



UNIVERSITY OF ICELAND

Hrein íslensk náttúra eða hvað?

Rannsóknir á áhrifum mengandi efna á íslenskar sjávarlífverur

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Ljósm. Pálmi Dungal

- Hrein náttúra, eða hvað?



Mengandi efni í íslenskum lífverum?

- Hversu mikið er um mengandi efni í íslenskum lífverum? Lítið, meðal eða mikið?
- Er íslenskt lífríki undir álagi af völdum mengandi efna?



Fyrirliggjandi upplýsingar

- Mengandi efni metin í:
 - fuglum
 - fálka, haferni, æður, fýl, langvíu, o.fl.
 - ref
 - fiskum
 - þorski, sandkola, hákarli, o.fl.



Dæmi um magn

- Fálki
 - PCB sambönd (Kristín Ólafsdóttir o.fl. 2001)



Dæmi um magn

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K. Ólafsdóttir et al. / Environmental Pollution 112 (2001) 245–251

Table 2
Organochlorine levels in breast muscle of eight bird species in Iceland^a

	n	% Fat	ΣHCH ^b	HCB	ΣPCB ^c	ΣDDT ^d	Transnonachlor	ΣPCB/ΣDDT ^e
Ptarmigan	11	2.0 [1.6–2.5]	0.09 (0.08) [0.03–0.26]	0.13 (0.10) [0.07–0.27]	0.39 (0.43) [1n.d.–3.6]	0.04 (0.05) [5n.d.–1.0]	<0.02 (<0.02) [8n.d.–0.04]	9.2
Mallard	12	1.3 [1.0–1.8]	0.07 (0.08) [2n.d.–0.76]	0.31 (0.27) [0.11–1.0]	1.6 (1.5) [0.41–52.1]	0.23 (0.27) [0.10–0.72]	0.02 (0.02) [4n.d.–0.05]	6.3
Tufted duck	8	1.9 [1.2–2.5]	0.05 (0.07) [1n.d.–0.18]	0.84 (0.83) [0.29–2.1]	16.9 (11.4) [7.7–81.8]	6.8 (6.9) [1.9–23.2]	0.04 (0.07) [2n.d.–0.12]	2.1
Golden plover	10	5.5 [4.1–9.7]	0.05 (0.12) [5n.d.–2.6]	4.0 (4.0) [2.4–6.9]	44.0 (48.5) [11.0–113]	6.7 (5.0) [1.0–390]	0.21 (0.32) [1n.d.–0.66]	8.1
Purple sandpiper	10	3.5 [2.7–4.5]	0.28 (0.26) [0.10–0.83]	5.0 (5.6) [1.6–11.4]	39.8 (73.5) [6.7–241]	7.0 (7.6) [1.9–21.9]	0.12 (0.13) [0.05–0.25]	7.7
Black guillemot	10	2.5 [1.7–4.5]	0.36 (0.30) [0.16–0.81]	6.4 (6.2) [3.5–16.8]	114 (111) [51.0–214]	22.5 (25.0) [4.9–61.3]	0.78 (0.81) [0.20–3.5]	4.8
Common eider ^f	17	2.8 [1.8–3.4]	Not analysed	0.73 (0.83) [0.25–1.7]	78.7 (81.3) [48.8–108]	11.2 (10.7) [8.4–17.0]	Not analysed	7.3
Gyrfalcon ^g	14	> 3	Not analysed	160 (130) [20.0–701]	4420 (4140) [730–29 500]	1940 (1600) [220–13 300]	Not analysed	2.4

^a Values are ng/g wet weight, geometric mean and (median) and range in square parentheses. n.d. indicates number of values below the detection limit which was at 0.01–0.02 ng/g wet wt. For calculation of the geometric mean, the non-detected values were given half the detection limit.



