	-1.6
	Sept	+0.9	+0.5	RARE	RARE	+1.3	+0.9	+0.5	-2.0

Other

Reg	Prd.	OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
		ECoast (N)	All	-2.2	-0.6	+2.2	-2.1	+2.6	-2.3
Sept	-2.2		-1.4	+2.3	-2.2	+2.2	-2.1	+0.6	-2.2

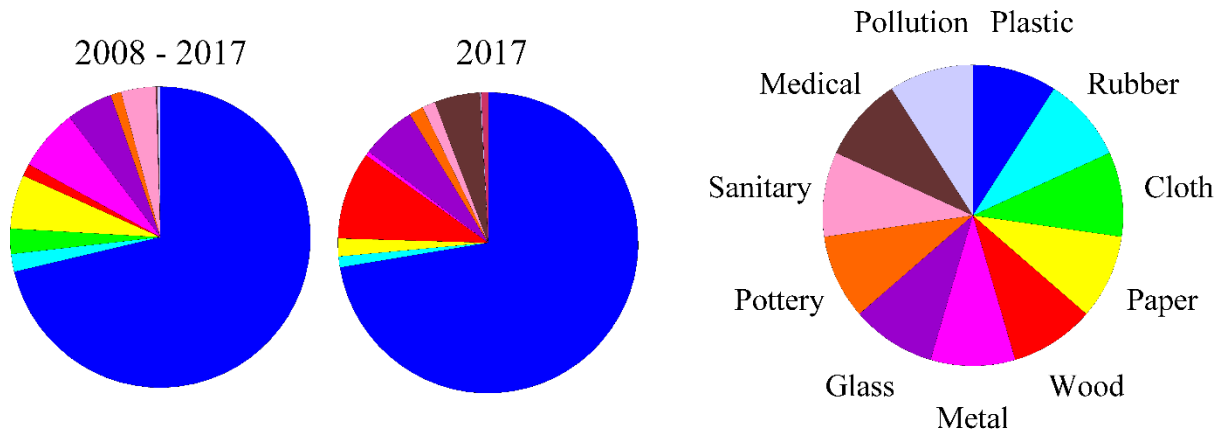
Absolute Average Foreshore Loadings

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01	22.8	17.4
		Plastic – Shopping Bags*	P1-02	9.3	8.9
		Plastic – Straws*	P1-03	6.2	5.1
		Sanitary – Cotton Buds	P1-04	2.5	3.7
		Sanitary – Wet Wipes	P1-05	3.3	3.1
		Paper – Coffee Cups*	P1-06	0.9	0.7
	Totals	All Plastic	P1-07	223.4	198.6
		All Sanitary	P1-08	8.7	10.0
		All Litter	P1-09	286.7	260.0
Industry	Totals	Plastic – Fishing Related	IN-01	10.7	11.4
		Plastic – Marine Related	IN-02	10.2	9.5
		Plastic – Aquaculture Related	IN-03	0.0	0.0
		Plastic – Farm Related	IN-04	0.0	0.0
		Total – Angling Related	IN-05	2.0	2.4
		Total – Fishing Related	IN-06	10.8	11.6
		Total – Marine Related	IN-07	10.3	9.6
		Total – Old Plastic	IN-08	81.8	73.1
Other	Individual Items	Metal – Drinks Cans	OT-01	10.7	8.1
		Plastic – Sweets/Crisps	OT-02	19.3	16.4
		Plastic – Cups	OT-03	0.3	0.3
		Plastic – Food Packaging	OT-04	11.5	8.9
		Paper – Smoking Related	OT-05	6.8	7.5
		Medical - Syringes	OT-06	0.2	0.1
		Plastic – 4/6 Pack Yokes	OT-07	0.1	0.1
		Rubber - Balloons	OT-08	0.1	0.1

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	236.3	179.9	71.3	72.4
Rubber	6.3	2.9	1.9	1.2
Cloth	9.0	4.7	2.7	1.9
Paper	19.2	23.4	5.8	9.4
Wood	4.4	1.2	1.3	0.5
Metal	21.9	14.7	6.6	5.9
Glass	16.5	3.8	5.0	1.5
Pottery	3.8	3.5	1.1	1.4
Sanitary	12.4	12.2	3.7	4.9
Medical	0.6	0.3	0.2	0.1
Pollution	1.1	1.9	0.3	0.7
<i>Total</i>	331.4	248.5		

Note: Total differs from previous table as years with less than four surveys dropped from calculations for SBLPIs (Total =260 np/100 m), but not from table above (Total = 249 np/100 m). For consistency the total in the table above is used.



Sub-Region Summary

- Apart from indicators associated with wet wipes, angling and smoking, most other pilot SBLPIs suggest improving beach conditions in this sub-region.
- For some indicators, however, this may be partly caused by very high values estimated from 2008 surveys.

SBLPI Summary

Priority One Indicators

- All priority one indicators are on the decline in the East Coast (N) sub-region, apart from that one associated with wet wipes.
- However, examination of the details of the pilot SBLPIs suggests that the indicators associated with cotton buds and paper cups have been gradually increasing since 2009. The overall decreasing trends are the result of very high estimated values in 2008.

Industry- related Indicators

- Indicators related to the fishing and marine industries show little evidence of trend.
- The indicator using plastic pieces, probably related to old plastic and possibly from remote sources, is decreasing.

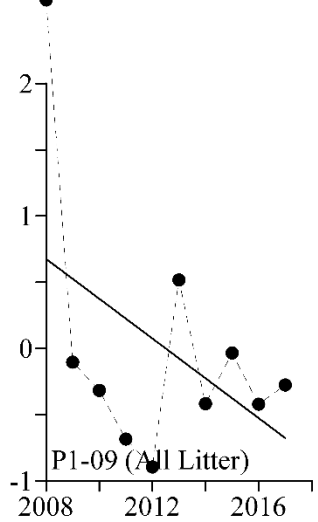
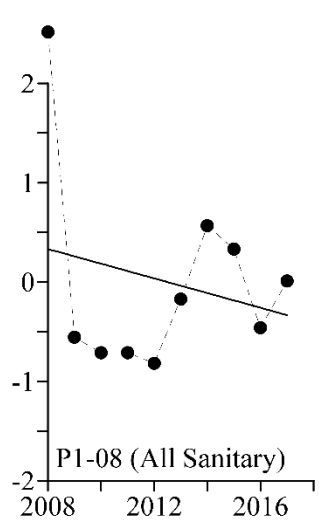
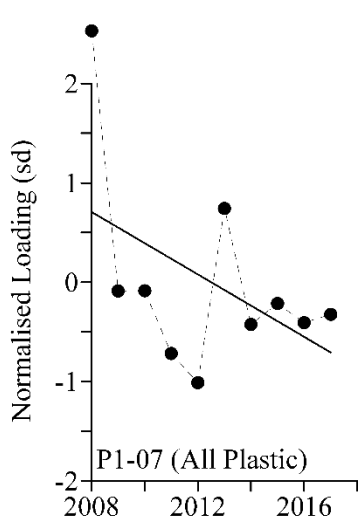
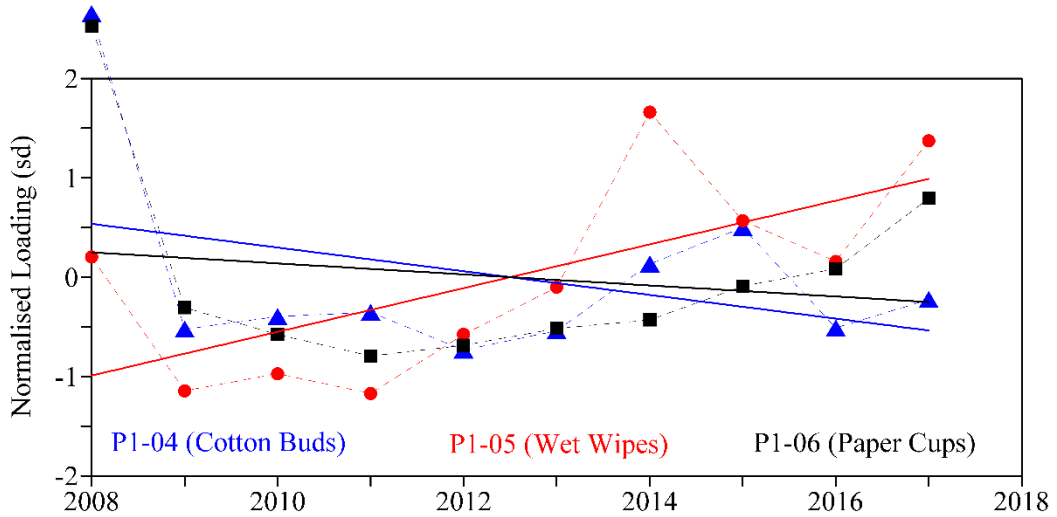
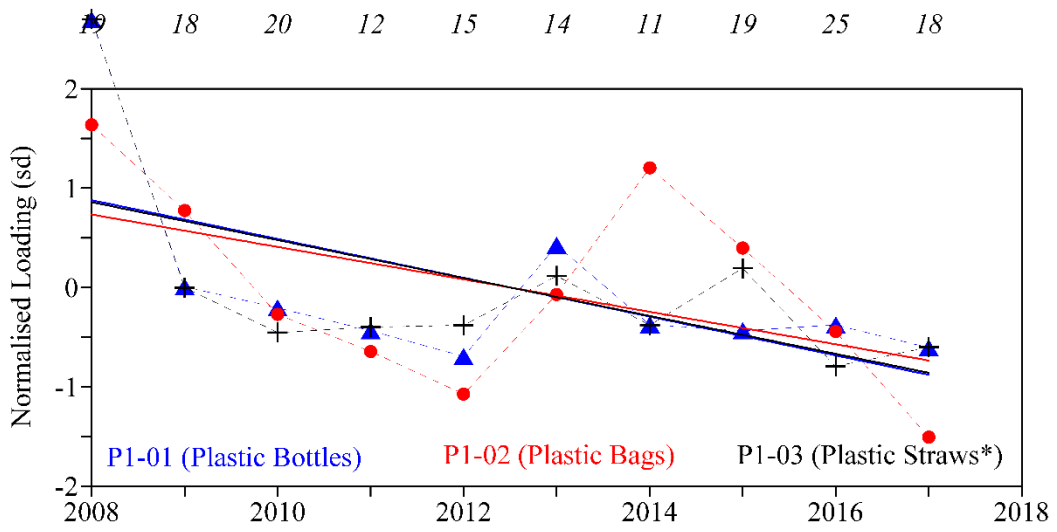
Other Specific Litter Items

- Indicators related to the specific litter items all show declines (apart from the flawed plastic sup indicator) apart from the indicator related to smoking products (cigarette papers and stubs)

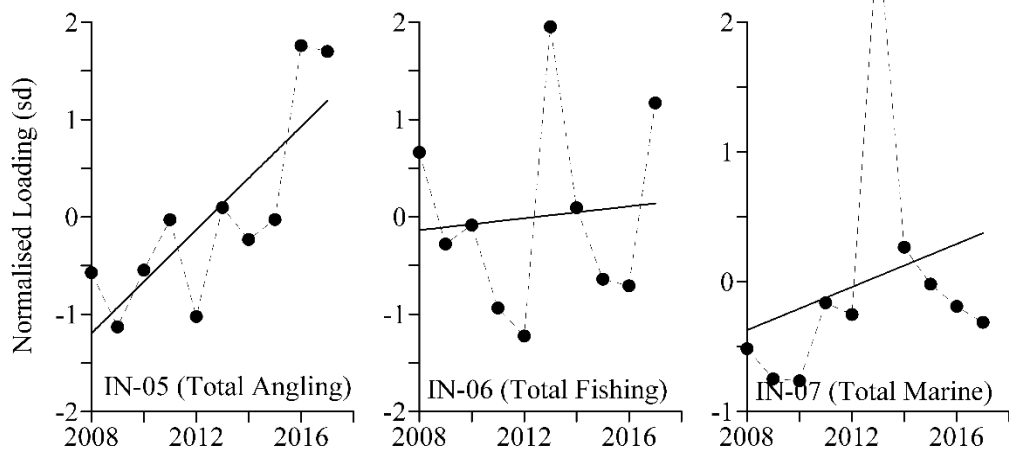
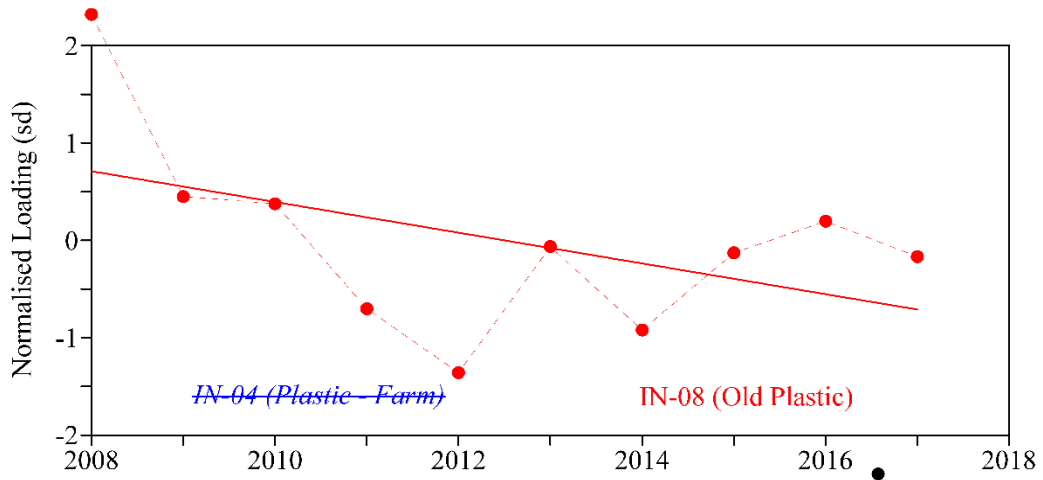
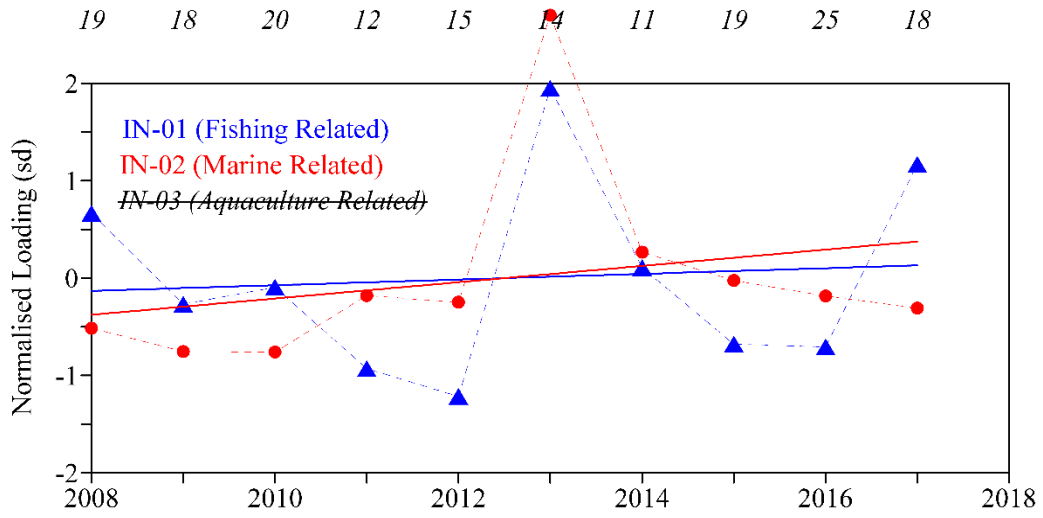
Technical Notes

1. Only “Open Coast” foreshores had enough surveys to use.
2. On the east coast, as winds are predominantly offshore, wind exposure direction not relevant (see Turrell, 2019).
3. There were sufficient surveys for indicators to be estimated for all years, both for the “any-month” and the “September Only” indicator sets.

