FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF ANIMAL SCIENCES AND AQUATIC ECOLOGY
AQUATIC ECOLOGY RESEARCH UNIT

# DEVELOPMENT OF A REEF FISH COMMUNITY EVALUATION SYSTEM FOR THE GALAPAGOS ISLANDS

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ESCUELA SUPERIOR POLITECNICA DEL LITORAL ESPOL

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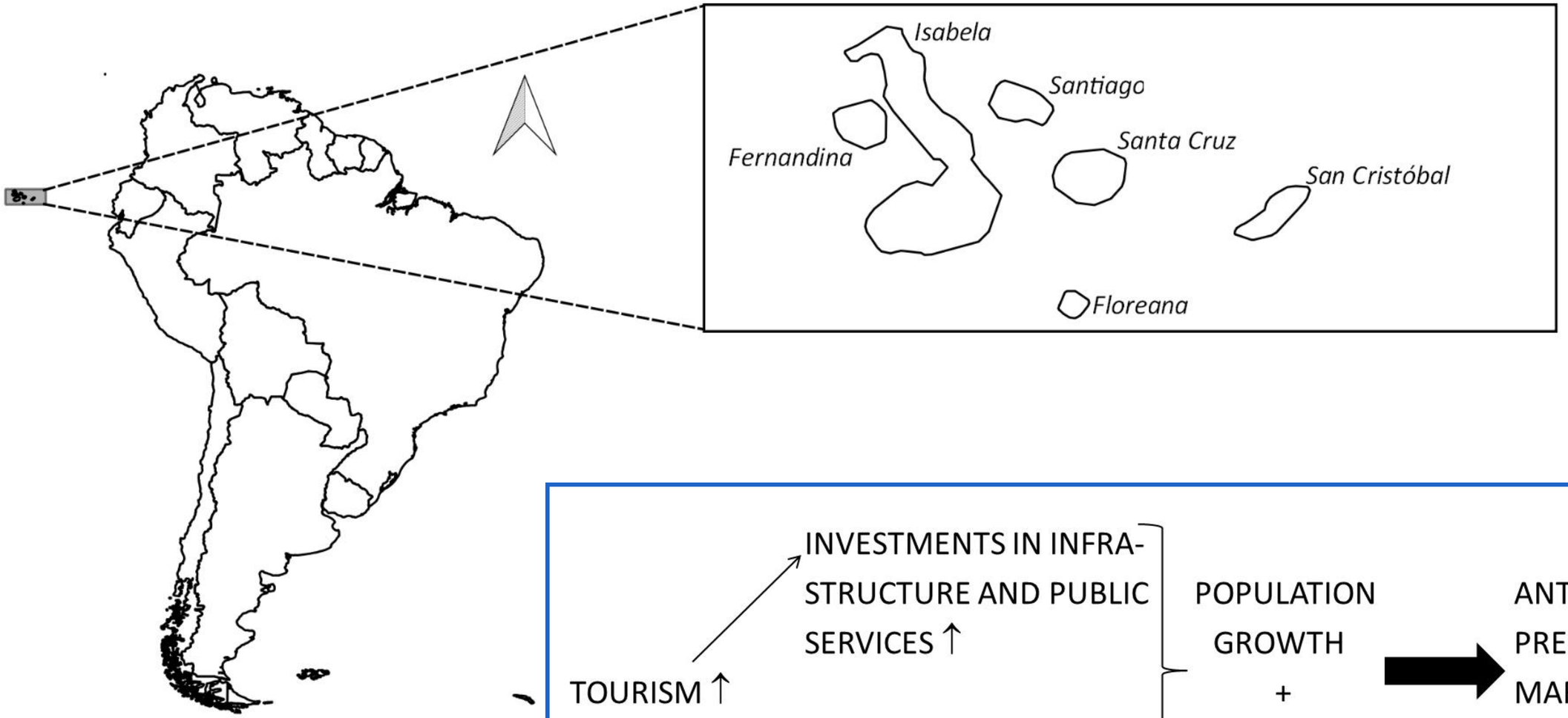
# INTRODUCTION AND PROBLEM STATEMENT