Dæmi um magn

- Hákarl
 - PCDD – díoxín í lifur (Strid o.fl. 2007)



Dæmi um magn

Table 1
Mean concentrations and min-max values of PCDDs/Fs (pg/g fat) in Greenland shark muscle and liver together with sum WHO TEQ concentrations (pg/g fat)

	Muscle (n = 10)		Liver (n = 10)	
	mean	min-max	mean	min-max
Lipid (%)	17	13-22	55	35-72
<i>PCDDs</i>				
2,3,7,8-TCDD	1.2	0.24-3.1	20	4.2-53
1,2,3,7,8-PeCDD	0.58	0.06-1.4	24	2.3-60
1,2,3,4,7,8-HxCDD	0.10	<0.08(6) ^a -0.32	2.5	0.35-6.2
1,2,3,6,7,8-HxCDD	0.67	0.05-2.0	20	1.5-66
1,2,3,7,8,9-HxCDD	0.10	<0.05(5)-0.33	2.5	0.19-7.0
1,2,3,4,6,7,8-HpCDD	0.25	<0.08(1)-0.55	2.2	0.20-5.8
<i>PCDFs</i>				
2,3,7,8-TCDF	5.8	0.49-15	280	30-890
1,2,3,7,8-PeCDF	0.78	<0.03(1)-2.0	54	2.5-150
2,3,4,7,8-PeCDF	1.3	0.08-2.8	73	4.1-200
1,2,3,4,7,8-HxCDF	0.56	<0.05(1)-1.4	18	0.72-54
1,2,3,6,7,8-HxCDF	0.61	<0.02(1)-1.7	17	0.49-55
1,2,3,7,8,9-HxCDF	nd	<0.07(10)	0.39	<0.06(3)-1.2
2,3,4,6,7,8-HxCDF	0.78	<0.16(1)-2.0	15	0.53-47
1,2,3,4,6,7,8-HpCDF	0.53	<0.45(7)-1.5	2.1	<0.18(1)-7.3
1,2,3,4,7,8,9-HpCDF	nd	<0.08(10)	0.25	<0.06(4)-0.85
∑PCDDs	2.9	0.45-7.0	71	8.8-180
∑PCDFs	10	1.0-24	460	39-1400
∑PCDDs/Fs	13	1.4-30	530	47-1600
<i>WHO-TEQs^b</i>				
PCDDs	1.9	0.31-4.4	47	6.7-110
PCDFs	1.2	0.09-2.7	56	4.5-170
<i>WHO-TEQs^c</i>				
PCDDs	1.9	0.31-4.4	47	6.7-110
PCDFs	1.4	0.11-3.3	72	5.4-210

^a Below the limit of detection (LOD), number of samples below LOD are given in parenthesis. For sum and mean calculations non detects have been treated as 1/2 LOD.

^b Calculated using WHO 2005 TEFs.

^c WHO 1998 TEFs.



Magn mengandi efna

- “lítið” í:
 - þorski, sandkola, rjúpu, andfuglum, o.fl.
- mikið í:
 - fálka
 - skúm
 - fýl
 - hákarli
 - kræklingi og nákuðungi nærri höfnum



Magn mengandi efna

- ástæður
 - enn illa þekktar
 - fæðunám, flutningi efna, ...
- áhrif
 - enn verr þekkt
 - ?????



Aðsteðjandi hættur

- olíuflutningar
- Olíuhreinsunarstöðvar
 - PAH sambönd
- ný efni
 - PFOS
 - Brómineruð eldhömlunarefni
 -



Þörf á aukinni þekkingu um:

- magn mengandi efna í íslenskum lífverum
- áhrif mengandi efna á íslenskar lífverur
 - frjósemi, afkomu, vöxt, hegðun,
 - krabbamein, æxlamyndun, vansköpun,



Háskóla­setur Suðurnesja

- Að Garðvegi 1, Sandgerði
 - Samstarf við Fræðasetrið í Sandgerði, Náttúrustofu Reykjaness og Botndýrarannsóknastöðina



Áherslur á Háskólasetri Suðurnesja

- á *áhrif* mengandi efna á ýmsar sjávarlífverur
 - þorsk, sandhverfu, hrognkelsi, krækling, nákuðung, beitukóng, ...



