

ion of the marine algal assemblage and seasonal variation
on Cumberland Island National Seashore jetty

Joseph P. Richardson, Ph.D. (SS 415-80-6381)
Associate Professor of Marine Biology
P.O. Box 20583
Marine Biology Program
Department of Biology and Life Sciences
School of Sciences and Technology
Savannah State College
Savannah, Georgia 31404
phone (912) 356-2314

Proposed duration: July 1, 1986 - August 31, 1987

Principal Investigator

Joseph P. Richardson Feb 4, 1986
date

Joseph P. Richardson
Associate Professor of Marine Biology

Authorized Organizational Representative

Wendell G. Rayburn 2-21-86
date

Wendell G. Rayburn
President
Savannah State College

Endorsement

Margaret C. Robinson 2/20/86
date

Margaret C. Robinson
Dean
School of Sciences and Technology

Authorized Organizational Representative

Prince K. Mitchell 2-20-86
date

Prince K. Mitchell
Vice-President
Business and Finance

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Purpose and Management Statement

This research project will investigate the benthic marine algal flora occurring on the jetty at the south end of Cumberland Island National Seashore throughout one year. The flora will be described in terms of: species identifications; species distributions in relation to tidal levels and exposure; species abundances (relative densities); and species seasonalities. Thus the flora will be described qualitatively and quantitatively, and natural seasonal alterations in species present and abundances will be recorded and analyzed. This information will be of interest to marine biogeographers in that it will provide a comprehensive description of benthic algae from a portion of the Carolinian biogeographic province (Humm 1969, Hoek 1975). Phytogeographic studies of this portion have previously been limited (Richardson in review b).

Of equal, but currently of more critical and timely importance, this study will provide missing information on environmental conditions and a resulting natural marine ecosystem at the south end of Cumberland Island National Seashore. This study will collect, record, analyze and document environmental conditions, ecosystem structure and natural variations at a location of the Seashore that is most likely to be impacted by planned channel alteration activities in the vicinity. Through the St. Marys River Entrance and St. Marys Sound, which border the south and southwestern sides of the Seashore, the present channel system is to be altered to serve the developing TRIDENT Submarine Base at St. Marys (Corps of Engineers Public Notice).

The study site itself, an approximately 2.5 mile long rock jetty, is an historic structure extending seaward from the south end of the Seashore. Although no plans have been publicly released, it is possible that the jetty system itself may be considered for alteration during the development and operation of the submarine base (Corps of Engineers, Savannah District, pers. comm.). Thus, if this study and the resulting qualitative and quantitative descriptions of this currently existing ecosystem and its parameters are to be accomplished, field visits and analyses must begin soon.

An additional and equally important facet of this project will result from its providing descriptive and quantitative data on the currently existing natural ecosystem. Once described, this ecosystem can be utilized as a monitor for potential environmental changes and impacts resulting from channel alterations and submarine base development and operation. Changes in water quality (including turbidity) and water flow dynamics (including flow velocity and wave energies and directions) could produce directly and indirectly (via competition and/or grazer/predator impact alteration) caused changes in the structure of the present ecosystem. Benthic marine algal populations are especially well suited for demonstrating environmental changes in their habitats because: they are obvious visibly, they cannot migrate, they respond to changes in water quality, especially turbidity, they respond to changes in wave energy and water flow dynamics, and they respond to changes in the abundances of other components of the ecosystem, for example competitors, grazers and predators of grazers. Normal seasonal alternations in species present, their abundances and relative distributions must initially be known, however, in order to separate these alterations from those

PROJECT SUMMARY

FOR NSF USE ONLY

DIRECTORATE/DIVISION	PROGRAM OR SECTION	PROPOSAL NO.	F.Y.
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NAME OF INSTITUTION (INCLUDE BRANCH/CAMPUS AND SCHOOL OR DIVISION)

Savannah State College
 School of Science and Technology
 Savannah, Georgia 31404

ADDRESS (INCLUDE DEPARTMENT)

Joseph P. Richardson
 Marine Biology Program
 Department of Biology and Life Science
 P.O. Box 20583
 Savannah State College

PRINCIPAL INVESTIGATOR(S)

Joseph P. Richardson

TITLE OF PROJECT

Investigation of the marine algal assemblage and seasonal variation
 on Cumberland Island National Seashore jetty

TECHNICAL ABSTRACT (LIMIT TO 22 PICA OR 16-ELITE TYPEWRITTEN LINES)

Benthic seaweeds are an inconspicuous component of the marine biota of coastal Georgia, and previously there has been limited study of Georgia seaweeds. Recent collections (one during winter and two during summer) of seaweeds from the jetty at the southern end of Cumberland Island National Seashore, however, have revealed the presence of algal species that do not occur elsewhere along coastal Georgia. A seasonal alternation of the jetty flora assemblage also appears to occur. As the TRIDENT submarine base in St. Marys, Georgia, develops, the waters adjacent to the southern end of Cumberland Island National Seashore will be influenced by dredging and channel alteration operations. This study proposes to make monthly field trips to the jetty throughout one year in order to obtain data on the jetty flora. Using vertical transects on the jetty, data will be obtained related to: species present, relative population densities, population microhabitats, and seasonal changes in species abundances. Because benthic seaweeds are sensitive to light and water flow dynamics, it is anticipated that the algal assemblage can serve as an indicator of possible changes in water quality, turbidity, water flow dynamics, and degree of exposure in the St. Marys Entrance vicinity. This research will thus provide basic information related to phytogeography of the southeastern coast, seasonality of southeastern inshore seaweeds, and baseline data on the present algal assemblage and its natural seasonal variations in an area scheduled for future environmental alteration.