TOURISM ↑ → INVESTMENTS IN INFRA-STRUCTURE AND PUBLIC SERVICES ↑

TOURISM ↑ → ECONOMY ↑

INVESTMENTS IN INFRA-STRUCTURE AND PUBLIC SERVICES ↑ + ECONOMY ↑ → POPULATION GROWTH + UNPLANNED URBANIZATION → ANTHROPOGENIC PRESSURE ON MARINE ENVIRONMENT ↑

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# OBJECTIVES

- Determination of water quality in relation to human activities (focus on eutrophication)

- Determination of fish community composition and relation with species richness and diversity (Shanon)

- Determination of key fish species in relation to chemical conditions and human activities

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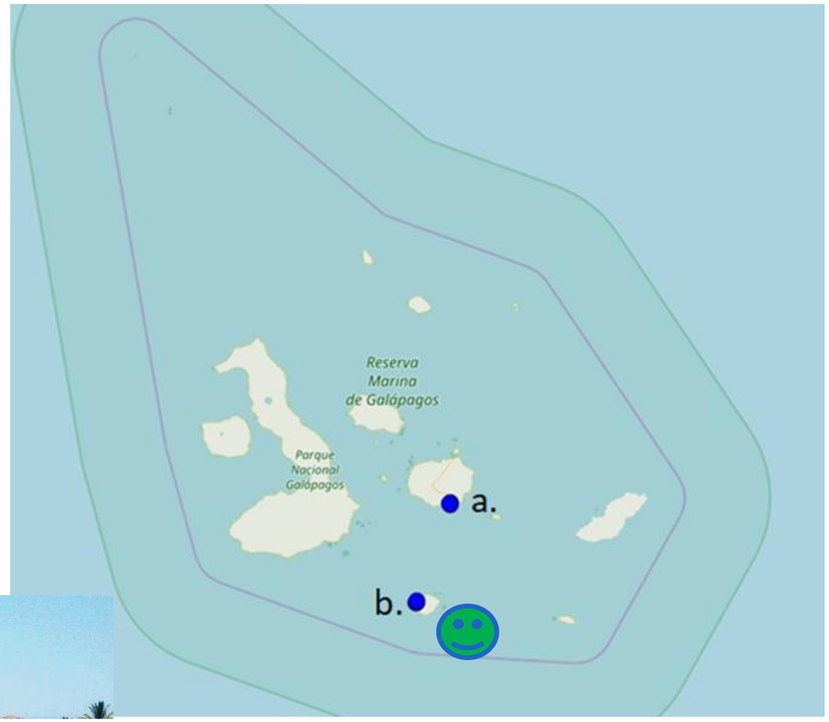
# MATERIAL AND METHODS: STUDY SITES

