

Integrated Assessment System for Marine Environmental Risk Assessment

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EDUCATION

- 1988–1991 E-wha Womans University, Korea
Biology B.S.
- 1999–2000 Sungkyunkwan University, Korea
Molecular Genetics M.S.
- 2001–2004 Yonsei University, Korea
Gene therapy Ph. D.

EXPERIENCE

- 1999–2000 Research Associate for the Life Science Institute, Sungkyunkwan university
- 2001– 2003 Researcher for Medical Science Research Center in Yonsei university
- 2004– present Senior research scientist for the Marine Functional Genomics Laboratory in Southern Coastal Environmental Research Division of KORDI

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환경 스트레스

자연적 영향

염니호, 산호의 백화현상, 폭조, 지진, 화산폭발,
해일, 허리케인과 폭우, 수온의 변동, 극심한 조석,
홍고기나 해양생물에 의한 기질의 침식,
자연적인 폐기물, 질병, 포식자 개체군의 폭발적증가

인간의 영향

오염, 하수, 산업 폐기물, 유류, 유해물질 유출, 농업 폐기물,
방사능 폐기물, 대기오염, 산성비, 온실효과, 오존층 감소, 해양
쓰레기, 인구증가, 서식지변화와 파괴, 관광과 여가, 채굴

생태계 평가

물리적 모니터링 화학적 모니터링 생물 모니터링

생물군집평가 생물독성시험 생물형태시험 생물능률측정 어류병리연구 서식지 평가

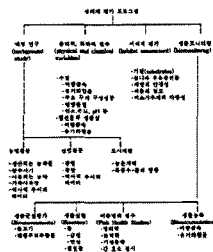


그림 25-10 수생태계의 평가 (aquatic ecosystem health/assessment) 평가용
대한 조식학회 표고그림의 개정 개정본(Seonock Woo et al., 1992)

<생물군집평가>

표 5-3-18. 기약면에서 출현한 저서동물종의 원종수와 종조수

Site / Sp.	1	2	3	4	5
Polychaeta					
<i>Corbula sp.</i>	1	1	1		
<i>Hydrobia ulvae</i>	2	1	1		
<i>Corbula bispinosa</i>	1	3	1		
<i>Hydrobia ulvae</i>	1	3	1		
<i>Hydrobia ulvae</i>	4	1	5		
<i>Hydrobia ulvae</i>	3	3			
<i>Hydrobia ulvae</i>	1	1			
<i>Hydrobia ulvae</i>	1	2	3		
No. of Species	2	7	2	0	
No. of Individuals	2	18	2	20	

표 5-3-19. 생식면에서 출현한 저서동물종의 원종수와 종조수

Site / Sp.	1	2	3	4	5
Polychaeta					
<i>Corbula sp.</i>	1	1	1		
<i>Hydrobia ulvae</i>	2	1	1		
<i>Corbula bispinosa</i>	1	3	1		
<i>Hydrobia ulvae</i>	1	3	1		
<i>Hydrobia ulvae</i>	4	1	5		
<i>Hydrobia ulvae</i>	3	3			
<i>Hydrobia ulvae</i>	1	1			
<i>Hydrobia ulvae</i>	1	2	3		
No. of Species	2	7	2	0	
No. of Individuals	2	18	2	20	

<생물독성시험>

어류독성 시험어종

APHIS, ARMA, WPC 등	U.S. EPA	OECD	국립환경연구원 수생-수중생물
▶ 담수어류 시험종, 대량 인 life stage 를 관찰하기 위해 대량으로 사육 중	▶ Atlantic salmon ▶ Bluegill sunfish ▶ Brook catfish ▶ Channel catfish ▶ Coho salmon ▶ Common carp ▶ Fathead minnow ▶ Guapo ▶ Red killifish ▶ Trianostema stickleback ▶ Zebrafish (11종)	▶ Daphnia magna ▶ Common carp ▶ Fathead minnow ▶ Guapo ▶ Zebrafish (7종)	▶ 송사리 ▶ 갈농어 ▶ OECD의 권장 종 사용

- 생물검정법에 사용되는 어종들 (담수어종에 제한)
- 담수종 이용 화학물질 검정 후 해양으로 외산
- 해산어 생물검정법은 후보 종 탐색수준
- 국내의 해산 시험어종 개발은 미진

