Papahānaumokuākea Marine National Monument

RESEARCH Permit Application

NOTE: ***This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).***

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.

- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.

- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:
Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
nwhipermit@noaa.gov
PHONE: (808) 397-2660 FAX: (808) 397-2662

<u>SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.</u>

Papahānaumokuākea Marine National Monument
Permit Application Cover Sheet

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

Summary Information

Applicant Name: Christopher Winn, PhD
Affiliation: Hawaii Pacific University, Oceanic Institute

Permit Category: Research
Proposed Activity Dates: 06/09/09-10/21/09
Proposed Method of Entry (Vessel/Plane): NOAA Research Vessel HI'IALAKAI
Proposed Locations: Shallow banks to depths of <1000m of the Monument waters associated with Kure Atoll, Midway Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Mokumanamana, and Nihoa Island.

Estimated number of individuals (including Applicant) to be covered under this permit: 5
Estimated number of days in the Monument: 30

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

The proposed activity would collect water samples from various depths and distances from the islands within the Monument to analyze and characterize the carbonate chemical make-up of the water surrounding the atoll systems in Papahanaumokuakea. Some analyses would take place onboard, while other, more complex analyses would be conducted in land-based laboratories once the ship returns to Honolulu. The analyses would be overseen by scientists at the Oceanic Institute in collaboration with scientists at NOAA's Pacific Marine Environmental Lab.

b.) To accomplish this activity we would ….

The R/V HI'IALAKAI's CTD would be utilized during non-diving hours and in conjunction with other projects onboard to collect water samples from waters associated with the atoll systems. Use of the CTD and associated instrumentation, including probes, Niskin water collecting bottles, and storage for transport would follow all standard hydrographic and water sampling methodology and procedures.

c.) This activity would help the Monument by …

By studying the oceanic carbon system we aim to vastly improve our knowledge of ocean acidification in Monument waters. We propose to do this by establishing a baseline of carbonate chemistry parameters that future environmental changes can be compared against. We also endeavor to broaden our understanding of the influence of ocean acidification on the marine communities of Papahanaumokuakea Marine National Monument.

Other information or background: Global climate change due to rising atmospheric Carbon Dioxide is a major threat to the world's coral reef ecosystems (Guinotte et al 2003). Of particular concern is the alteration of the ocean's carbonate chemistry, often coined Ocean Acidification. Evidence indicates that the ocean's pH and CaCO3 saturation state has declined in recent decades and will continue to do so in the foreseeable future (Caldeira and Wickett 2003, Feely et al 2004). These changes will likely cause rates of biogenic calcification to decline and rates of carbonate dissolution to increase (Lechercq et al 2000, Orr et al 2005, Morse et al 2006).

The coral reef ecosystem of the Hawaiian Archipelago covers a significant latitudinal gradient, spanning from 19 degrees to 29 degrees north and covering approximately 1500 miles. CaCO3 saturation state decreases with increasing latitude in the open ocean and forecasted ocean acidification is expected to have a larger and more immediate effect on calcifying organisms in high latitude regions compared to lower latitude regions (Kleypas et al 2006). Substantial speculation and significant uncertainty exist on the quantitative impact of ocean acidification on coastal ocean systems including high latitude coral reefs of the Northwester Hawaiian Islands (NWHI) where growth conditions are often suboptimal with regards to light and temperature regimes (Grigg 1982, 1983).

Coastal regions of the worlds' ocean remain largely under sampled and little is known about the state of the carbon systems found there (Chavez et al 2007). Previous research has shown that dissolution of high magnesium calcite from carbonate banks can serve to buffer reef habitat and locally elevate the aragonite saturation state of the surrounding ocean (Agegian et al 1988). While there is significant effort focused on forecasting global, large-scale ocean impacts of climate change and acidification, assessing the potential impact on the various NWHI islands, atolls, banks and shoals requires a finer-scale investigation of the local conditions.

The Gulf of the Farallones National Marine Sanctuary is also beginning to address these issues and collaboration between these two sanctuary sites may prove invaluable to the Sanctuary Program's informed ecosystem based management of our national marine protected areas.

Selected references:

Guinotte, J., R. Buddemeier and J. Kleypas (2003). Future coral reef habitat marginality: temporal and spatial effects of climate change in the Pacific basin. Coral Reefs 22:551-558.
Caldeira, K. and M. E. Wickett (2003). Oceanography: Anthropogenic carbon and ocean pH. Nature 425: 365.

