문서번호 APCC-출장-17-0897(2017-08-01)

결재	선임연구원	팀장	부서장	부서장
	08/01 유태우	08/01 조재필	08/01 김형진	대결 08/01 김형원
협조				

TRAVEL REPORT FORM
출장보고서

I. **Reporter** 보고자

Department 소속	Position 직위(직급)	Name 성명	Travel Date 날짜	Note 비고
응용사업본부	선임연구원	유태우	7/23~7/29	

II. **Major Activities** 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

- 홍콩 HKUST에서 개최된 Gordon Research Conference (“Impacts of Water Quality and Climate Change on Marine Life”) 참석

- Top class researcher들의 최신 연구 동향 습득

- “Epigenetic basis for different acclimation capacity of fish to climate change” 제목으로 포스터 발표(발표자료 첨부)

- 해외 공동 연구자들과 진행 중인 프로젝트 토론

- 발표된 연구들의 특징은 아래와 같음
  > 연구 대상 지역: 기후 변화에 의해 가장 악영향을 받는 열대/아열대 지역의 산호/어류에 대한 physiology, ecology, systems biology 연구가 주를 이루었고, 남북극의 생물에 대한 연구도 있었음.

  > 연구 대상 생물: bacteria나 virus보다는 host organism에 대한 연구가 청중들로부터 더 좋은 반응을 얻음.
  > 연구진의 국가: 호주, 홍콩, 중국, 유럽, 일본 등이 주를 이룸

2. Relevance to APEC Climate Center’s Activities 결론 및 소감

- Leading group에서는 모델링 등의 예측보다 생물별 특징 및 biomarker 발굴 연구 등 solution-oriented 연구를 많이 진행하고 있음을 확인

- 개인적인 의견으로는 기후 변화 시나리오 및 이상 기후를 고려한 지역별/종별 특징 연구를 전혀 행하고 있지 않기 때문에, 상세화된 기후 데이터와의 융합 연구가 필요해 보임.

III. **References** 참고사항

(with attachment of any information or report in case of attendance of conferences, workshops and meetings) 학술대회, 워크숍, 회의 등 참석 시 관련 정보 및 문서 첨부

1. Presented and Collected Materials 주요 수집자료

Gordon Research Conference는 전세계의 유명 연구자들의 unpublished data를 발표하기 위한 conference이기 때문에 conference book 등을 제공하지 않고, 사진 촬영 등도 철저하게 금지함. 따라서 수집자료가 존재하지 않음.

2. Suggestions and Remarks 건의사항

Epigenetic basis for different acclimation capacity of fish to climate change

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Global warming influence the ocean chemistry. While increased water temperature affects physiology, survival, and distribution of marine ectotherms, several studies show same species from different locations have dissimilar level of thermal acclimation. We collected the Great Barrier Reef fish, *Acanthochormis Polyacanthus*, from two geographical locations (Heron and Palm island) and reared them in a present and future projected temperature. We generated whole genome bisulfite sequencing dataset of each fish and then compared the differences of DNA methylation on two fish genomes. While two fish populations has similar level of overall methylation level, there was distinct pattern of differentially methylated regions. Especially more mitochondrial genes were differentially methylated in Heron fish compared to Palm fish, implying epigenetic switching on mitochondrial functions for efficient adaption to thermal stress. Our study indicate that adaptation in different environments is possibly accompanied by population-specific epigenetic modification

Population-specific epigenome influences the acclimation capacity of reef fish to ocean warming

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Introduction

The impact of ocean warming on marine ecosystems depends on the capacity of organisms to acclimate or adapt to new conditions. While increased water temperature affects physiology, survival, and distribution of marine ectotherms, several studies have shown that the same species from different geographical locations can vary in their capacity for thermal acclimation. We collected breeding pairs of the reef fish *Acanthochormis polyacanthus* from two locations in the Great Barrier Reef (Heron and Palm Islands) and reared their offspring in present-day and future projected water temperatures. The lower latitude population from Palm Island, that typically experiences warmer temperatures, had a limited ability to developmentally acclimate than the cooler higher latitude Heron Island population. However, the molecular mechanisms behind this disparity in acclimation potential are unknown.

Figure 1. Sampling locations of the studied fish

Methods

We, therefore, sequenced the genome of one individual from each island, measured the genome-wide methylation patterns of each fish, and then identified differences in the methylomes of the two populations.