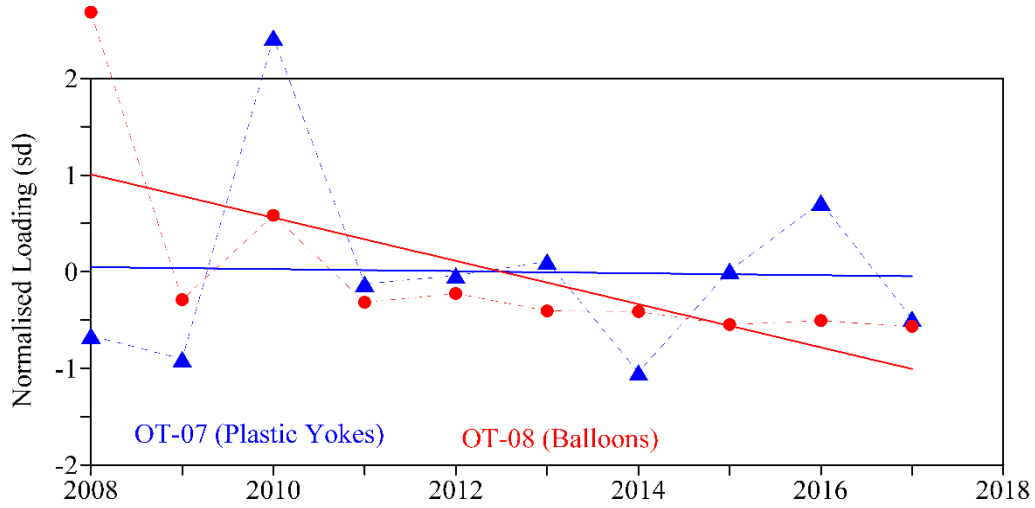
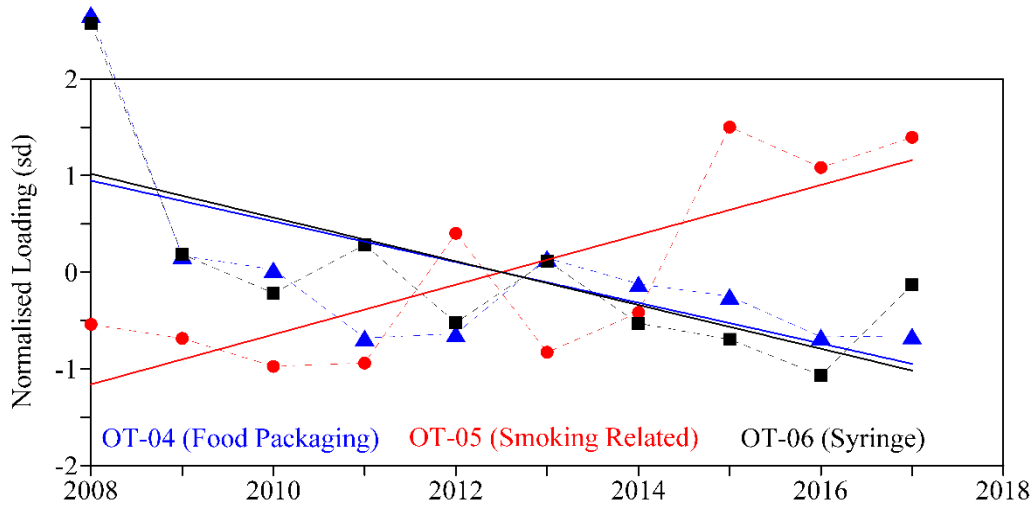
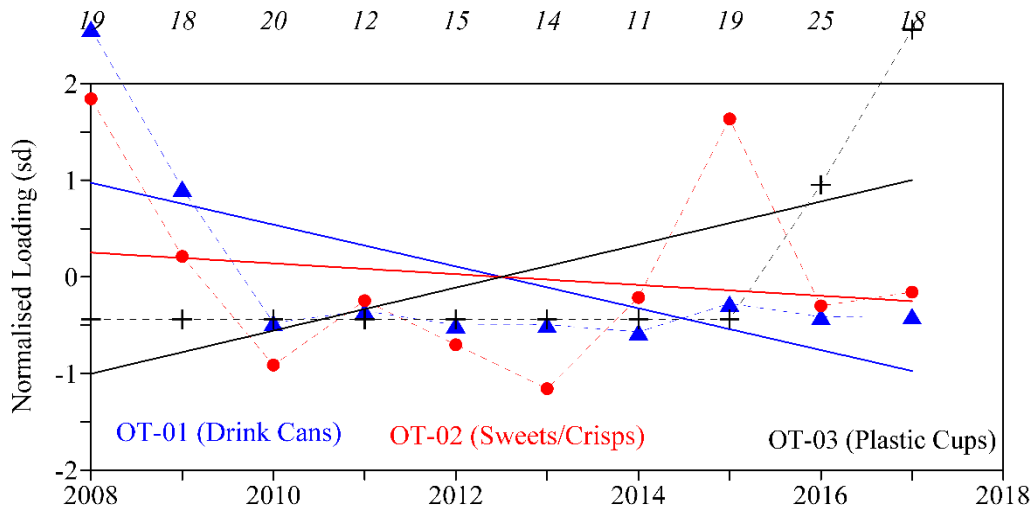
East Coast (N), All Months – PRIORITY 1



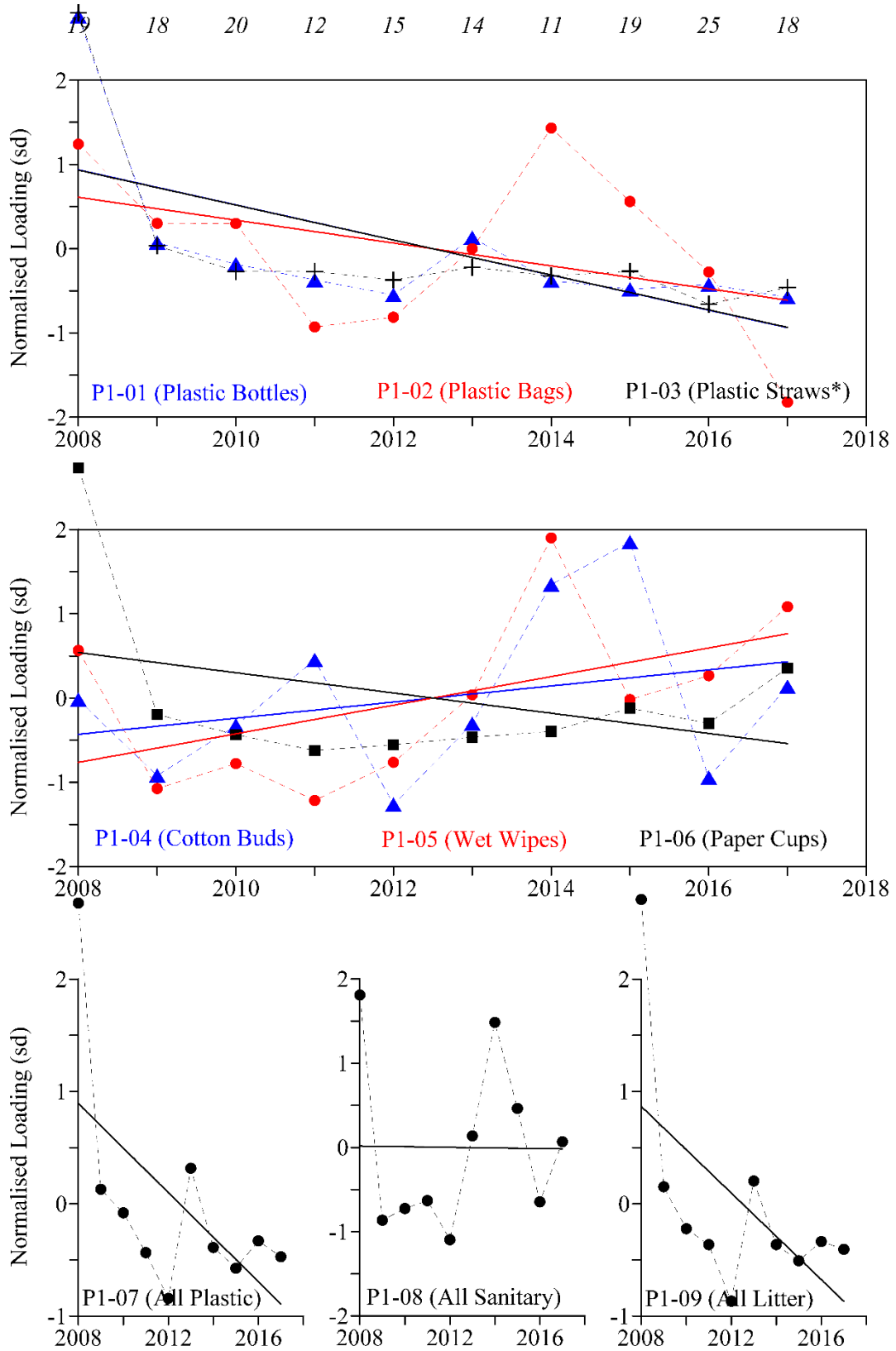
East Coast (N), All Months – INDUSTRY



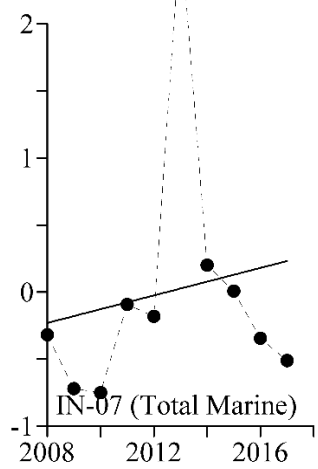
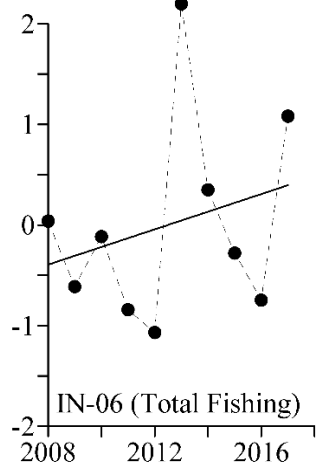
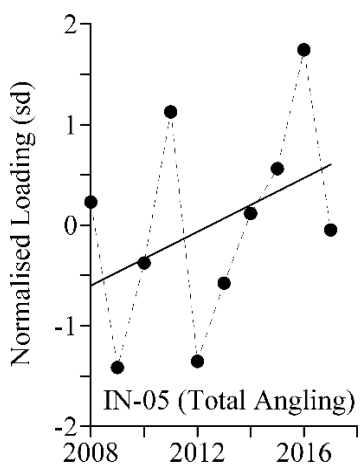
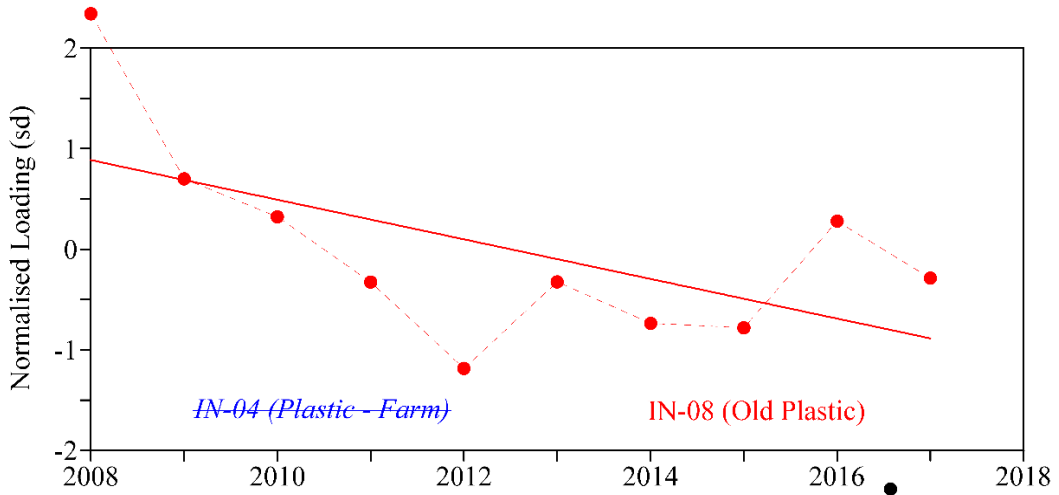
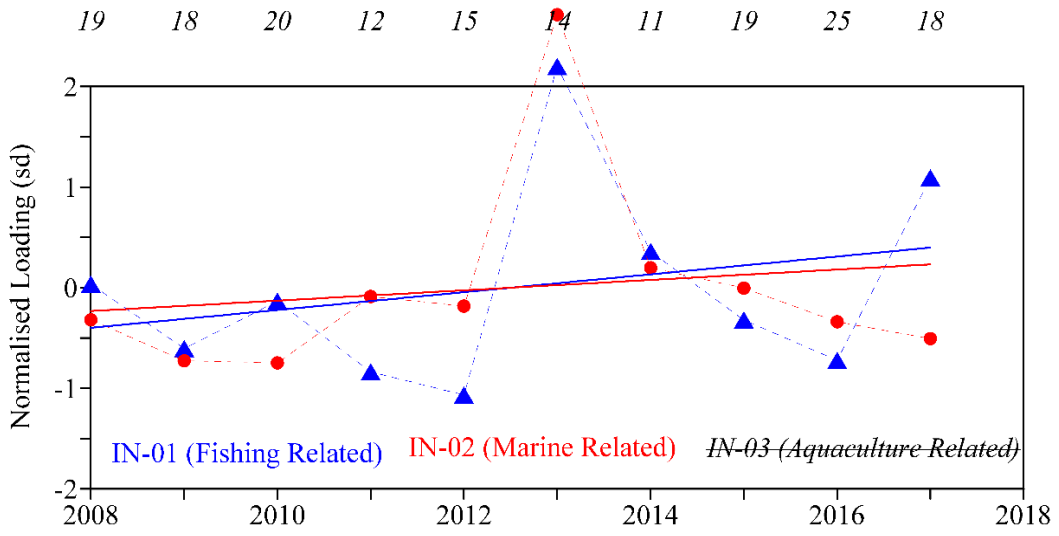
East Coast (N), All Months – OTHER