대표적 시험어종의 연구내용

연구내용	Zebrafish (Danio rerio)	Japanese medaka (Oryzias latipes)	Minnow (Phoxinotus phoxinotus)	Atlantic salmon (Salmo salar)	Rainbow trout (Oncorhynchus mykiss)
분포 및 생태적 특성	●	●	●	●	●
생물사	●	●	●	●	●
1차 생식	●	●	●	●	●
산란행동	●	●	●	●	●
산란주기, 자란	●	●	●	●	●
산란 특성 (시간, 기온, 간격)	●	●	●	●	●
사육방법	●	●	●	●	●
초기발생과정	●	●	●	●	●
표준화된 시험방법	●	●	●	●	●

A. *Colletes chalybeator* (Mason)
 B. *Dufourea pallens* (Mason) (Synonym)
 C. *Pseudopenthes promelas* (Mason) (Synonym)
 D. *Chromopenthes nigriceps* (Mason) (Synonym)
Solenopsis geminata (Mason) (Synonym)
 E. *Myrmica ruginodis* (Mason) (Synonym)
 F. *Camponotus pennsylvanicus* (Mason) (Synonym)
 G. *Mutilla korymbosa* (Mason) (Synonym)
 (Mason's synonymy is not generally accepted)

* * * EPA (1981) Method for Measuring the Antler Toxicity of Ethanol and Acetic Acid. EPA-600/3-81-001.

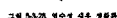


표 5-3-23. 여수 및 포항 지역의 물 공급수에서의 염수성 세균, 세균도

[illegible]

표 3-3-14. 작·발행일 별 국·외의 노동시간 및 처사를 평가

[illegible]

그림 5-3-21. 공작수에 노출시킨 염수성 알버미아 노랑피루스의 생존율

표 5-3-15. 단작류 10일 사팔 복설 시험 결과

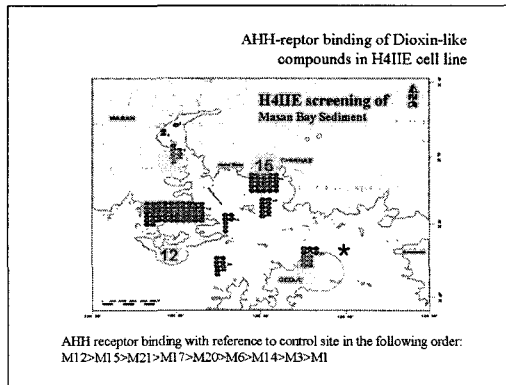
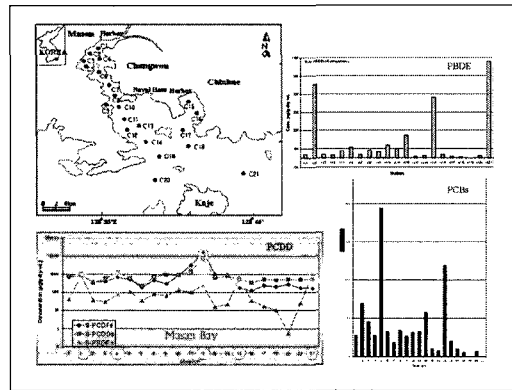
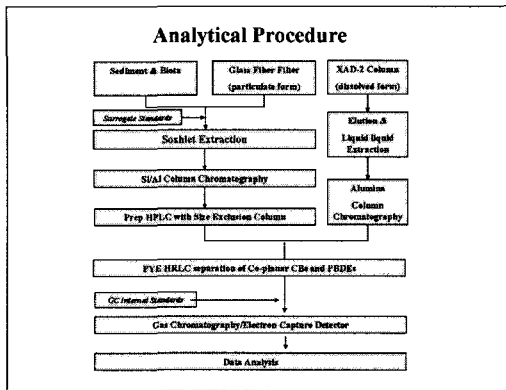
지역	경점	경준율 (%)		함모니아 농도 (mg/l)
		AVG	SD	
울진대포구	거점	77.5	9.6	0.71
	3	76.3	4.8	1.06
	5	88.1	10.0	0.43
	6	92.5	2.9	0.62
역수	2	75.0	5.8	2.30
	5	70.0	4.1	0.60
	7	72.5	8.0	1.07