**Santa Cruz (a)**

Highest tourist numbers

12.000 inhabitants

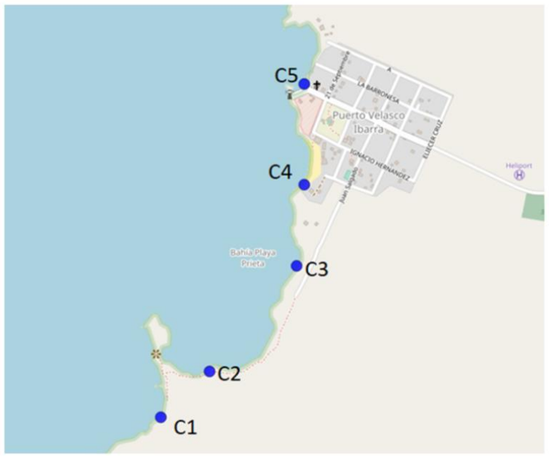



**Floreana (b)**

Lowest tourist numbers

145 inhabitants


(a) Santa Cruz




(b) Floreana

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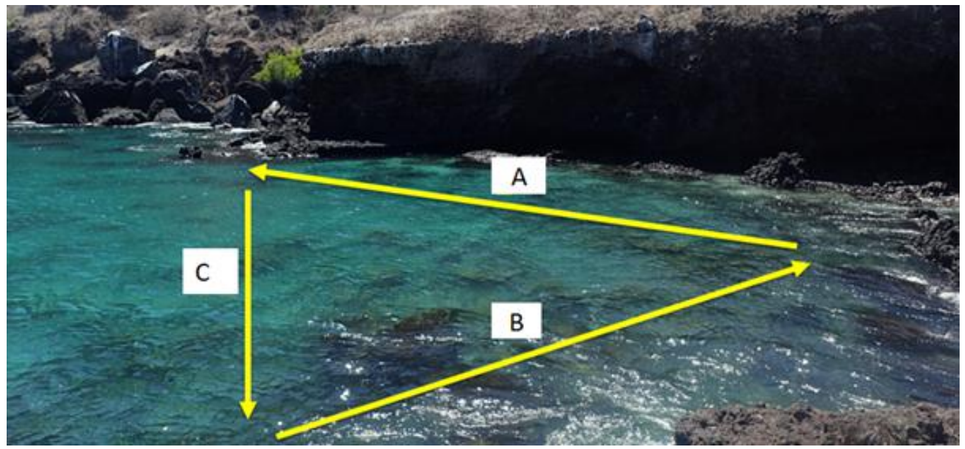
# MATERIAL AND METHODS: SAMPLING

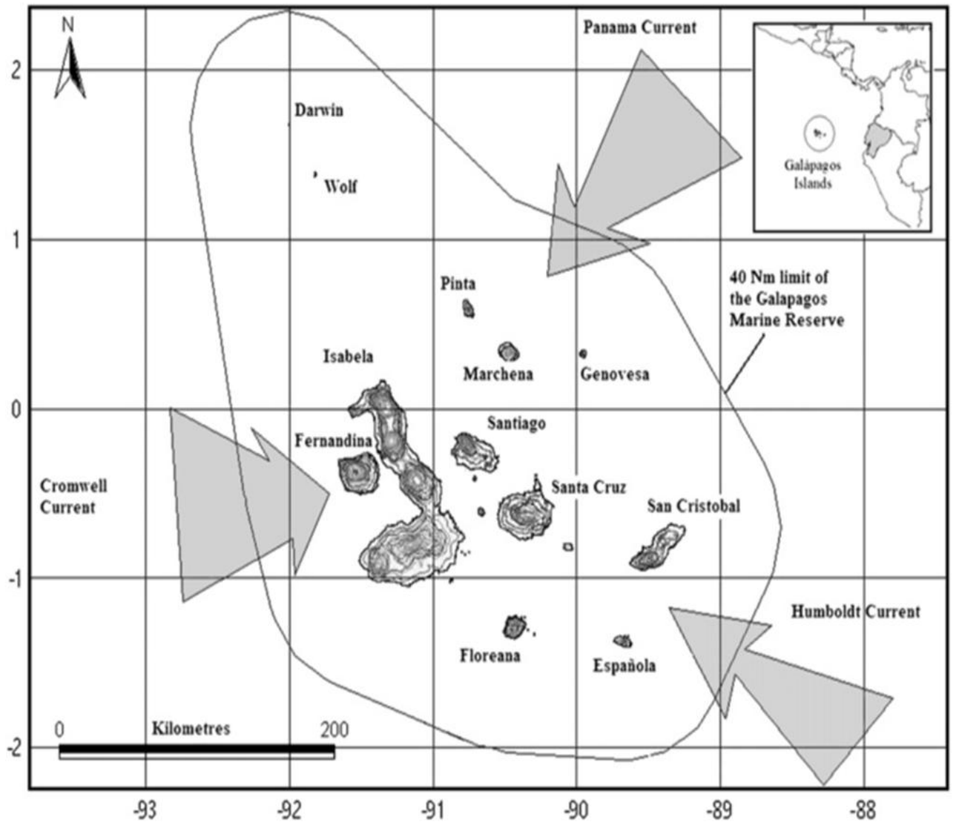
1. Chemical monitoring
2. Video monitoring and fish counting