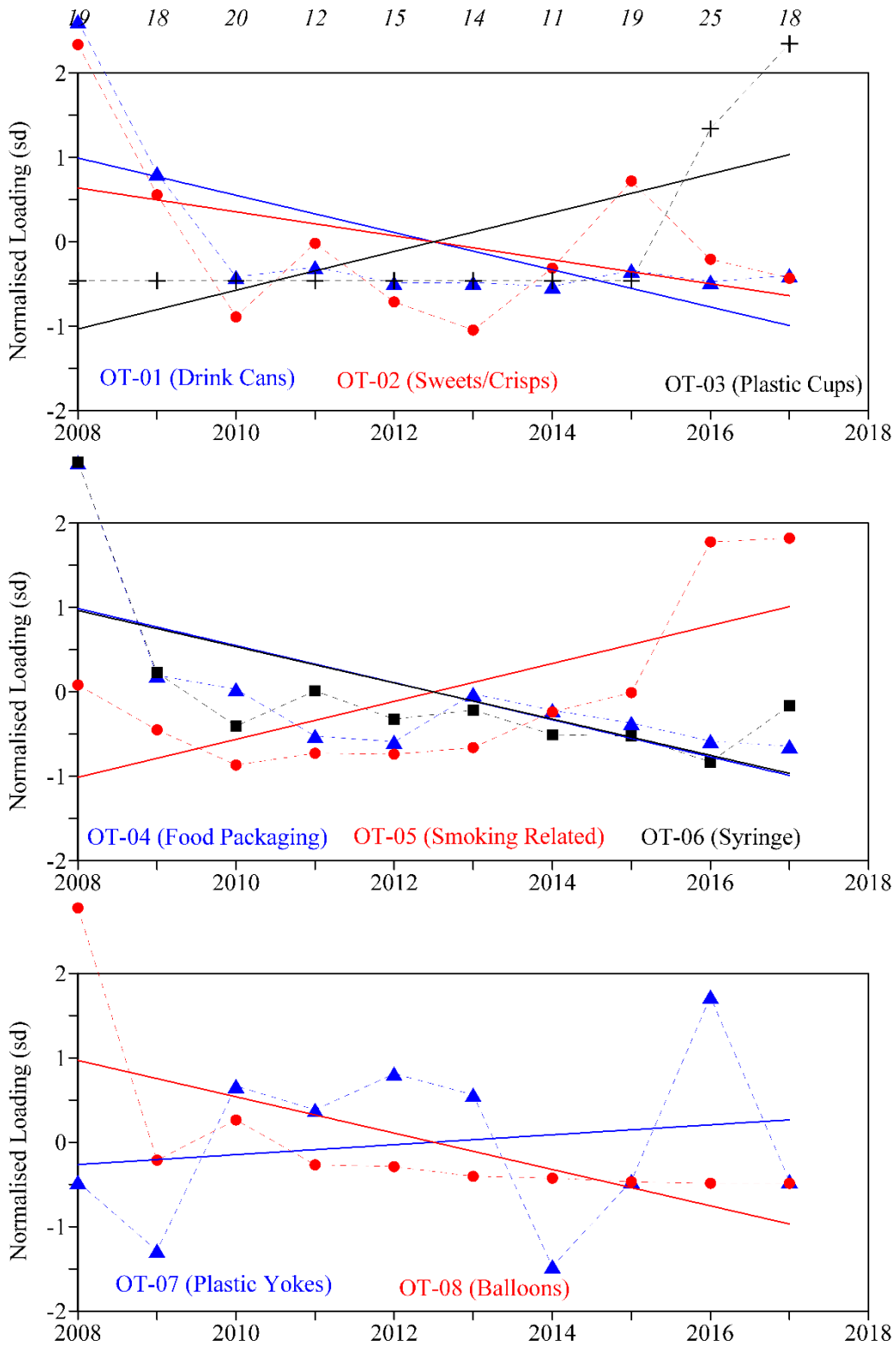
East Coast (n), September – PRIORITY 1



East Coast (N), September – INDUSTRY



East Coast (N), September – OTHER



5. Full Sub-Region Assessment – Firth of Forth

Pilot - Scottish Beach Litter Performance Indicators - Firth of Forth Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
Forth	All	-1.8	-1.6	-0.9	-1.5	+1.9	+0.7	-0.9	+0.3	-0.1
	Sept	-2.2	-2.5	-1.3	-1.4	+1.9	-0.8	-2.2	-1.6	-1.6

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
Forth	All	-0.3	+0.7	RARE	RARE	-0.6	-0.3	+0.7	+0.1
	Sept	-1.9	+0.2	RARE	RARE	-1.2	-2.1	-2.0	-0.1

Other

Reg	Prd.	OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
		Forth	All	+0.9	-1.9	+2.3	-1.3	+2.1	-1.1
Sept	-0.4		-2.3	+1.8	-1.0	+1.8	-1.1	-1.7	RARE

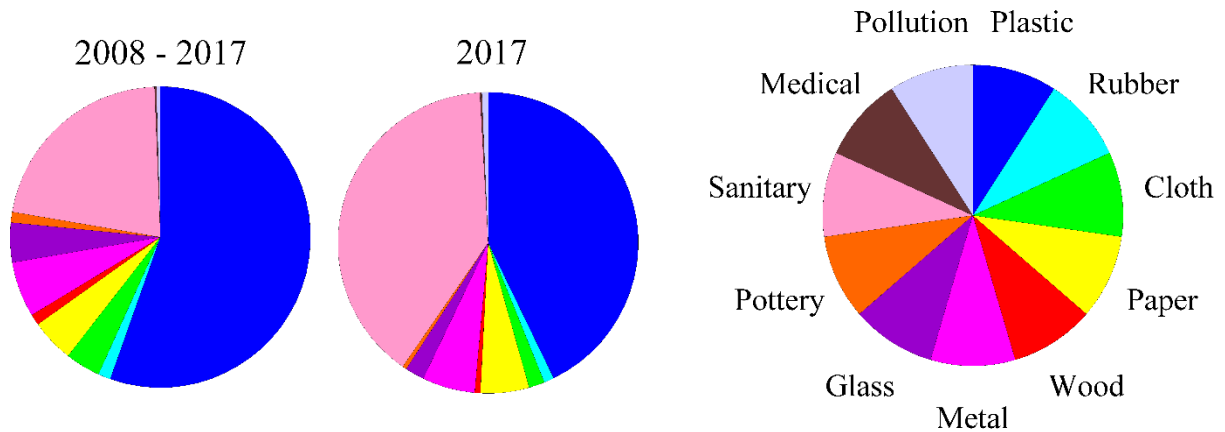
Absolute Average Foreshore Loadings

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01	9.7	14.2
		Plastic – Shopping Bags*	P1-02	10.8	8.2
		Plastic – Straws*	P1-03	9.1	6.5
		Sanitary – Cotton Buds	P1-04	62.4	36.4
		Sanitary – Wet Wipes	P1-05	16.0	24.9
		Paper – Coffee Cups*	P1-06	0.5	0.5
	Totals	All Plastic	P1-07	177.1	188.9
		All Sanitary	P1-08	97.4	75.1
		All Litter	P1-09	341.3	340.9
Industry	Totals	Plastic – Fishing Related	IN-01	3.5	2.1
		Plastic – Marine Related	IN-02	2.1	3.4
		Plastic – Aquaculture Related	IN-03	0.0	0.0
		Plastic – Farm Related	IN-04	0.0	0.0
		Total – Angling Related	IN-05	2.4	1.3
		Total – Fishing Related	IN-06	3.6	2.1
		Total – Marine Related	IN-07	2.3	3.6
		Total – Old Plastic	IN-08	73.8	84.4
Other	Individual Items	Metal – Drinks Cans	OT-01	8.0	11.0
		Plastic – Sweets/Crisps	OT-02	25.3	21.9
		Plastic – Cups	OT-03	0.7	0.6
		Plastic – Food Packaging	OT-04	6.3	6.3
		Paper – Smoking Related	OT-05	12.3	8.9
		Medical - Syringes	OT-06	0.1	0.1
		Plastic – 4/6 Pack Yokes	OT-07	0.2	0.6
		Rubber - Balloons	OT-08	0.0	0.1

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	186.3	130.1	55.4	42.8
Rubber	4.4	3.3	1.3	1.1
Cloth	12.7	5.2	3.8	1.7
Paper	15.6	15.9	4.6	5.2
Wood	4.0	1.9	1.2	0.6
Metal	20.0	17.2	5.9	5.7
Glass	14.3	6.3	4.3	2.1
Pottery	3.8	1.4	1.1	0.5
Sanitary	72.9	120.0	21.7	39.5
Medical	0.7	0.7	0.2	0.2
Pollution	1.4	2.0	0.4	0.7
<i>Total</i>	336.2	303.9		

Note: Total differs from previous table as years with less than four surveys dropped from calculations for SBLPIs (Total =340 np/100 m), but not from table above (Total = 304 np/100 m). For consistency the total in the table above is used.



Sub-Region Summary

- As with the Clyde, this sub-region has a high proportion of sanitary items.
- However, the total beach litter loadings are not particularly high. This is most likely due to the effect of wind, tides and currents along the Scottish east coast.
- In general, apart from those associated with wet wipes and smoking waste, all pilot SBLPIs in the Firth of Forth are suggestive of static or improving litter conditions.

SBLPI Summary

Priority One Indicators

- Indicators associated with plastic bags and plastic bottles are both on the decline in Firth of Forth.
- The indicator associated with plastic bags shows some stability after 2014, when the shipping bag charge was introduced.

Industry - related Indicators

- There are static, or slightly decreasing trends in all SBPIs in this sub-category.

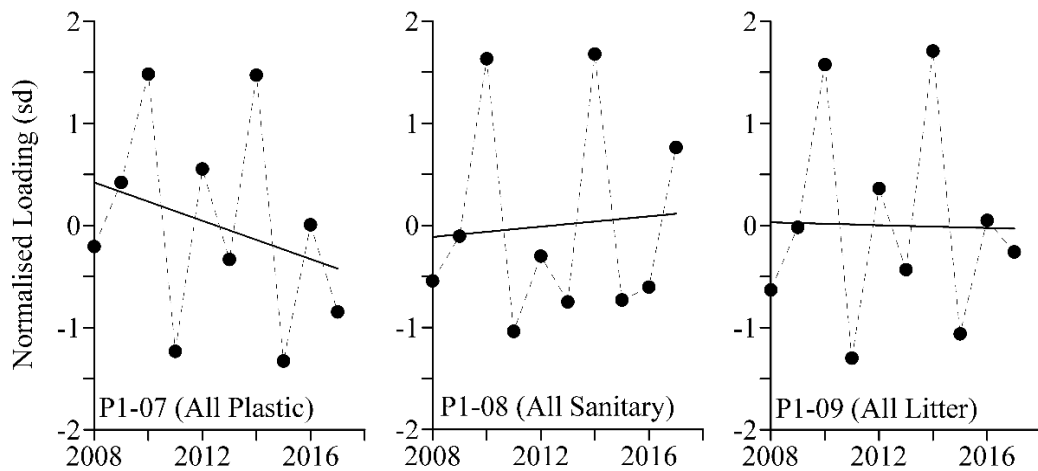
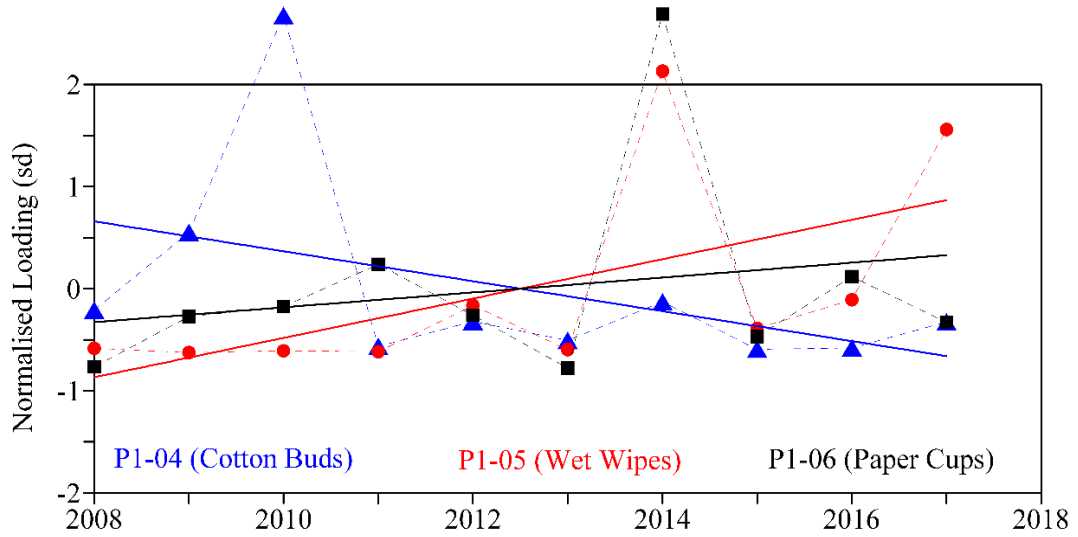
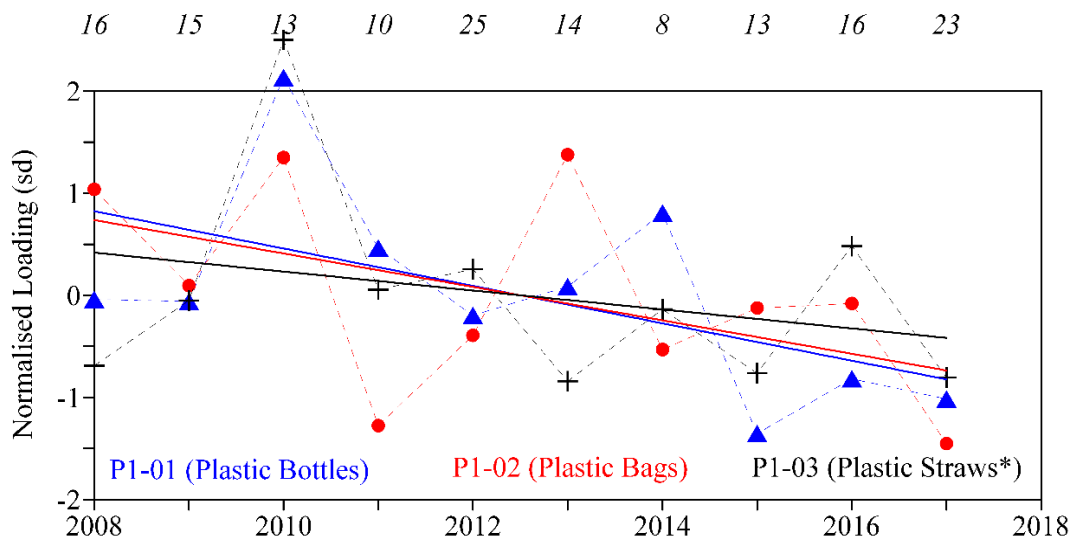
Other Specific Litter Items

