10. CONTAMINANTS IN BIOTA

Key messages

- Shellfish flesh is closely monitored to protect the health of consumers and also as an indicator of environmental quality.
- The abundance of species of phytoplankton responsible for producing biotoxins is low and does not appear to be increasing in coastal waters of Northern Ireland.
- Levels of biotoxins in shellfish flesh infrequently exceed thresholds considered safe for human consumption. Closures of shellfish harvesting areas due to the presence of biotoxins are uncommon.
- Long term monitoring of blue mussels in the Victoria Channel (Belfast Lough) shows a decline in the level of industrial discharges of heavy metals.

Who is responsible for monitoring the levels of contaminants in seafood for human consumption?

Responsibility for monitoring contaminants in shellfish is shared among a number of government departments and agencies. DARD has the role of promoting sustainable aquaculture through the licensing of shellfish harvesting beds. The Food Standards Agency in Northern Ireland (FSA), as the competent authority under EC food hygiene legislation, is responsible for classifying shellfish harvesting areas when the product harvested is being placed on the market for human consumption. Shellfish harvesting areas are classified according to the levels of *Escherichia coli* (*E.coli*) detected in flesh samples over a period of time (Class A, B or C). Each classification determines the level of post harvest treatment required before the product can be placed on the market.

Once shellfish beds have been classified for 3 successive years, demonstrating a sustainable and viable fishery, NIEA will designate the harvesting areas under the EC Shellfish Waters Directive. This affords additional protection to the waters in which our shellfish grow. Designated areas are located in all of our sea loughs (Figure 1.2).

What contaminants can occur in shellfish?

Shellfish feed by filtering their food from the sea, with the result that contaminating particles in the water can accumulate in their flesh. These include bacteria such as faecal coliforms and viruses which occur in sewage and agricultural pollution. Consumption of shellfish contaminated by these organisms can cause stomach upsets.