Feely, et al. (2004). Impact of anthropogenic CO2 on the CaCO3 system in the ocean. Science 305: 362 – 366.

Lechercq, N., J-P. Gattuso and J. Jaubert (2000). CO2 partial pressure controls calcification rate of a coral community. Global Change Biology 6: 329-334.

Orr et, al. (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437: 681 – 686.

Morse, J.W., A.J. Anderson and F.T. Mackenzie (2006). Initial responses of carbonate-rich shelf sediments to rising atmospheric pCO2 and “ocean acidification”: Role of high Mg-calcites. Geochemica et Cosmochimica Acta 70: 5814 - 5830.

Kleypas J.A., R.A. Feely, V.J. Fabry, C. Langdon, C.L. Sabine and L.L. Robbins (2006). Impacts of ocean acidification on coral reefs and other marine calcifiers: A guide for future research. A report of a workshop held 18-20 April 2005. NSF, NOAA, and USGS, St. Petersburg, FL 88pp.

Grigg, R.W. (1982). Darwin Point: A threshold for atoll formation. Coral Reefs 1:29-34.

Grigg, R.W. (1983). Community structure, succession and development of coral reefs in Hawaii. Mar Ecol Prog Ser 11:1-14.

Chaves, F.P., et. al. (2007). Coastal Oceans. IN: The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle, Synthesis and Assessment Product 2.3, Report by the U.S. Climate Change Science program and Subcommittee on Global Change Research.

Agegian, C.R., F.T. MacKenzie, J.S. Tribble and C. Sabine (1988). Carbonate production and flux from a mid-depth bank ecosystem, Penguin Bank, Hawaii. In: Agegian CR (ed) Biogeochemical cycling and fluxes between the deep euphotic zone and other oceanic realms. National Undersea Research Program, U.S. Dept. of Commerce, Washington, D.C.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Winn, Christopher, D.

Title: Associate Dean for Marine Programs, Hawaii Pacific University

1a. Intended field Principal Investigator (See instructions for more information):

Ann Mooney
[redacted]

2. Mailing address (street/P.O. box, city, state, country, zip):
[redacted]
and
[redacted]

Phone: [redacted]

Fax: [redacted]

Email: [redacted]

For students, major professor's name, telephone and email address:

3. Affiliation (institution/agency/organization directly related to the proposed project):
Hawaii Pacific University

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):

Sam Kahng
Ann Mooney
Peter Amsler
Caitlyn Miles
Chris Winn

Section B: Project Information

5a. Project location(s):

		Ocean Based	
☒ Nihoa Island	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Necker Island (Mokumanamana)	☐ Land-based	☒ Shallow water	☒ Deep water
☒ French Frigate Shoals	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Gardner Pinnacles	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Maro Reef			
☒ Laysan Island	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Lisianski Island, Neva Shoal	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Pearl and Hermes Atoll	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Midway Atoll	☐ Land-based	☒ Shallow water	☒ Deep water
☒ Kure Atoll	☐ Land-based	☒ Shallow water	☒ Deep water
☐ Other			

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:
The CTD casts would occur on transects conducted from shallow to deep water. The exact number and location of the transects would be determined and adjusted to work within the operational limitations of each site. A list of potential positions will be submitted with the compliance information sheet.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

☒ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource
☐ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
☐ Anchoring a vessel
☐ Deserting a vessel aground, at anchor, or adrift
☐ Discharging or depositing any material or matter into the Monument
☐ Touching coral, living or dead
☐ Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
☐ Attracting any living Monument resource
☐ Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
☐ Subsistence fishing (State waters only)
☐ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6 Purpose/Need/Scope ***State purpose of proposed activities:***
The purpose of the proposed research is to establish a modern day baseline of the carbonate properties of the waters surrounding the atolls of the NWHI. This will allow future researchers and managers to track and measure changes to the chemistry of the ocean due to alterations in the global climate. The proposed research will provide the co-trustee agencies with pertinent data regarding the oceanographic conditions surrounding the atoll systems under their protection by:
1. Performing Conductivity, Temperature and Depth (CTD) casts to gather profiles for pH, oxygen and fluorescence. pH is one of four parameters necessary to completely describe the carbon system in seawater and fluorescence can be used to estimate chlorophyll. These data, along with the alkalinity data (described below) will be used to characterize the carbon system within the water column surrounding the reef environments in the monument. The oxygen and fluorescence data will be obtained along with temperature and salinity profiles to allow for the interpretation of the carbonate system parameters.
2. Alkalinity will be measured on subsamples drawn from the CTD casts, providing a second carbon system parameter and allowing for the full characterization of the carbon system. A few subsamples will also be drawn for the determination of oxygen concentrations via winkler titration. These oxygen measurements will be used to maintain the calibration of the continuous oxygen sensor included on the CTD. In addition, a few subsamples will also be collected for the analysis of dissolved inorganic carbon (DIC). These samples will be used to confirm our calculation of DIC concentrations and pCO2 levels from the pH and alkalinity measurements described above.

