

Native Hawaiian Culture and Arts Program
Submitted by the Polynesian Voyaging Society
February, 1991

I. APPLICATION TYPE

Purchase of Service: Canoe Construction Coordinator

II. PROPOSAL DESCRIPTION

A. Goal, Objectives and Methodology

GOAL: Recover and relearn knowledge, skills and traditions associated with constructing traditional Hawaiian ocean voyaging canoes and build mastery in the canoe building arts in line with the Exploration project Plan and the overall mission, goals and objectives of NHCAP.

OBJECTIVES:

- a. Produce an open ocean voyaging canoe built with traditional materials
- b. Produce a traditional coastal sailing canoe built with materials native to Hawaii, using traditional methods and tools.
- c. Preserve the canoe building arts by including apprentices in all phases of the canoe construction project.

PVS will form a canoe construction steering committee to work in coordination with NHCAP's Project Manager to accomplish the objectives listed above. This steering committee will be comprised of resources within the Society and will also draw from other experts in the community. The Society's work will be based upon the foundation of knowledge established by 16 years of sailing Hokule'a. Recognizing the educational value of this component of the Exploration Project, community involvement and documentation will be priorities in all phases of work.

METHODOLOGIES:

Objective: Produce an open ocean voyaging canoe built with traditional materials.

The areas of coordination which fall under this objective are listed as A, B, C, D and E in the Request for Proposal. A brief methodology description for each area follows.

A: Canoe design, testing and modifications as required:

PVS will monitor the construction of the canoe to assure adherence to design specifications. The selection of materials, their structural strength and durability will

be assessed on an on-going basis. PVS will plan, implement and coordinate the testing of the canoe as described in the Exploration plan under training voyages. This testing will be done in conjunction with the requirements for crew training. Modifications to canoe design will be made as needed, based upon the findings of these sea trials. Specific design factors relating to sail performance will be tested through sea trials with Hokule'a. The two major series of sea trials will be conducted from May 1 - July 26, 1992 and May 1 - September 26, 1993.

B: Construction of other canoe parts:

PVS will provide the required coordination to plan and implement the production of other canoe parts as specified by traditional canoe design. These parts include but are not limited to: gunnels, cross beams, decking, post, rails and steering sweeps. The sail rigging will include mast, spars, booms and mast steps. This work will be sub-contracted to expert woods craftsmen in Hawaii. PVS will hold responsibility for ensuring fabrication of these parts with appropriate materials, with assessment based on but not limited to strength, durability and accessibility. PVS will also monitor construction of these canoe parts to ensure adherence to design specifications. Evaluation and assessment will be on-going and will include sea-trials. Based on the findings of the sea trials and in coordination with the Project Manager and sub-contractors, appropriate modifications will be made.

C: Harvesting and replanting of olona:

PVS will sub-contract with community experts in the harvesting and replanting of olona. Contracts will address site assessment, availability of olona plants and harvesting and replanting procedures to assure the preservation and re-cultivation of this natural resource. This area of responsibility will be carried out as described in the Exploration Plan.

D: Production of sennit and olona cordage:

Based on cordage requirements to sail Hokule'a the Society will determine the cordage requirements for the lashing, rigging, provision and sailing of the traditional voyaging canoe. Once this determination is made, the Society will sub-contract with experts in the community for the production of the olona cordage. Critical factors in the award of these contracts will be the ability to produce cordage which will meet the strength and durability requirements for lashing and rigging the canoe. According to the Exploration plan, olona is limited in supply and difficult to obtain. It is the Society's initial assessment that this source will meet only a fraction of the total lashing requirements. To address this shortfall, the Society will sub-contract with experts in Hawaii and other Pacific Islands for the production of sennit. It is estimated that a minimum of 10 miles of 3/8" sennit will be needed, and production of this sennit presents a prime opportunity for community involvement.

E: Assembling canoe:

Assembly of the traditional canoe will include lashing and rigging of the iakos, gunnels, manus and wais to the hulls. The decking will also have to be lashed, along with the lashing of the posts and rails to the iakos. Rigging will include the mast steps, masts, spars, booms, steering sweeps and safety nets. The timeline specifies that the traditional canoe will need to be rigged, lashed and assembled three times. It is the Society's estimation that each assembly will take a minimum of 12 days.

The timeline also calls for Hokule'a to be rigged, lashed and assembled 4 separate times, and it is PVS's estimation requirements will be the same as for the traditional canoe.