MaxN=maximum number of a certain species occurring at the same time in a frame (time saving method)

3. Data analysis: Species Richness and Shanon Diversity index
4. Determination of key species

# RESULTS: WATER QUALITY BETWEEN TWO ISLANDS




**Temperature**

Santa Cruz: 22.54°C

Floreana: 20.43 °C

**Nitrate**

Santa Cruz > Floreana (p=0.01235)

**Total phosphorus**

Santa Cruz > Floreana (p=0.0074)

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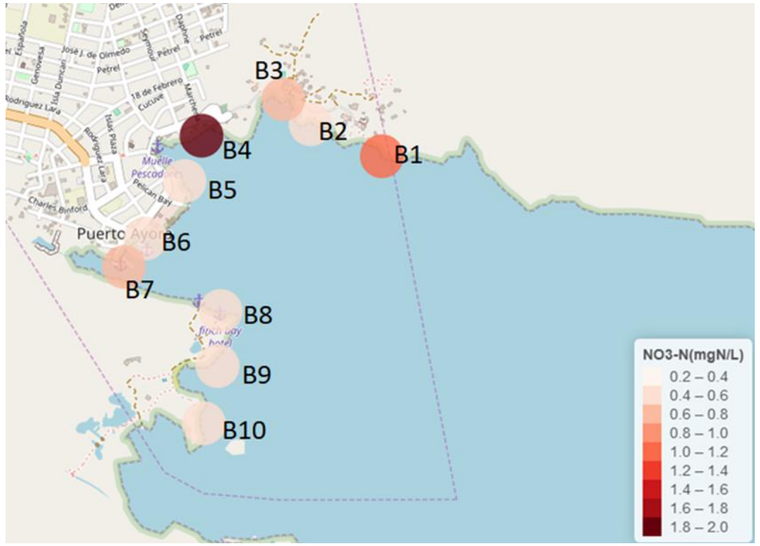
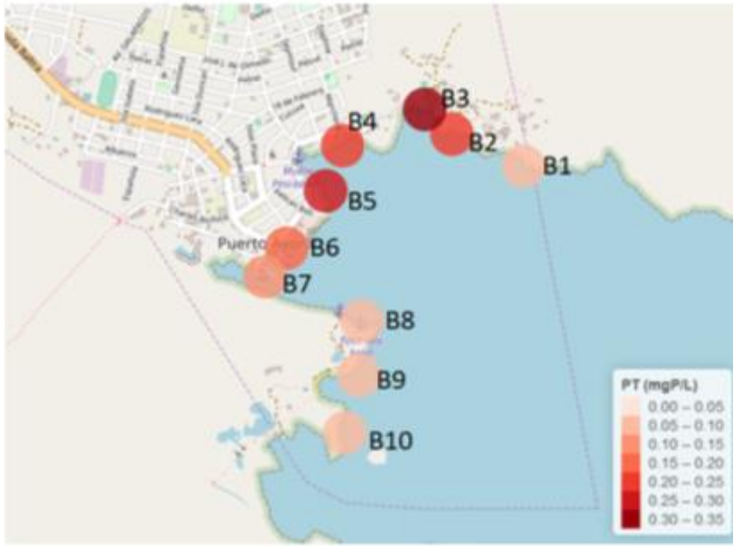
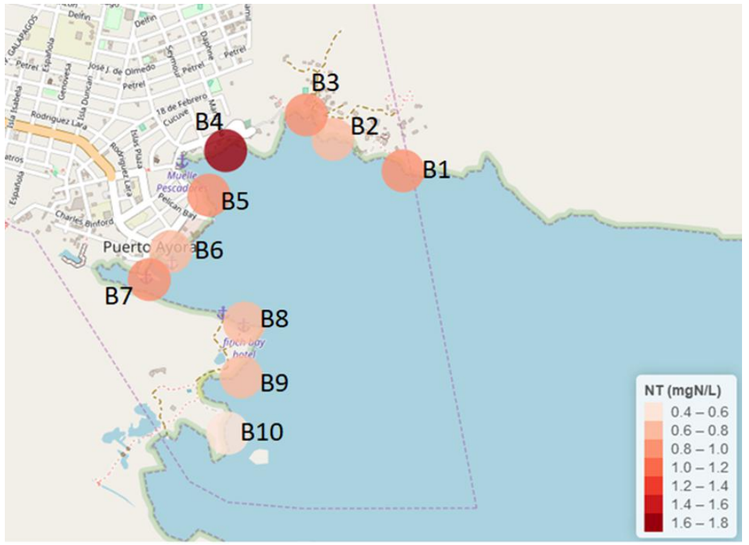
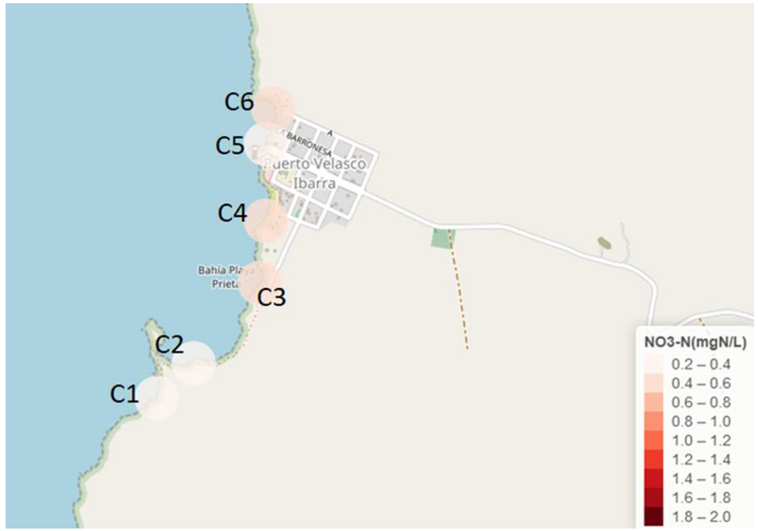
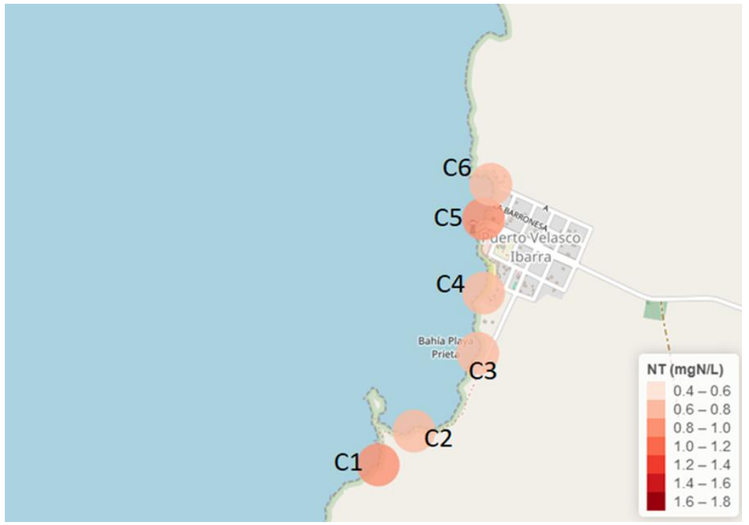
Clear difference in nutrient concentrations between islands, and logical relation with human activities and density