PROJECT DESCRIPTION

Background and Introduction

Macroscopic marine algae in Georgia have received limited interest from phycologists. This lack of attention is probably due to a number of environmental factors, especially absence of natural inshore hard substrata and presence of turbid coastal water, which create inshore habitats inhospitable for many seaweeds. Thus seaweeds do not form a conspicuous component of Georgia's coastal biota.

Initially, Chapman (1971, 1973) reported forty-three species of seaweeds from inshore Georgia locations, and recently Richardson (1985_{a,b}) added twenty-six species from coastal Georgia. During these two previous studies, three collections were conducted at the jetty at the south end of Cumberland Island National Seashore. These collections revealed the presence on the jetty of seaweed taxa that were not encountered elsewhere in Georgia. Thus based on the limited studies, it appears that the Cumberland Island jetty algal flora is distinct from the flora of the remainder of the Georgia coastal zone.

Cumberland Island National Seashore is located on the southernmost barrier island of Georgia's coast. At its southern end occurs St. Marys River Entrance and Cumberland Sound which are to be dredged for operation of a TRIDENT submarine base at Kings Bay, Georgia (Corps of Engineers 1985, Walsh 1985). Survey grids and monitoring have begun to determine the effects of shoreline processes such as erosion due to dredging and channel alteration operations (Walsh 1985).

As a result of dredging, channel alteration and submarine base development and operation, changes in shoreline processes, water flow and water quality characteristics at the south end of Cumberland Island National Seashore can be expected. In anticipation of possible changes in the local marine environment, the following research project is proposed.

Marine algae were chosen for study for a variety of reasons. Benthic seaweeds represent a diverse group of marine organisms possessing varieties of life history strategies, morphologies and adaptations. Although a variety of biological characteristics are thus represented, benthic seaweeds grow attached to their substrate, and therefore changes in algal populations are generally evident. Such organisms are good potential indicator species for monitoring changes in environmental conditions of their habitat. As photosynthetic organisms seaweeds are sensitive to light conditions (including penetration) which can be affected by water turbidity and sea surface state. Intertidal seaweeds are also influenced by water flow dynamics including wave energy and indirect effects such as sedimentation and scouring. Thus the diverse benthic algal assemblage on the Cumberland Island jetty can serve as a sensitive monitor of possible changes in water quality and flow characteristics in the vicinity of St. Marys River Entrance and the south end of Cumberland Island National Seashore.

Besides being potential indicator species of environmental changes, the seaweeds of Cumberland Island jetty represent an interesting assemblage of species relative to the flora of the remainder of Georgia's coast. Table 1 lists 29 species of seaweeds reported from three collections from Cumberland Island jetty. Two of these collections were made during summer months and one was made during winter. Although these three collections represent limited study and sampling, it appears from the limited data that the jetty flora is distinct in Georgia. Seventeen of the species (59%) do not occur elsewhere on Georgia's coastline (Table 2 and Richardson 1985b and in review b). Of the red algae, 83% of the species present do not occur elsewhere on the Georgia coast. However, 76% of the total species reported from Cumberland Island jetty do occur on jetties in North Carolina (Tables 1 and 2; Richardson 1985b, Richardson in review b). Thus the algal assemblage, as known to date, appears to be rather distinct in Georgia and of biogeographic interest.

Additional field studies of the seaweeds are necessary for a more complete characterization of the assemblage. The limited collections indicate a degree of natural seasonal variation in the assemblage (Table 1). In order to recognize changes in the algal flora (including population size changes within a species) which may be due to environmental alteration, the natural seasonal variations and changes must first be described. The investigation described in this proposal should result in a more complete description of the algal flora present at the jetty and the current natural seasonal changes in that species assemblage. Thus information will be obtained that applies to marine phytogeography in the Carolinian province and seasonality of inshore seaweeds along the south Atlantic coast. Additionally, the study will describe the natural dynamics of a species assemblage sensitive to water quality and flow patterns in its vicinity, and this information might be valuable for monitoring direct and indirect effects of future development and operation of the submarine base at St. Marys, Georgia.

Research Objectives

1. To develop a complete species list of intertidal and shallow subtidal seaweeds occurring on Cumberland Island jetty.
2. To describe the natural seasonal alternation of seaweed species on the jetty.
3. To describe the relative abundances and population densities of the seaweed species on the jetty throughout the year, noting changes due to seasonality.
4. To provide additional information on the coastal benthic seaweeds of Georgia and this portion of the Carolinian province for biogeographic purposes.
5. To provide baseline data on the natural seaweed assemblage and its seasonal variations which might be used for environmental monitoring purposes in anticipation of future potential environmental (water quality and dynamics) alterations.

Significance of Proposed Research

It is anticipated that this study will provide timely information on an existing natural marine ecosystem which may soon experience change due to planned development in its vicinity. The natural seasonal alternations of the algal flora will be described, and this information is presently needed in order to be able to distinguish natural changes in the flora from potential changes that might occur due to planned future environmental alteration.