Sérstaða Háskóla­seturs Suðurnesja

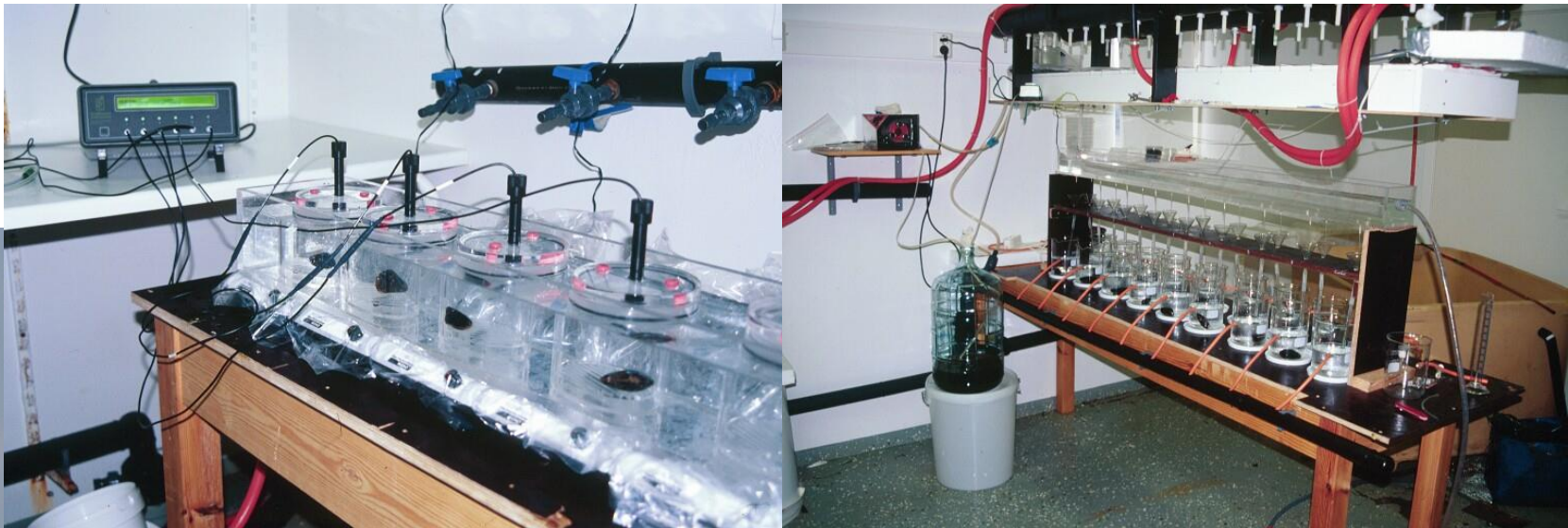
- Einstakur tilraunastofusjór (9°C, 32 prómill)
- Þekking/sérhæfing
 - Notkun bíómarkera – líffræðileg svörun við álagi
 - Öndun, fæðunám, erfðaskemmdir, o.fl.



Bíómarkerar

- Álagsmat á einstakar lífverur
 - Öndun og fæðunám kræklinga
 - Metið vaxtarrými (Scope for growth)

ljósm. Halldór P. Halldórsson



Bíómarkerar

- Álagsmat á einstakar lífverur
 - Öndun og fæðunám kræklinga í Reykjavíkurbær

Table 3
Energy budget and SFG values (average \pm SE) for resident mussels (*Mytilus edulis*) ($n = 16$) estimated in April, September and October 2000

Site	Time	Dry weight (g)	Length (cm)	Clearance rate ($l g^{-1} h^{-1}$)	C ($J g^{-1} h^{-1}$)	A ($J g^{-1} h^{-1}$)	Oxygen consumption ($\mu mol O_2 g^{-1} h^{-1}$)	R ($J g^{-1} h^{-1}$)	SFG ($J g^{-1} h^{-1}$)
<i>2000</i>									
Hvalfjörður (reference)	10 Apr.	0.65 ± 0.05	5.36 ± 0.07	3.13 ± 0.16	31.26 ± 1.60	15.63 ± 0.80	18.21 ± 0.97	8.30 ± 0.44	7.33 ± 0.83
Keflavík harbour	7 Apr.	0.60 ± 0.02	5.23 ± 0.06	$3.70 \pm 0.17^*$	37.02 ± 1.70	18.51 ± 0.85	17.66 ± 1.42	8.05 ± 0.65	$10.46 \pm 1.06^*$
<i>2000</i>									
Hvalfjörður (reference)	21 Sept.	0.70 ± 0.06	4.86 ± 0.02	3.20 ± 0.15	32.02 ± 1.48	16.01 ± 0.74	12.35 ± 0.74	5.63 ± 0.34	10.38 ± 0.80
Reykjavík harbour, mouth	28 Sept.	0.88 ± 0.02	4.38 ± 0.05	$1.97 \pm 0.07^{***}$	19.73 ± 0.72	9.86 ± 0.36	$21.55 \pm 0.76^{***}$	9.83 ± 0.35	$0.05 \pm 0.45^{***}$
Hafnarfjörður harbour	14 Oct.	0.82 ± 0.03	4.46 ± 0.05	$2.70 \pm 0.15^*$	27.07 ± 1.45	13.52 ± 0.73	$16.15 \pm 0.72^{***}$	7.36 ± 0.33	$6.16 \pm 0.77^{***}$
Keflavík harbour	02 Oct.	0.44 ± 0.02	4.58 ± 0.04	$3.90 \pm 0.11^{***}$	38.99 ± 1.11	19.50 ± 0.56	$20.46 \pm 0.77^{***}$	9.33 ± 0.35	10.17 ± 0.64

