



Contributions of the Department of **Chemistry** and **Biochemistry (CAB)** to the Marine Sciences

Faculty and Student Research Highlights

The Department of Chemistry and Biochemistry faculty and students have a strong focus in marine related science ranging from marine-derived pharmaceutical discovery to analysis of organic components of sea water and artificial contaminants such as GenX (PFAS). Research is funded at the regional, state, and national levels (e.g. NSF, NIH, NOAA) and collaborators include university, government, and corporate partners.

Marine-Derived Pharmaceutical Discovery and Development

Drug DISCOvery Group

- **R. Thomas Williamson** - Drug Discovery and Development – Chair of Pharmaceutical Chemistry Ph.D. Program. Advanced natural products structure elucidation via Nuclear Magnetic Resonance (NMR). Numerous local, national, and international collaborators.
- **Wendy Strangman** – Marine Natural Products Discovery and Metabolomics – Interdisciplinary research with UNCW departments of Biology (Julia Buck, Patrick Irwin, and Amy Wilbur, Joseph Pawlik, Jessie Jarvis) and national collaborators – anti-cancer, anti-viral, and HAB toxin research.

Additional Marine Natural Products Drug Synthesis and Discovery

- **Thomas Coombs** – Chemical synthesis of the anti-cancer natural product nakadomarin A using new photochemistry methodology
- **Sridhar Varadarajan** - Synthesis of new anti-tumor compounds derived from the brevetoxin molecular scaffold
- **Soon Goo Lee** - 'Genomic identification - Structure-based functional study - Protein/Metabolic engineering' research strategy to understand the production of secondary metabolites and increase the nutritional and pharmaceutical values of plants for human health.
- **Ying Wang** - A Novel Chemosensory Secretion Product of the Pygmy Sperm Whale (In collaboration with Anne Pabst and Alison Taylor). - Super muscles of whales and dolphins. In collaboration with Anne Pabst and Steve Kinsey, studying the molecular basis of oxygen storage in the muscles of deep-diving mammals. - In collaboration with Wendy Strangman, searching for pharmaceutical interventions to hereditary cataracts from the large reservoirs of marine natural products

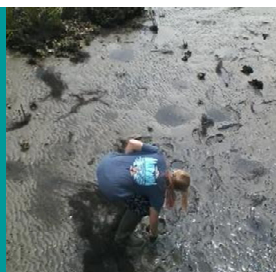
Marine and Atmospheric Chemistry Research Laboratory (MACRL):

This highly collaborative interdisciplinary group of 5 chemistry faculty is focused on detecting and quantitating natural and organic components in the atmosphere and ocean.

- Brooks Avery
- Winifred Johnson
- Robert Kieber
- Ralph Mead
- Stephen Skrabal

MACRL Research Activities

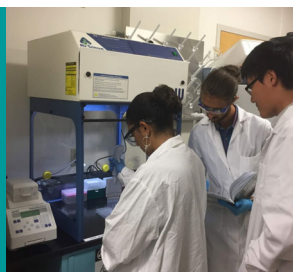
- Characterizing the role microorganisms play in the oceanic carbon cycle
- The environmental chemistry and fate of per- and polyfluoroalkyl substances (PFAS) in the ocean
- Monitoring the occurrence and atmospheric impacts of biofuel derived ethanol
- Understanding the cycling of metals in the Cape Fear River
- Biological distribution of metals in fish and birds of coastal North Carolina



Hannah Doane, a MACRL Chemistry MS student, collects sediment pore water samples for analysis of GenX and other PFAS



Drs. Avery and Harfmann of the MACRL group collect sea surface microlayer samples.



Dr. Wang observing MS students **Mindy Rodriguez** and **Harison Wooten** preparing PCR samples for amplifying a whale myoglobin gene.



Students in the Drug DISCOvery group isolate new bacteria from marine parasites and purify novel bioactive compounds

Selected Recent Publications in High-Impact Scientific Journals from CAB Faculty and Students

He, D.; Ladd, N. S.; Saunders, C.J.; **Mead, R.N.**; Jaffe, R. Distribution of n-alkanes and their $\delta^{2}\text{H}$ and $\delta^{13}\text{C}$ values in typical plants along a terrestrial-coastal-oceanic gradient, *Geochimica et Cosmochimica Acta*. **2020**, 281, 32-52.

