3.10 Dissolved Oxygen

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There is an optimum range for dissolved oxygen concentration in oceanic water to avoid stress and potential death to ocean life. Projections indicate that concentrations could decrease by up to 20%, in part because of ocean warming and increased stratification in calm waters, leading to dead zones where no marine life is maintained. Other human-induced depletion is caused by excessive nutrient discharge into river and coastal systems. Observations are vital to give early warning of oxygen-depleted areas and to track the impact of climate change.

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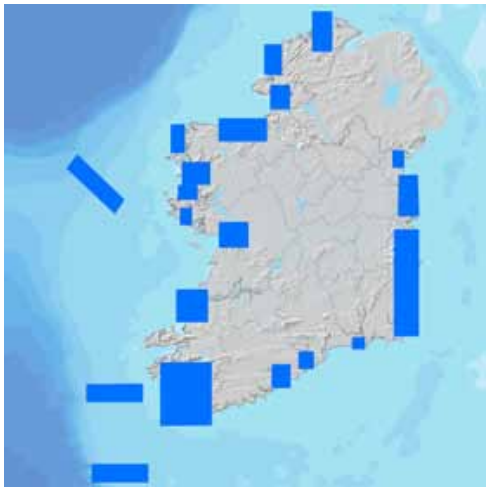

Map 3.10. Location of areas where dissolved oxygen observations are made.

Measurements

As part of the EPA's national estuarine and coastal waters-monitoring programme, dissolved oxygen measurements have been made in 20 coastal locations during the summer months since 2001. Additional measurements have been made off-shore by the *RV Celtic Explorer* and *RV Celtic Voyager* operated by the Marine Institute. All the measurements have been in areas of less than 200m depth.

'Modelled dissolved oxygen saturation shows healthy levels for the seas around Ireland.'

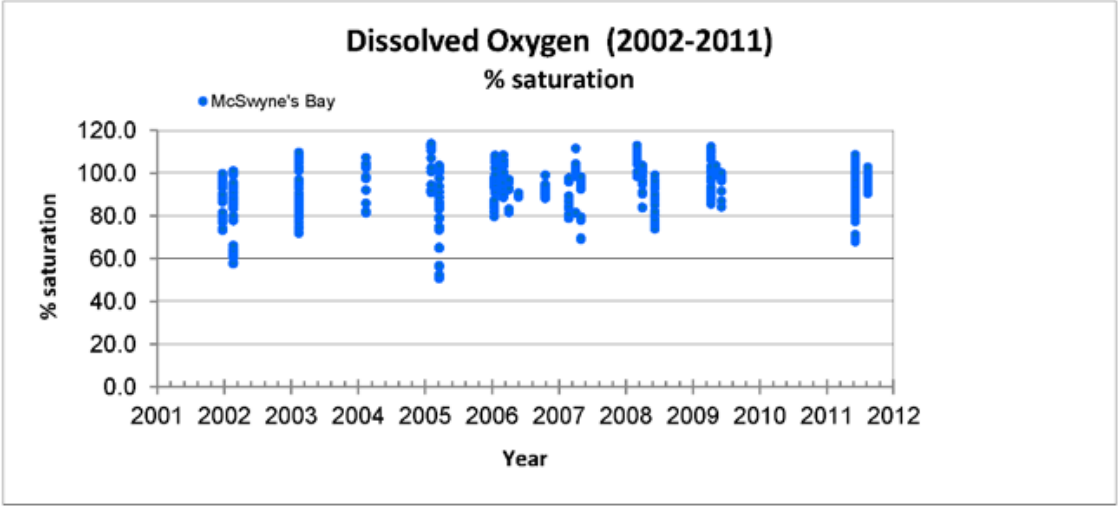

Figure 3.19. Percentage saturation of dissolved oxygen at McSwyne's Bay, Co. Donegal, 2002–2011.