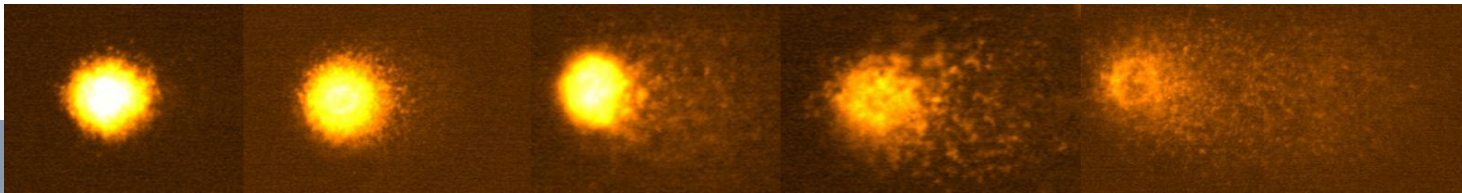
ANOVA, $^*P < 0.05$ and $^{***}P < 0.001$.

C = clearance rate \times energy value ($10 J l^{-1}$); A = $C \times$ absorption efficiency (0.5); R = respiration $\times 1 \mu mol O_2 h^{-1}$ ($0.456 J h^{-1}$); $SFG = A - R$.



Bíómarkerar

- Álagsmat á einstakar lífverur
 - Skemmdir á erfðaefni (single strand breakages)



Comet assay; ljósm. Halldór P. Halldórsson



Bíómarkerar

- Álagsmat á einstakar lífverur
 - Skemmdir á erfðaeefni (single strand breakages)

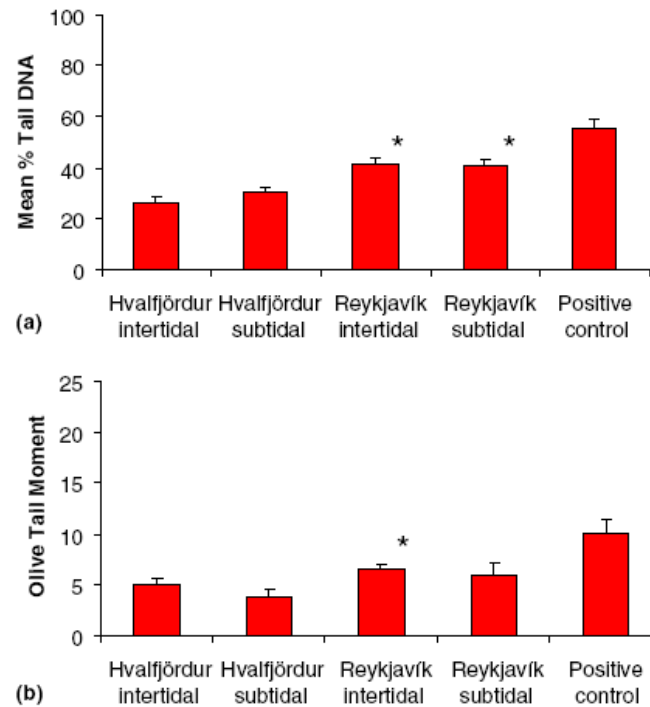


Fig. 1. DNA strand breaks (a. % tail DNA, b. Olive tail moment) in gill cells of mussels (*Mytilus edulis* L.) deployed in intertidal and subtidal zones in Reykjavík harbour and at the reference site Hvalfjörður (mean \pm SE $n = 6$). * = Significantly different from reference site (Nested ANOVA and Newman-Keuls test, $p < 0.01$).

