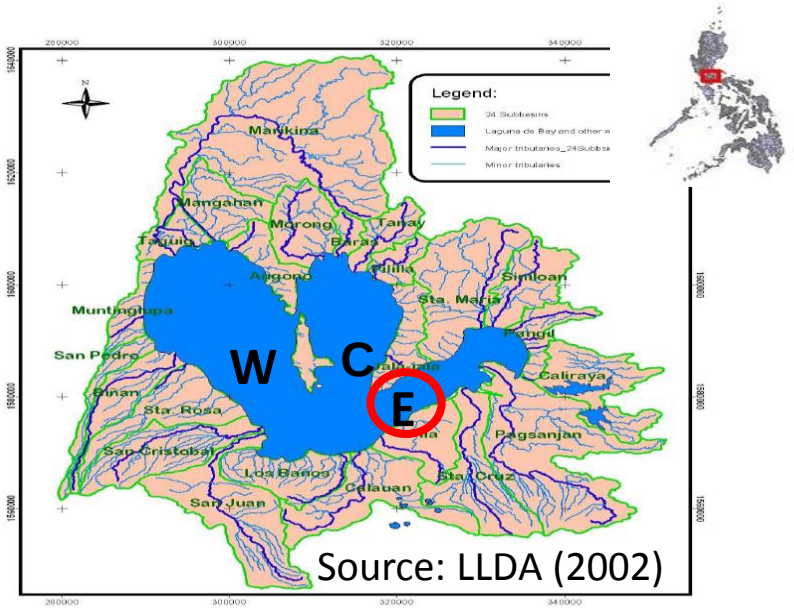
INTRODUCTION

- **Laguna Lake**, a vital and dynamic natural resource
- Anthropogenic pressures
  - West – industries and residential areas
  - **East**– agricultural land uses



INTRODUCTION

Whitegoby
Glossogobius giuris

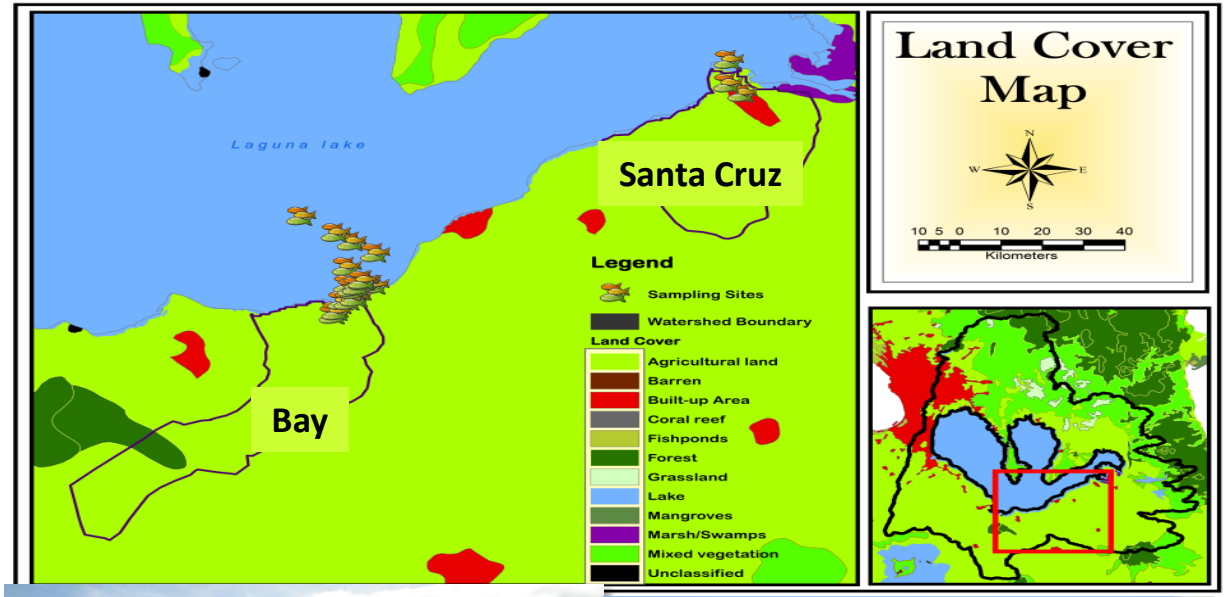
- Declining native fish production
- Few studies on contamination magnitude in Laguna Lake using fish species
- Increasing demand on useful tools in biomonitoring