This study will also provide a detailed description of the natural algal assemblage from an inshore hard substrate within the Carolinian province. Species abundance, diversity and seasonality data will provide phytogeographic information which is currently limited from this portion of the southeastern coast. Recent studies of the inshore marine algal flora of Georgia have suggested that Georgia's coastal macroalgal flora is relatively distinct by lacking a number of species common elsewhere in the Carolinian province and by lacking a distinct summer assemblage (Richardson 1985b, and in review b). These studies, however, also noted that at the northern and southern (Cumberland Island jetty) boundaries of coastal Georgia, macroalgal species assemblages more typical of the Carolinian province appear. This study will thus provide additional information at a distinct boundary between subdistricts within a phytogeographic province. The relatively high algal species diversity at this jetty indicated from limited previous study (Chapman 1971, Richardson in review b) also suggests that detailed investigation of this site could provide a great deal of inshore macroalgal diversity and seasonality data for this region of the southeastern coast.

Relation to Investigator's Current Research and Research Goals

This research will complement the principal investigator's past research, present research and interests. The PI has conducted studies of benthic macroalgae on coastal jetties within the Carolinian province (Richardson 1978a,b, 1979, 1981, 1982, 1985a,b, in review a,b). Many of these studies involved species characterized by seasonal appearances, and through field and laboratory culture investigations, the relationships between species seasonalities and life histories were determined (Richardson 1978a,b, 1979, 1981, 1982). Additionally, most of these previous investigations involved species which occurred at their latitudinal distribution limits on the southeastern coast. Phytogeographic studies which specifically investigate the relationship between a species' seasonal appearance, especially at its distribution limit, and its life history strategy and adaptations, remain a prime interest for the PI. Determining the factor(s) causing a species' seasonality through field and culture experimentation, is also of direct interest.

This proposed research will thus continue and complement the PI's goals of macroalgal ecology research. This project extends the PI's ecological investigations by additionally considering the possible effects of habitat and environmental alterations on the natural species diversity, abundance and seasonal alterations.

Currently the PI is investigating the floristic and seasonal characteristics of the Georgia inshore macroalgal flora (Richardson 1985^{a,b}, in review ^{a,b}). This research is a portion of a NIH sponsored biomedical research project involving an investigation of the production of potentially useful bioactive (antibiotic, antifungal, immuno-active) metabolites by marine macroalgae (Screen *et al.* 1985). The PI's responsibilities in the project include: acquiring data on spatial and temporal variations in species' abundances, collecting and providing algal material for chemical extractions, culturing marine algae to provide material for chemical extractions, experimenting with culture conditions to determine conditions that result in optimal algal biomass and metabolite productions, and determining life histories through culture and field experimentation.

The PI is also currently a co-investigator in a NOAA, NMFS sponsored project investigating community structure on Georgia continental shelf natural and artificial reefs. The PI is investigating the recruitment and subsequent development of macroalgal assemblages on these offshore hardbottoms using direct observation and collection and experimentation with periodically sampled artificial substrates placed at two research sites. Thus, information about the macroalgal flora occurring on the Georgia continental shelf is also being obtained, and it will complement the floristic studies of the Georgia coastal zone.

Relation to Present State of Knowledge in Field

As described in the Introduction, the macroalgae of coastal Georgia have received limited study; and specifically, reports of the marine algae of Cumberland Island National Seashore are limited to three collections (Chapman 1971, Richardson in review ^b). These three collections, however, have revealed a relatively rich and seasonal algal assemblage. This limited study at Cumberland Island, together with recent studies of the macroalgae along the remainder of coastal Georgia, suggest that a phytogeographic boundary within the Carolinian province exists at Cumberland Island. This proposed project will provide seasonality and more complete species abundance data from this portion of the Carolinian province. The development of a TRIDENT submarine base in the adjacent Kings Bay Harbor will cause environmental alterations in the vicinity, and the macroalgal assemblage at Cumberland Island jetty could provide a useful monitor of water quality and water dynamic changes that might result from the planned development. The collection of algal assemblage floristic and seasonality data for the jetty must initially be made however, in order to determine the natural species abundances and alternations, and currently this data is very limited and incomplete.

Materials and Methods

Monthly field trips to Cumberland Island jetty will be made for one year. Field work will be conducted during low tide at which time sampling and data collection will occur. Samples of algal species not identifiable in the field (for example *Enteromorpha* spp.) will be collected, labeled and preserved for specific identification in a lab at Savannah State College. Voucher specimens will be deposited in the Marine Algal Herbarium at Savannah State College and in the Herbarium of the Cumberland Island National Seashore. Identifiable species will be noted with limited collection. Salinity and light penetration will be measured during each trip.

In order to describe relative abundances, two transects, each running from the top of the jetty to the low water level (and subtidally when conditions permit) will be established on each side of the jetty (thus four transects total) during each monthly field trip. Transects will be established seaward of the shoreline at low tide and near the shoreline at low tide. Along each transect the algal flora will be described in terms of: height above low water level, surface exposure, relative species density, and condition of individuals (eg. stunted, reproductive, etc.). In addition, abundance and estimated density, height above low water level, and condition of individuals will be noted and recorded for the surrounding areas on the jetty. Thus four broad vertical zones on the jetty will be examined on both a fine scale and on a larger scale in order to collect data on rare and cryptic species as well as on the general algal distributions. A similar method of data accumulation and analysis for species distribution and description on breakwaters was described and employed by Trevino-Murphy *et al.* (1985) along the Mexican tropical Pacific coast (App. I & II). Benthic fauna will also be recorded and described.