- Apart from the flawed Plastic Cup indicator, the only indicator that stands out from a picture of gradual decreases is that one related to smoking, which shows an increase.

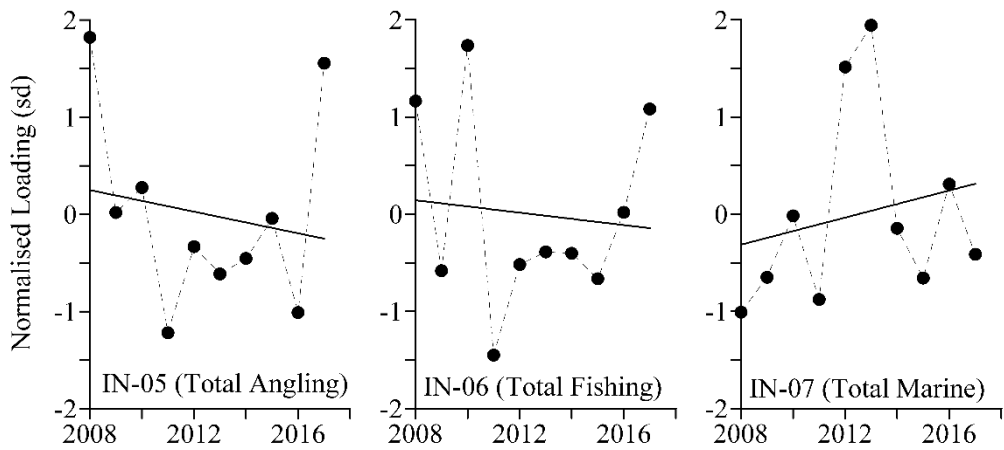
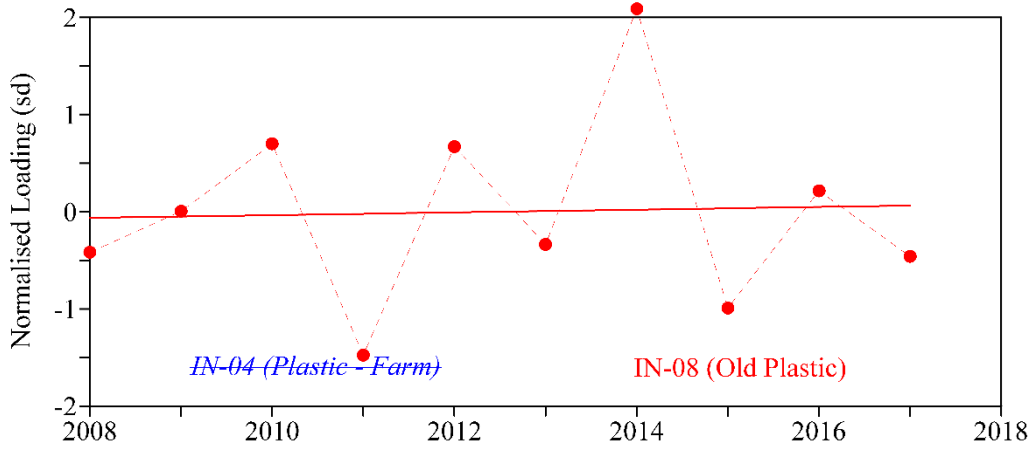
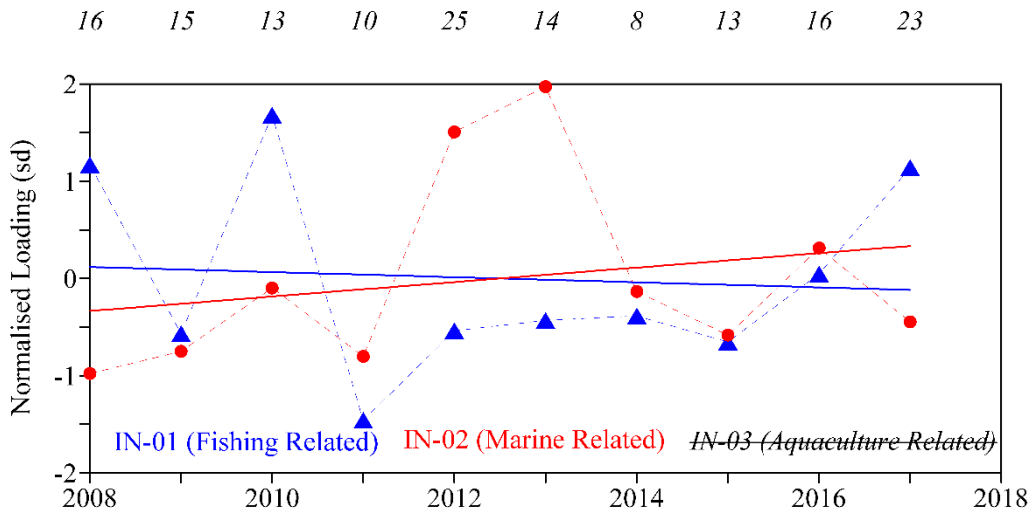
Technical Notes

1. Only "Open Coast" foreshores had enough surveys to use.
2. On the east coast, as winds are predominantly offshore, wind exposure direction not relevant (see Turrell, 2019).
3. While the "Any-Month" indicator set has all years present, the "September" indicator set has 2011, 2013 and 2014 missing

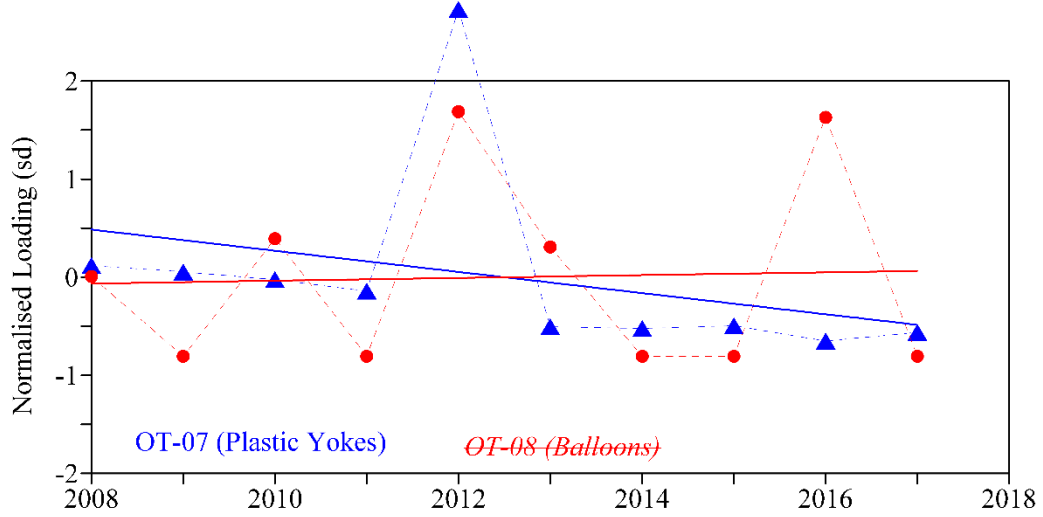
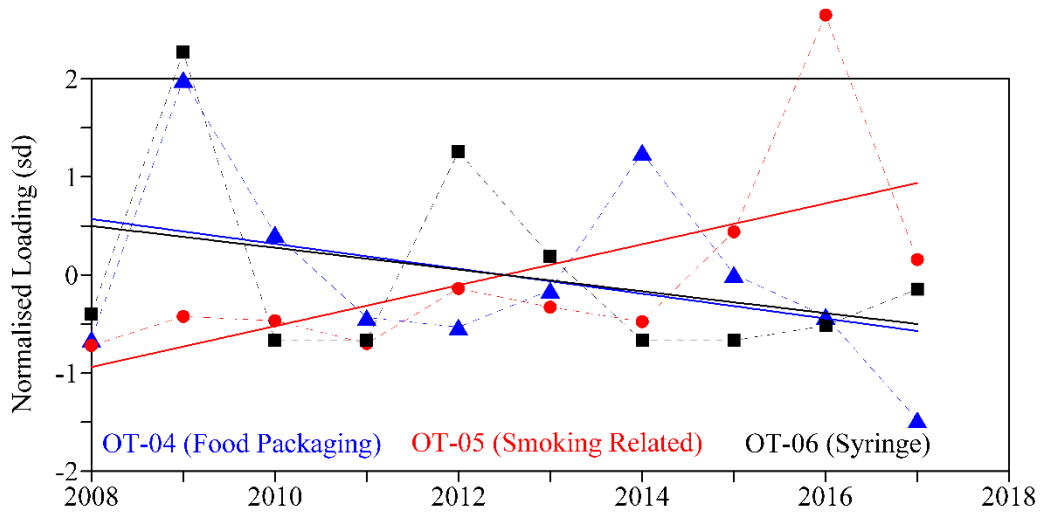
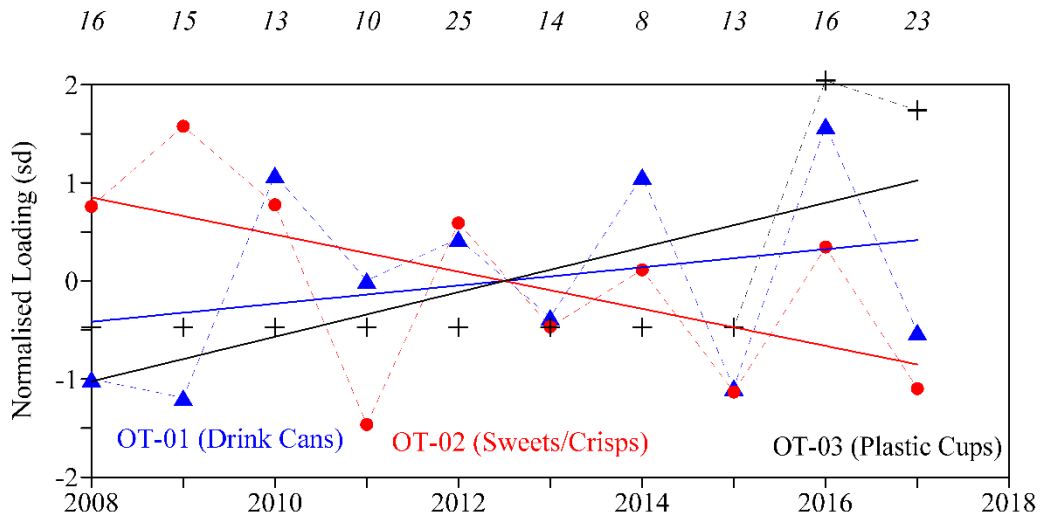
Firth of Forth, All Months – PRIORITY 1