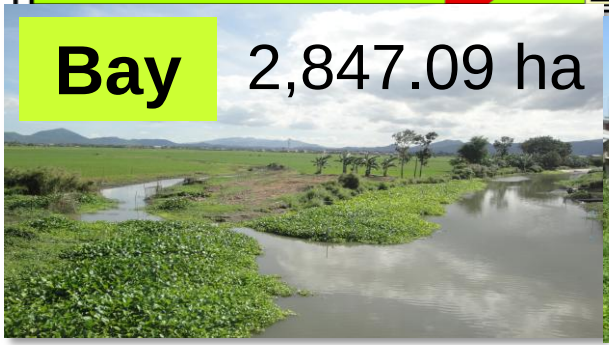
INTRODUCTION

- **Stress** → reduced efficient use of energy
→ decreased developmental stability of individuals
(Møller, 1997; Escos *et al*., 2000)

- **Fluctuating asymmetry** - subtle differences between left and right sides of bilateral traits
(Palmer and Strobeck, 2003)
  - ✓ potential biomarker of stress within populations

MATERIALS AND METHODS





Study Area

MATERIALS AND METHODS

Fish Collection

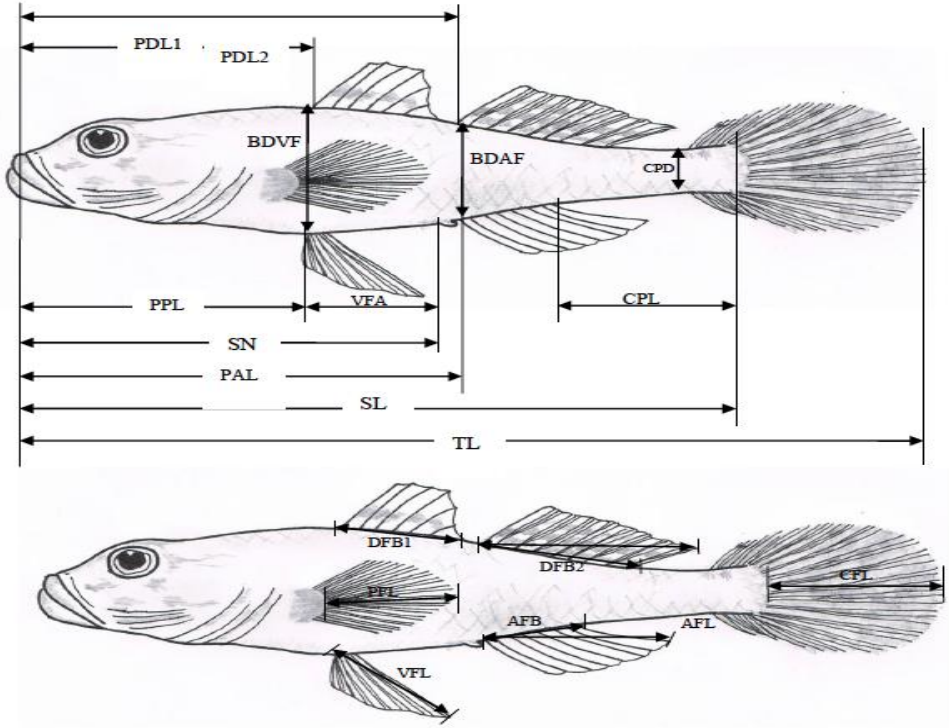
UPLB-LRS

Santa Cruz

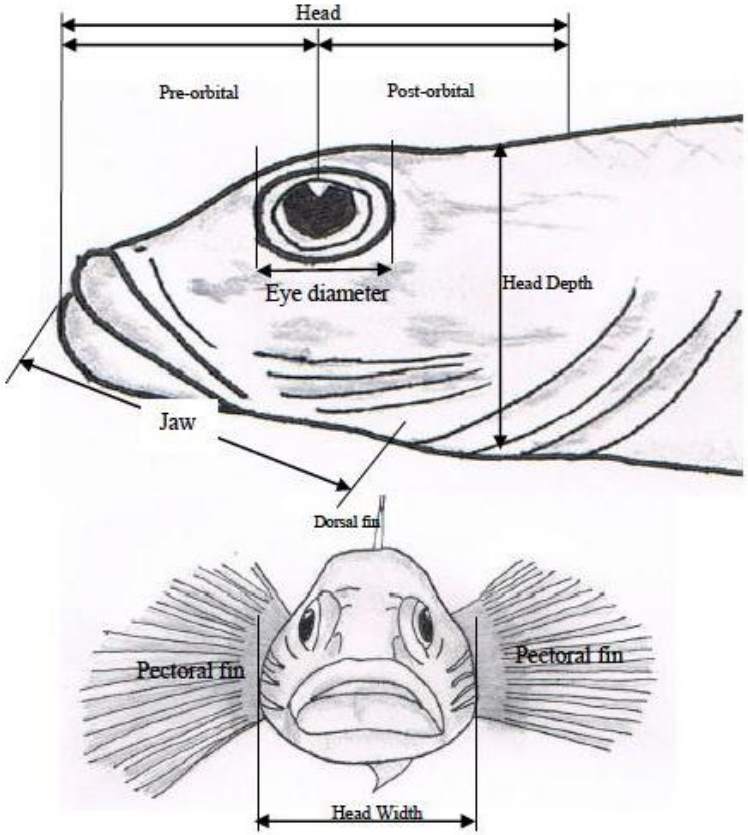
Bay

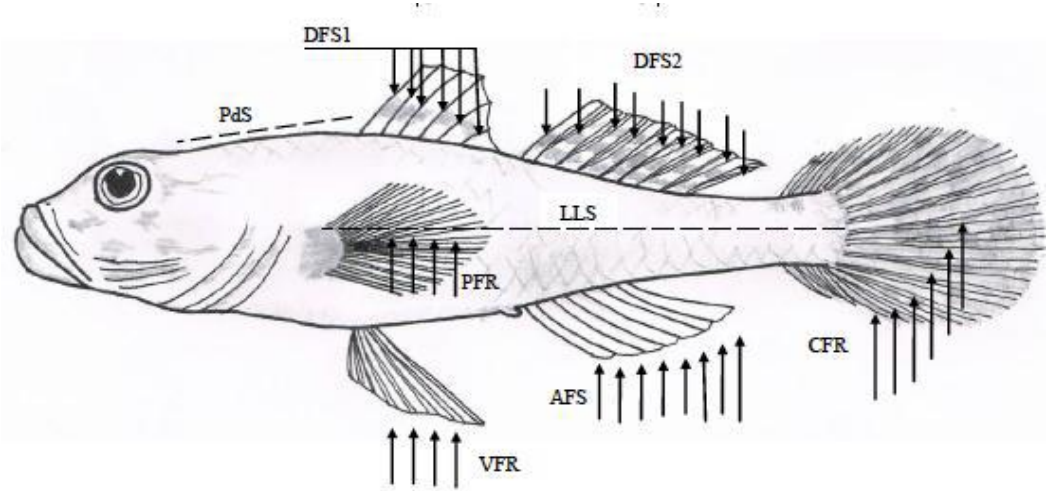
MATERIALS AND METHODS

Linear Morphometrics