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?
This proposed project will involve water sampling only and will have no adverse impact on the ecological integrity of the Monument. Participants in the project will attend a Hawaiian Cultural Briefing prior to entering Papahanaumokuakea to instill an awareness of the natural, cultural and historical value of the Monument.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects?
All management regulations pertaining to Monument waters and special protected areas will be strictly adhered to. The proposed activity will enhance knowledge of the

environment of Papahanaumokuakea and expand the base of information managers can draw from. The proposed project involves no direct contact with any Monument resources other than the microfauna found in the water column and little to no adverse effects are anticipated.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.
There is no practicable alternative to conducting the proposed project in the Monument. This study was designed specifically to characterize the carbonate chemistry of Monument waters. Most open ocean carbonate chemistry sampling is done absent of the presence of atolls. The NWHI present a unique opportunity to understand how atolls, reefs and banks affect and alter the overall global scheme of carbonate chemistry.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
All activities proposed contribute to a better understanding of the carbonate chemistry of the Monument waters. This benefits the management of the Monument by establishing a baseline to compare future climactic events to and also will serve the international community by presenting a role model for other sanctuary sites' monitoring of global carbonate chemistry changes. There are to be no adverse impacts on Monument cultural, natural or historical resources.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.
The proposed project will use the minimum amount of time needed within Monument waters to effectively characterize the carbon systems found there. The sampling schedule will optimize the amount of operational days spent in Papahanaumokuakea.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
The personnel selected by Hawaii Pacific University and the Papahanaumokuakea Marine National Monument have experience and training in water sampling techniques. Similar protocols have been followed in other field/research expeditions with no adverse effects, but yielding significant gains to the global scientific community. Team members will be extensively trained and work closely in conjunction with the vessel crew who spend many hours at sea working within the Monument successfully conducting operations in accordance with the rules and regulations set out by the co-trustee agencies.

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
This project is funded by NOAA's National Ocean Service office of the Papahanaumokuakea Marine National Monument. Hawaii Pacific University will provide personnel, expertise and laboratory efforts in collaboration with this project.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.
Standard water sampling methods and procedures will be executed during all activities. All applicable shipboard safety standards will be followed and enforced. The purpose and intention of the proposed project is to assess and record the carbonate chemistry characteristics of the water surrounding the atolls of the Monument, with little to no impact on resources. Previous cruises about R/V HI'IALAKAI have utilized CTD methods with little to no adverse impacts to the Monument's cultural, natural or historical resources, qualities or ecological integrity.

i. Has your vessel has been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?
NOAA R/V HI'IALAKAI is outfitted with a mobile transceiver unit and satisfies all applicable requirements to conduct research in Papahanaumokuakea Marine National Monument.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.
We are not aware of any factors that would make issuance of a permit for the proposed project inappropriate.

8. Procedures/Methods:
CTD Casts: The CTD casts will be performed using the shipboard rosette on R/V HI'IALAKAI along transect lines conducted from shallow to deep water. The location and orientation of the transect lines for each atoll will be determined prior to sailing and based on detailed analysis of available bathymetry data. Depth and distance between casts will be determined from the best available data and transects will take place during non-diving hours. All pertinent information such as GPS coordinates will be recorded. The ship currently utilizes one SBE 9 (SN-09P35130-0737) and will have affixed an SBE18 pH probe, which will be calibrated prior to each cast. The CTD will be run and operated by the shipboard survey technician with assistance, if necessary, from the participants listed on the proposed project.