표 5-3-16. 포합 표출피격물의 단각류 성장 독성 시험 결과

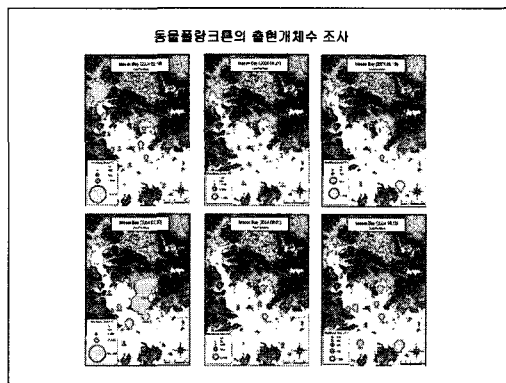
지역	정점	석공무게	일일 성장 (㎍/㉔)		성장률 (%)	
		(mg)	AVG	SD	AVG	SD
용성대조구	거계	2.00	0.07	0.02	86.0	3.3
포함	3	2.18	0.08	0.02	75.6	7.7
	5	2.54	0.05	0.01	86.7	9.4
	(6차구)	2.14	0.08	0.00	90.0	6.7

생물특성평가를 위한 바이오마커 개발 및 특성반응 예측 유전자 탐색
 어류 생식특성 및 유전진성 검색 지표 개발 및 현장평가
 특성 평가에 적합한 검증용 생물 탐색
 (식물종형광체, 동물종형광체, 효소류, 무척추동물 등)
 바이오마커의 개발, 현장실험 적용 및 특성 반응유전자 발현장상 분석
 대상 해양의 특성 정보 파악
 ELISA kit 및 DNA chip 개발을 통한 현장실험 평가

가. 오염노출평가



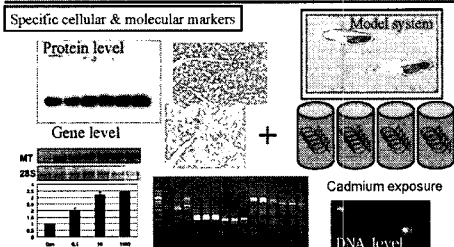
나. 생태환경평가



나. 생물영향평가

An integrated assessment system

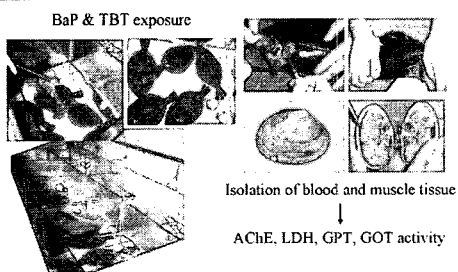
Whether an organism physiologically stressed?
Is the physiological impact of the stress?
Possible to quantify the health status against the stressor?



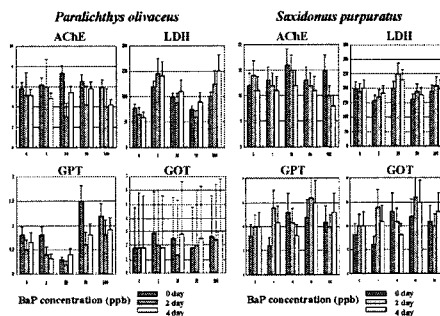
(1) Biomarkers at protein level

Acetylcholine esterase (AChE)
Lactate dehydrogenase (LDH)
Glutamic pyruvic transferase (GPT)
Glutamic oxalacetic transferase (GOT)
LPO, GSH, MnSOD, cytochrome P-450.....

Flounder (*Paralichthys olivaceus*) & clam (*Saxidomus purpuratus*)