Monthly collections for one year will provide data indicating seasonal alternations. Logistical assistance has been offered (when available) by the superintendent of Cumberland Island National Seashore (see letters from Cumberland Island National Seashore, October 30, 1984; September 10, 1985).

Facilities Available

Lab facilities and headquarters for this research will be in the Griffith-Drew Science Center, headquarters for the Marine Biology Program, Department of Biology and Life Sciences of the School of Sciences and Technology, Savannah State College, Savannah, Georgia. Laboratory space, microscopes and supplies, aquaria, herbarium space, and lab supplies are available for this project. Office space, computer facilities and secretarial service are also available. The principal investigator is experienced with field studies of jetty floras of the southeast and with the inshore algal flora of Georgia.

Special Considerations

Field work for this project will be performed at the jetty on the south end of Cumberland Island National Seashore, and thus travel to the study area once per month is necessary. Logistical assistance with transportation to the study site on Cumberland Island has been offered by the Park Superintendent on a "when available and feasible basis." During previous field visits and from subsequent correspondence, park personnel appear interested in the research and willing to allow and help, when possible, with the research (see following correspondence).



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE

CUMBERLAND ISLAND NATIONAL SEASHORE

P.O. Box 806

St. Marys, Georgia 31558

N1433(CUIS)

August 31, 1984

Joseph P. Richardson, Ph.D.
Associate Professor of Marine Biology
P. O. Box 20583
Savannah State College
Savannah, Georgia 31404

Dear Dr. Richardson:

Your letter and algae specimens arrived last Friday in fine shape. Thank you for the specimens, they will be added to our herbarium.

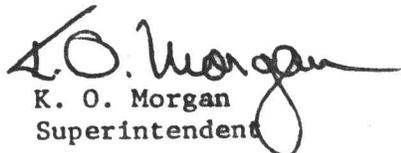
It sounds like the trip was indeed worth the effort but I agree that it is a push for a single day's trip. Reservations are easier to secure for camping during the winter than during the summer months. The ferry does not run on Tuesdays and Wednesdays during the winter months and the park is closed to the general public during the managed deer hunts which are scheduled for Tuesdays through Thursdays. The dates of these hunts are:

October 23-25
November 6-8
November 27-29

December 18-20
January 1-3, 1985

I hope that your next trip is as successful.

Sincerely,


K. O. Morgan
Superintendent



United States Department of the Interior

NATIONAL PARK SERVICE

CUMBERLAND ISLAND NATIONAL SEASHORE

P.O. Box 806

St. Marys, Georgia 31558

IN REPLY REFER TO:

N14(CUIS)

October 30, 1984

Joseph P. Richardson, Ph.D.
Savannah State College
Marine Biology Program
P. O. Box 20583
Savannah, Ga. 31404

Dear Mr. Richardson,

Many thanks for the fine algae specimens which you collected at the Cumberland Island jetty. We at Cumberland are not only impressed with the variety you collected, but are awed by the beauty of the individual mounts themselves.

The specimens have been accessioned into the Cumberland Island herbarium collection under accession number 227. If in the future you need to refer to these specimens please refer to the aforementioned accession number.

Please feel free to make a collection trip(s) to the island in the near future. Call several days in advance of your trip down and I can arrange a VIP (Volunteer in the Park) certification for you, so that you can stay in a research dormitory which we have available, in addition to arranging transportation for you and your equipment to and fro.

I'm looking forward to seeing you soon and assisting in any way that may be helpful.

Sincerely,

Burt Rhyne
Curator



United States Department of the Interior

NATIONAL PARK SERVICE

CUMBERLAND ISLAND NATIONAL SEASHORE

P.O. Box 806

St. Marys, Georgia 31558

IN REPLY REFER TO:

N14 (CUIS)

September 10, 1985

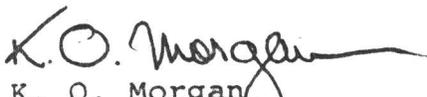
Dr. J. P. Richardson
Savannah State College
Department of Biology and Life Sciences
Marine Biology Program
Savannah, Georgia 31404

Dear Dr. Richardson:

Thank you for your letter of August 26, the herbarium specimens and the report about the Cumberland Island jetty flora. The specimens have been added to our herbarium and the report will be cataloged into the library.

If your one year study proposal bears fruit, we would be glad to assist you with transportation to and from the jetty on a "when available and feasible basis". It is my understanding that the assistance would be needed once a month. I am not aware of any possible funding sources. Good luck on the proposal.

Sincerely,


K. O. Morgan
Superintendent

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Table 1.