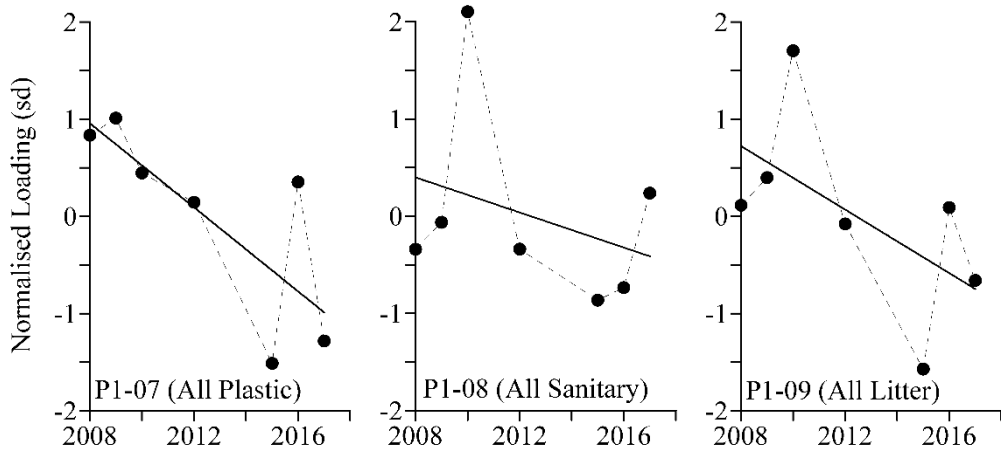
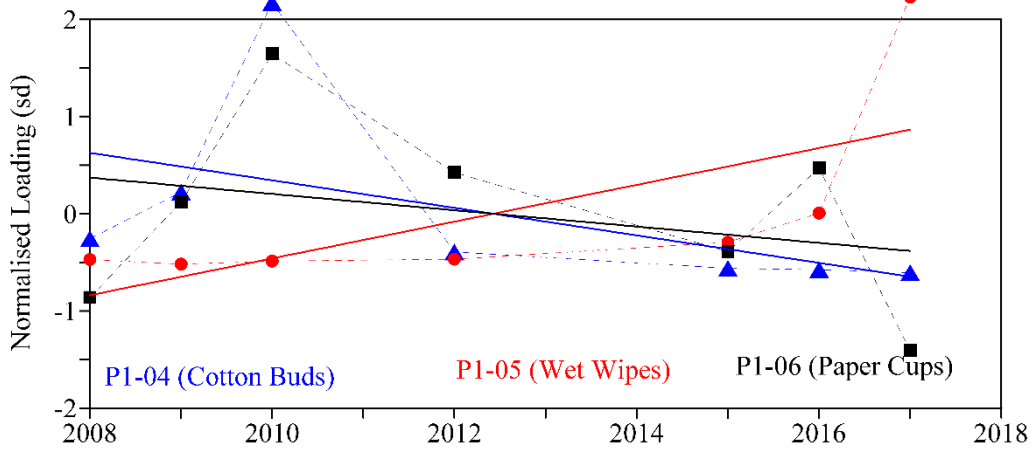
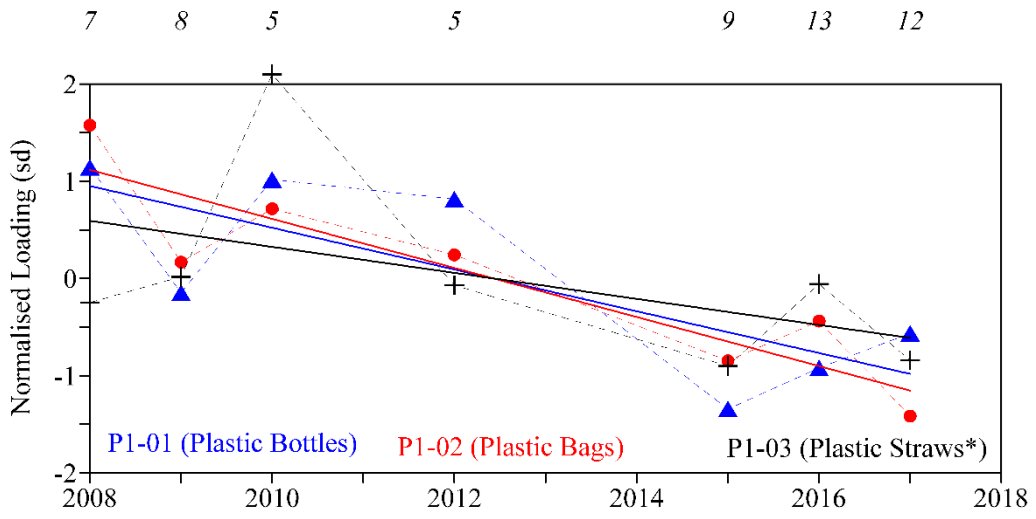
Firth of Forth, All Months – INDUSTRY



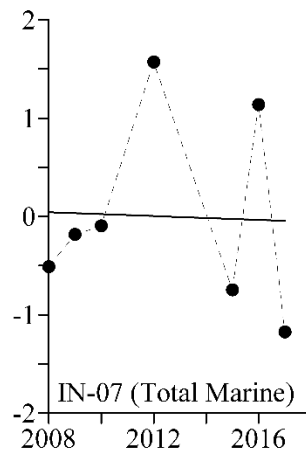
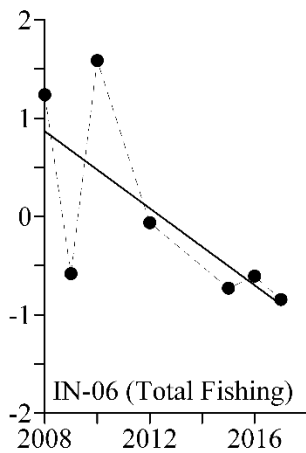
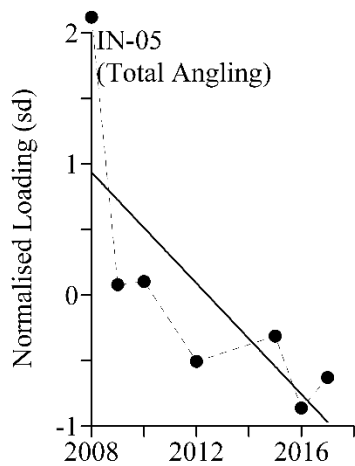
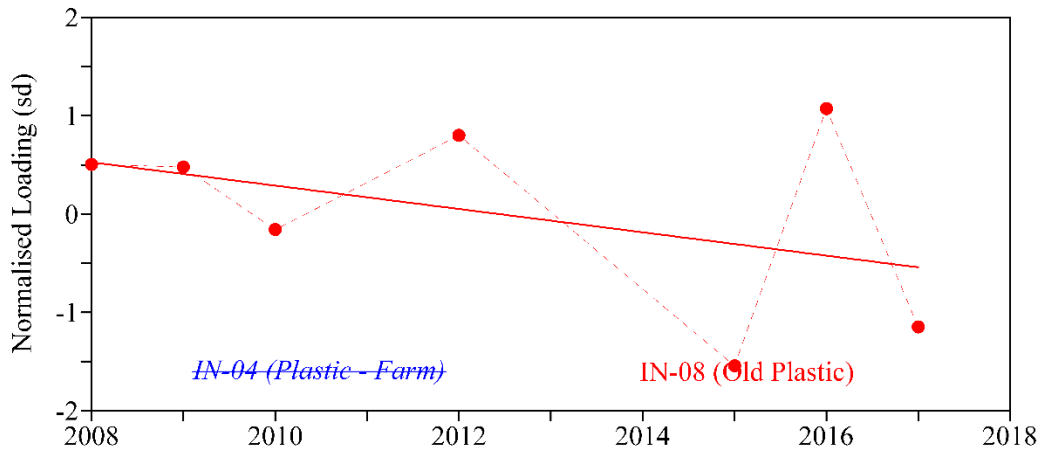
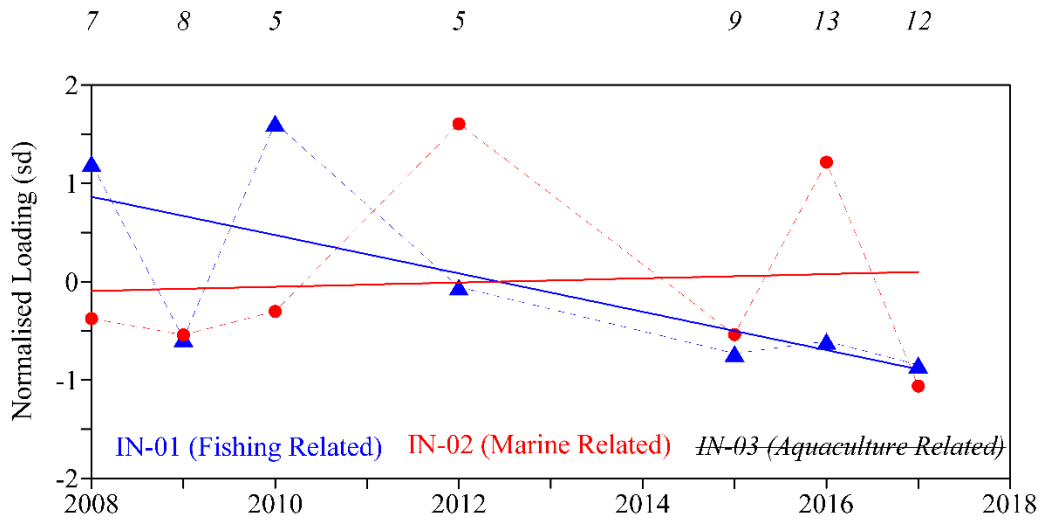
Firth of Forth, All Months – OTHER



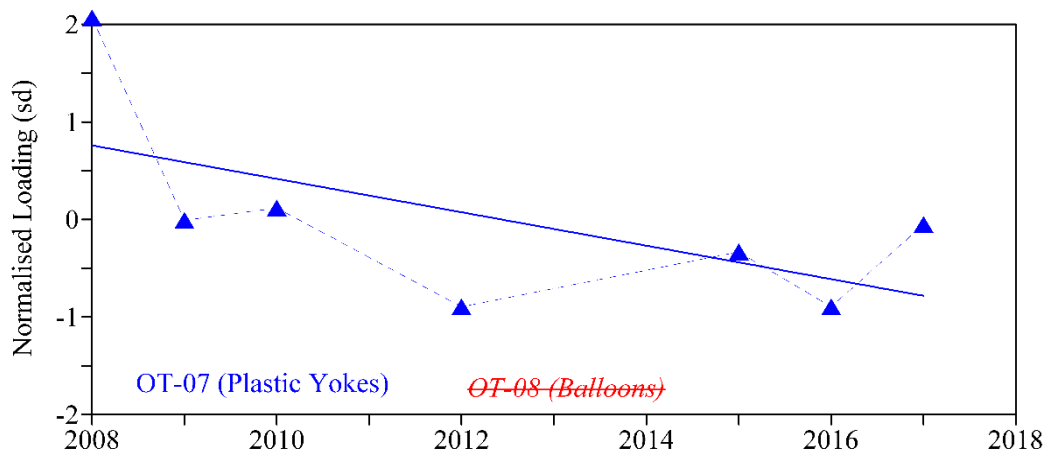
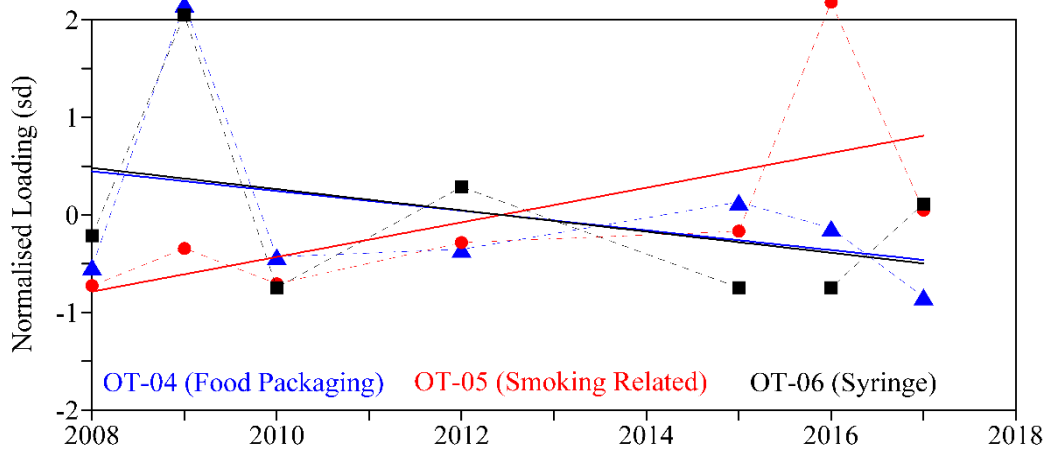
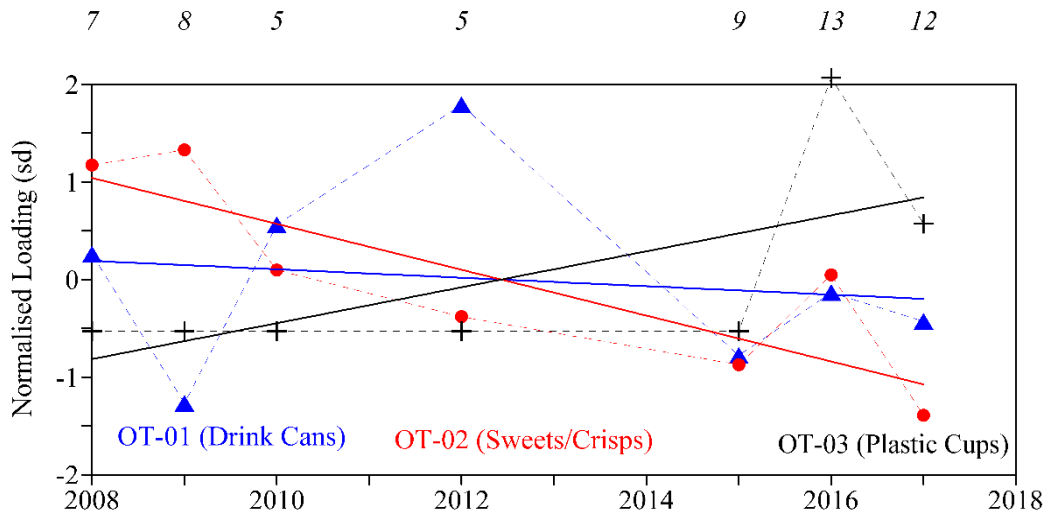
Firth of Forth, September – PRIORITY 1



Firth of Forth, September – INDUSTRY



Firth of Forth, September – OTHER



6. Full Sub-Region Assessment – Firth of Forth Harbours

Pilot - Scottish Beach Litter Performance Indicators - Firth of Forth (HARBOURS) Sub-Region

SBLPI Values

	Increasing by 2 or more standard deviations per decade		Increasing by 1 to 2 standard deviations per decade		Increasing or decreasing by 0 to 1 standard deviations per decade		Decreasing by 1 or more standard deviations per decade
RARE – item found in this sub-region so few times that an indicator is not relevant							

Priority One

Reg	Prd.	Plastic			Sanitary		Paper	Totals		
		P1-01 Botts	P1-02 Bags	P1-03 Straws	P1-04 Buds	P1-05 Wipes	P1-06 Cups	P1-07 Plas	P1-08 Sani	P1-09 All
Forth	All	-1.1	+0.1	-2.9	+0.5	+2.9	-0.7	-1.4	+3.0	+1.2
	Sept	x	x	x	x	x	x	x	x	X

