

Managing for dynamic coastal change at Tentsmuir Forest

Courtesy of Stewart Angus/NatureScot

Tentsmuir forest is located on the east coast of Scotland, north of St Andrews, and is managed by Forestry and Land Scotland (FLS). The forest was planted in the 1920s and covers 1,500 hectares (ha), primarily consisting of Scots pine (610 ha), Corsican pine (300 ha), Sitka spruce (150 ha) and birch (150 ha), with a small area of Lodgepole pine (25 ha). Tentsmuir National Nature Reserve borders the forest and includes the dynamic sand dunes at Tentsmuir Point, restored ancient sand dunes at Tayport Heath and ponds at Morton Lochs, all of which are managed by NatureScot. Careful management has created a mixture of open space, ponds, trees and sand dunes that are rich in wildlife and classified as Special Areas of Conservation and Sites of Special Scientific Interest.

Management objectives

Tentsmuir forest is managed for timber production, biodiversity, and recreation, with visitors to the beach, forest, and coastal paths. Management of the site takes into account the sensitivity of the adjacent nature reserve.

Risks and opportunities

Main climate change risks

Tentsmuir is a coastal forest with low elevation, ranging from 1–10 m above sea level, with an average of 5 m. The primary climate change risks include sea level rise and increased winter rainfall. The coastline is dynamic, with ongoing deposition and erosion, and under a high-emissions scenario, the sea level may rise by up to 91 cm by 2100. Sea level rise exacerbates coastal erosion and saltwater intrusion; it also reduces the drainage capacity of coastal sites through backing up drains and increased sediment blocking drain outlets, which is already an issue for areas of this site. Increased winter rainfall will worsen waterlogging and flooding, exacerbated by the reduced drainage capacity.

Vulnerabilities

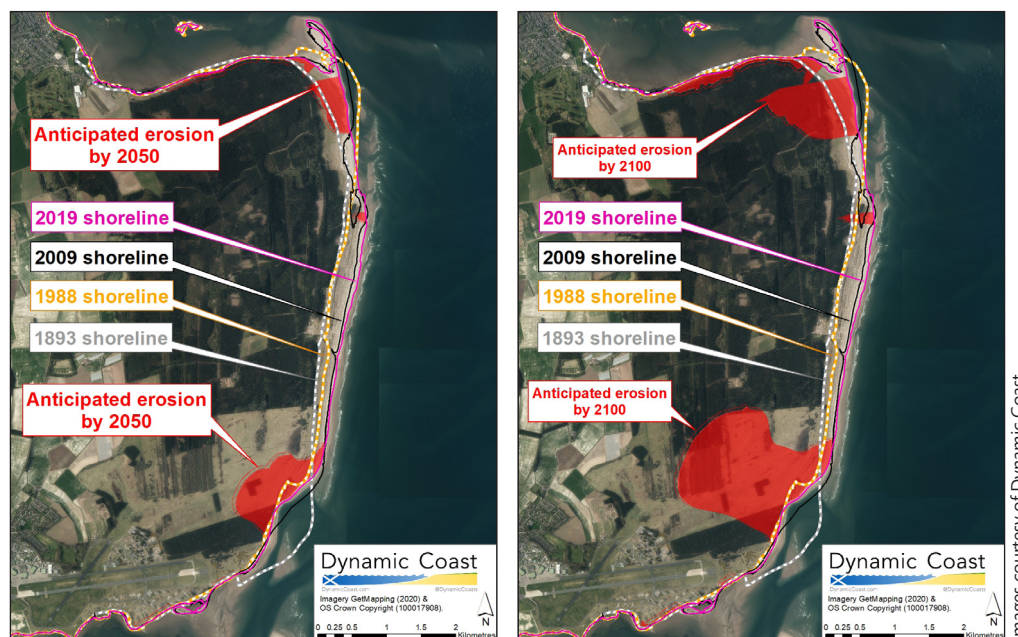
The coastal location influences the soil structure and local climate, increasing the risk of seasonal drought, flooding, wind damage and salt burn to vegetation. Parts of the forest were badly affected by windblow caused by Storm Arwen in 2021. High winter water tables are influencing areas within the forest via reduced rooting depth, resulting in wind throw and mortality. Seasonal variability in water levels has led to drought crack in some Sitka spruce stands. Dothistroma Needle Blight (DNB) is causing reduced growth rates in Lodgepole and Scots pine stands.