Results

While the two populations have an overall similar level of methylation, there are distinct and specific patterns of differentially methylated regions. Specifically, more mitochondrial genes are differentially methylated in fish from Heron Island compared to those from Palm Island, highlighting the importance of an epigenetic switching on of mitochondrial genes in response to thermal stress.

Table 1. Genome assembly and gene annotation stat of *A. polyacanthus* from two islands

	Heron	Palm
N50	527,731	334,400
Min length	500	500
Max length	3,215,819	2,466,117
Sum	943Mb	992Mb
# of scaffolds	16,609	30,414
# of genes	23,465	25,301
CEGMA results	79.84% (Complete), 99.19 (Partial)	78.23% (Complete), 97.98 (Partial)
Coverage	129.1	173.3

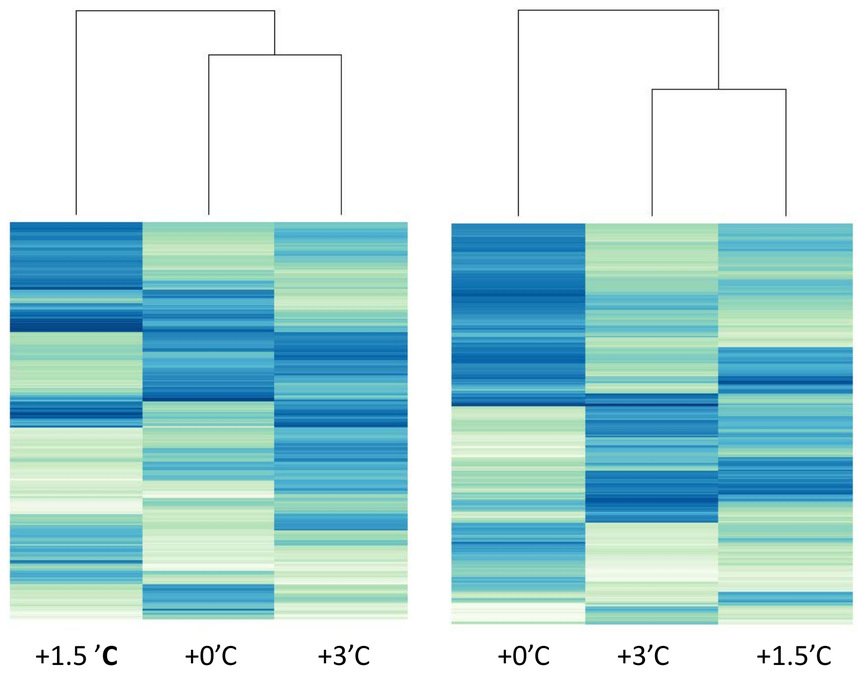

Figure 2. Methylation patterns of heron (left) and palm (right) fish

Table 2. The number of CpG DMR genes

Island	Comparison	Hyper	Hypo
Heron	Cont. vs. Dev. +1.5	98	79
	Cont. vs. Dev. +3	49	43
	Dev. +1.5 vs. Dev. +3	101	78
Palm	Cont. vs. Dev. +1.5	89	105
	Cont. vs. Dev. +3	127	176
	Dev. +1.5 vs. Dev. +3	48	42

Table 3. The representative CpG DMR genes

Heron fish	Palm fish
thioredoxin reductase 1	DENN domain-containing protein 4C
Periphilin-1	D(3) dopamine receptor
sigma non-opioid intracellular receptor 1	solute carrier family 2
putative Polycomb group protein ASXL2 iso form X	equilibrative nucleoside transporter 2
cbp/p300-interacting transactivator 3	Thioredoxin-related transmembrane protein 1
prostaglandin E synthase 3	Synaptogyrin-3
butyrophilin-like protein 2	apolipoprotein O
solute carrier family 2	hydroperoxide isomerase ALOXE3
Laccase domain-containing protein 1	type-4 ice-structuring protein-like
acylglycerol kinase, mitochondrial	renalase isoform X2
peroxisomal biogenesis factor 6	mitofusin-1
Ephrin type-B receptor 4	squalene monooxygenase
thioredoxin-like protein AAED1	solute carrier family 23 member 1
	aquaporin-11
	ephrin type-B receptor 4-like
	melanopsin-A-like

Conclusions

Our study suggests that adaptation to a local environment is accompanied by population-specific epigenetic modifications that can lead to differences in the potential to acclimate to a warming ocean.