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Time-series and Trends

Figure 3.19 shows the percentage saturation of dissolved oxygen taken at sampling sites in McSwyne's Bay, Co. Donegal, mainly during summer months, from 2002 to 2011. Measurements were made at water depths ranging from just below the surface to 30 m. In general, the saturation levels were high over the period of the observations. Super-saturated values (>100%) usually occur in the well-mixed surface layer, while the lower saturation values are found in stratified sub-surface layers.

The distribution of bottom oxygen saturation levels is not measured directly but inferred from a robust model which uses the *in situ* data measurements. Figure 3.20 shows that highest bottom saturation values of 90% to 100% are associated with shallow bays and the mixed

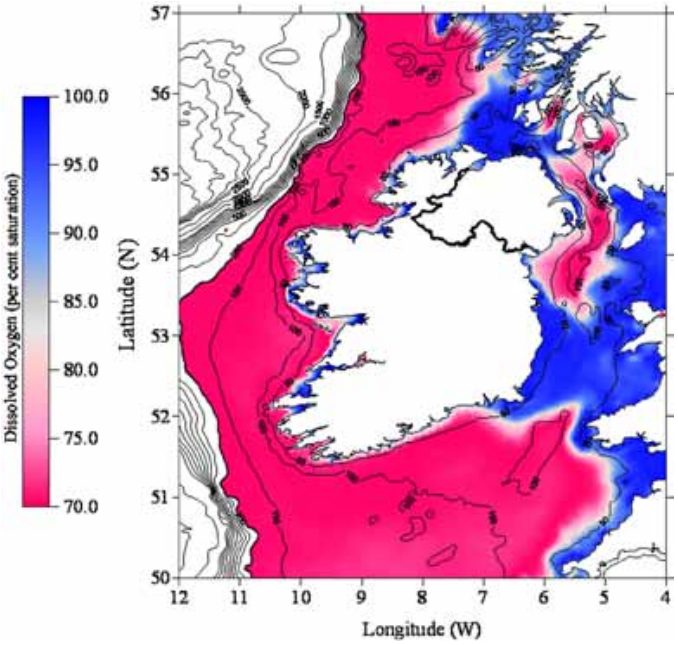

Figure 3.20. Distribution of modelled bottom dissolved oxygen saturation in Irish coastal and shallow shelf waters.

waters of the southern and eastern Irish Sea, and the southern Malin shelf between Ireland and Scotland. The lower values (approximately 70%) are associated with deep bays in southwest Ireland and offshore areas where the water is stratified. The sharp transition zone between higher and lower saturation levels reflects the distribution of thermal boundaries that separate mixed and stratified waters in the region. Saturation levels below 30% would be a cause for concern at the typical temperatures of the waters around Ireland.

A reduction in bottom dissolved oxygen levels due to enhanced stratification, while not sufficient in itself to cause oxygen depletion, increases the vulnerability of these stratified waters to impacts from the collapse of naturally occurring phytoplankton blooms and inputs from human activities such as discharges from wastewater treatment plants.

'Observations are vital to give early warning of oxygen-depleted areas and to track the impact of climate change.'

Maintaining the Observations

The EPA carries out annual measurements of dissolved oxygen content in coastal and estuarine waters as one of the measures under the Water Framework Directive. The Marine Institute measures dissolved oxygen during annual ship surveys carried out in offshore waters.

Further Information and Data Sources

O'Boyle, S., and Nolan, G. (2010) The influence of water column stratification on dissolved oxygen levels in coastal and shelf waters around Ireland, *Biology and Environment: Proceedings of the Royal Irish Academy,* Vol. 110B, No. 3, pp. 195–209.

O'Boyle, S., McDermott, G. and Wilkes, R. (2009) Dissolved oxygen in estuarine and coastal waters around Ireland, *Marine Pollution Bulletin,* Vol. 58, pp. 1657–663.

Vaquer-Sunyer, R and Duarte, C.M. (2008) Thresholds of hypoxia for marine biodiversity, *Proceedings of the National Academy of Sciences*. Vol. 105, p. 40.