Water Sampling: The rosette has a capacity of 12 Niskin bottles. These bottles will have pre-determined sampling depths for each cast. Discrete subsamples will be collected to determine alkalinity. Alkalinity will be determined by potentiometric titration in a temperature-controlled open cell and the equivalence point will be determined via a gran plot with corrections for competing side reactions involving sulfate and fluoride. Analysis of DIC will be performed utilizing the SOMMA system (Single Operator Multi-Metabolic Analyzer). Precision and accuracy will be maintained on all alkalinity and DIC analyses using standard seawater analysis protocols and intercalibration will be conducted with similar programs to ensure data quality.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

Common name:
Seawater

Scientific name:

& size of specimens:
Amount of seawater samples for analysis are approximately 300ml per Niskin bottle. 30ml will be for pH analysis, and 250ml will be stabilized and stored according to standard seawater sampling protocols for further analysis at Hawaii Pacific University's Oceanic Institute. The total number of samples is variable and dependent on working conditions, specifically halting or conducting additional sampling with respect to tidal changes, weather and unforeseen oceanographic conditions.

Collection location:
Seawater samples will be collected over the duration of the cruise in conjunction with the CTD casts.

☐ Whole Organism ☐ Partial Organism

9b. What will be done with the specimens after the project has ended?
Water samples will be brought on board for pH analysis and initial processing, labeling and storage. Once returned to Honolulu, further analysis will be conducted at Oceanic Institute to determine DIC and alkalinity.

9c. Will the organisms be kept alive after collection? ☐ **Yes** ☒ **No**
n/a

• General site/location for collections:
Prior to embarking in the cruise, transect lines for each atoll will be mapped out and planned according to other RAMP cruise parameters.

• Is it an open or closed system? ☐ Open ☐ Closed
n/a

• Is there an outfall? ☐ Yes ☐ No
n/a

• Will these organisms be housed with other organisms? If so, what are the other organisms?
n/a

• Will organisms be released?
n/a

10. If applicable, how will the collected samples or specimens be transported out of the Monument?
Seawater samples will be stabilized and stored onboard utilizing HgCl2.

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:
The proposed project is a joint project between Hawaii Pacific University, the Monument and the Coral Reef Ecosystems Division and will be carried out with close ties with the Pacific Marine Environmental Lab. All data and analyses will be available for any interested party and to date no projects are currently studying bank effects of carbonate atoll systems on the open ocean. Other National Marine Sanctuary Sites, namely the Gulf of the Farallones National Marine Sanctuary, are establishing carbonate sampling protocols for coastal shorelines and the leads of their project have been in contact with a Papahanaumokuakea research team member to discuss collaboration and information sharing.

12a. List all specialized gear and materials to be used in this activity:
Spectrophotometer, CTD, SBE18 pH probe, Niskin bottles and other water sampling gear mentioned in above methods section.

12b. List all Hazardous Materials you propose to take to and use within the Monument:
MSDS attached:
1. Bromocresol Purple
2. HgCl2

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:
none

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:
Sample and data analysis, and write-up will be completed within 1 year of disembarking on the final cruise, no later than September 2010. Publications will be submitted at that time.

