THE 'TYNE FISH PROJECT' – CONCENTRATIONS OF DIOXINS (PCDD/F) AND PCBS IN DIFFERENT FISH SPECIES AND SAMPLE TYPES FROM THE TYNE RIVER ESTUARY, UK, WITH DIETARY INTAKE ESTIMATES FOR ANGLERS.

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Introduction

The River Tyne estuary is located in a densely populated conurbation of around a million people on both sides of the river banks. The area has a long industrial heritage and significantly contaminated areas on both shores have been the subject of specific investigations and remediation. For some of these sites the Food Standards Agency (FSA) has provided advice about the potential for contamination in the food chain. Industrial discharges also exist from present industry in addition to some contemporary raw sewage discharge during storm events. In some cases the quality of water and sediment in the river has been impacted. In addition upstream discharges from numerous towns and villages in the catchment have the potential for input. Nevertheless, a substantial amount of angling takes place on the Tyne estuary, in the vicinity and downstream of these sites, and it is known that catch is often consumed. Some areas around the lower sections of the river have populations that are of low socio-economic status, and it may be that, for some consumers, locally caught fish represents a regular part of the diet. Newcastle City Council is concerned about possible health impacts of entry into the food pathway of contamination of the river.

The Food Standards Agency has already reported on PCDD/F and PCBs in wild fish, mussels and farmed fish[1] and is currently investigating contamination of freshwater fish in unmanaged UK waterways and possible exposure for anglers who consume their catch. However, no work has been carried out with regard to estuarine fish in England. With good quality background information already existing for the Tyne environment and the situation clearly representing a potential risk to consumers, the Food Standards Agency provided the Local Authority, Newcastle City Council, with a grant towards the sampling and testing of fish caught in the Tyne estuary.

The objectives of this research were twofold. Firstly, to determine the concentrations of a range of contaminants in different fish species and sample types from the Tyne Estuary. Secondly, to develop daily intake estimates associated with consumption of the fish to assess any health risk for anglers and local residents consuming those fish. Analysis of dioxins (PCDD/F) and polychlorinated biphenyls (PCB) and congener profiling took place as part of this wider study.

Materials and Methods

A steering group for the Project was brought together to ensure all stakeholders' needs were met, and to maximise value for money regarding integration with and benefit for other Tyne projects. The steering group also provides interpretation and effective dissemination of the results. Steering group members include experts and researchers from Newcastle University, local administrative authorities Newcastle City Council (NCC) and Gateshead Metropolitan Borough Council (GMBC), UK Government Health Protection Agency, Food Standards Agency, Environment Agency, Marine Fisheries Agency, Natural England and the Tyne Rivers Trust, a charitable body set up to manage and improve the Tyne Catchment through practical enhancements and educational activities.

Newcastle City Council and Newcastle University collected the fish samples and information on local angling activities and consumption patterns.

Over two kg each of Codling (G*adus morhua*) n=8, Whiting (*Merlangius merlangus*) n=22, Flounder (*Platichthys flesus*) n=19 and Eel (A*nguilla anguilla*) n=14 were collected from the Tyne by three methods;

- Approaching individual recreational fishermen on the Walker Riverside area (Jan to June 09) (codling and flounder),
- Fishing competitions on the Copthorne area (June to August 2009) (whiting, eel and flounder) - thanks to competitors and Rutherford's Angling Ltd,
- Open fishing competition (November 09) (codling, flounder, whiting, eel and pouting collected from Hebburn and Jarrow sites) - thanks to South Shields Angling Club.

Laboratory analysis was carried out by the Food and Environment Research Agency (Fera) (formerly CSL), Sand Hutton, York. Edible tissue from fish of the same species were pooled and homogenised to make composite samples. Cod liver was also analysed since it is traditionally consumed as part of Eastern European and Scandinavian diets and immigrants residing in the Tyneside area can be expected to consume liver from cod caught in the Tyne. For white or non-oily fish, organic contaminants tend to accumulate to a much greater extent in the liver than the muscle.