Morphometric characters: caudal peduncle depth (CPD), body depth at pelvic fin origin (BDPF), body depth at anal fin origin (BDAF), pectoral fin length (PFL), pectoral fin width (PFW) (Source: Corpuz *et al*., 2013; Vedra *et al*., 2013)





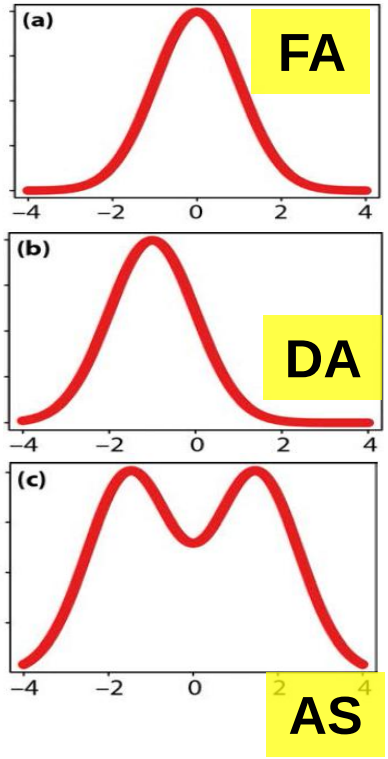
Characters of *G. giuris* assessed for FA: a) **morphometric** (head length (HL), head depth (HD), jaw length (JL), pre-orbital length (PrOL), post-orbital length (PoOL), opercular length (OL), opercular width (OW); b) **meristic** (pectoral fin rays (PFR), lateral line scales (LLS), transverse scales (TS), caudal peduncle scale row (CPSR) (Source: Corpuz *et al*., 2013; Vedra *et al*., 2013)

