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Scotland's National Coastal Change Assessment

Alistair Rennie[1], Jim Hansom[2] & James Fitton[3]
Email: alistair.rennie@snh.gov.uk Twitter: @RennieAlistair
([1] Scottish Natural Heritage [2] University of Glasgow [3] Aalborg University)

Introduction:

Climate change is expected to increasingly effect erodible or 'soft' coastlines via increased erosion extents and rates alongside increased flooding. This has previously unknown implications for society's assets. Yet national change and vulnerability assessments are rare, leaving all levels of Government, businesses and society unable to prepare develop sustainably.

In Scotland, the evidence on coastal change is partial and often not up to date. On mobile coasts updates have not been made in decades.

Public sector duties under the 2009 Climate Change (Scotland) Act, requires public sector adaptation. Dynamic Coast was commissioned to inform this evidence gap thereby enabling cross sector adaptation planning.

Headline conclusion:

Scotland's coast is responding to climate change. £340m of assets are at risk if recent erosion continue to 2050. A window of opportunity exists to plan, mitigate and adapt in advance to avoid widespread harm and cost to government, businesses and communities.

Our approach:

Our evidence base uses over 3,000 georectified maps and 2 million data points to compare the position of tide lines from the 1890s, 1970s and Modern data on all of Scotland's 3,800km of erodible 'soft' coast.

It is now possible to see how the coast has changed over the last 130 years via publicly-available web-maps at dynamiccoast.com.

Where recent erosion is significant (i.e. greater than 10 m or faster than 0.5myr) the recent rate has been projected landward to consider which assets are at increased risk, should change past rates continue. See Vulnerability Assessment.

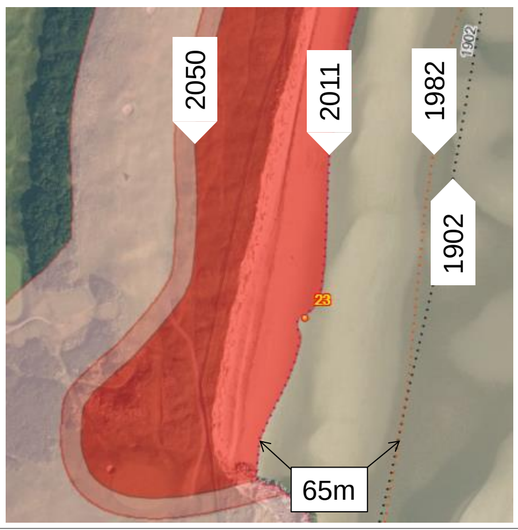
To appreciate the distribution of assets around the entire coast, a Whole Coast Assessment was carried out to intersect asset data (Roads, Rail, Houses & Designated Sites) with various coastal types and rates of erosion.

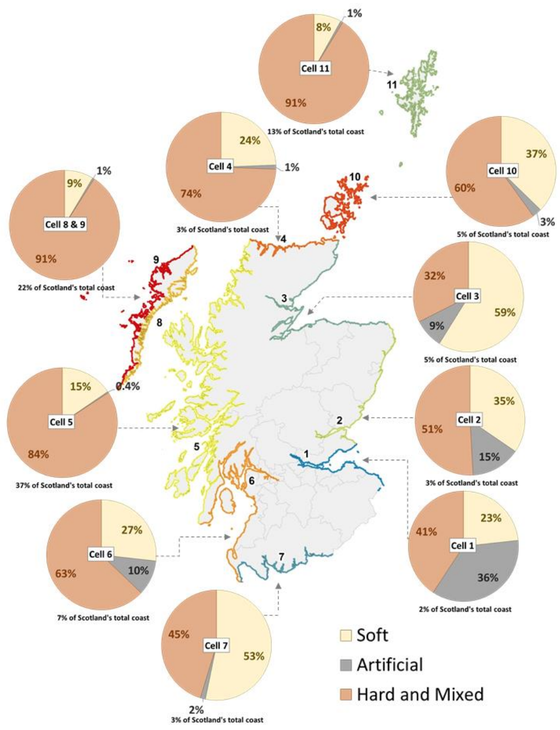
Results:

Coastal Type

- Hard & Mixed
- Soft (erodible)
- Artificial

Categorised by air photos to enable analysis to concentrate on dynamic shores.





Change results
Example of erosion at Montrose up to 65m of erosion between 1982 & 2011, projected forward to 2050.