Data Analysis

Congener patterns for cod muscle data from the study were compared with previous cod muscle studies in the UK[2], Norway[3] and the Baltic[4]. Cod liver data was compared with cod liver data from Norway[3] and the Baltic[4] . Whiting muscle data was compared with previously collected whiting muscle data from the UK[2]. Flounder muscle was compared with previous UK data[2] Norway[3], Finland[5] and South Korea[6]. Eel data was compared with other eel data from the UK[2], Norway[3], and Amsterdam[7].

Results and discussion

The Tyne Fish Project data is unique as it is the first study to investigate the range of dioxins PCDD/F and PCB in a range of fish species and sample types from an estuarine river, complimenting previous FSA studies. Table 1 shows the concentrations of Dioxins and PCBs found in fish sampled as part of the Tyne Fish Project.

Table 1 Dioxin and PCB results from Tyne fish study

Sample Details:	whiting, composite	flounder, composite	eel, composite	cod composite	cod livers-composite
WHO TEQ ng/kg whole					
dioxin	0.06	0.14	0.51	0.05	9.86
non ortho-PCB	0.05	0.07	0.72	0.05	17.71
ortho-PCB	0.04	0.07	2.48	0.07	23.89
Sum of WHO TEQs (upper)	**0.15**	**0.28**	**3.71**	**0.17**	**51.46**

The wider Project also provides valuable information regarding local anglers and their families' exposures to contaminants via consumption of their catch.

The Food Standards Agency has estimated the average UK dietary intake of PCDD/F and dioxin-like PCB to be 0.9 pg WHO-TEQ/kg bodyweight/day in 2001 (FSA 2003). This is within the 2001 Committee on Toxicology (COT)[9], recommended UK TDI for mixtures of PCDD/F and dioxin like PCBs.

The FSA advises that women of reproductive age and girls should maintain consumption of dioxins and dioxin like PCBs below 2 pg WHO-TEQ/kg bodyweight per day, which equates to 0.84 ng/week for a 60 kg person. Boys, men and women past reproductive age are recommended to maintain consumption of dioxins and dioxin like PCBs below 8 pg WHO-TEQ/kg bodyweight per day, which equates to 3.36 ng/week for a 60 kg person. Table 2 shows the number (and size) of portions that would make up this maximum recommended intake after the background intake of 0.9 pg/kg body weight has been taken into consideration.

Whiting and cod from the Tyne Fish Project demonstrate higher concentrations of dioxins and dioxin like PCBs than the previous wider UK studies, eel concentrations are within the range of other studies and there is no comparable data available for UK cod liver or flounder.

The results of this study indicate that women and girls of reproductive age should be advised not to consume Tyne eel more than once a week and all persons should be recommended to consume Tyne cod liver only occasionally. This advice is purely with respect to dioxins and dioxin-like PCBs – actual advice given to anglers will take the other contaminants measured within the wider project into consideration.

Table 2 Recommended maximum consumption rate calculations

Sample Details:		fish portion size (g)	sum ng/kg WHO-TEQ dioxins and dioxin like PCBs in one portion	maximum number of portions women of reproductive age and girls should eat per week	maximum number of portions women of post reproductive age, men and boys should eat per week
whiting	TFP 2009/10 composite of 22	140	0.021	22	142
	FSA[9] 1994-1996 mean n=14	140	0.014	33	213
	FSA[9] n=1 2003-4	140	0.0126	37	237
flounder	TFP 2009/10 Composite of 19	140	0.0392	12	76
eel	TFP 2009/10 Composite of10	70	0.5194	1	6
	FSA[9] 1994-1996 mean n=10	70	1.4	0.3	2.1
	FSA[9] n=1 2003-4	70	0.182	3	16
cod	TFP 2009/10 Composite of 8	140	0.0238	19	125
	FSA[9] 1994-1996 mean n=30	140	0.014	33	213
	FSA[9] n=1 2003-4	140	0.014	33	213
cod liver	TFP 2009/10 composite of 8	20	7.2044	0.1	0.4

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