Bíómarkerar

- Álagsmat á einstakar lífverur
 - Skemmdir á erfðaeefni (DNA viðbætur)

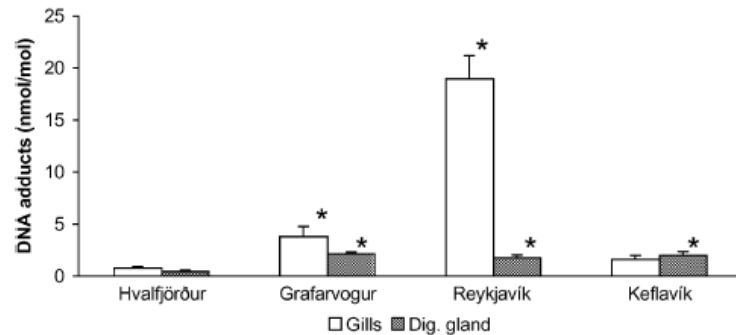


Fig. 3. Levels of DNA adducts (nmol/mol) in gills and digestive gland of *M. edulis* collected at sites on the south-west coast of Iceland (mean + S.E., analysis of five pools consisting of five mussels per pool). Significantly different from the reference site Hvalfjörður (* $P < 0.05$).

G. Ericson et al. / Mutation Research 516 (2002) 91–99

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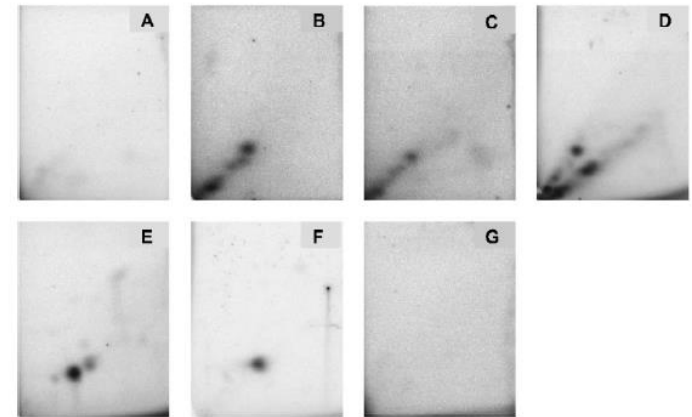


Fig. 2. Representative autoradiograms of ^{32}P -post-labelled DNA adducts in gills of *Mytilus edulis* collected at the reference site Hvalfjörður (A); Grafarvogur (B); Keflavík (C); Reykjavík harbour (D); the positive control sample from perch exposed to benzo[a]pyrene (E); the standard BaP-dG adduct (F) and the negative control of salmon sperm DNA (G).



Bíómarkerar

- Mikið álag á sjávardýr nærri hafnarsvæðum
 - Vansköpun hjá sniglum
 - Vaxtarrými kræklinga lítið
 - Skemmdir á erfðaefni

 - PAH sambönd úr olíu
 - Lífræn tinsambönd úr botnmálningu



Háskóla­setur Suðurnesja

- Mikilvægt í íslenskum umhverfisrannsóknum



Háskólaásetur Suðurnesja

- Mikilvægt í íslenskum umhverfisrannsóknum



Garðvegur 3

- Frekari uppbygging á tilraunaaðstöðu að Garðvegi 3 – samvinna við:
 - Sandgerðisbæ, Fræðasetrið, Náttúrustofu Reykjaness, Keldur og Botndýrarannsóknastöðina
 - Tilraunir með fiska
 - Þorskrannsóknir (Guðrún Marteinsdóttir og nemendur)
 - Tilraunir með bóluefni (Bjarnheiður Guðm. Keldur)
 - Rannsóknir á áhrifum mengandi efna



Framtíðarspurningar

- Áhrif efna úr olíum (PAH o.fl.) á fiska og hrygggleysingja?



Framtíðarspurningar

- Álag á sjávarlífverur af völdum
 - eldvarnarefna (brominated flame retardants)
 - vatnsvarnarefna (Perfluorinated compounds; FFOS, PFOA)



Framtíðarspurningar

- Tengsl mengandi efna við sjúkdóma í lífverum (og í manninum)



Framtíðarspurningar

- Tengsl mengandi efna við sjúkdóma í lífverum (og í mannum)
 - áhrif á varnarkerfi líkamans



Framtíðarspurningar

- Tengsl mengandi efna við sjúkdóma í lífverum (og í manninum)
 - áhrif á varnarkerfi líkamans



Framtíðarspurningar

- Tengsl mengandi efna við sjúkdóma í lífverum (og í mannum)
 - áhrif á varnarkerfi líkamans



Framtíðarspurningar

- Takk fyrir