Enzyme activities in BaP-exposed flounder and clam



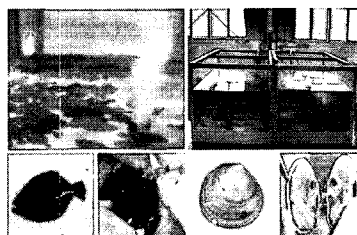
(2) Bioassay at DNA level

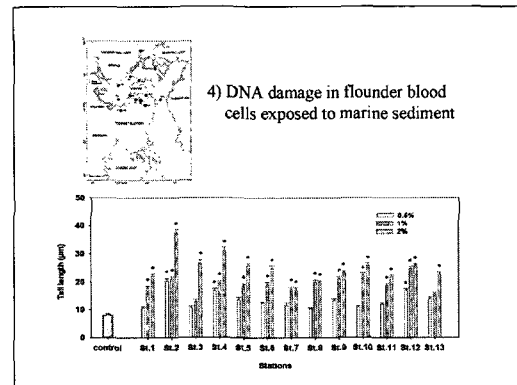
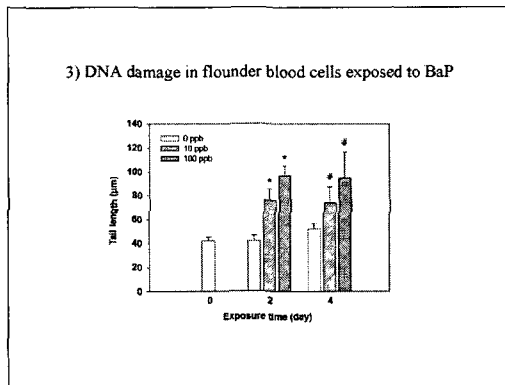
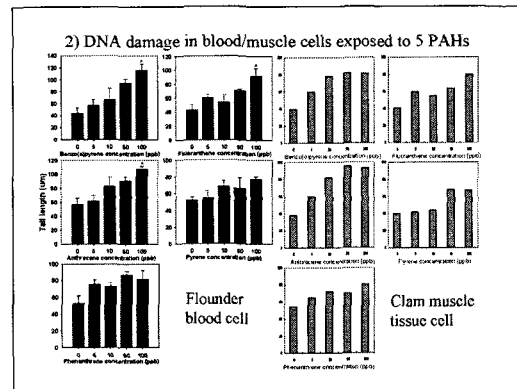
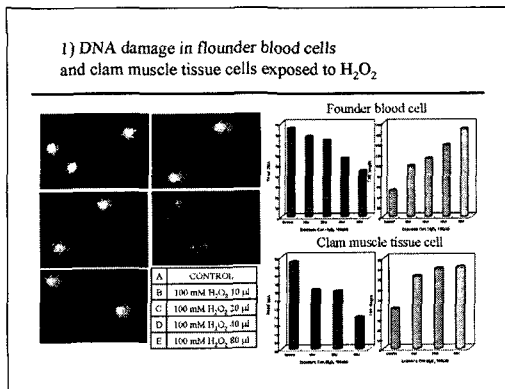
Comet assay



Comet assay in blood/tissue cells exposed to toxicants

H₂O₂, PAHs & marine sediment





(3) Development of biomarkers at gene level

Targeted gene cloning

cDNA chip

Differential Display Polymerase Chain Reaction

Analyses of differentially expressed genes

• Identification

Degenerate primer using target cloning

cDNA subtraction

Differential display PCR (DD-PCR)

Serial analysis of gene expression (SAGE)

• Quantification

Northern blotting

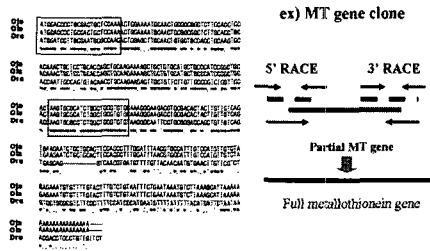
Reverse Northern blotting

cDNA (micro)array hybridization

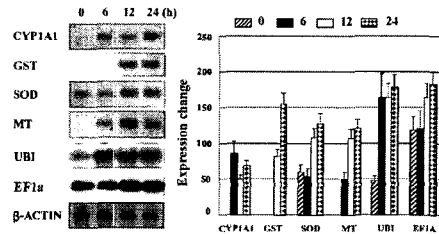
Quantitative PCR (Q-PCR)

Competitive PCR

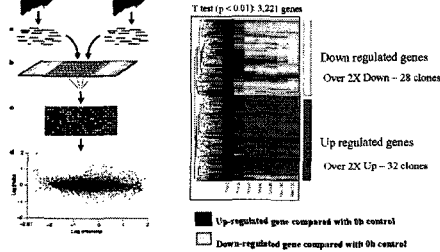
1) Target cloning of stress responsive genes in rockfish (*Sebastes schlegelii*)