Erosion & Flooding

For the first time erosion and flood risk can be considered together.

Dynamic Coast provides intelligence on change for flood maps, informs an update schedule of surveys, and informs the benefit provided by enhanced or reduced protection offered by natural structures.

By understanding coincident assets, this informs joint solutions and empowers Flood Risk Management, informs Shoreline Management Plans, Local Development Plans & National / Local Marine Plans.

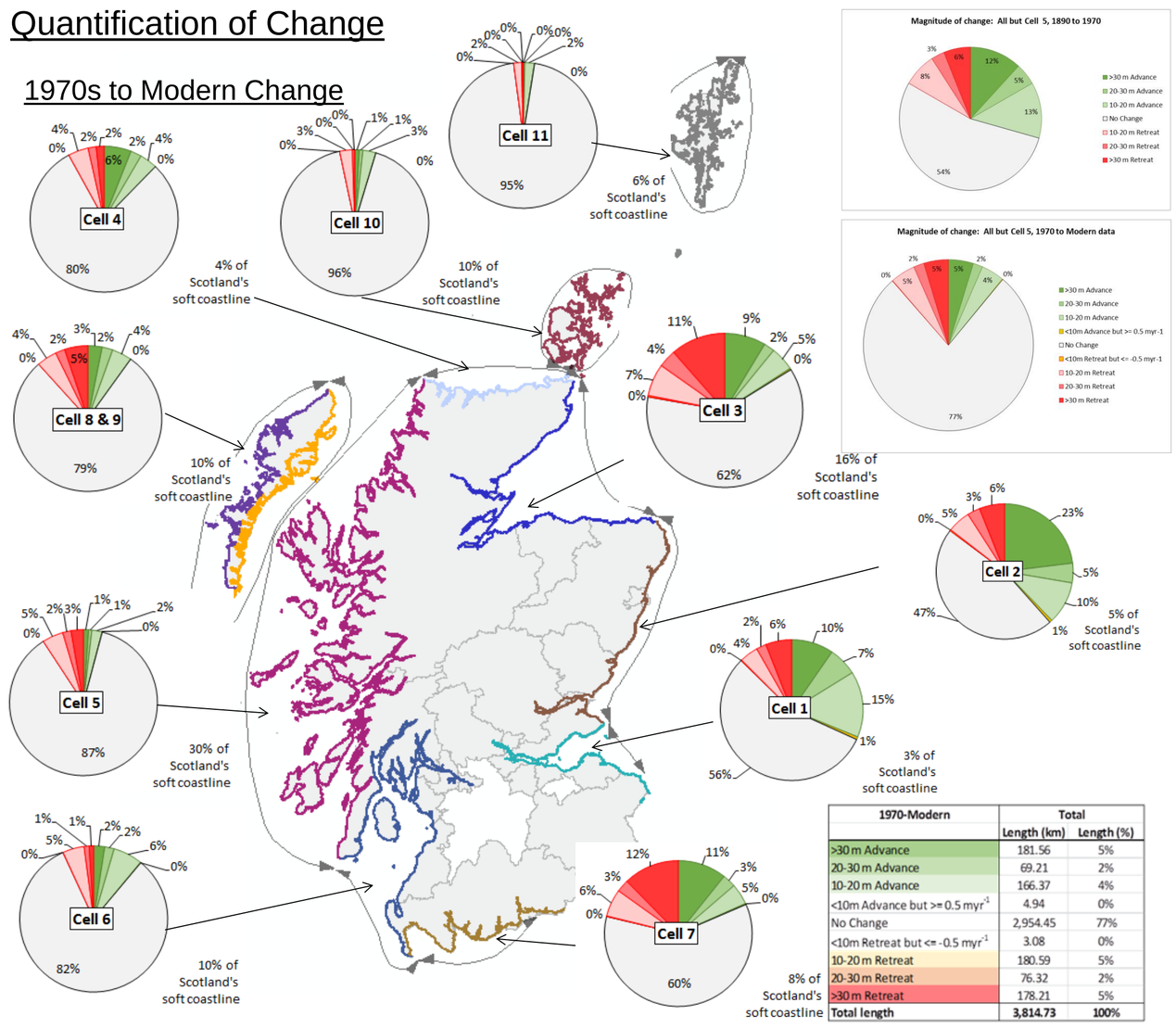
Results:

Whole Coast Assessment *e.g. 156km of roads lie within 10m of MHWS, incl. 53km on soft coasts*