Industry

Reg	Prd.	Plastic				Totals			
		IN-01 Fish	IN-02 Mar	IN-03 Aqua	IN-04 Farm	IN-05 Angle	IN-06 Fish	IN-07 Mar	IN-08 Old P
Forth	All	+1.3	+2.2	RARE	RARE	+1.8	+1.3	+2.2	-1.8
	Sept	x	x	x	x	x	x	x	x

Other

Reg	Prd.	OT-01 Cans	OT-02 Sw/Cr	OT-03 Cups(P)	OT-04 Food	OT-05 Smoke	OT-06 Syng	OT-07 Yoke	OT-08 Ball
		Forth	All	-1.6	-0.9	+2.3	-1.1	+0.9	+0.8
Sept	x		x	x	x	x	x	x	x

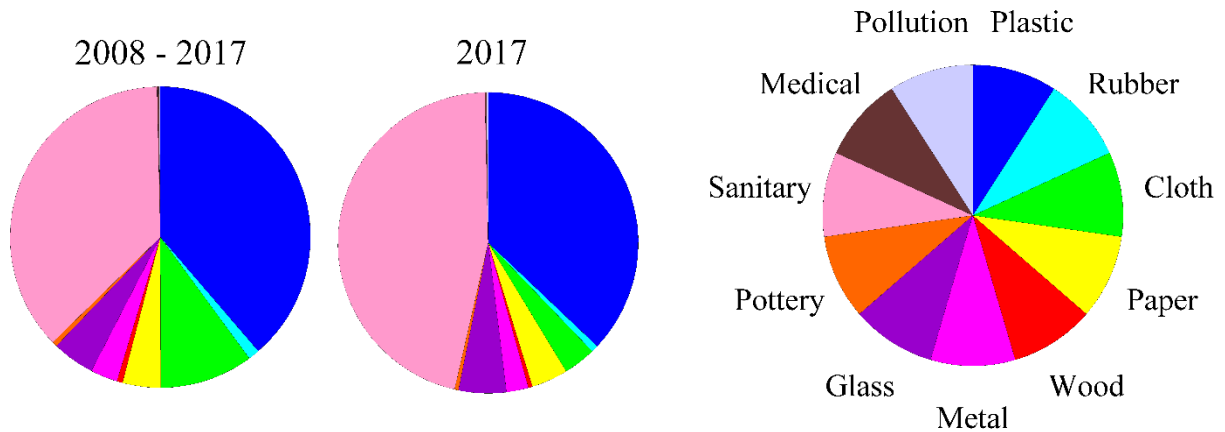
Absolute Average Foreshore Loadings

Group	Type	SBLPI		Average Loading September (np/100m)	Average Loading All Months (np/100m)
Priority One	Individual Items	Plastic – Bottles*	P1-01	x	13.6
		Plastic – Shopping Bags*	P1-02	x	19.6
		Plastic – Straws*	P1-03	x	16.9
		Sanitary – Cotton Buds	P1-04	x	62.8
		Sanitary – Wet Wipes	P1-05	x	123.9
		Paper – Coffee Cups*	P1-06	x	1.1
	Totals	All Plastic	P1-07	x	620.9
		All Sanitary	P1-08	x	405.8
		All Litter	P1-09	x	1438.3
Industry	Totals	Plastic – Fishing Related	IN-01	x	7.6
		Plastic – Marine Related	IN-02	x	11.0
		Plastic – Aquaculture Related	IN-03	x	RARE
		Plastic – Farm Related	IN-04	x	RARE
		Total – Angling Related	IN-05	x	3.8
		Total – Fishing Related	IN-06	x	7.6
		Total – Marine Related	IN-07	x	11.4
		Total – Old Plastic	IN-08	x	389.4
Other	Individual Items	Metal – Drinks Cans	OT-01	x	22.1
		Plastic – Sweets/Crisps	OT-02	x	40.8
		Plastic – Cups	OT-03	x	2.2
		Plastic – Food Packaging	OT-04	x	9.3
		Paper – Smoking Related	OT-05	x	33.4
		Medical - Syringes	OT-06	x	0.3
		Plastic – 4/6 Pack Yokes	OT-07	x	0.4
		Rubber - Balloons	OT-08	x	0.3

Litter Composition

Item	2008 to 2017 (np/100m)	2017 (np/100m)	2008 to 2017 (%)	2017 (%)
Plastic	583.3	588.6	38.7	37.1
Rubber	18.0	12.2	1.2	0.8
Cloth	152.0	55.4	10.1	3.5
Paper	61.5	62.3	4.1	3.9
Wood	9.2	6.9	0.6	0.4
Metal	43.9	37.8	2.9	2.4
Glass	68.9	81.6	4.6	5.1
Pottery	8.3	6.5	0.5	0.4
Sanitary	557.0	731.7	36.9	46.1
Medical	3.2	3.2	0.2	0.2
Pollution	2.3	2.6	0.2	0.2
<i>Total</i>	1507.6	1588.7		

Note: Total differs from previous table as years with less than four surveys dropped from calculations for SBLPIs (Total = 1438 np/100 m), but not from table above (Total = 1588 np/100 m). For consistency the total in the table above is used.



Sub-Region Summary

- Harbours in the Firth of Forth have the highest total litter loading of any Scottish Sub-Region where SBLPIs have been calculated – i.e. 1,600 np/100m.
- They also have the highest proportion of sanitary items (nearly 50%), and this proportion is increasing at the fastest rate of any SBLPIs.
- All SBLPIs associated with industries are increasing.

SBLPI Summary

Priority One Indicators

- Indicators associated with plastic bags and plastic straws are both on the decline in Firth of Forth harbours, as is the total plastic load.
- What is increasing rapidly is the load from sanitary items, including wet wipes.
- Examination of the details of this increase might suggest some control has been imposed over the last two to three years, but this has not yet reduced total loads, just stopped them increasing.

Industry- related Indicators

- All industry loads (angling, fishing and shipping related) are on the increase in Firth of Forth harbours.
- At the same time small pieces of plastic, possibly from old plastic from remote sources, are on the decrease. This suggests that the increase comes from local sources.

Other Specific Litter Items

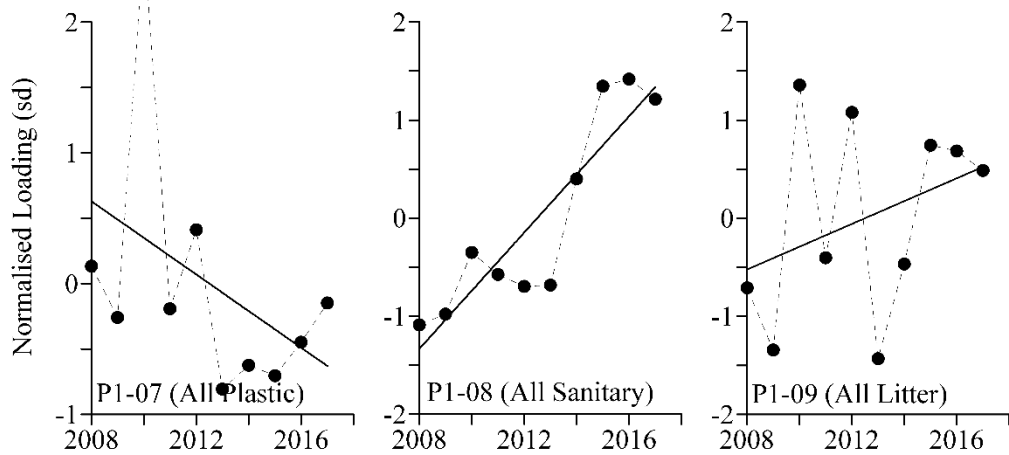
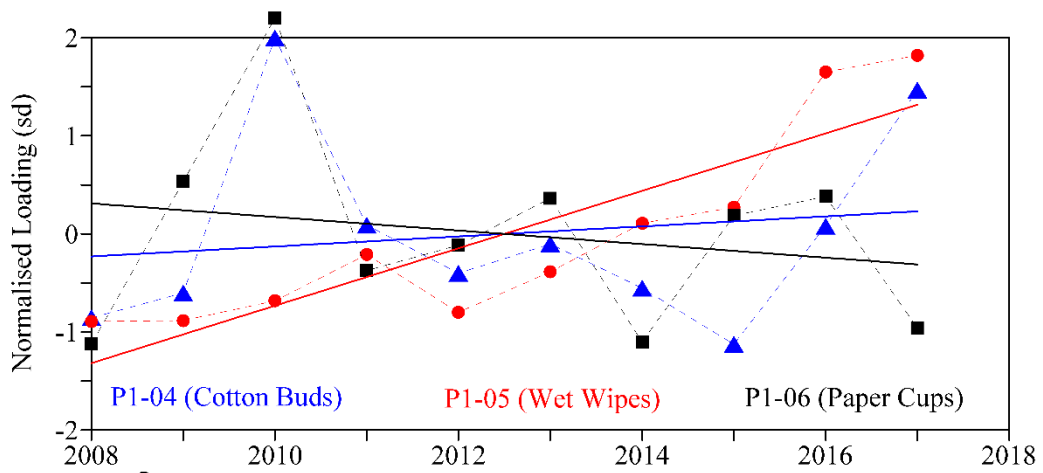
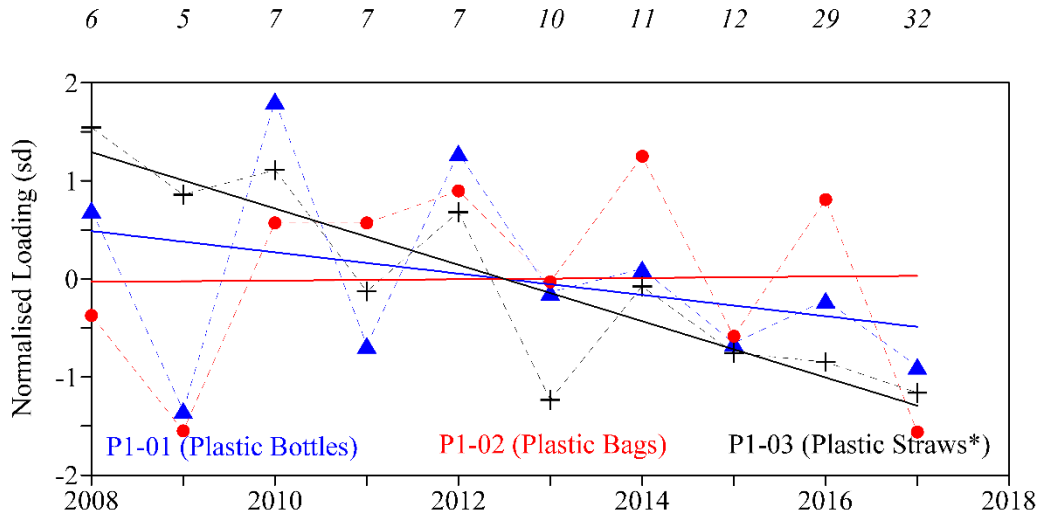
- Drinks cans and food packaging are all decreasing

Technical Notes

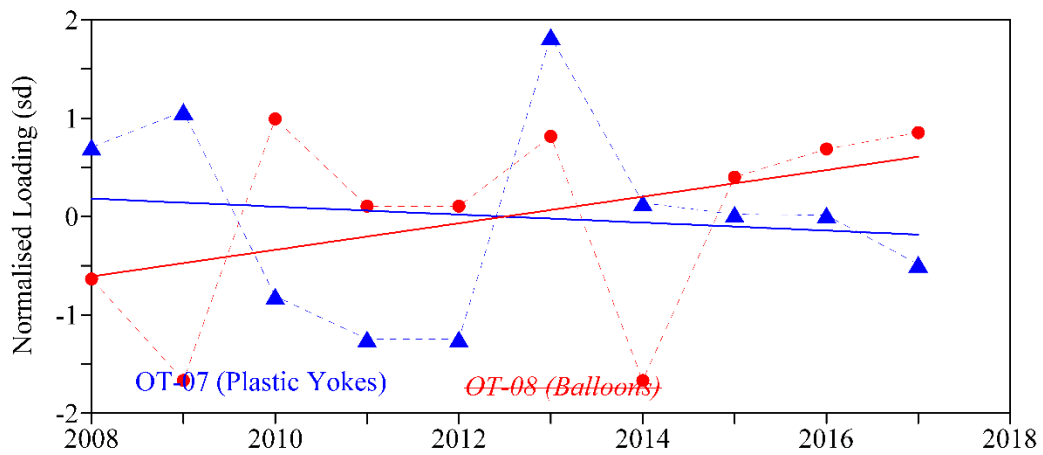
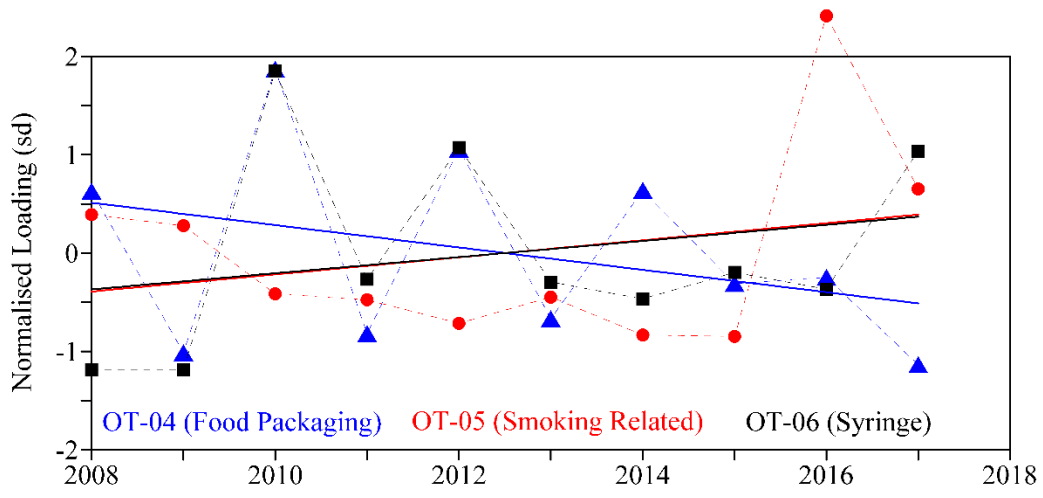
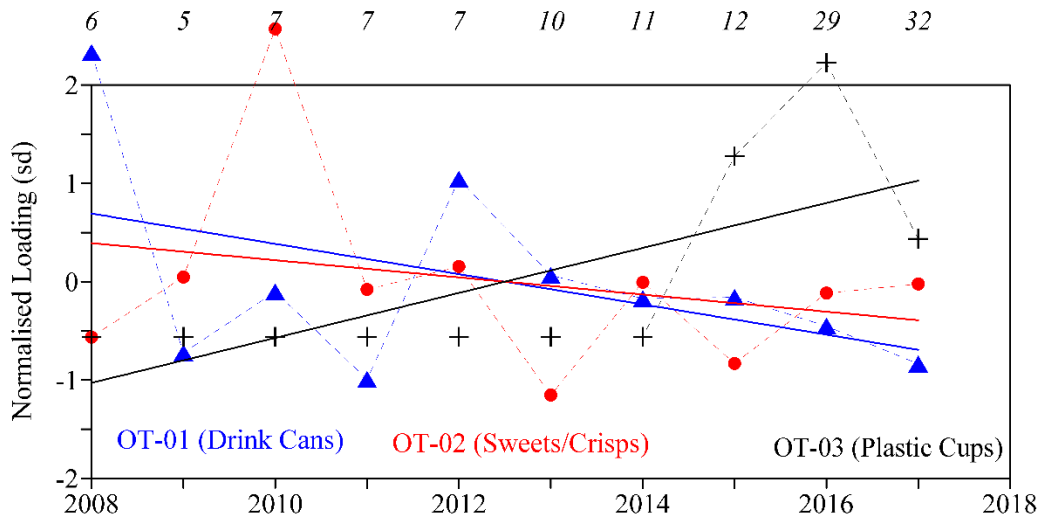
1. Only “Harbour” foreshores are used.
2. On the east coast, as winds are predominantly offshore, wind exposure direction not relevant (see Turrell, 2019).
3. The “Any-Month” indicator set has all years present, the “September” indicator set has 2011, 2013 and 2014 missing.