SPECIES REPORTED FROM CUMBERLAND ISLAND JETTY, GEORGIA

EXCLUSIVE
TO CUI JETTY
IN GA

SPECIES	FEB	JUL	AUG ¹	NC ² JETTIES	FL ³ ROCKS
BRYOPSIS PLUMOSA	+	+		+	
ENTEROMORPHA FLEXUOSA	+	+		+	+
BOSTRICHIA RADICANS	+	+			
* GELIDIUM CRINALE	+	+		+	+
* GRACILARIA FOLIIFERA	+	+	+	+	+
* GRATELOUPIA FILICINA	?	+	+	+	+
* GYMNOGONGRUS GRIFFITHSIAE	+	+	+	+	+
* HYPNEA MUSCIFORMIS	?	+	+	+	+
BLIDINGIA MARGINATA	+				
ENTEROMORPHA LINZA	+			+	+
ENTEROMORPHA PROLIFERA	+			+	
ULVA CURVATA	+				
PETALONIA FASCIA	+			+	+
SCYTOSIPHON LOMENTARIA	+			+	
* CALLITHAMNION BYSSOIDES	+			+	
* PORPHYRA CAROLINENSIS	+			+	
PORPHYRA ROSENGURTTII	+			+	
* ULVA FASCIATA			+	+	+
ULVA RIGIDA		+		+	
* PADINA VICKERSIAE		+	+	+	
* ACROCHAETIUM SERIATUM			+	+	
* BRYOCLADIA CUSPIDATA		+	+		+
* CALLITHAMNION SP.			+		
* CERAMIUM FASTIGIATUM			+	+	
* ERYTHROTRICHIA CARNEA			+	+	+
* HYPOGLOSSUM TENUIFOLIUM			+	+	
* POLYSIPHONIA GORGONIA		+	+		
POLYSIPHONIA HAVANENSIS		+			
* RHODYMENIA PSEUDOPALMATA VAR. CAROLINIANA			+	+	

¹CHAPMAN, R.L. 1971²WILLIAMS, L.G. 1948; 1949³HUMM, H.J. 1952KAPRAUN, D.F. & F.W. ZECHMAN, 1982
RICHARDSON, J.P. (PUBL. & UNPUBL.)

Table 2. Quantitative comparisons of Cumberland Island jetty algal assemblage with jetty Floras in North Carolina and Florida.

CUMBERLAND ISLAND JETTY, GEORGIA

	TOTAL		EXCLUSIVE TO CUIJ IN GA		SHARED WITH NC JETTIES		SHARED WITH MARINELAND	
	No.	%	No.	%	No.	%	No.	%
CHLOROPHYCEAE	8	28	1	13	6	75	3	38
PHAEOPHYCEAE	3	10	1	33	3	100	1	33
RHODOPHYCEAE	18	62	15	83	13	72	7	39
TOTAL FLORA	29		17	59	22	76	11	38
YEAR ROUND	8		5	63	7	88	6	75
WINTER FLORA	9		2	22	7	78	2	22
SUMMER FLORA	12		10	83	8	67	3	25
	29		17		22		11	

Publications in Last Five Years

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- Richardson, J.P. 1982. Life history of Bryopsis plumosa (Hudson) Agardh (Chlorophyceae) in North Carolina, USA. Botanica Marina 25:177-183.
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VITA

Joseph Powell Richardson, Ph.D.
Associate Professor of Marine Biology
Marine Biology Program
P.O. Box 20583
Savannah State College
Savannah, Georgia 31404
(912) 356-2314
Social Security: 415-80-6381

Home: 1837 Walthour Road
Savannah, Georgia 31410
(912) 897-3180
Born: July 8, 1952

Education

B.A. Biology, University of Tennessee, Knoxville, TN 1974.

Ph.D. Marine Sciences, University of North Carolina, Chapel Hill, NC 1978.

Honor Societies

Phi Beta Kappa
Phi Kappa Phi
Beta Beta Beta

Professional Organizations

International Phycological Society
Phycological Society of America
Board of Trustees, Savannah Science Museum

Professional Experience

- 1984 - Present Associate Professor of Marine Biology
Department of Biology and Life Sciences
Savannah State College
Savannah, Georgia 31404
- 1979 - 1984 Assistant Professor of Biology
Department of Biology and Life Sciences
Savannah State College
- 1982 - Present Field Investigator, Marine Fish Intercept Interviewer.
KCA Research, for National Marine Fisheries Service
National Statistical Survey of Marine Recreational Fishermen
- 1983 - Present Field Scientist. Consultant to Water and Air Research, Inc.
for National Marine Fisheries Service. Environmental investigations
relating to dredge, fill and water-development projects.
- 1976 - 1978 Graduate Teaching Assistant, Curriculum of Marine Sciences,
University of North Carolina, Chapel Hill, NC.

Courses Taught

Oceanography
Marine Biology
General Biology
Marine Invertebrate Zoology
Introduction to Marine Science

Biological Oceanography
Physiological Ecology
Marine Chemistry
Marine Environments

Research Experience

Marine algal metabolites: Production, analysis and biological activity. NIH, MBRS Program research grant to Drs. J.P. Richardson and C.O. Emeh, SSC. 1983-1987, \$304,627.

Research and undergraduate training grant to study the marine fisheries ecology and community structure of selected reef fishing sites. NMFS, Department of Commerce. 1984-1985, Drs. M.R. Gilligan and J.P. Richardson, investigators. \$26,242.

Continuation of NMFS, Department of Commerce grant, 1985-1986. \$27,000.

Spatial and temporal distributions of benthic marine algae in coastal Georgia, 1979-present.

Descriptive and quantitative analysis of geology, chemistry, biology and water flow in a salt marsh tidal creek; faculty advisor to student, SSC, 1981.

Quantitative investigation of effects of lunar tidal rhythms on capture of commercial shrimp species in a Georgia estuary; faculty advisor to student, SSC, 1980-1981.

Development of Marine Algal Herbarium at Savannah State College, 1979-present.

Dissertation research: Field, laboratory and culture experimental investigations of life-histories of subtidal benthic marine algae, and the environmental factors affecting their growth, reproduction and development in a seasonal environment; University of North Carolina, 1975-1978.