MATERIALS AND METHODS

FA Analyses

- methods of Palmer (1994), Wilkins *et al. (*1995), Leung *et al*. (2000), Fessehaye *et al.* (2007), Muallil *et al.* (2014)

- **One sample t-test** – test for directional asymmetry (DA)
  - p value < or = 0.05 (excluded in the analysis)
- **Kurtosis function** – test for antisymmetry (AS)
  - - kurtosis, platykurtic (excluded in the analysis)



MATERIALS AND METHODS

FA Indices for FA level comparison

- FA1 = $|R - L|$
- FA2 = $|R - L| / (R + L) / 2)$
  - ✓ positive correlation between FA and character size exists
- CFA1 = $|FA_{ij}|$ $j = 1$ to k
  - ✓ summation of absolute FA values across traits (j) for each individual (i)
- CFA2= $|FA_{ij}| / \text{avg} |FA_j|_j = 1$ to k
  - ✓ summation of standardized absolute FA values

RESULTS

Morphometric characters exhibiting FA in reference population (N=31)

Character	r	p	FA index	Mean±SD
CPD	0.331	0.069	FA1	0.136±0.269[b]
OL	0.362*	0.045	FA2	0.020±0.011

based on series of tests (Shapiro-Wilk test, t-test, kurtosis); Shapiro-Wilk test: <0.05, normally distributed

Captive condition / artificial environmental condition → restrictions to ecological requirements, lack of natural stimuli

RESULTS

Morphometric characters exhibiting FA in wild populations

Character	r	p	FA index	Mean±SD
Bay (N=38)				
HL	0.001	0.996	FA1	1.019±0.816
CPD	-0.059	0.731	FA1	0.366±0.350[a]
PFW	0.045	0.795	FA1	0.549±0.370
ED	0.025	0.884	FA1	0.326±0.220
OW	0.219	0.200	FA1	0.719±0.507
Santa Cruz (N=42)				
CPD	0.234	0.075	FA1	0.419±0.359[a]
PFW	0.069	0.661	FA1	0.424±0.352
BDPF	0.263	0.088	FA1	0.746±0.676
OW	0.292	0.057	FA1	0.879±0.652

RESULTS

Meristic characters exhibiting FA

Character	r	p	FA index	Mean±SD
Reference (N=31)				
PFR	0.022	0.905	FA1	0.903±0.296[a]
Bay (N=38)				
LLS	-0.138	0.421	FA1	0.639±0.585
PFR	0.039	0.821	FA1	1.056±0.575[a]
Santa Cruz (N=42				
TS	0.054	0.732	FA1	0.512±0.499
PFR	-0.209	0.178	FA1	0.884±0.579[a]

RESULTS

Comparison of FA in *G. giuris* populations from three sites for each character and across all characters

Character (FA index)	N	df	MS	F	P	Rank
CPD (FA1)	110	2	.770	6.661**	.002	Santa Cruz^{a}>Bay^{a}>Reference^{b}
PFR (FA1)	110	2	.328	1.209^{ns}	.303	Bay^{a}>Reference^{a}>Santa Cruz^{a}
PFW (FA1)	79	77	-	.329^{ns}	.137	Bay^{a}>Santa Cruz^{a}
OW (FA1)	79	77	-	1.359	.245	Santa Cruz^{a}>Bay^{a}
CFA1	110	2	118.597	77.427**	.000	Bay^{a}>Santa Cruz^{b}>Reference^{c}
CFA2	110	2	142.786	29.878**	.000	Bay^{a}>Santa Cruz^{a}>Reference^{b}

CONCLUSION

- FA may indicate the decreased developmental stability in populations in the face of stressors and to perceive changes in the surrounding environment
  - ✓ artificial environmental condition in the reference site
  - ✓ presence of anticholinesterase pesticides in the agricultural sites

RECOMMENDATIONS

- ✓ Investigate on *G. giuris* populations from the other bays and tributaries surrounding the lake for an overall assessment on the status of this fishery resource
- ✓ Increase number of samples and include seasonal variation

ACKNOWLEDGMENT

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THANK YOU
Source: 2013 Ecological Footprint Report