Shimizu, M.; Summerlin, S.L.; Felix, J.D.; Halls, J.; **Avery, G.B.**; **Kieber, R.J.**; Lane, C.S.; **Mead, R.N.**; **Willey, J.D.** Variable Ethanol Concentrations and Stable Carbon Isotopes Reveal Anthropogenic Ethanol Contributions to Rainwater” *Atmos. Environ.* **2020**, 234, 117578.

Willey, J.D.; **Avery, G.B.**; Felix, J.D.; **Kieber, R.J.**; **Mead, R.N.**; Shimizu, M.S. Rapidly increasing Ethanol Concentrations in Rainwater and Air. *NPJ: NPJ: Clim. Atmos. Sci.* **2019**, 2, 1-5.

Ashley, W. L.; Timpy, E. L.; **Coombs, T. C.** Flow Photo-Nazarov Reactions of 2-Furyl Vinyl Ketones: Cyclizing a Class of Traditionally Unreactive Heteroaromatic Enones, *J. Org. Chem.*, **2018**, 83, 2516-2529.

Fribley, A.M.; Xi, Y; Makris, C.; Alves-de-Souza, C.; York, R.; Tomas, C.; Wright, J.L.C.; **Strangman, W.K.** Identification of portimine B, a new cell permeable spiroimine that induces apoptosis in oral squamous cell carcinoma. *ACS Med. Chem. Lett.* **2019**, 10, 175-179.

Bogart, J. W.; Kramer, N. J.; Turlik, A.; Bleich, R. M.; Catlin, D. S.; Schroeder, F. S.; Nair, S. K.; **Williamson, R. T.**; Houk, K. N.; Bowers, A. A. Interception of the “Bycroft-Gowland” intermediate in the enzymatic macrocyclization of thiopeptides. *J. Am. Chem. Soc.* **2020**, Just Accepted.

Liu, Y.; Navarro-Vázquez, A.; Gil, R. R.; Griesinger, C.; Martin, G.E.; **Williamson, R.T.** Application of Anisotropic NMR Parameters to the Confirmation of Molecular Structure. *Nature Protocols*, **2019**, 14, 217-247.
Invited submission

Wang, Y.; Latypov, R. F. Quantitative Evaluation of Protein Solubility in Aqueous Solutions by PEG-Induced Liquid-Liquid Phase Separation, Protein Self-Assembly: Methods and Protocols, *Methods in Molecular Biology*, **2019**, vol. 2039, 39-49.

Lee, S.G.; Salomon, E.; Yu, O.; Jez, J.M. Molecular basis for branched steviol glucoside biosynthesis. *Proc. Natl. Acad. Sci. USA*, **2019**, 116,13131-13136.
Highlighted in the Record, El Mundo, and Chemical & Engineering

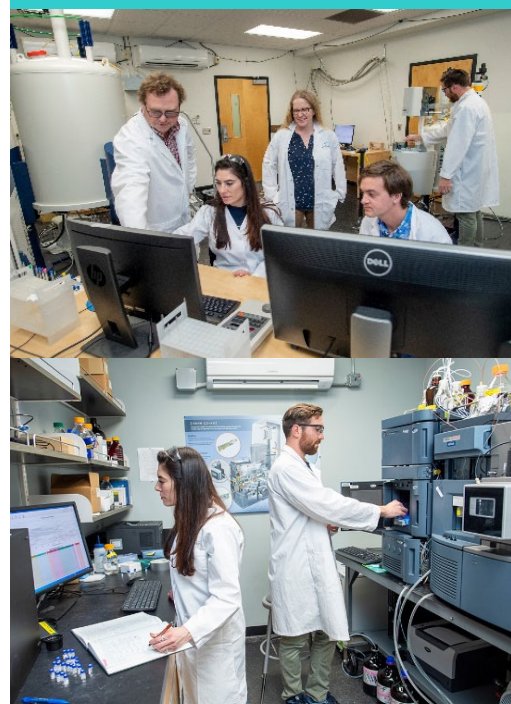
Contributions to Marine Science Curriculum

Course topics

- Biochemistry
- Coastal Management
- Oceanography
- Pharmaceutical Discovery and Development
- Quantitative Methods

Applied Learning

Student training in the CMS NMR and Mass Spectrometry Core Facility



Assistant Professor **Winifred Johnson** directing a course at the Coastal Ocean Environment Summer School in Ghana (COESSING). <https://coessing.org/>



Faculty and students perform Halloween-themed chemistry magic experiments for the public at Hew Hanover Country Agricultural Extension office for the annual PumpkinPalooza event

Masters student **Charles Johnson** works with students from D.C. Virgo School