Comparison of hermit crab populations, sex ratios and size distributions by numerically characterizing shell size and shape; graduate research assistant, UNC, 1975.

Zizania aquatica (Wild rice) cultivation and transplantation from Cape Fear River Estuary to North Carolina Botanical Garden, Chapel Hill, NC; graduate research assistant, UNC, 1974.

Development of technique for and quantification of housedust algae in relation to season and atmospheric conditions; undergraduate research assistant, University of Tennessee, 1973-1974.

Analysis of insulation efficiencies in commercial fishing vessel ice bunkers, and analysis of marketable finfish captured in commercial shrimp trawls; North Carolina Sea Grant research assistant, 1971.

Cruise and Field Experience

R.V. Calanus cruise, Little Bahama Bank, May 1975, Geological Oceanographic Research.

Marine Laboratory experience: Summer 1976, Institute of Marine Sciences, Morehead City, NC; Marine Mycology and dissertation research.

R.V. Seahawk cruise, Georgia continental shelf, November 1985, Live bottom/reef community research.

Marine algae collections: Bahamas - May 1975
New England to Nova Scotia - September 1976
Florida and Keys - March 1977
California - August 1977
Inshore North Carolina & Georgia - 1976-1985
Georgia continental shelf - 1984-present

Professional Meetings/Presentations

American Inst. of Biological Sciences: Tempe, AZ, 1974; Athens, GA, 1978, Gainesville, FL 1985.
Assoc. Southeastern Biologists: Savannah, GA, 1974; Knoxville, TN, 1981.
Ninth International Seaweed Symposium: Santa Barbara, CA, 1977.
Northeastern Algal Symposium, Woods Hole, MA: 1977, 1978.
Southeastern Estuarine Research Society, Savannah, GA, 1983.
Southeastern Algal Colloquy: Savannah, GA, 1980; Melbourne, FL, 1984; Beaufort, NC, 1985.
Gray's Reef Marine Sanctuary Management Workshop: Jekyll Island, GA, 1981; Savannah, 1984.
Georgia Academy of Science: Carrollton, GA, 1985.

Presentations/Abstracts

Richardson, J.P., R.D. Holland, P.L. Walne & R.P. Hornsby. 1974. Quantification of algal populations of housedust. ASB Bull. 21(2):78.

Holland, R.D., P.L. Walne, J.P. Richardson & R.P. Hornsby. 1974. Allergenic effects of housedust algae. ASB Bull. 21(2):62.

Richardson, J.P., R.D. Holland & P.L. Walne. 1974. Studies on quantification of algal populations in housedust; possible relevance to human allergenicity. Journal of Phycology 10(suppl.):19.

Richardson, J.P. 1977. Overwintering of Dictyota dichotoma near its northern limit of distribution on the east coast of North America. Journal of Phycology 13(suppl.):58.

Richardson, J.P. 1978. Growth and reproductive strategies of Ectocarpus fasciculatus in a seasonal environment. Journal of Phycology 14(suppl):4.

Richardson, J.P. 1981. Abundance of shrimp in response to moon stage. ASB and Beta Beta Beta Regional meeting, Knoxville, TN.

Arkwood, G.D., T.R. Kozel & J.P. Richardson. 1983. Effects of Altosid SR-10 and salinity on three Poecilids. SEERS Meeting, 1983, Savannah, GA.

Richardson, J.P. 1984. Additions to the inshore benthic algal flora of Georgia. Sixth Southeastern Phycological Colloquy, F.I.T., Melbourne, FL.

Screen, P.A., C.L. Taylor, C.O. Emeh & J.P. Richardson. 1985. Sensitivity of several pathogenic microorganism to metabolites of Ectocarpus siliculosus and Bryopsis plumosa. GA Journal of Science 43:56.

Richardson, J.P. 1985. Floristic characteristics of the benthic marine algae of coastal Georgia. Journal of Phycology 21(suppl.):10.

Richardson, J.P. 1985. Additions to the coastal seaweeds of Georgia. Bull. GA Academy of Science 43:10.

Publications and Manuscripts

Richardson, J.P. 1978. Effects of environmental factors on the life histories and seasonality of some inshore benthic marine algae in North Carolina. Ph.D. dissertation, University of North Carolina, Chapel Hill, NC. 141 pp.

Richardson, J.P. 1978. Key to common North Carolina summer algae. (in) North Carolina Marine Education Manual, Coastal Ecology. L. Maudlin & D. Frankenberg (eds.). UNC Sea Grant Publication. UNC-SG-78-14-C.

Richardson, J.P. 1979. Overwintering of Dictyota dichotoma (Phaeophyceae) near its northern distribution limit on the east coast of North America. Journal of Phycology 15(1):22-26.

Richardson, J.P. 1980. Checklist of seaweeds likely to be found on the continental shelf of Georgia. Appendix E - Marine Flora. (in) Final Environmental Impact Statement on the Proposed Gray's Reef Marine Sanctuary. Marine Sanctuary Program, Office of Coastal Zone Management, NOAA.

Richardson, J.P. 1981. Persistence and development of Dasya baillouviana (Gmelin) Montagne (Rhodophyceae, Dasyaceae) in North Carolina. Phycologia 20(4):386-391.

Richardson, J.P. 1982. Life history of Bryopsis plumosa (Hudson) Agardh (Chlorophyceae) in North Carolina, USA. Botanica Marina 25:177-183.