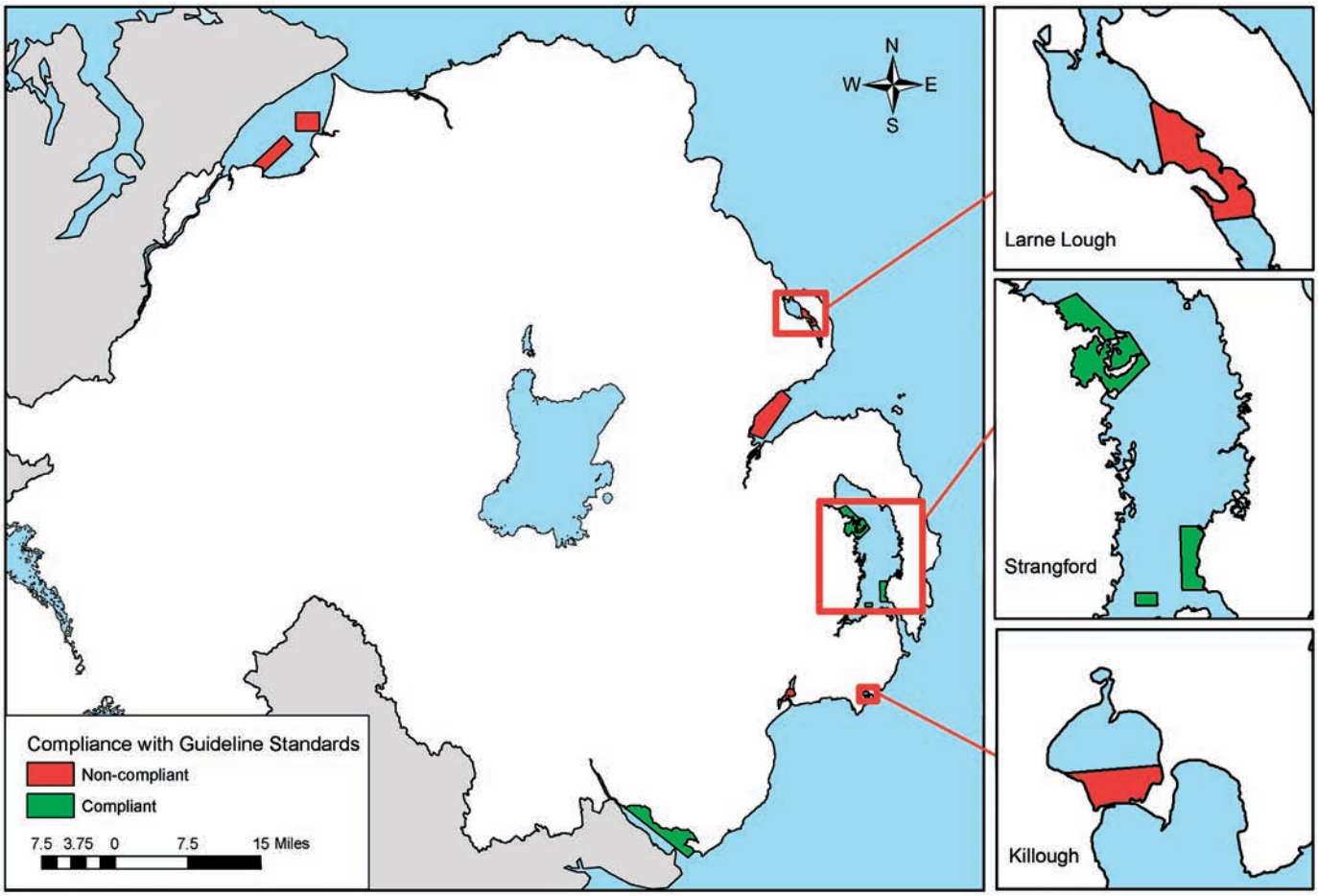

Figure 10.1 Compliance with Guideline Coliform Standards in 2009.

A small number of naturally occurring species of phytoplankton produce biotoxins. These biotoxins can accumulate in the flesh of some species of bivalve shellfish (e.g. mussels, oysters and scallops) that feed on phytoplankton by filtering it from the water. The biotoxins can cause serious illness in humans if contaminated shellfish are eaten. The type of illness is known by the syndrome caused by different toxins. Potent neurotoxins can cause paralytic shellfish poisoning (PSP). Paralytic shellfish poisoning symptoms are facial tingling and numbness that can develop into extensive muscular paralysis and, in severe cases, lead to death.

Lipophylic shellfish toxins are responsible for diarrhetic shellfish poisoning (DSP), a severe gastrointestinal disorder with diarrhoea, vomiting, and abdominal cramps. The final syndrome, amnesic shellfish poisoning (ASP) is caused by a compound called domoic acid. The symptoms are nausea, vomiting, abdominal cramps, diarrhoea, memory loss, decreased consciousness, seizures, confusion and disorientation.

Heavy metals and organic pollutants described in Chapter 9 may also find their way into shellfish flesh, where they have the potential to cause human health problems or interfere with the growth and reproduction of the shellfish.

How is shellfish contamination monitored?

FSA and NIEA conduct complementary monitoring programmes in conjunction with AFBI, analysing water quality and shellfish flesh quality as required by EC legislation outlined above. Waters are monitored for trace metals, indicator bacteria and toxin-producing species of phytoplankton. Shellfish flesh is monitored for biotoxins, trace metals and other chemical contaminants, as well as indicator bacteria. Analytical work is conducted by AFBI, NIEA and the Public Health Laboratory.

Are our shellfish safe to eat?