4. Firth of Forth Harbours are: Blackness; Bo'ness - Grangepans - east of beach; Cramond; Granton Harbour beach; Portobello; Queensferry High Street; South Queensferry; Wardie Bay

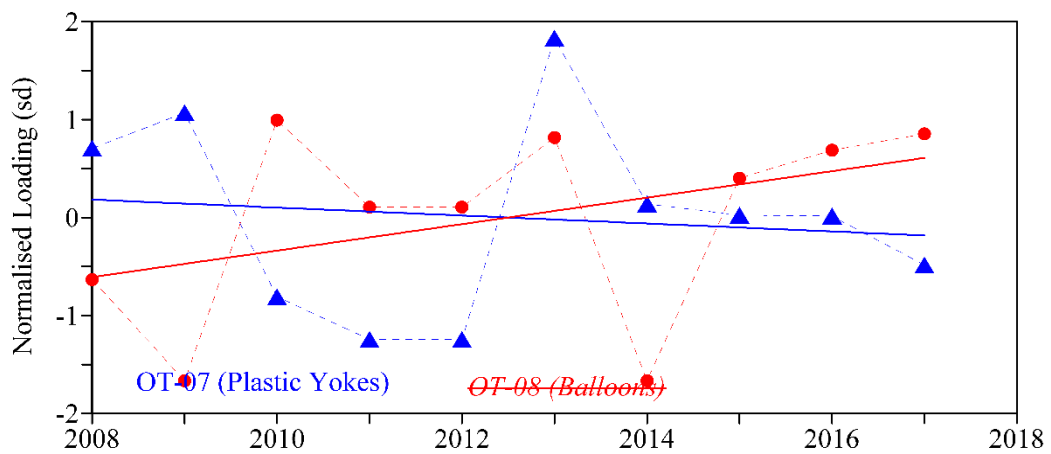
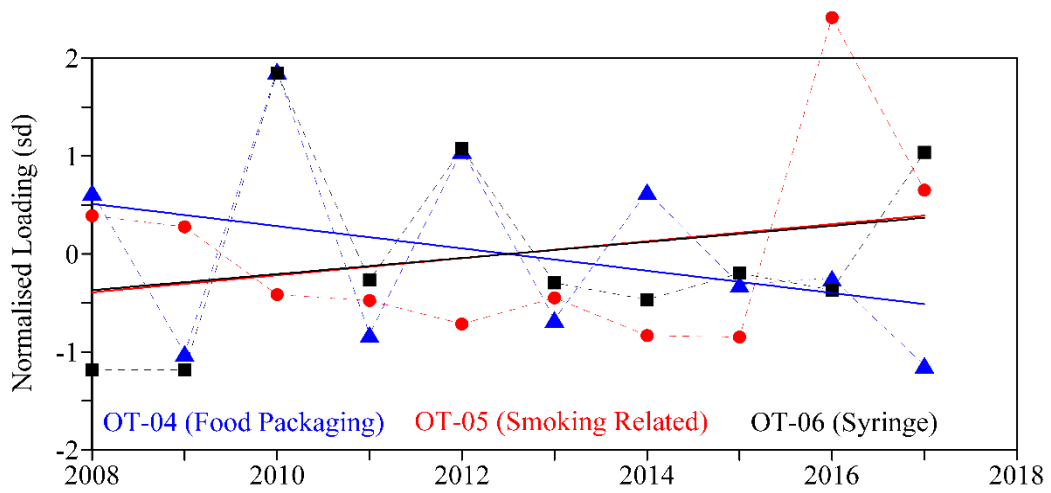
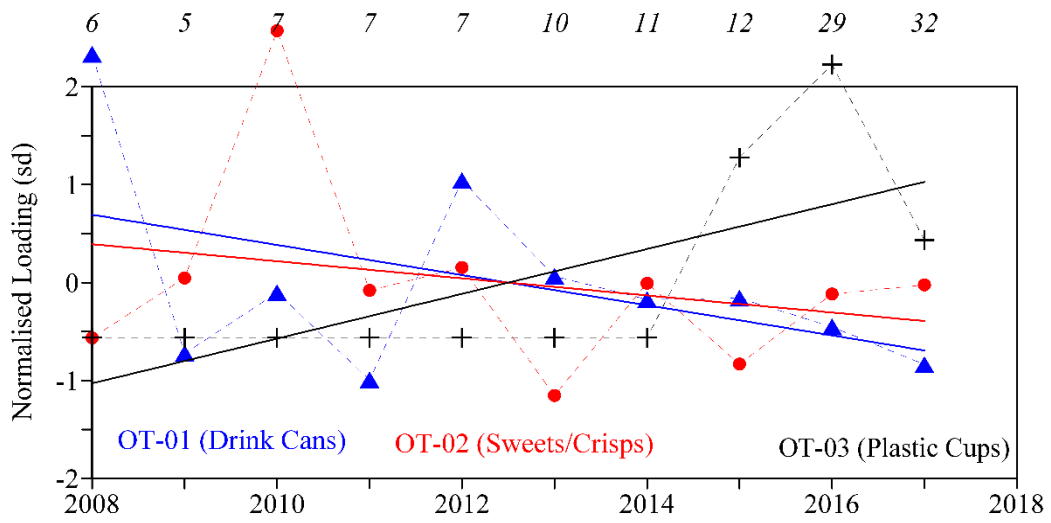
Firth of Forth (HARBOURS), All Months – PRIORITY 1



Firth of Forth (HARBOURS), All Months – INDUSTRY



Firth of Forth (HARBOURS), All Months – OTHER



7. References

Marine Conservation Society (2018): Beachwatch dataset <http://www.mcsuk.org/beachwatch/>

Turrell, W.R. (2018). A simple model of wind-blown tidal strandlines: how marine litter is deposited on a mid-latitude, macro-tidal shelf sea beach. *Marine Pollution Bulletin*, 137, 315–330.

Turrell, W. R. (2019). Spatial distribution of foreshore litter on the northwest European continental shelf. *Marine Pollution Bulletin*, 142, 583–594.

8. Acknowledgements

I would like to thank the Marine Conservation Society for providing Beachwatch data from their volunteer beach litter monitoring programme. A huge debt of gratitude goes to all the volunteers involved in the litter picks which produced the data. Particular thanks to Calum Duncan and Catherine Gemmell of MCS for all their help, and their inspirational leadership in Scotland.

9. Appendix 1 Scottish Beach Litter Performance Indicators - Technical Note

Introduction

Coastal Sub-Regions

Using the beach location (latitude and longitude), each beach was examined using the satellite images contained in Google maps. The location of each survey with respect to principal sea areas around Scotland's coasts was determined, as was the nature of the surveyed foreshore. Foreshores were categorised as beaches, bays, sea lochs or harbours. A bay was defined as relatively short foreshores having semi-enclosing adjacent coastlines extending out to sea for distances approximately equal to or greater than the foreshore length itself. Sea lochs are glacially-cut fjords, and are well identified and named in Scotland. Harbours were defined as foreshores within industrial areas with man-made substrates and/or retaining structures.

The east coast of Scotland has a much simpler morphology than the west coast. Whereas the west coast has island chains, peninsulas and glacially-cut fjords, the east coast has no offshore islands of any size, and has linear coasts devoid of fjords. While foreshores on the east coast predominantly face east, a few major embayments disrupt this general trend, specifically the Dornach, Cromarty, Tay and Forth firths, and the inner Moray Firth (a firth in Scotland is a large embayment or channel, normally navigable in some way). Foreshores on the west coast can face in any direction, owing to the complex topography. For this reason west coast beaches and bays had a further parameter added, determined from the satellite images, namely the direction they face (the exposure). Hence a beach recorded as having an exposure to the SW would experience winds directed perpendicularly onshore for winds blowing from the south west. Initial analysis of the data showed that beaches and bays on the west coast, outside the Clyde sea area, predominantly faced westwards, with a minority facing east.

Table A1 Relationship between Scottish Marine Regions and the coastal sub-regions used to derive Scottish Beach Litter Performance Indicators (SBLPIs).

	Scottish Marine Region	SBLPI Coastal Sub-Region
1	Solway	Solway
2	Clyde	Clyde
3	Argyll	Firth of Lorn; Malin Shelf
4	West Highland	S Minch; N Minch
5	Outer Hebrides	Atlantic; S Minch; N Minch
6	North Coast	No Data
7	Orkney	Orkney
8	Shetland	No Data
9	Moray Firth	Moray Firth; Inner Moray Firth; Cromarty and Dornoch
10	North East	East Coast (North)
11	Forth and Tay	Tay; Forth; East Coast (N); East Coast (S)

Water Body Types

Data Exclusions

For the purpose of this analysis all data from harbours were rejected as the potential effect of local litter sources was determined as being too great a possibility. Other sites rejected were within river channels or at landward extremes of estuaries where marine deposition of litter could be augmented by riverine sources. On the west coast, all surveys on foreshores with an exposure towards the north, northeast, east, southeast or south were excluded from the analysis. These included many on the eastward and hence sheltered side of islands and peninsulas and hence

MCS/OSPAR Databases

The data available in the MCS and OSPAR databases have almost identical litter categories. These are listed in the table below.

Table A2 N refers to the data category index number used in the MSS data files and the MCS data files. The “MCS Data Files” column shows the data header descriptions in the raw Beachwatch data supplied to Marine Scotland by MCS. The “OSPAR Data Files” column gives the corresponding data column header in the data downloaded from the OSPAR online database (OSPAR, 2018). The “OSPAR Description” provides the corresponding full description, and category number, of the litter category as presented in OSPAR (2010). Note that the OSPAR category number differs from the MSS/MSC data files category number.

MSS and MSC		OSPAR	
N	MCS Data Files	OSPAR Data Files	OSPAR Description
1	Plastic: Yokes	Plastic: Yokes [1]	1 4/6-pack yokes
2	Plastic: Bags	Plastic: Bags [2]	2 Bags (e.g. shopping)
3	Plastic: Small_bags	Plastic: Small_bags [3]	3 Small plastic bags, e.g., freezer bags
4	Plastic: Meshbags	Plastic: Meshbags [24]	24 Mesh vegetable bags
5	Plastic: Cleaner	Plastic: Cleaner [5]	5 Cleaner (bottles, containers and drums)
6	Plastic: Drinks	Plastic: Drinks [4]	4 Drinks (bottles, containers and drums)
7	Plastic: Toiletries	Plastic: Toiletries [7]	7 Cosmetics (bottles & containers e.g. sun lotion, shampoo, shower gel, deodorant)
8	Plastic: Car_parts	Plastic: Car_parts [14]	14 Car parts
9	Plastic: Caps	Plastic: Caps [15]	15 Caps/lids
10	Plastic: Cigarettelighters	Plastic: Cigarettelighters [16]	16 Cigarette lighters
11	Plastic: Combs	Plastic: Combs [18]	18 Combs/hair brushes
12	Plastic: Food	Plastic: Food [6]	6 Food containers incl. fast food containers
13	Plastic: Cups	Plastic: Cups [21]	21 Cups
14	Plastic: Cutlery	Plastic: Cutlery [22]	22 Cutlery/trays/straws
15	Plastic: Fishing_line	Plastic: Fishing_line [35]	35 Fishing line (angling)
16	Plastic: Fishing_net_small	Plastic: Fishing_net_small [115]	115 Nets and pieces of net < 50 cm
17	Plastic: Fishing_net_large	Plastic: Fishing_net_large [116]	116 Nets and pieces of net > 50 cm
18	Plastic: Floats	Plastic: Floats [37]	37 Floats/Buoys
19	Plastic: Foam_sponge	Plastic: Foam_sponge [45]	45 Foam sponge
20	Plastic: Gloves	Plastic: Gloves [25]	25 Gloves (typical washing up gloves)
21	Plastic: Gloves_pro	Plastic: Gloves_pro [113]	113 Gloves (industrial/professional gloves)
22	Plastic: Oil_small	Plastic: Oil_small [8]	8 Engine oil containers and drums <50 cm
23	Plastic: Industrial	Plastic: Industrial [40]	40 Industrial packaging, plastic sheeting