Richardson, J.P. (unpublished manuscript). Effects of grazing and predation on community structure of a subtidal rocky substrate in a North Carolina estuarine ecosystem.

Richardson, J.P. 1984. (Unpublished manuscript, contracted research). Vegetative analysis of the old Folly Causeway between Oak Island Canal and Long Island, Charleston County, South Carolina, May 22, 1984.

Richardson, J.P. 1985. (Unpublished manuscript for Cumberland Island National Seashore). Preliminary summary of the marine algal flora at the jetty on Cumberland Island National Seashore.

Richardson, J.P. (in review). Additions to the macroalgal flora of coastal Georgia. (submitted to GA Journal of Science).

Richardson, J.P. (in review). Floristic and seasonal characteristics of inshore Georgia macroalgae. (submitted to Bull. Mar. Sci.).

Budget Explanation Page

A. Senior Personnel

1. PI - Joseph P. Richardson

	<u>Salary</u>	<u>Fringe</u>
Summer 1986: 1/9 AY salary = 1/9 x \$29282 =	\$ 3254	\$ 645
First summer salary for: field trips, acquiring supplies, arranging sampling schedule and trips, developing sampling scheme. (Fringe rate during summer = 19.81%)		
AY 1986-87: 1/9 AY salary = 1/9 x \$32210 =	3579	1002
(assuming 10% increase over 1985-86 AY salary)		
AY salary for release time during AY for field trips, sample processing and data processing. (Fringe = 28%)		
Summer 1987: 2/9 AY salary = 2/9 x \$32210 =	7158	1418
Second summer salary for finishing field work, data analyses and publication preparation. (Fringe = 19.81%)		
 Total for PI	 13991	 3065

B. Other Personnel

4. One undergraduate student research assistant for assistance with specimen handling, preservation, data processing and field trip preparation.

Summer 1986: 15 hrs/week x 6 weeks x \$4/hr =	360
1986-87 AY : 15 hrs/week x 30 weeks x \$4/hr =	1800
Summer 1987: 15 hrs/week x 10 weeks x \$4/hr =	<u>600</u>

Total for Other Personnel 2760

Total Salaries and Wages 16751

C. Fringe Benefits (Total) 3065

Total Salaries, Wages and Fringe Benefits = \$ 19816

D. No permanent equipment requested.

E. Travel

1. Domestic

Field trips to Cumberland Island jetty (study site)

1 trip/month x 12 months x 260 mi/trip x 0.20/mi =	\$ 624
Ferry to Cumberland Island: \$6.25/trip x 12 trips =	75
Motel: 6 nights x \$35/night =	210
(When necessary due to time of low tide, ferry schedule and in case of bad weather).	
Food: \$10/trip x 12 trips =	<u>120</u>

Total for field work 1029

Travel to meetings for presentations of research = 400

Total Travel = 1429

F. No Participant Support Costs

G. Other Direct Costs

1. Materials and Supplies = \$415
Bags, labels, buckets, rope, gloves, formalin, herbarium paper,
jars, film, wet suit top, other field gear, film processing.

2. Publication costs (materials, illustrations, page charges) = 400

Total Other Direct Costs = 815

H. Total Direct Costs (A-G) = 22060

I. Indirect Costs (68.8% of salaries and wages) = 11525
(App. III)

J. Total Requested = 33585

Savannah State College Share

1. AY 1986-87 release time = 3579

2. AY 1986-87 fringe benefits = 1002

3. Indirect costs for AY 1986-87 (68.8% of PI salary) = 3152

4. Provision of institutional equipment, including: = 7750
Selectra II Stereomicroscope, AO Stereomicroscope,
B & L compound microscope, AO compound microscope
with camera, underwater photometer, refractometer,
herbarium case and equipment

5. Secretarial service = 600

6. Secretarial/office supplies = 50

7. Telecommunications = 50

8. Duplication service and supplies = 50

9. Computer hardware, software and supplies = 125

10. Drafting & darkroom supplies, publication supplies = 250

11. Travel to meetings (presentation of research) = 200

Institutional Matching Share 16808

Total Cost = 50,393

Summary of all Current and Pending Research Support

	A	B	C	D	E		F
	Source of Support	Project Title	Award Amount (or Annual Rate)	Period Covered by Award	Person-Months or % of Effort Committed to the Project		Location Where Research is/will be per- formed
					ACAD.	SUMM.	
I.	Joseph P. Richardson						
A.	Current Support						
	NOAA	1.	27000	9/1/85-8/31/86	5%	0%	SSC
	NIH	2.	64754	6/1/85-5/31/86	11%	67%	SSC
B.	Proposals pending						
1.	This proposal	NPS	3.	7/1/86-8/31/87	11%	33% *	SSC
2.	Pending	(none)					
3.	Renewal applications (planned)	NIH	2.	6/1/86-5/31/87	11%	67%	SSC
II.	Co-investigator	N/A					
III.	Transfer of support	N/A (none)					
IV.	Other agencies for this proposal	ONR	Office of Naval Research				
		NSF	National Science Foundation				

Project Titles

1. Research and undergraduate training grant to study the marine fisheries ecology and community structure of selected reef fishing sites (NOAA, NMFS)
2. Marine algal metabolites: production, analysis, biological activity (NIH, Minority Biomedical Research Support Program)
3. Investigation of the marine algal assemblage and seasonal variation on Cumberland Island National Seashore jetty (this proposal)

* 33% = 11% during summer 1986, and 22% during summer 1987.