Asset / Receptor	Unit	Within 10m of MHWs: All	Coastal Type: Hard & Mixed	Soft	Artificial	Erodable (UPSM40+)	Within 50m of MHWS: All	Coastal Type: Hard & Mixed	Soft	Artificial	Erodable (UPSM40+)
Community Services		1	1	0	0	0	78	48	20	10	45
Non Residential Property		463	197	103	163	245	9,045	4,393	2,309	2,343	5,101
Residential Prop	#	458	107	109	242	332	24,449	9,966	7,194	7,289	15,276
Septic Water Tanks		367	219	139	9	181	1,656	954	677	25	769
Utilities		25	10	7	8	14	312	137	80	95	184
Rail		15	2	9	3	9	104	27	58	18	61
Roads	km	156	87	53	16	68	1,336	733	497	107	590
Clean Water Network		87	50	22	16	41	931	507	304	120	452
Cultural Heritage		135	63	55	17	74	1,029	471	438	120	529
Environment	ha	4,204	2,575	1,586	43	1,790	23,430	14,873	8,424	133	8,615
Runway		0	0	0	0	0	3	2	0	1	2

Quantification of Change

1970s to Modern Change



1970-Modern	Total: Length (km)	Length (%)
>30 m Advance	181.56	5%
20-30 m Advance	69.21	2%
10-20 m Advance	166.37	4%
<10m Advance but >= 0.5 myr^{-1}	4.94	0%
No Change	2,954.45	77%
<10m Retreat but <= -0.5 myr^{-1}	3.08	0%
10-20 m Retreat	180.59	5%
20-30 m Retreat	76.32	2%
>30 m Retreat	178.21	5%
Total length	3,814.73	100%

Vulnerability Assessment.
NCCA identifies where, and how much, erosion is anticipated; establishes what the coincident assets are; and empowers integrated approaches to risk management for development of joint mitigation and adaptation plans.

	Coincident assets / factors										
Assets etc at risk from erosion	Airports	Buidings	Roads	Rail	Fresh Water Network	Septic Water	Cultural Heritage	Natural Heritage	Flood risk	PVA	Examples
Airports		-	-	-	-	-	-	xx	xxx	-	Islay & Benbecual Airport
Buidings	-		-	-	x	-	x	x	xxx	xx	Southeness (Solway)
Roads	-	-		-	-	-	x	xx	xxx	-	Strone Point (Clyde), Monifieth (Tay), Balephetrish Bay (Tiree)
Rail	-	-	-		-	-	-	-	xxx	-	Corpach (Loch Linnhe), Brora (Moray Firth)
Fresh Water Network	-	x	xxx	-		-	x	-	xxx	xx	Broughty Ferry (Tay), Toward (Clyde), Elie (Fife), Inellan (Clyde)
Septic Water	-	xxx	xx	-	-		-	xx	xxx	xxx	Corpach (Loch Linnhe), Western Isles Orkney, Wemyss (Fife)
Cultural Heritage	-	x	x	-	-	-		xxx	xxx	xx	Dysart, St Andrews & Wemyss (Fife), Dalmeny (Forth), Dunrobin (Moray)
Natural Heritage	-	-	-	-	-	-	x		xxx	xx	Solway, Culbin Sands & Dornoch (Moray), Tiree,
Flood risk	-	-	x	-	-	-	x	xxx		x	Solway, Uists, Culbin Sands & Golspie (Moray Firth), Barry Links (Tay)
PVA	-	xxx	x	-	xx	-	x	xx	xxx		Southerness (Solway), Prestonpans (Forth), Broughty Ferry (Tay)
Key	- no coincidence						xx often coincident				
	x some coincidence						xxx high coincidence				

Conclusions:

- Across Scotland 12% of soft coast is erosional, 11% accretional and 77% stable since the 1970s.
- Since the 1970s, the proportion of advancing coast has fallen by 22%, the proportion of retreating coast has increased by 39% and average rates of erosion have doubled to 1.0m/yr.
- All Scottish shores have assets at risk in the next 30 years. These results underestimate future risk due to quickening sea level rise (& associated impacts). Integrated management approaches are urgently needed.
- A window of opportunity exists to plan, mitigate and adapt together in advance to avoid widespread harm and cost.

References:

Fitton, Hansom & Rennie, 2016 A national coastal erosion susceptibility model for Scotland. Ocean & Coastal Management. 132:80-89