24	Plastic: Crisp	Plastic: Crisp [19]	19 Crisp/sweet packets and lolly sticks
25	Plastic: Pens	Plastic: Pens [17]	17 Pens
26	Plastic: Plastic_small	Plastic: Plastic_small [117]	117 Plastic/polystyrene pieces 0 - 2,5 cm
27	Plastic: Plastic_large	Plastic: Plastic_large [46]	46 Plastic/polystyrene pieces 2,5 cm > < 50 cm
28	Plastic: Plastic_vlarge	Plastic: Plastic_vlarge [47]	47 Plastic/polystyrene pieces > 50 cm
29	Plastic: Shoes	Plastic: Shoes [44]	44 Shoes/sandals
30	Plastic: Shotgun	Plastic: Shotgun [43]	43 Shotgun cartridges
31	Plastic: Strapping	Plastic: Strapping [39]	39 Strapping bands
32	Plastic: String	Plastic: String [32]	32 String and cord (diameter less than 1 cm)
33	Plastic: Rope	Plastic: Rope [31]	31 Rope (diameter more than 1 cm)
34	Plastic: Tangled	Plastic: Tangled [33]	33 Tangled nets/cord/rope and string
35	Plastic: Toys	Plastic: Toys [20]	20 Toys & party poppers
36	Plastic: Bag_ends	Plastic: Bag_ends [112]	112 Plastic bag ends
37	Plastic: Other_bottles	Plastic: Other_bottles [12]	12 Other bottles, containers and drums
38	Plastic: Buckets	Plastic: Buckets [38]	38 Buckets
39	Plastic: Crates	Plastic: Crates [13]	13 Crates
40	Plastic: Fertiliser	Plastic: Fertiliser [23]	23 Fertiliser/animal feed bags
41	Plastic: Fibre_glass	Plastic: Fibre_glass [41]	41 Fibre glass
42	Plastic: Fishboxes	Plastic: Fishboxes [34]	34 Fish boxes
43	Plastic: Hard_hats	Plastic: Hard_hats [42]	42 Hard hats
44	Plastic: Injection_gun	Plastic: Injection_gun [11]	11 Injection gun containers
45	Plastic: Jerry_cans	Plastic: Jerry_cans [10]	10 Jerry cans (square plastic containers with handle)
46	Plastic: Light_sticks	Plastic: Light_sticks [36]	36 Light sticks (tubes with fluid)
47	Plastic: Fish_tags	Plastic: Fish_tags [114]	114 Lobster and fish tags
48	Plastic: Lobsterpots	Plastic: Lobsterpots [26]	26 Crab/lobster pots
49	Plastic: Octopus_pots	Plastic: Octopus_pots [27]	27 Octopus pots
50	Plastic: Oil_large	Plastic: Oil_large [9]	9 Engine oil containers and drums > 50 cm
51	Plastic: Oyster_nets	Plastic: Oyster_nets [28]	28 Oyster nets or mussel bags including plastic stoppers
52	Plastic: Oyster_trays	Plastic: Oyster_trays [29]	29 Oyster trays (round from oyster cultures)
53	Plastic: Mussel_sheeting	Plastic: Mussel_sheeting [30]	30 Plastic sheeting from mussel culture (Tahitians)
54	Plastic: Other	Plastic: Other [48]	48 Other plastic/polystyrene items (please specify in other item box*)
55	Rubber: Balloons	Rubber: Balloons [49]	49 Balloons, including plastic valves, ribbons, strings etc.
56	Rubber: Boots	Rubber: Boots [50]	50 Boots
57	Rubber: Tyres	Rubber: Tyres [52]	52 Tyres and belts
58	Rubber:	ONLY MSC (??)	ONLY MSC (??)

	Tyres_holes		
59	Rubber: Other	Rubber: Other [53]	53 Other rubber pieces (please specify in other item box*)
60	Cloth: Clothing	Cloth: Clothing [54]	54 Clothing
61	Cloth: Sacking	Cloth: Furnishings [55]	55 Furnishing
62	Cloth: Furnishings	Cloth: Sacking [56]	56 Sacking
63	Cloth: Shoes	Cloth: Shoes [57]	57 Shoes (leather)
64	Cloth: Other	Cloth: Other [59]	59 Other textiles (please specify in other item box*)
65	Paper: Bags	Paper: Bags [60]	60 Bags
66	Paper: Cardboard	Paper: Cardboard [61]	61 Cardboard
67	Paper: Purepak	Paper: Purepak [118]	118 Cartons e.g. tetrapak (milk)
68	Paper: Tetrapak	Paper: Tetrapak [62]	62 Cartons e.g. tetrapak (other)
69	Paper: Cig_packets	Paper: Cig_packets [63]	63 Cigarette packets
70	Paper: Cig_stubs	Paper: Cig_stubs [64]	64 Cigarette butts
71	Paper: Cups	Paper: Cups [65]	65 Cups
72	Paper: Newspapers	Paper: Newspapers [66]	66 Newspapers & magazines
73	Paper: Other	Paper: Other [67]	67 Other paper items (please specify in other item box*)
74	Wood: Corks	Wood: Corks [68]	68 Corks
75	Wood: Lolly	Wood: Lolly [72]	72 Ice lolly sticks / chip forks
76	Wood: Lobsterpots	Wood: Lobsterpots [71]	71 Crab/lobster pots
77	Wood: Crates	Wood: Crates [70]	70 Crates
78	Wood: Fish_boxes	Wood: Fish_boxes [119]	119 Fish boxes
79	Wood: Brushes	Wood: Brushes [73]	73 Paint brushes
80	Wood: Pallets	Wood: Pallets [69]	69 Pallets
81	Wood: Other_small	Wood: Other_small [74]	74 Other wood < 50 cm (please specify in other item box*)
82	Wood: Other_large	Wood: Other_large [75]	75 Other wood > 50 cm (please specify in other item box*)
83	Metal: Aerosol	Metal: Aerosol [76]	76 Aerosol/Spray cans
84	Metal: Bbqs	Metal: Bbqs [120]	120 Disposable BBQ's
85	Metal: Drink	Metal: Drink [78]	78 Drink cans
86	Metal: Food	Metal: Food [82]	82 Food cans
87	Metal: Caps	Metal: Caps [77]	77 Bottle caps
88	Metal: Fishing	Metal: Fishing [80]	80 Fishing weights
89	Metal: Foil	Metal: Foil [81]	81 Foil wrappers
90	Metal: Scrap	Metal: Scrap [83]	83 Industrial scrap
91	Metal: Wire	Metal: Wire [88]	88 Wire, wire mesh, barbed wire
92	Metal: Electrical	Metal: Electrical [79]	79 Electric appliances
93	Metal: Lobsterpots	Metal: Lobsterpots [87]	87 Lobster/crab pots and tops
94	Metal: Oil	Metal: Oil [84]	84 Oil drums
95	Metal: Paint_tins	Metal: Paint_tins [86]	86 Paint tins
96	Metal:	Metal: Other_small	89 Other metal pieces < 50 cm (please specify

	Other_small	[89]	in other item box*)
97	Metal: Other_large	Metal: Other_large [90]	90 Other metal pieces > 50 cm (please specify in other item box*)
98	Glass: Bottles	Glass: Bottles [91]	91 Bottles
99	Glass: Bulbs	Glass: Bulbs [92]	92 Light bulbs/tubes
100	Glass: Other	Glass: Other [93]	93 Other glass items (please specify in other item box*)
101	Pottery: Construction	Pottery: Construction [94]	94 Construction material e.g. tiles
102	Pottery: Octopus_pots	Pottery: Octopus_pots [95]	95 Octopus pots
103	Pottery: Other	Pottery: Other [96]	96 Other ceramic/pottery items (please specify in other item box*)
104	San: Buds	San: Buds [98]	98 Cotton bud sticks
105	San: Tampons	San: Tampons [100]	100 Tampons and tampon applicators
106	San: Towels	San: Towels [99]	99 Sanitary towels/panty liners/backing strips
107	San: Wipes	San: Wipes	NO OSPAR CATEGORY
108	San: Condoms	San: Condoms [97]	97 Condoms
109	San: Toilet	San: Toilet [101]	101 Toilet fresheners
110	San: Other	San: Other [102]	102 Other sanitary items (please specify in other item box*)
111	Med: Containers	Med: Containers [103]	103 Containers / tubes
112	Med: Syringes	Med: Syringes [104]	104 Syringes
113	Med: Other	Med: Other [105]	105 Other medical items (swabs, bandaging etc.) (please specify in other item box*)
114	Faeces: In_bags	Faeces: In_bags [121]	121 Bagged dog faeces
115	Pollutants: Small	Pollutants: Wax_small [108]	108 Paraffin or wax pieces 0 - 1 cm
116	Pollutants: Medium	Pollutants: Wax_medium [109]	109 Paraffin or wax pieces 1 - 10 cm
117	Pollutants: Large	Pollutants: Wax_large [110]	110 Paraffin or wax pieces > 10 cm
118	Pollutants: Other	Pollutants: Other [111]	Other (please specify in other item box*)

SBLPI Categories

This section presents the details of the SBLPIs. It shows which data categories from the MSC database for Scotland have been used within each separate indicator.

In the tables below N refers to the location in the MSS data files. The OSPAR full litter category descriptions (OSPAR, 2010) presented in Table x have been used to describe each component of an SBLPI. The “OS” column gives the OSPAR litter category number.

Priority One

Type	SBLPI		MCS/MSS Data Files	OS	
Individual Items	Plastic – Bottles*	P1-01	6	Drinks (bottles, containers and drums)	4
	Plastic – Shopping Bags*	P1-02	2	Bags (e.g. shopping)	2
	Plastic – Straws*	P1-03	14	Cutlery/trays/straws	22
	Sanitary – Cotton Buds	P1-04	104	Cotton bud sticks	98
	Sanitary – Wet Wipes	P1-05	107	Wet Wipes [NO OSPAR CATEGORY]	
	Paper – Coffee Cups*	P1-06	71	Cups	65
Totals	All Plastic	P1-07	1 to 54 - Summed		
	All Sanitary	P1-08	104 to 110 - Summed		
	All Litter	P1-09	1 to 118 – Summed (Plastic + Cloth + Rubber + Paper + Wood + Metal + Glass + Pottery + Sanitary + Medical + Other)		All

Industry

Type	SBLPI	MCS/MSS Data Files		OS	
Totals	Plastic – Fishing Related	IN-01	16	Nets and pieces of net < 50 cm	115
			17	Nets and pieces of net > 50 cm	116
			18	Floats/Buoys	37
			34	Tangled nets/cord/rope and string	33
			42	Fish boxes	34
			47	Lobster and fish tags	114
			48	Crab/lobster pots	26
			49	Octopus pots	27
	Plastic – Marine Related	IN-02	21	Gloves (industrial/professional gloves)	113
			22	Engine oil containers and drums <50 cm	8
			31	Strapping bands	39
			33	Rope (diameter more than 1 cm)	31
			38	Plastic Buckets	38
			39	Plastic Crates	13
			43	Hard hats	42
			45	Jerry cans (square plastic containers with handle)	10
	Plastic – Aquaculture Related	IN-03	51	Oyster nets or mussel bags including plastic stoppers	28
			52	Oyster trays (round from oyster cultures)	29
			53	Plastic sheeting from mussel culture (Tahitians)	30
	Plastic – Farm Related	IN-04	40	Fertiliser/animal feed bags	23
	Total – Angling Related	IN-05	15	Plastic Fishing line (angling)	35
			88	Metal Fishing weights	80
	Total – Fishing Related	IN-06	76	Wood Crab/lobster pots	71
			78	Wood Fish boxes	119
			93	Metal Lobster/crab pots and tops	87
			102	Metal Octopus pots	95
			IN-03	Plastic – Fishing Related	
	Total – Marine Related	IN-07	77	Wood Crates	70
			80	Wood Pallets	69
			94	Metal - Oil drums	84
			95	Metal - Paint tins	86
		IN-02	Plastic – Marine Related		
Total – Old Plastic	IN-08	26	Plastic/polystyrene pieces 0 - 2,5 cm	117	
		27	Plastic/polystyrene pieces 2,5 cm > < 50 cm	46	
		28	Plastic/polystyrene pieces > 50 cm	47	

Other

Type	SBLPI		MCS/MSS Data Files		OS
Individual Items	Metal – Drinks Cans	OT-01	85	Drink cans	78
	Plastic – Sweets/Crisps	OT-02	24	Crisp/sweet packets and lolly sticks	19
	Plastic – Cups	OT-03	13	Plastic cups	21
	Plastic – Food Packaging	OT-04	12	Food containers incl. fast food containers	6
	Paper – Smoking Related	OT-05	69	Cigarette packets	63
			70	Cigarette butts	64
	Medical - Syringes	OT-06	112	Syringes	104
	Plastic – 4/6 Pack Yokes	OT-07	1	4/6-pack yokes	1
Rubber - Balloons	OT-08	56	Balloons, including plastic valves, ribbons, strings etc.	49	

Sub-Region Details

Sub-Region		Comment
N	Name	
1	Solway	<ul style="list-style-type: none"> Not enough surveys
2	Clyde	<ul style="list-style-type: none"> Good survey coverage – can calculate all year, and September only, indicators All wind exposure directions included as within the Clyde there is a complex shoreline Only “Open Coast” water body type used
3	Malin Shelf	<ul style="list-style-type: none"> Not enough surveys Complicated by east/west exposures, as well as “Loch”, “Embayment” and “Open Coast” water types
4	Firth of Lorn	
5	South Minch	
6	Atlantic	
7	North Minch	
8	Orkney	<ul style="list-style-type: none"> Not enough surveys for September analysis Enough for “any month” analysis
9	Moray Firth	<ul style="list-style-type: none"> Not enough surveys for September analysis Enough for “any month” analysis but 2009, 2012, 2014 and 2015 have less than 4 surveys each hence removed
10	Inner Moray Firth	<ul style="list-style-type: none"> Not enough surveys
11	Cromarty/Dornoch	
12	East Coast (North)	<ul style="list-style-type: none"> Good survey coverage – can calculate all year, and September only, indicators Only “Open Coast” water body type used
13	Firth of Tay	<ul style="list-style-type: none"> Not enough surveys
14	Firth of Forth	<ul style="list-style-type: none"> Good survey coverage – can calculate all year, and September only, indicators Only “Open Coast” water body type used
15	East Coast (South)	<ul style="list-style-type: none"> Not enough surveys

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