# RESULTS: NUTRIENT CONCENTRATIONS FOR INDIVIDUAL SITES

| | $NO_3^-$-N (mgN/L) | Total P (mgP/L) | Total Nitrogen (mgN/L) |
|---|---|---|---|
| SANTA CRUZ |  |  |  |
| FLOREANA |  |  |  |

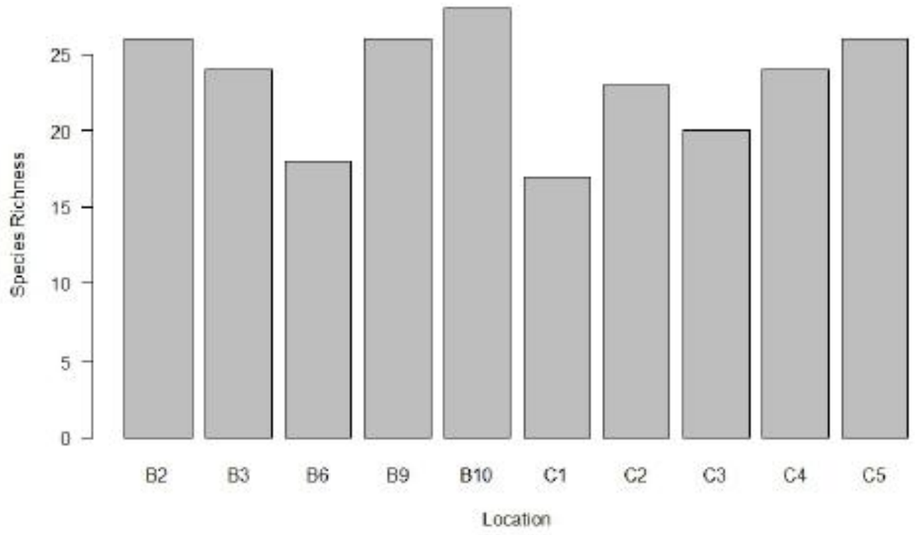


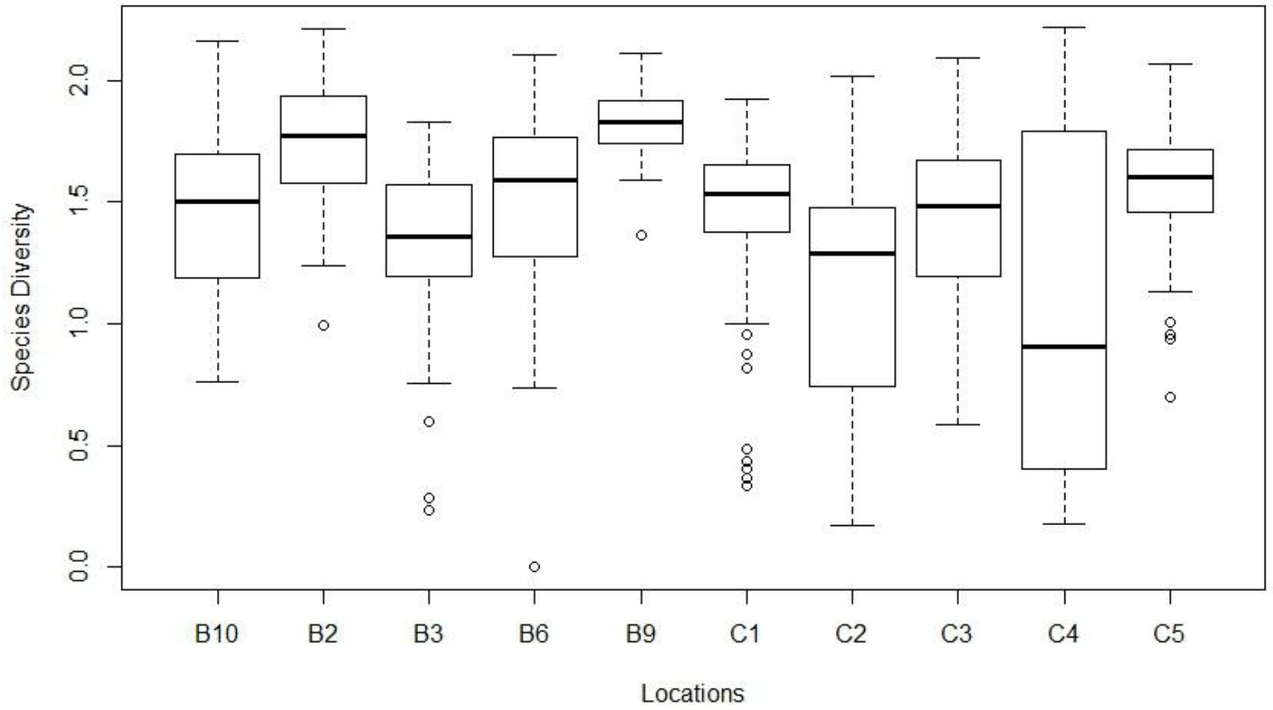
Higher nutrient concentrations in Santa Cruz, and more diverse, visual link with pollution sources