FSA carries out official controls on shellfish, from classified harvesting areas, destined for human consumption. Shellfish are routinely monitored for the bacteria *E.coli*, biotoxins and chemical contaminants in order to protect

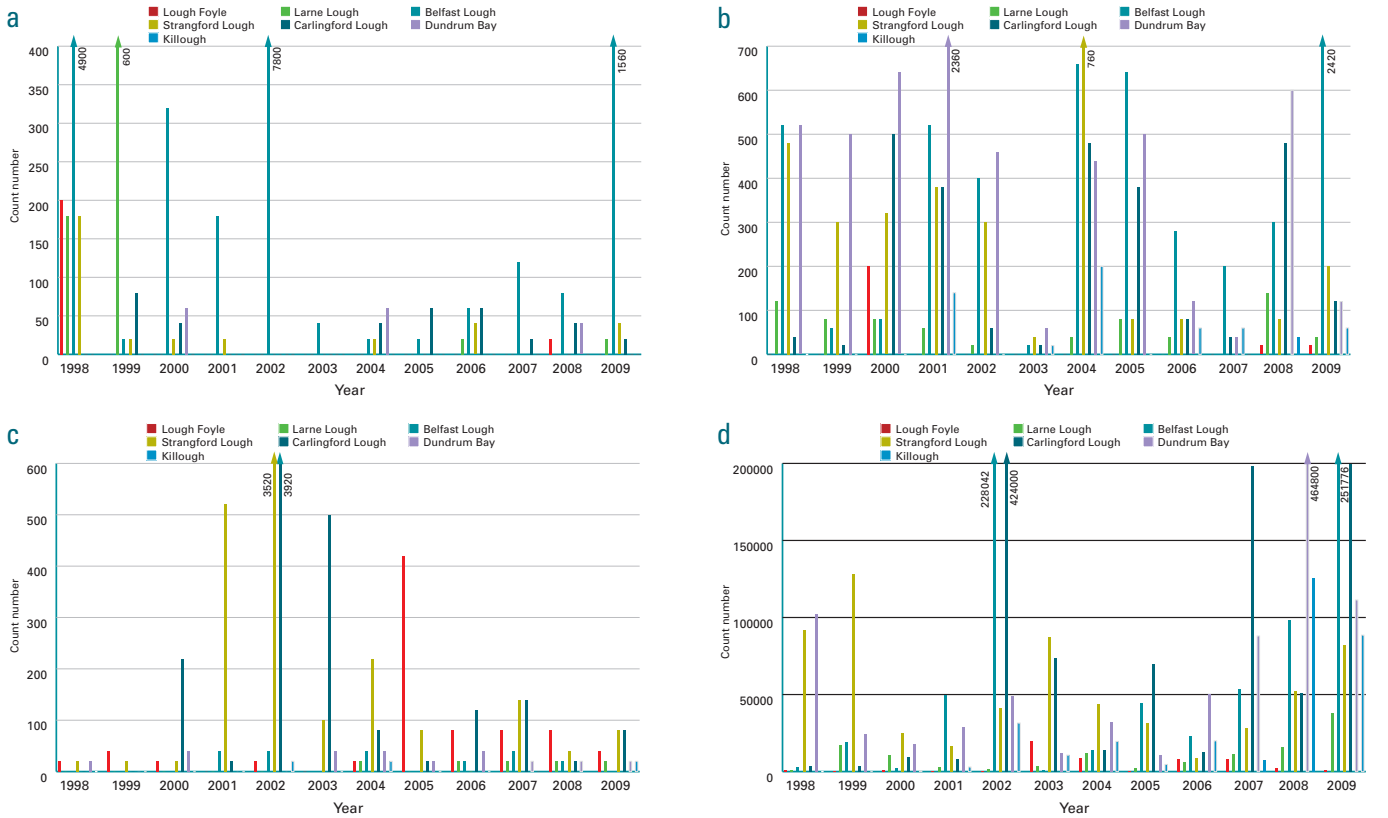

Figure 10.2 The abundance of toxin producing phytoplankton in coastal waters of Northern Ireland between 1998 and 2009. a) *Alexandrium* spp. b) *Dinophysis* spp. c) *Prorocentrum lima* spp. d) *Pseudo-nitzschia* spp.

public health. Based on the presence of bacteria of faecal origin, harvesting areas are classified in descending order of quality as A, B, or C. Each classification determines the level of post-harvest treatment required before the product can be placed on the market. Where harvesting areas return results of below a "C" category, the harvesting area will be temporarily closed until satisfactory results are returned. It is the Food Business Operator's responsibility to ensure that the food they place on the market is safe to eat and so they must also have additional controls in place.