15. List all Applicants' publications directly related to the proposed project:

• Lamb, M.F. et al., Internal Consistency and synthesis of Pacific Ocean CO2 data. Deep-Sea Research, submitted.
• Millero, F.J., A.G. Dickson, G. Eischeid, C. Goyet, P.Guenther, K.M. Johnson, K. Lee, D. Purkerson, C.L. Sabine, R. Key, R.G. Schottle, D.R.W.Wallace, R.J. Wilke and C.D. Winn. Alkalinity measurements in the Indian Ocean during the WOCE Hydrographic Program CO2 survey cruises 1994-1996. Marine Chemistry. Submitted.
• Yuan-Huli, Li. D.M. Karl. C.D. Winn, F.T Mackenzie and K. Gans. 2000. Remineralization ratios in the subtropical North Pacific Gyre. Aquatic Chemistry. 6: 65-86
• K.M. Johnson, A.G. Dickson, G. Eischeid, C. Goyet, P.Guenther, K. Lee, D. Purkerson, C.L. Sabine, R. Key, F.J. Millero, .R.G. Schottle, D.R.W.Wallace, R.J. Wilke and C.D. Winn. 1998. Coulometric total carbon dioxide analysis for marine studies: An assessment of the quality of total inorganic carbon measurements made during the US Indian Ocean CO2 survey 1994-1996. Marine Chemistry. 63: 21-37.
• Winn, C.D., Y.H. Li, F.T. Mackenzie and D.M. Karl. 1998. Rising surface ocean total dissolved inorganic carbon at the Hawaii Ocean Time-series sites. Marine Chemistry. 60: 33-47.
• Emerson, S., P.Quay, D. Karl, C. Winn, L.Tupas and M. Landry. 1997. The carbon pump in the Subtropical Pacific ocean: Implications for the global carbon cycle. Nature. 389: 951-954.
• Karl, D.M., J.R. Christian, J.E. Dore, D.V. Hebel, R.M. Letelier, L.M. Tupas and C.D. Winn. 1996. Seasonal and interannual variability in primary production and particle flux at Station ALOHA. Deep-Sea Research. 43: 539-568.
• Letelier, R.M., J.E. Dore, C.D. Winn and D.M. Karl. 1996. Temporal variations in photosynthetic carbon assimilation efficiencies at Station ALOHA. Deep-Sea Research. 43: 467-490.
• Winn, C.D., L. Campbell, R. Letelier, D. Hebel, L. Fujieki, and D. M. Karl. 1995. Seasonal variability in the Phytoplankton Community of the North Pacific Subtropical Gyre. Global Biogeochemical Cycles. 9: 605 - 620.
• Sabine, C.L. F.T. Mackenzie, C.D. Winn and D.M. Karl. 1995. Geochemistry of particulate and dissolved inorganic carbon at the Hawaii Ocean Time-series station, ALOHA. Global Biogeochemical Cycles. 9: 637-652.
• Winn, C.D., J.P. Cowen and D.M. Karl. 1995. Microorganisms in deep sea hydrothermal plumes. In: Karl, D.M. [ed.] Microorganisms in Extreme and Unusual Environments CRC Press Inc. pp 255-274.
• Karl, D.M., R. Letelier, D. Hebel, L. Tupas, J. Dore, J. Christain and C.D. Winn. 1994. El Nino-induced changes in the central North Pacific Gyre ecosystem structure and productivity. Nature. 373: 230-234.
• Winn, C.D., C.J. Carrillo, F.T. Mackenzie, C.L. Sabine and D.M. Karl. 1994. Air-sea carbon dioxide flux in the North Pacific Subtropical Gyre. Global Geochemical Cycles. 8: 157-163.
• Winn, C.D., R. Lukas, D. Hebel, C. Carrillo, R. Letelier and D.M. Karl. 1993. Time-series measurements in the oligotrophic ocean: Resolving variability in the North Pacific subtropical gyre. In: Saxen, N. [ed.] Recent Advances in Marine Science and Technology. Pacific Congress on Marine Science and Technology pp. 139-150.

• Letelier, R.M., R.R. Bidigare, D.V. Hebel C.D. Winn and D.M. Karl. 1993. Temporal variability of the phytoplankton community structure at the US-JGOFS time-series station ALOHA (22o 45'N, 158o00'W) based on pigment analysis. Limnology and Oceanography. 38: 1420-1437.
• Karl, D.M., G. Tien, J. Dore and C.D. Winn. 1993. Total dissolved nitrogen and phosphorus concentrations at U.S.-JGOFS Station ALOHA: Redfield reconciliation. Marine Chemistry. 41: 203-208.
• Karl, D.M., R. Letelier, D.V Hebel, D.F. Bird and C.D. Winn. 1992. Trichodesimum blooms and new nitrogen in the North Pacific Gyre. In E.J. Carpenter, D.G. Capone and J.G. Rueter (eds.), Marine Pelagic Cyanobacteria: Trichodesimum and other Diazotrophs. Kluwer Academic Publishers. pp. 219-237.
• Karl, D.M., J.E. Dore, D.V. Hebel and C.D. Winn. 1991. Procedures for paticulate carbon, nitrogen, phosphorus and total mass analyses used in the US-JGOFS Hawaii Ocean Time-Series Program. In: D.Spencer and D. Hurd. (eds.), Marine Particles: Analysis and characterization, American Geophysical Union, Geophysical Monograph 63. pp. 71-77.
• Karl, D.M. and C.D. Winn. 1991. A sea of change: Monitoring the ocean's carbon cycle. Environmental Science and Technology, 25: 1977-1981.
• Karl, D.M., D.R. Jones, J.A. Novitsky, C.D. Winn and P. Bossard. 1987. Specific growth rates of natural microbial communities measured by adenine nucleotide pool turnover. Journal of Microbiological Methods. 6: 221-235.
• Winn, C.D., D.M. Karl and G. Massoth. 1986. Microbial biomass in hydrothermal plumes on the Juan de Fuca Ridge. Nature. 320: 744-746.
• Karl, D.M. and C.D. Winn. 1986. Does adenine incorporation into nucleic acids measure total microbial production?: A response to comments by Fuhrman et al. Limnology and Oceanography. 31: 1382-1392.
• Winn, C.D. and D.M. Karl. 1986. Diel nucleic acid synthesis rate measurements: Conflicts with division rate estimates by DNA accumulation. Limnology and Oceanography. 31: 637-645.
• Karl, D.M., and C.D. Winn. 1984. Adenine metabolism and nucleic acid synthesis: Applications to microbiological oceanography. In: J.E. Hobbie and P.J. LeB. Williams (Eds.). Heterotrophic Activity in the Sea. Plenum Publishing Corporation. pp. 197-215.
• Winn, C.D. and D.M. Karl. 1984. Laboratory calibrations of the 3H-adenine technique for measuring rates of RNA and DNA synthesis in marine microorganisms. Applied and Environmental Microbiology. 47: 835-842.
• Winn, C.D. and D.M. Karl. 1984. Microbial productivity and growth rate estimates in the tropical North Pacific Ocean. Biological Oceanography. 3: 123-145.
• Winn, C.D. 1984. Application of the rate of nucleic acid synthesis to the study of microbial growth and production in seawater. Ph.D. Dissertation, University of Hawaii.
• Betzer, P.R., W.J. Showers, E.A. Laws, C.D. Winn and G.R. DiTullio. 1984. Primary productivity and particle fluxes on a transect of the equator at 153o W in the Pacific Ocean. Deep-Sea Research. 31: 1-11.

