**Quantitative Fisheries Lab (Yi-Jay Chang;** **yjchang@ntu.edu.tw** **)**

漁業資源是地球上極為重要的生物資源，其數量隨時間變化，這些變化可能源於生物本身的特性、海洋生態環境的改變，或人為活動的干擾和影響。海洋並非無限廣大，漁業資源也不是取之不盡、用之不竭。不當捕撈、海洋環境破壞和污染會導致漁業資源的枯竭，並破壞海洋生物的棲息環境。因此，我們需要深入了解海洋生物的生長、存活、再生過程，及其與人類捕撈和環境變動之間的關聯，並以科學為基礎制定全面的漁業管理方法，確保漁業資源得以永續利用。我們研究室將研究成果轉化為科學建議，提供給台灣及國際漁業管理機構，作為制定漁業管理決策的重要參考。

1. 漁業生態學

研究並瞭解重要經濟漁業生物（例如洄游性魚類）的生物學、生態學和生活史，以及其與環境因子或生態棲地之間的關聯。內容涵蓋生活史參數的估計與生物學數學模型的理論與實務應用。

2. 漁業觀測資料分析

對漁業觀測資料進行分析與研究，例如利用統計學及機器學習方法解析漁業資料，瞭解漁業（船隻）與魚類族群的時空動態。

3. 魚類族群動態學及資源評估

針對重要經濟漁業生物（例如洄游性魚類）進行族群動態學研究與資源評估，提供國內外漁業管理機構資源永續利用的科學建議。此領域包括應用各種進階統計方法發展資源評估模式，利用電腦模擬探討資源評估模式中的方法學各種挑戰，以及漁業管理策略評估。

4. 氣候變遷對漁業資源的影響

研究氣候變遷下物種分布的變化與物種分布模型。將環境因子，棲地指標及大尺度氣候變遷納入資源評估模式，進行風險評估。此外，研究以生態系為基礎的漁業資源評估與管理方法。

**Marine Benthic Ecology lab (Chih-Lin Wei;** **clwei@ntu.edu.tw** **)**

請參考實驗室網站:

<https://iobenthos.weebly.com/prospective-student.html>

**Functional Reef Ecology (Vianney Denis;****vianneydenis@ntu.edu.tw****)**

* Segmenting reefs for the study of coral population dynamics

The increasingly affordable technologies of photogrammetry and artificial intelligence (AI) now allow three-dimensional (3D) reconstruction of entire reef areas and their automatic annotation. These tools could prove to be powerful tools for studying coral demography. However, the lack of comprehensive training datasets limits the broad application of these methods in population dynamics studies. This project aims to train and deploy existing AI tools for segmenting and labelling individual coral colonies in 3D models and 2D images. Using some representative reef taxa, the differences in the size structure of colonies at different latitudes will be investigated to estimate population growth rates under different environmental conditions.

We seek individuals with a strong background and/or high interest in coral ecology, 3D modeling and photogrammetry, in artificial intelligence applications—particularly in training and deploying machine learning models for ecological data annotation.

Interested candidates should have strong programming skills in R and/or Python. Skills in image and video editing and analysis, familiarity with tools for coral segmentation, and a solid understanding of population dynamics analysis will also be highly valued.

Diving is not required for this particular project, but candidates with a diving license and experience can help with side projects of the lab.

**Marine Biodiversity and Phylogenomics lab (Wei-Jen Chen;** **wjchen1971@ntu.edu.tw** **)**

實驗室研究工作的主要方向如下：

 1.海洋生物多樣性與親緣關係研究

探索生物多樣性及地理分布模式，運用分子工具及整合性的分析方法，重建生物演化歷史。

2.演化機制之探討

透過族群遺傳學以及親緣地理學的分析，研究自然選擇、適應輻射、基因飄變及其他演化驅動的機制，了解影響生物形態、行為與生態的因素。

3.海洋生物保育

聚焦於海洋生態系統，調查物種分布與多樣性，評估人類活動對海洋環境的影響並提出可行的保育策略。

4.跨領域研究及技術應用

使用如基因組學、環境DNA (eDNA) 分析及其他尖端技術並結合生態學的視角解決科學問題。

 這些研究方向共同促進我們對生物多樣性與演化過程的理解，並支持海洋環境的保護與管理。各項研究成果可參考 : <https://sites.google.com/site/wjchenactinops/home/research-work>

The main axes of research work in the lab are as follows:

1. **Biodiversity and Phylogenetic Studies**
Exploring patterns of biodiversity and geographic distribution of marine species, utilizing molecular tools and integrated approaches to reconstruct their evolutionary histories.
2. **Investigation of Evolutionary Mechanisms**
Studying mechanisms such as natural selection, adaptive radiation, genetic drift, and other evolutionary drivers to understand factors influencing morphology, behavior, and ecology through the population genetics and phylogeographic analyses.
3. **Marine Conservation**
Focusing on marine ecosystems by investigating species distribution and diversity, assessing the impact of human activities on marine environments, and proposing potential conservation strategies.
4. **Application of Interdisciplinary Research Techniques**
Employing cutting-edge technologies such as genomics, environmental DNA (eDNA) analysis, and other advanced methodologies, integrating ecological perspectives to address scientific questions.

