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Geographical Study Area:
North Atlantic
Northeast Atlantic/Northern Isles of Scotland/Shetland Islands

Key Hazards:
Great Storms
Eustatic and Isostatic Sea Level Rise
Tsunami
Peat Slides/Mass Wasting
Coastal Sand Mobilization
Oil Spills

Past Impacts:
Coastal settlement disruption and destruction by sand inundation, and possibly tsunami events
Disruption of maritime resource exploitation and agricultural activities by high winds, water turbulence, salt deposition on terrestrial areas, and coastal sand movements.
Destruction of farmland and transportation infrastructure by peat slide events
One major, storm-related, oil spill (1993; the 16th largest on record, larger in volume than the Exxon Valdez)

Human Response/Mitigation:
Sand Inundation: requests to the government for tax relief (early 1700s); local regulation of travel on sand areas by domestic livestock (early 1700s); settlement abandonment and relocation (late 1600s and early 1700s); planting of stabilizing vegetation on dunes (1800s?)
Storms: importation of food; building of breakwaters and other forms of coastal protection (1800s and 1900s)

Future Risks:
Great storms – unknown exposure, possibly only moderate increase over historical levels
Tsunami – unknown, but likely at long (millenial) intervals
Sand Movements – moderate exposure, with significant mitigation resources available, but of critical importance
Oil Spills – unknown exposure, significant mitigation resources available
Peat Slides – high exposure, few resources for mitigation beyond basic clean-up; high relevance to current land-use debates.

Worksheet for Hazards Group Discussion

New Knowledge

1. Maritime hunter-forager occupation for the Shetland Islands began around or before 6,000 years BP, prior to large-scale settlement by Neolithic agriculturalists 5,500-6,000 years BP. Early sites may have been largely destroyed by sea level rise and coastal erosion.

2. Coastal environments in Shetland and in other areas of Northern Scotland were affected by tsunamis generated by submarine sediment slides several times over the last 10,000 years, including a possible event around that would have selectively impacted zones of high human economic activity around 4000 years BP.

3. Great storms have made periodic, major impacts on the geomorphology of selected areas of Shetland's coasts, with likely associated effects on island terrestrial ecology, marine ecology, and human economies.

4. Movements of coastal sands have buried human settlements and landscapes in diverse areas on time scales ranging from day to century intervals, depending on dynamic interactions of climate, sea level, and human land use practices; strong geographical bounding of these processes could have created severe imbalances in community scale impacts of global change and subsequent human responses.

5. Global-warming related seasonal desiccation of elevated blanket bog in northern environments, followed by temperate zone grade severe precipitation events, can trigger massive peat slides in the Shetland Islands, with corresponding major human impacts.

6. Culture contacts between early medieval Scandinavian migrant populations and indigenous Pictish populations in the Northern Islands of Scotland may have taken place over a substantial transition period. Various types of interactions may have been much more geographically diverse than previously envisioned by archaeologists.

Emerging Research Questions

1. What are the thresholds of predictability, severity and duration that affect social and political perceptions of extreme environmental changes; how are those perceptions conditioned by systems of recording and transmitting knowledge in different societies?

2. How are responses to cyclical or less predictable, severe environmental events and processes produced by within societies with differently structured webs of power and authority?

3. How do phases of storminess in the North Atlantic, and related patterning in greater regional circulation phenomena (e.g. NAO and AO), fit into larger, longer-term patterns of global climate change? What were the impacts over time and space of extreme storminess and volcanic activity at different periods across the North Atlantic\?

4. Can abrupt and severe change in political or large-scale market forces simulate or act synergistically with extreme environmental changes to catalyze rapid adaptive social changes in human societies?

5. What are the roles played by social responses to short-term, extreme changes in the formation of long-term adaptive strategies by societies? Are “shocks to the system” actually required for humans to abandon long-standing perceptions of their environments and develop new strategies, rather than expanding investments in existing modes of adaptation.

Limits

1. High resolution dating of archaeological and geological records of change is needed: can sub-decadal and intra-annual time scales be achieved for studies of a usefully large number of places and time periods?

2. Despite many years of field and lab research there is a very uneven geographical coverage of environmental and cultural data over areas where inter-regional comparisons and synthesis are critical to understanding past, present and future impacts of global changes.

3. Much relevant traditional environmental knowledge has been lost in many areas through the combination of population aging, economic and cultural globalization effects, and profound environmental transformations from economic activities and a warming planet.

Blockages

1. There are many remaining issues of sub-optimal communication about the nature and meaning of data of mutual interest among researchers in different disciplines, and from different international research cultures. For example, some historians use scientific data uncritically, and at least an equal number of scientists use historical information from texts with equal naiveté.

2. At this point there are many researchers in the social sciences and the humanities who have no real interest in the physical environment as an active variable in human existence.

Action Areas

1. Expand environmental science datasets that record past extreme events and aid in defining their extent of causation and periodicity within larger sequences of global change. Ensure that important samples of paleoenvironmental and archaeological data are actually representative and appropriate in scale to the models that are built on them.

2. Expand and accelerate the collection of traditional environmental knowledge regarding hazards, as well as periods of relative stability: this is a very time-sensitive issue. Promote local recording of TEK, and train local community researchers to advance the collection of comparable data.

3. Expand geophysical and archaeological research activities that push the frontiers of high-resolution dating, and the development of archaeological theory around the definition of site-formation processes on sub-decadal, decadal and shorter time scales.

Deliverables/Outreach/Broader Impacts

1. Place past environmental disasters in a scientific framework that accurately represents their predictive relevance to projected trends of global change. Make this information available for incorporation in local heritage education activities and products (e.g. school projects at various levels, heritage site interpretation materials, with local participation in supporting research highlighted), and in environmental management planning from the local to the international levels.

2. Publish research results in a very broad spectrum of professional and popular media, while striving to maintain accuracy.

3. Promote interaction among stakeholders in different regions facing similar issues of achieving economic sustainability in highly dynamic environments that produce regular, if unpredictable, episodes of extreme environmental change.