Over the last 10 years, the results of monitoring have shown that the overwhelming majority of shellfish waters fall into Class A and B categories, based on the bacterial analysis (Table 10.1). This means that all of our shellfish can be placed on the market after a minimum of 42 hours of purification. In addition, approximately 40% of our shellfish waters met the guideline coliform standards in 2009 (Figure 10.1). This is broadly equivalent to Class A.

Routine monitoring to detect the presence of toxin producing species of phytoplankton in coastal waters of Northern Ireland shows that the levels of these species are generally low (Figure 10.2). The levels of phytoplankton detected in water samples rarely exceed trigger levels that require the collection of additional shellfish flesh samples for biotoxin analysis. Furthermore, recent analysis of the monitoring data shows that there has been no increase in the abundance of toxin producing species over the last 13 years[1]. The biotoxins responsible for PSP, DSP and ASP have been detected in the flesh of shellfish collected from coastal waters of Northern Ireland. However, such occurrences are infrequent and the closure of shellfish harvesting areas, due to toxic episodes, is uncommon.

The presence of harmful algal blooms (e.g. red tides) in the water provides an early warning of potential problems but these blooms do not always produce toxins. For example, the organism *Pseudonitzschia* is widespread in our shellfish waters and can potentially produce the toxin domoic acid. However, there have been no closures from this.

The levels of trace organic compounds are so low that NIEA monitoring has been suspended. However, the programme is held under review

Year	No of licensed shellfish beds	% in Class, based on *E.coli*			No. of Temporary Closures	
		A	B	C	*E.coli*	DSP
2009	43	9	91	0	1	5
2008	38	13	87	0	0	0
2007	40	30	70	0	0	6
2006	38	37	63	0	0	3
2005	39	33	76	0	0	2
2004	31	24	76	0	0	2
2003	29	17	83	0	0	15
2002	24	24	76	0	0	18

Table 10.1 Classification of the designated shellfish areas in Northern Ireland. *E. coli* is a bacterium of faecal origin; DSP (Diarrhetic Shellfish Poisoning) is a potential effect of a harmful algal bloom.

and, if appropriate, will be repeated once every 6 years. The strict guideline limits for metals in shellfish flesh have occasionally been exceeded but the exceedences have no pattern and no management intervention is indicated. The overwhelming majority of results are well below 50% of the EC Food Safety Guideline limit.

What do these programmes tell us about the 'clean-up' of our marine environment?

These programmes also provide the opportunity to determine long term trends in many marine contaminants since the early 1980s. Marine organisms, particularly blue mussels *Mytilus edulis,* have a long history as monitors of the environment. As mussels filter particles from the water and have a sedentary lifestyle, they provide a convenient tool for assessing changes in contaminant loads over time.

Studies known globally as 'mussel watch'were first undertaken in Northern Ireland from 1979 to 1980 [2,3]. The results of these studies were used to select sites for the early shellfish waters and dangerous substances monitoring programmes in Northern Ireland. Many of the downward trends discussed in Chapter 9 are clearly shown in shellfish flesh concentrations. Although not sited in a designated shellfish area, the data from blue mussel flesh in Victoria Channel (Belfast Lough) provide an excellent long term perspective of industrial pollutants in the Lough (Figure 10.2 a and b). The reductions of inputs from and later closure of an industrial point source in Belfast Lough are mirrored in decreases in both cadmium and mercury concentrations in mussel flesh (Figure 10.3 a and b).

All shellfish flesh monitoring data is forwarded to the UK Clean Seas Evidence Group (CSEG) for onward international reporting to OSPAR and ICES.

What further work is required?