Appendix I. Matrix of microhabitat parameters, microhabitats present at the jetty, and legend for abundance and estimated density of species present within the microhabitats. (Adapted from Treviño-Murphy *et al.* 1985).

Matrix of Microhabitat Parameters

<u>Tide Level</u>	<u>Water Impact</u>	<u>Exposure to Light</u>
I Supralitoral	1 Direct hard	A Direct sun
II High mesotidal	2 Lateral or diagonal	B Semi-protected
III Mid mesotidal	3 Turbulence	C Total shade
IV Low mesotidal	4 Pool	
V Infralitoral	5 Splash	

Microhabitats Present at Jetty

I	5A 5B 5C	III	1A 1B 1C	IV	1A 1B 1C
II	1A 1B 1C		2A 2B 2C		2A 2B 2C
	2A 2B 2C		3A 3B 3C		3A 3B 3C
	3A 3B 3C		4A 4B 4C		4A 4B 4C
	4A 4B 4C			V	3A 3B 3C

Legend for Abundance and Density

<u>Abundance</u>	<u>Estimated Density (% cover in microhabitat)</u>
1 very few	a less than 10%
2 few	b 10-30%
3 common	c 30-70%
4 very abundant	d 70-90%
	e greater than 90%

Appendix II. Proposed format for data sheet to be used in the field for recording abundance and estimated density of species within various microhabitats on jetty. One data sheet will be used for each of the four transect areas each month. Data sheets will be prepared on water proof paper prior to field trips, and expected species will be listed prior to field trip. (Adapted from Trevino-Murphy et al. 1985)

RATE AGREEMENT
COLLEGES AND UNIVERSITIES

INSTITUTION: Savannah State College
State College Branch
Savannah, Georgia 31404

Date: June 18, 1985

FILING REF: The Preceding
Agreement was dated:
August 2, 1984

THE RATES APPROVED IN THIS AGREEMENT ARE FOR USE ON GRANTS, CONTRACTS AND OTHER AGREEMENTS WITH THE FEDERAL GOVERNMENT, SUBJECT TO THE CONDITIONS IN SECTION II.

SECTION I: RATES(S)

<u>TYPE</u>	<u>EFFECTIVE PERIOD</u>		<u>RATE</u>	<u>LOCATIONS</u>	<u>APPLICABLE TO</u>
	<u>FROM</u>	<u>TO</u>			
<u>INDIRECT COST RATES*</u>					
PREDETERMINED	7/1/84	6/30/85	76.1%	On-Campus	All Programs
PREDETERMINED	7/1/85	6/30/86	68.8%	On-Campus	All Programs

*Revised
69.63%*

BASE

*Direct salaries and wages including vacation, holiday, sick leave pay and other paid absence, but excluding other fringe benefits.

TREATMENT OF FRINGE BENEFITS: Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages, and are charged to grants, contracts and other agreements as part of the normal charges for salaries and wages. Fringe benefits applicable to direct salaries and wages are treated as direct costs. They include: FICA, Retirement, Life Insurance, and Hospital Insurance.

INSTITUTION: Savanhan State College
AGREEMENT DATED: June 18, 1985
PAGE 2.

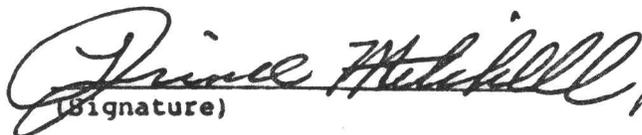
SECTION II: GENERAL

- A. LIMITATIONS: The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the institution were included in its indirect cost pool as finally accepted; such costs are legal obligations of the institution and are allowable under the governing cost principles; (2) The same costs that have been treated as indirect costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment, and (4) The information provided by the institution which was used to establish the rates is not later found to be materially incomplete or inaccurate.
- B. ACCOUNTING CHANGES: If a fixed or predetermined rate is in this Agreement, it is based on the accounting system purported by the institution to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this rate require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from indirect to direct. Failure to obtain approval may result in cost disallowances.
- C. FIXED RATES: If a fixed rate is in the Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the cost used to establish the fixed rate and actual costs.
- D. USE BY OTHER FEDERAL AGENCIES: The rates in this Agreement were approved in accordance with the authority in Office of Management and Budget Circular A-88, and should be applied to grants, contracts and other agreements covered by Office of Management and Budget Circular A-21, subject to any limitations in A above. The institution may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.
- E. SPECIAL REMARKS: None.

INSTITUTION: Savannah State College
AGREEMENT DATED: June 18, 1985
PAGE 3.

BY THE INSTITUTION:

SAVANNAH STATE COLLEGE
(Institution)


(Signature)

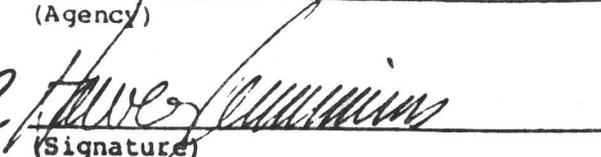
Mr. Prince Mitchell
(Name)

Vice President for
Business and Finance
(Title)

(Date)

BY THE COGNIZANT AGENCY ON BEHALF OF THE
FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES
(Agency)


(Signature)

Harvey Cummins
(Name)

Acting Director
Division of Cost Allocation
(Title)

June 18, 1985
(Date)

Contact: Harry Bobeng

Telephone: (404) 221-2455