# RESULTS: FISH MONITORING AND ASSESSMENT, BASED ON SHANNON-DIVERSITY INDEX

B2,B3,B6,B9,B10: locations of Santa Cruz

C1,C2,C3,C4,C5:  locations of Floreana




| | | |
|---|---|---|
| 16 fish species | 23 fish species | 10 fish species |

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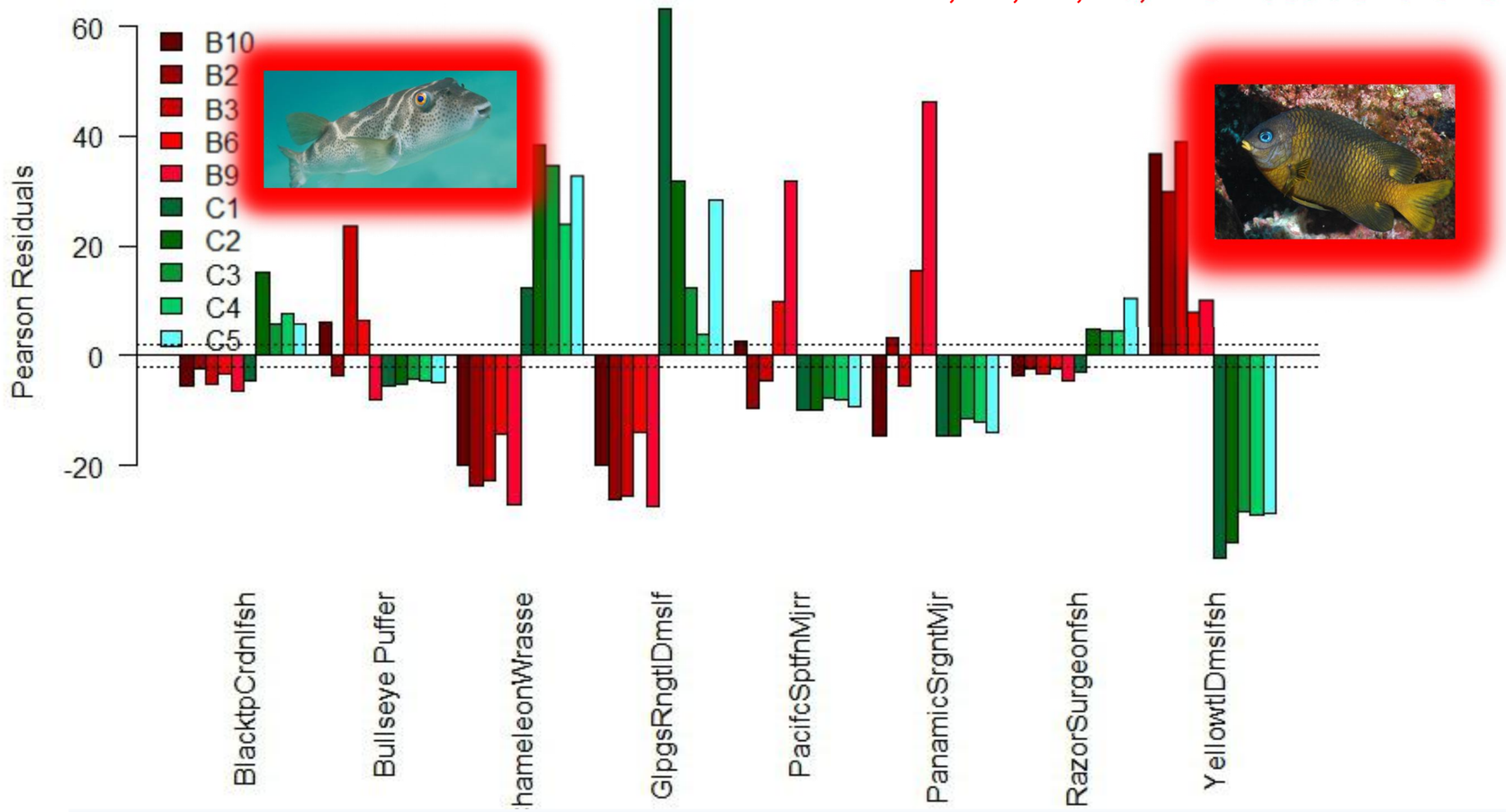
No difference in species richness between islands, but higher diversity in Santa Cruz. Possible explanation: more diverse habitats.