The chemicals we monitor and the way in which we monitor them will continue to change as new substances enter the marine

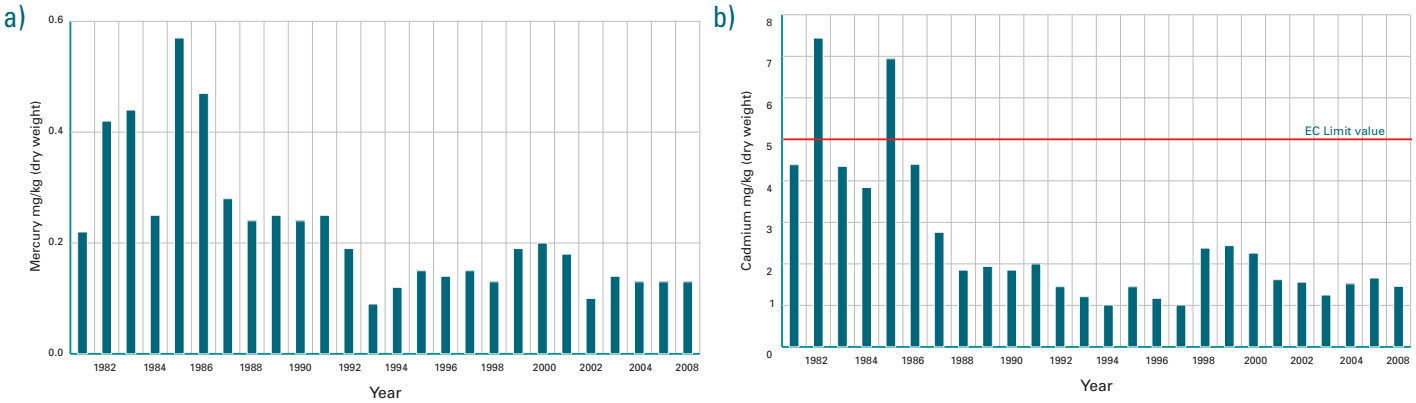

Figure 10.3 Average concentrations of (a) mercury and (b) cadmium in blue mussel flesh from Victoria Channel in Belfast Harbour between 1981 and 2008.

environment and novel sampling and analytical techniques are developed. While the priority is to ensure the protection of human health, many of the monitoring programmes also provide a valuable tool for assessing the wider contaminant status of the marine environment. Further work is required to understand more fully the relationship between contaminants entering the environment and concentrations in animal tissue. The information obtained from the monitoring programmes also contributes to the design standards for waste water treatment works and sewerage systems

FSA in Northern Ireland currently undertakes a monitoring programme of finfish landed by the Northern Ireland fishing fleet. A range of chemical contaminants including specific heavy metals, polycyclic aromatic hydrocarbons and pesticides are assessed.

FSA, AFBI, DARD and NIEA need to continue their co-operation in monitoring biota and associated water monitoring to maximise value for money in these programmes.

Red tide in Belfast Port

Legislation	
Marine Strategy Framework Directive (2008/56/EC) Descriptor 9 Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards	
Other relevant EC Directives and Regulations (full references and corresponding regulations – Appendix II)	
Water Framework Directive	Driving overall improvements in water quality
Environmental Quality Standards in the field of water policy	Control discharges that are likely to contain dangerous substances that go into water
Dangerous Substances Directive and its "daughter" directives	Control discharges that are likely to contain dangerous substances that go into water
Shellfish Waters Directive	Protect shellfish populations by maintaining water quality
EC Food Hygiene Regulations Regulation	Protecting public health by classifying & monitoring shellfish for human consumption
International Agreements	
OSPAR Convention for the protection of the marine environment of the North-East Atlantic	Hazardous Substances Strategy
National and Local legislation	
Food and Environment Protection Act Part I (FEPA)	Power to close shellfisheries
Water (Northern Ireland) Order 1999	Allowing NIEA to set appropriate consent conditions for sewage and industrial effluent treatment