PVS will hold responsibility for transporting all canoe materials to launching site. Based on the construction of Hokule'a, it is the Society's assessment that the actual assembly and rigging of this canoe will require the manpower of at least 32 people - 8 teams of 4. We propose designating a leader for each team, and will utilize the resources within the Society. These individuals have gained their knowledge and experience through the assembly, rigging and maintenance of Hokule'a, and in our estimation are among the best riggers in Hawaii. The other 24 individuals needed for the canoe's assembly will be students and helpers drawn from the community. We will also integrate this process with the requirements of the crew training component.

F: Production of canoe accessories:

The Exploration Plan does not provide information or guidelines regarding required canoe accessories. The Society's estimation of what may be required is based on past experience and includes:

- bailers
- anchors
- Coast Guard required safety gear (running lights, fixed bilge pumps, approved life preservers, flares, fire extinguisher, sound producing devices, life rings, first aid kits, emergency position indicator radio beacon, safety harnesses, signal mirrors, man overboard pole, portable bilge pumps, strobe lights, flashlights, VHF radio, single side band radio, reburied batteries and argos transponder)

Production of the bailers and anchors will be sub-contracted to experts in the community, with the requirement that this be done with traditional materials in the traditional manner. The Society will purchase and store all other equipment.

The Society will not be responsible for the following items, which should be addressed in other areas of this project.

- . cooking equipment
- . water and food storage containers
- . fishing gear
- . lauhala and cordage materials not addressed by this proposal
- . plant transportation
- . traditional and modern medicines
- . storage of lauhala sails
- . gifts

Objective: Produce a traditional coastal sailing canoe built with materials native to Hawaii, using traditional methods and tools.

Areas of coordination falling under this objective include:

- . research and design
- . collection of materials
- . construction of tools
- . construction of canoe

Methodology for each area is discussed below.

Research and design:

PVS will use its existing research committee and will contract any work falling outside the committee's scope and expertise. Developing a canoe design will include surveying existing koa canoes in Hawaii which are traditional in design. It will be NHCAP's responsibility to determine the traditional canoe specifications. Traditional materials and tools to be used will be determined through a survey of existing koa canoes and literature pertaining to this subject. Research regarding canoe construction will be deferred. The Society will sub-contract with a master canoe builder to train apprentices. The Society's first choice is Mau Piaiug. He has been born into a voyaging tradition and canoe building continues to be part of his daily life; he has a good and well established relationship with Hawaii's community; he has demonstrated his commitment to passing on his knowledge and he is well able to bridge the cultural gaps between his island society and Hawaii.

Collection of materials:

This function will be sub-contracted to individuals knowledgeable in native woods. PVS will monitor material collection to ensure adherence to design requirements. Materials will be needed for the following canoe parts:

- . hull
- . manus
- . wai
- . seats
- . iakos
- . decking
- . mast step
- . ama
- . spar
- . boom
- . cleats
- . paddles
- . steering paddles
- . bailers

Construction of tools

Community experts, the master canoe builder and apprentices will be drawn together to design a plan and construct the needed tools. Sub-contracting will be done on an as needed basis. Tools that may be needed are listed below, but the list is not limited to these items.

- . adzes of various sizes
- . pump drills
- . chisels
- . stone hammers
- . sanding and caulking tools

Construction of canoe

This will be done under the direction of the master canoe builder. Hull construction will be done in two phases. The first will include selection of the log, harvesting and hollowing. All of this will take place in the forest. With the help of the community the log will be hauled out using traditional techniques. The Society estimates it will not be possible to transport the log to Honaunau in a traditional manner, but conducting a portion of this process in the traditional way will provide insight into what was required of ancient Hawaiians.

The second phase include construction of the hulls at the canoe construction site in Honaunau. All other canoe parts will be constructed at the project site according to design specifications.

Appropriate ceremonies including canoe launching:

This work will be sub-contracted to experts who will research and conduct the

appropriate ceremonies relating to canoe construction and including the launching of the canoe.

Objective: Preserve the canoe building arts by including apprentices in all phases of the canoe construction project.

The Society will work in conjunction with the Project Manager and in concert with the requirements of the crew training and education components of the project to meet this objective and to develop a master/apprenticeship program. Virtually all phases of the canoe construction component lend themselves to this kind of program.

IV. APPLICANT EXPERIENCE

The vast water and island world of Polynesia is the most extensive nation on earth. It covers 10 million square miles -- all of Asia could fit within the Polynesian Triangle. The world of Polynesia was colonized and populated by voyagers who shared a common heritage. Their connecting link was the canoe.