Find detailed information in UKFS Practice Guide **Adapting forest and woodland management to the changing climate.**

Information on the UK Forestry Standard and supporting guidance is available at www.forestresearch.gov.uk/ukfs

Coastal change is expected to accelerate in the coming decades.



Note: These maps are based on a High Emissions Scenario (RCP8.5 95%) sea level and no active coastal management.

Further information on the Tentsmuir forest design plan

Further information on Dynamic Coast

The 2017 Dynamic Coast 1 Report for Cell 2 – Fife Ness to Cairnbulg Point

Further information on Tentsmuir National Nature Reserve

Identifying and selecting measures

Evidence is being collected to inform a review of the Tentsmuir management plan. FLS forest planners work closely with Dynamic Coast, NatureScot and the Scottish Environment Protection Agency to improve the resilience of the forest and dunes.

Naturally regenerated trees have been removed from restored dunes. In future, effort needs to focus on supporting resilient, healthy forests and dunes as our climate continues to change. Species selection is also increasingly important; as well as tree health considerations, tree species need to be windfirm and tolerate fluctuating water levels. Certain species experience salt burn under coastal conditions, so a protective belt of more resilient species could be beneficial. Further assessments of elevation and hydrology are needed to understand the likely impacts.

Implementing adaptation measures

Drain maintenance is on-going and measures are in place to prevent the backflow of saltwater, although some of these are already failing. Further engineering solutions or adaptations will be needed. Some wet areas are unsuitable for commercial crops and are moving to alternative management. Stands that have failed because of windblow are being cleared and restocked areas will be replanted with windfirm species where appropriate. Sitka spruce showing drought crack will not be suitable for timber production and will be harvested for other markets, so will not need to be thinned.

Scots pine stands are being thinned to increase airflow and reduce the impacts of DNB, with up to 50% of infected material removed. Stand management and felling age are adjusted for the reduced growth rate and increased thinning. The regenerating birch understorey is being encouraged in pine stands. Thinning has not reduced the high infection rates of DNB in Lodgepole pine, therefore the remaining component will be felled over time.

Birch understorey in a pine stand.



Windblow in a Corsican pine stand.



Photo courtesy of Forestry and Land Scotland

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Monitoring and assessment

Dynamic Coast will continue to carry out assessments of coastal erosion and annual monitoring for DNB damage is carried out by FLS as part of the crop condition survey.

There is an opportunity to utilise multiple data and evidence sources, such as LiDAR to assess small changes in elevation, and hydrology modelling to reduce the uncertainty of flood and drought risk for individual coupes. These could support the production of a resilient forest management plan.

Lessons learnt

The coastal location and low elevation present an opportunity to monitor the impacts of sea level rise on forests and to inform the future management of Tentsmuir Forest and other coastal woodlands. Coastal monitoring will also allow targeted harvesting prior to loss from coastal erosion.

St Andrews University and the Eden Estuary Local Nature Reserve Advisory Group are trialling nature-based solutions in the Eden Estuary to improve resilience against storms, drainage, coastal erosion and sea level rise. This will generate learning opportunities associated with the research, as well as solutions which may be appropriate for Tentsmuir Forest.

Intended future outcomes

As the sea level and water table continue to rise and the coast continues to adjust, both the forest species composition and management will need to change. However, the site will continue to be managed for recreation and timber, and to support biodiversity. The land management plan was under review in 2022. Stands at higher elevations could be managed as a Scots pine overstory with a birch understorey, sites classed as 'very wet' could be planted with willow or alder and managed for biodiversity. Sites classed as 'wet' could be planted with spruce. Where possible, stands will be managed as continuous cover forestry to reduce summer desiccation on young trees. Ongoing evaluation alongside partners will take place, considering factors such as sea level, coastal erosion, drainage patterns, hydrology and elevation. This will inform management decisions.

This case study is one of a number supporting the UKFS Practice Guide on *Adapting forest and woodland management to the changing climate*