• Laws, E.A., D.M. Karl, D.G. Redalje, R. Jurick and C.D. Winn. 1983. Variability in ratios of phytoplankton carbon to RNA and ATP to Chl a in batch and continuous cultures. Journal of Phycology. 19: 439-445.
• Karl, D.M., C.D. Winn,and D.C.L. Wong. 1981a. RNA synthesis as a measure of microbial growth in aquatic environments. I. Evaluation, verification and optimization of methods. Marine Biology. 64: 1-12.
• Karl, D.M., C.D. Winn, and D.C.L. Wong. 1981b. RNA synthesis as a measure of microbial growth in aquatic environments. II. Field applications. Marine Biology. 64: 13-21.
• Winn, C.D. 1978. Soil respiration and microbial activity in the San Gabriel National Forest. M.S. thesis, Calfornia. State University at Fullerton.
• Winn, C.D., and P. Driscoll. 1996. Hawaii time-series data reveals rising ocean CO2 levels. U.S. JGOFS News. September 1996.
• Schottle, R. and C.D. Winn. 1996. DOE CO2 survey science team completes Indian Ocean surey. U.S. JGOFS News. May 1996.
• Winn, C.D. and A. Dickson. 1995. Still more great data from the Indian Ocean!! U.S JGOFS News. July: 6.
• Winn, C.D. 1994. From the Bering Sea to Fiji: CO2 survey crosses the Northern Pacific. U.S.JOFS News. April: 10.
• Winn, C.D., R. Lukas, D.M. Karl, E. Firing and C. Chiswell. 1993. Hawaii Ocean Time-series Program: Data Report 3. School of Ocean and Earth Science and Technology, University of Hawaii.
• Winn, C.D. 1992. HOT Program Builds Time-Series Set of Carbon Measurements for Central Pacific. U.S. JGOFS Newsletter. December: 9.
• Winn, C.D., R. Lukas, D.M. Karl, E. Firing and C. Chiswell. 1991. Hawaii Ocean Time-series Program: Data Report 2. School of Ocean and Earth Science and Technology, University of Hawaii.
• Chiswell, S., E. Firing, D.M. Karl, R. Lukas and C.D. Winn. 1990. Hawaii Ocean Time-series Program: Data Report 1. School of Ocean and Earth Science and Technology, University of Hawaii.
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With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as "confidential" prior to posting the application.

_____ _____

Signature Date

SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE BELOW:

Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
FAX: (808) 397-2662

DID YOU INCLUDE THESE?

☒ Applicant CV/Resume/Biography
☒ Intended field Principal Investigator CV/Resume/Biography
☒ Electronic and Hard Copy of Application with Signature
☐ Statement of information you wish to be kept confidential
☒ Material Safety Data Sheets for Hazardous Materials