# RESULTS: KEY INDICATOR SPECIES

C1,C2,C3,C4,C5: locations of Floreana

B2,B3,B6,B9,B10: locations of Santa Cruz

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Species that occur on both islands, easy to identify and present in high abundances, and are most clearly linked to chemical disturbance

# CONCLUSIONS

- Higher nutrient concentrations on Santa Cruz
- No difference in species richness, and increased diversity in Santa Cruz (habitat diversity?): not good indicator characteristics
- Different species composition between islands (and sites) and linked to eutrophication, potential to determine indicators
- Bullseye puffer and Yellow Tail Damselfish as indicator species for increased human activities
- Limitations in the analysis due to counting methodology: use of more advanced approaches (automated identification and counting) and countings standardisation needed.

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**THANK YOU FOR YOUR ATTENTION!**

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# REFERENCES


- Bustamante, R. H., et al. (2002). Outstanding marine features of Galapagos. In *A biodiversity vision for the Galapagos Islands*. Puerto Ayora.
- Edgar, G. J., et al. (2004). Regional biogeography of shallow reef fish and macro-invertebrate communities in the Galapagos archipelago. *Journal of Biogeography*, *31*(7), 1107–1124.
- Fernández, A. R. (2008). Coastal nutrient and water budget assessments for Puerto Ayora, Academy Bay, Santa Cruz Island.
- Gardener, M. (2014). *Community Ecology: analytical methods using R and Excel*. Exeter: Pelagic Publishing.
- Jennings, et al. (1994). The inshore fish assemblages of the Galapagos archipelago. *Biological Conservation*, *70*(1), 49–57.
- Pratt, T., et al. (2005). Development and experimental assessment of an underwater video technique for assessing fish-habitat relationships. *Archiv Für Hydrobiologie*, *164*(4), 547–571.
- Werdeman, J. L. (2006). Effects of populated towns on water quality in neighboring Galàpagos bays, *7940*(March), 1–39.