These research axes collectively enhance our understanding of biodiversity and evolutionary processes while supporting the conservation and management of marine environments

**Marine Ecology and Geochemical Application Lab (Ming-Tsung Chung;** **mingtsungchung@ntu.edu.tw****)**

1. The impact of ocean acidification on fish otolith morphology and hearing ability

The acidified environment could influence the formation and physiological function of biogenic carbonates in marine organisms. For bony fishes, otolith carbonates play a crucial role in sound detection, and their diverse morphology may reflect the functional demands for hearing among species. The overgrowth of otoliths induced by ocean acidification has been reported, but the impact on hearing capacity remains poorly understood. This project will explore the relationship between endolymph (the fluid that surrounds the otolith) chemistry, otolith formation, and hearing ability by rearing fish in different pH-controlled environments. The key techniques used in the project include micro-computer tomography (micro-CT) to monitor otolith morphology and the auditory brainstem response approach to determine the hearing frequency of fish during ontogenetic development. Candidates with experience in fish rearing, chemical analysis, or a background in fish physiology are encouraged to apply.

1. Thermal sensitivity of field metabolism in marine macrofauna and megafauna

The energetic cost and metabolism determine the distribution of marine organisms and are closely related to their response to temperature, particularly in a warming ocean. However, different functional groups of marine organisms may adopt various metabolic strategies or energy allocation in response to temperature increases. Therefore, this project employs a novel δ13C metabolic proxy, accompanied by a δ18O temperature proxy, to evaluate the thermal sensitivity of metabolism in wild-caught marine animals, including marine mammals, bony fishes, sharks, cephalopods, and crustaceans. The proxy will be estimated using isotope analyses on various biogenic structures, such as otoliths, statoliths, shells, teeth, vertebrae, and eyestalks. Candidates with experience in isotope analyses and modelling, sclerochronology, or studying the aforementioned animals are encouraged to apply.

**Ecoinformatics lab (Chih-hao Hsieh;** **chsieh@ntu.edu.tw** **)**

My lab is interested in developing and applying quantitative methods to study marine ecosystem processes, with special focus on plankton and fisheries.

**Ecological Stoichiometry Lab (Pei-Chi Ho;** **pcho13806@ntu.edu.tw** **)**

Ecological stoichiometry is the study of elemental ratios in living organisms and ecosystems. In my lab, we investigate the stoichiometry (elemental C:N:P ratios) of marine organisms—particularly plankton—and explore how the elemental imbalances between organisms and environments influence ecological processes in marine systems. Current projects in the lab include: (1) examining the stoichiometry of micro-, nano-, and picoplankton communities and how the dominance of autotrophic versus heterotrophic strategies affects plankton community stoichiometry, (2) studying how zooplankton secondary production and trophic transfer efficiency are impacted by stoichiometric imbalances between zooplankton and their prey, and (3) analyzing taxon-specific stoichiometry in zooplankton. Additionally, we use stable isotope analyses to investigate marine plankton food web structures. If you’re interested in plankton and food web ecology and of course, ecological stoichiometry, we welcome you to join us!

生態元素比計量學研究生物體與生態系統中元素比例。我的實驗室測量海洋浮游生物的元素比例（主要為碳：氮：磷這三種重要生物組成元素比例），並探討生物體與環境之間的元素比不平衡如何影響海洋系統中的生態過程。我們目前的研究項目包括：(1) 探索microplankton、nanoplankton和picoplankton群集的生物元素比，以及自營與異營營養策略的優勢度如何影響浮游生物群集生物元素比；(2) 研究環境變遷下浮游動物的次級生產和營養傳遞效率如何受到浮游動物與其獵物之間元素比失衡的影響；(3) 分析浮游動物特定分類群的生物元素比。此外，我們利用穩定同位素分析來研究海洋浮游生物食物網結構。如果您對浮游生物和食物網生態學有興趣，或想了解生態元素比如何連結海洋生物活動與物質傳遞，歡迎加入我們的研究團隊！

**Marine Microbial Ecology Lab (Yi-Chun Yeh;** **yichunyeh@ntu.edu.tw** **)**

* **Marine microbial community dynamics and its impact on ecosystem functioning**

Marine microbial ecology is crucial because microbes form the foundation of ocean ecosystems, driving key processes like nutrient cycling, carbon sequestration, and climate regulation. Our lab seeks to investigate interactions between microorganisms and the marine environment across temporal and spatial scales, studying everything from microbial diversity to their impact on biogeochemical cycles. We welcome students with a background in biology, microbiology, marine science, environmental science, or a related field. Students will gain hands-on experience in molecular biology, microbiology, bioinformatics, lab work, and scientific communication and have the chance to participate in at-sea fieldwork.

**Fish Ecophysiology Lab (Jen Chieh Shiao;** **jcshiao@ntu.edu.tw** **)**

Otoliths, the calcium carbonate structures in the inner ear of fish, record information of fish's age and environment. Currently, we are developing a convolutional neural network model that can automatically determine otolith age. This research requires strong programming skills in Python. Additionally, we employ stable isotope analysis to investigate fish migration and isotope assimilation mechanisms. This type of research will allow you to learn the principles and operation of isotope mass spectrometers. If you are interested in using otolith techniques to study fish life history, age, growth, and fisheries managements, we welcome you to join our laboratory.