Gene expression change of stress responsive genes in BaP-exposed rockfish (*Sebastes schlegelii*)



2) Subtractive cDNA library from BaP-exposed rockfish (*Sebastes schlegelii*)

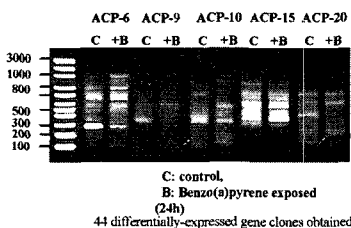


List of Differentially Expressed Genes After B[a]P Exposure

Candidate Genes

1. C1q-like adipose specific protein a
2. cytochrome b5b
3. fibrinogen alpha
4. putative transposase
5. proteasome 26S regulatory subunit
6. myosin heavy chain 10a
7. malate dehydrogenase
8. anchor attachment protein 1
9. putative peroxase
10. Purolectin
11. Antifreeze protein 15-12 precursor
12. metalloprotease/disintegrin ADAM10
13. ATP-dependent Clp protease ATP-binding subunit
14. arachidonate 5-lipoxygenase
15. complement component C1a
16. complement component C7a
17. complement component C9
18. putative transferrin
19. liponitidase-like 2
20. 5'-nucleotidase cytosolic II
21. apolipoprotein A1 precursor
22. cytosolic dipeptidase
23. inter-alpha-trypsin inhibitor
24. reverse transcriptase-like protein
25. ubiquitin specific protease 40
26. transferrin
27. beta-thymosin
28. acute phase serum amyloid A
29. warm-temperature acclimation-related protein
30. C-type lectin domain
31. serotransferrin precursor

3) Stress-responsive gene isolation by Differential Display Polymerase Chain Reaction



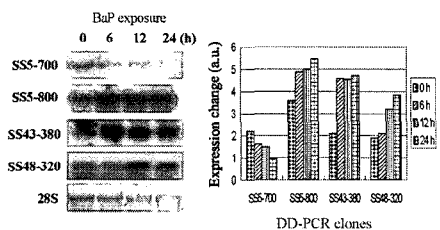
Differentially expressed genes identified by DD-PCR

Clone	Size (bp)	Putative identity*	DD-PCR*
S34-400	245	Allatropin neuropeptide precursor	Up
S34-500	493	Alpha-interferon inducible protein	Up
S34-500	395	Penicillin G acylase precursor	Up
S34-500	467	Glucosylase	Up
S35-400	474	Fructose-1,6-bisphosphate aldolase	Up
S35-700	342	Betaine-homocysteine methyltransferase	Down
S35-800	472	Warm-temperature-acclimation-related-6SLD-protein-like-protein	Up
S35-900	749	ECCL-2/adenovirus E1B 19 kDa-interacting protein	Up
S39-380	509	Glycine max beta-tubulin hydroxylase	Up
S35-550	346	Translation initiation factor eIF-2B beta subunit gene	Up
S343-380	353	Serum amyloid A protein	Up
S346-320	216	Cytochrome P450 1A	Up

* Basic Local Alignment Search (BLAST) at NCBI

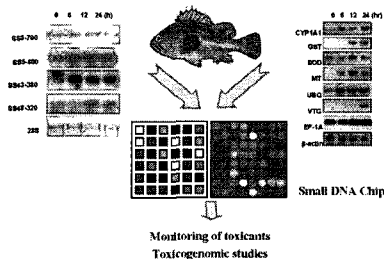
* Up- or down-regulated in benzo(a)pyrene exposed rockfish (24 h)

Gene expression change of DD-PCR clones in BaP-exposed rockfish



J. Environ. Toxicol. Vol 20 (1) pp 67-73

4) Development of Small DNA Chip using Rockfish (*Sebastes schlegelii*) Genes



5) Stress Related Genes from *Oryzias javanicus*

Oryzias javanicus Metallothionein 유전자 클로닝

[illegible]

Oxidative Stress Related Genes from *Oryzias javanicus*

- Catalase (CAT)
- Glucose-6-Phosphate Dehydrogenase (G-6-PD)
- Glutathione Reductase (GR)
- Glutathione Peroxidase (GPx)
- Glutathione S-transferase (GST)
- Superoxide Dismutase (SOD)

중금속 노출에 따른 MT 유전자의 차등발현

