To concentrate or to flux?

Nico W. van den Brink[1], M. Gloria Pereira[2] and Richard F. Shore[2]

1 Wageningen University. Division of Toxicology
PO Box 8000, 6700AE Wageningen The Netherlands
Email: Nico.vandenbrink@wur.nl

2 Centre for Ecology & Hydrology (NERC)
Lancaster Environment Centre , Library Avenue, Bailrigg
Lancaster UK. Email: mdgds@ceh.ac.uk; rfs@ceh.ac.uk

Setting the scene

The quality of our environment can be assessed by various monitoring approaches, the results of which provide a yardstick against which to quantify change. Often practical considerations play a role in the choice of sample types. However, it is essential to determine exactly what the data are telling us, as measurements in different compartments may indicate contradictory trends.

Trend monitoring

- Generally studies show declining concentrations of legacy compounds in environmental samples, e.g. in Arctic seabirds and Polar bears (figure 1)

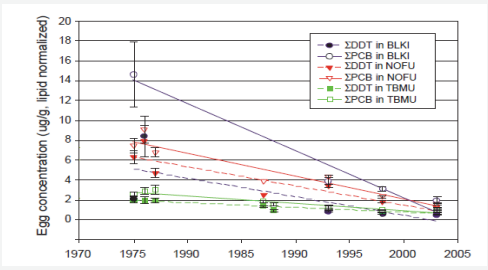
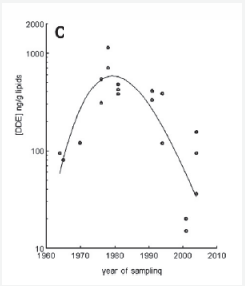
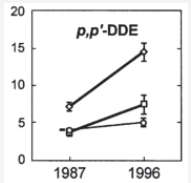


Figure 1. Levels of DDTs and PCB in different Arctic seabird species (BLKW: Black-legged Kittiwake, NOFU: Northern fulmar, TBMU: Thick-billed murre) (Braune et al., 2005).

- More recent studies see declining concentrations in one part of the ecosystem and levelling of even increasing in other (figure 2).





B

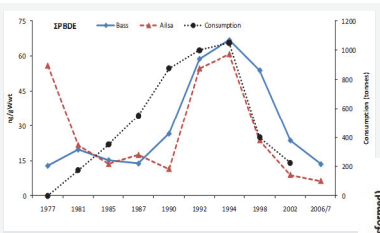
Gobionotothen gibberifrons
Chaenocephalus aceratus
Champsocephalus gunnari

Benthic feeding
Pelagic feeding

A

Figure 2. Levels of DDE in A. different **Antarctic seabirds** (van den Brink et al. 2011)
B. Different **Antarctic fish species** (Goerke et al. 2004)

- Monitoring of PBDEs in pelagic feeding marine birds show temporal trends closely related to production figure (Crosse et al, 2012a), while levels in terrestrial birds of prey remain high, even after the use of the PBDEs was stopped (Crosse et al, 2012b; figure 3).



A

B

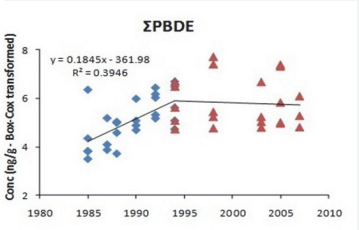
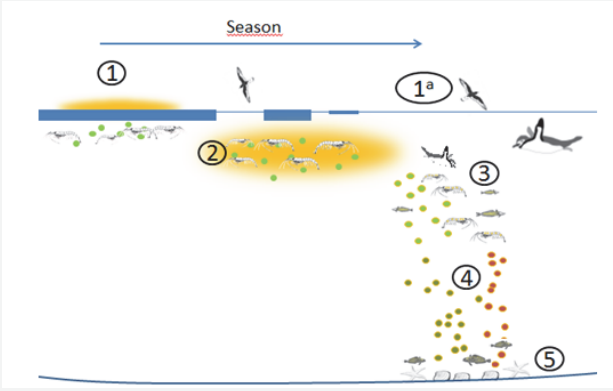


Figure 3

A. Modelled PBDE production (●) (right hand axis) and sum liver PBDE concentrations in gannet eggs from Bass Rock (♦) and Ailsa Craig (▲) (left hand axis)

B. Change in liver PBDE concentrations over time in sparrowhawks from England

Hypothesis: flux or burden?



Case: Pelagic-benthic coupling in Antarctic marine system

During winter organics accumulate on the ice (1 and 1a), which in spring are being released into the water. They accumulate in the algae which bloom early spring (2). Because of intense algal blooms, retention in pelagic system is relatively low → sedimentation of algae with associated chemicals (3 and 4). Accumulation of organics in benthic organisms: the ultimate sink of the chemicals (5).

Case: PBDEs in marine and terrestrial predatory birds

Trends in concentrations of PBDEs in pelagic feeding Atlantic seabirds are likely to be driven by similar processes described for Antarctic pelagic birds and so reflect PBDE input in the system. The sparrowhawks are feeding in systems from which organic contaminants cannot be exported; soil is the ultimate sink for POPs in terrestrial systems. PBDEs in terrestrial birds feeding on soil based food webs therefore reflect burden.

Conclusions

- In pelagic ecosystems measurements of organic compounds may reflect fluxes likely related to inputs of contaminants in the system
- Benthic or soil systems can be regarded as final sink of organic contaminants, likely related to the burden of contaminants in the system
- Time series of same ecosystem may provide conflicting results, providing specific information

- **When monitoring it is essential to have clear insight in environmental kinetics of chemicals for a balanced interpretation of the results**

References

Braune BM, Outridge PM, Fisk AT, Muir DCG, Helm PA, Hobbs K, Hoekstra, P F, Kuzyk, Z A, Kwan, M, Letcher, R J, Lockhart, WL, Norstrom, RJ, Stern GA, Stirling, I. 2005. Science of the Total Environment. 2005;351 Special Iss. SI:4-56.

Crosse, JD, Shore RF, Jones, KC & Pereira, MG, 2012a. Environmental Pollution.161:93-100

Crosse, JD, Shore, RF, Wadsworth, RA, Jones, KC and Pereira, MG 2012b. Environmental Science & Technology 46: 13504−13511.

Goerke H, Weber K, Bornemann H, Ramdohr S, Ploetz J. 2004. Marine Pollution Bulletin 48: 295-302

van den Brink NW, Riddle MJ, van den Heuvel-Greve MJ, van Franeker JA. 2011. Marine Pollution Bulletin 62: 128-132