When Westerner James Cook finally landed in Hawaii, he was astounded by the language he heard spoken. It was similar to the language he had heard in New Zealand, in the Central Pacific and in Tahiti. He asked, "How shall we account for this nation having spread itself to so many detached islands so widely disjoined from each other in every quarter of the Pacific Ocean?"

The Polynesian Voyaging Society was founded in 1973 to demonstrate that the ancient Polynesians settled their vast nation by design and with purpose. This non-profit educational organization was dedicated to conducting experimental research on Polynesian Voyaging and disseminating the results of that research. The Society's goal was to dispute those scholars who claimed that the early voyagers were merely victims of nature who drifted helplessly on the open ocean from one island to another. In the early years of its life, the Society designed a large voyaging canoe, raised construction funds and built Hokule'a.

In 1976, Hokule'a sailed to Tahiti. The sixty foot performance accurate replica of traditional voyaging canoes was navigated by Mau Piailug. He used no instruments on that voyage to Tahiti -- depending instead on his senses and the elements of nature. Piailug is a master navigator from the island of Satawal in Micronesia, and is one of a few remaining experts who were born into a voyaging heritage.

In 1980, the Hokule'a returned to Tahiti, this time with a young Hawaiian serving as navigator. He was the first Polynesian in modern times to navigate without instruments.

In 1985, the Society undertook its most ambitious endeavor, retracing the migratory routes of the early Polynesians. This 16 thousand mile voyage was a tremendous undertaking. Hokule'a and her crews traveled throughout the Polynesian Triangle -- to Tahiti, the Cook Islands, New Zealand, Tonga, Samoa, back to Tahiti and then home to Hawaii. The entire journey was done without the aid of any navigational instruments.

The success of the "Voyage of Rediscovery" best demonstrates the ability of the Polynesian Voyaging Society and its members in meeting all of the evaluation criteria listed in the Purchase of Service Proposal. Many of the evaluation criteria have already been addressed in this application: the technical expertise and experience of the organization; the Society's ability to conduct research; develop and implement evaluation procedures; commitment to education and documentation, and experience in working in coordination with other individuals and groups in these efforts.

The ability of PVS to network and cooperate with people throughout Hawaii and other Pacific Island nations is best symbolized by the crew which brought the Hokule'a home to Hawaii in 1987. Crew members aboard represented the peoples of Tahiti, the Cook Islands, New Zealand, Tonga, Samoa, the Marquesas and Hawaii. Through their presence on the canoe, each of these individuals and the island nations represented demonstrated the depth of their commitment to recognizing the achievements of Polynesian explorers.

The Society's experience in coordinating volunteers and maximizing community involvement can be seen in the fact that with the exception of one paid staff member, the Voyage of Rediscovery was accomplished through the efforts of volunteers, in Hawaii, but throughout the Pacific. Many PVS members have already been active as volunteers with NHCAP. Their contributions are listed as an exhibit to this application.

The Society's fiscal responsibility is seen in the management of the Voyage of Rediscovery budget which totaled nearly \$1.5 million.

The commitment to the Native Hawaiian community and culture spans 16 years. It is a commitment which embraces not only Hawaiians and Hawaii, but all of the people of the Pacific with whom we share a common and proud voyaging heritage.

V. OTHER KEY PROJECT STAFF, SUB-CONTRACTORS AND VOLUNTEERS

See exhibits

VI. PROJECT PARTICIPANTS

See exhibits

VII. PROPOSED BUDGET - EXPENSES

We have reviewed the budget and make the following comments:

- . it lacks clarity
- . no figures have been submitted for 1994
- . the budget is not consistent with the timeline
- . it appears the figures are not realistic.

The two weeks we had to draft this proposal did not allow sufficient time to prepare an accurate budget. What we have presented to you is done with the caveat that in all probability adjustments will have to be made as the project moves forward.

The following changes are reflected in the attached budget:

- . for fiscal years 1990 and 1991, we expect an overage as insufficient funding was allocated for the construction of the traditional canoe

- administrative and planning costs have been deleted from the 1990 budget. Funds are allocated in 1991 - 1993 budget years with an increase in administrative costs
- adjustments have been made to reallocate funds and activities between fiscal years 1990 and 1991 to complete the immense amount of work scheduled for 1990.

We suggest meeting with the Project Manager to formulate a more accurate and realistic budget.

VIII. PROPOSED BUDGET -- CASH INCOME

It is anticipated that the cost of this project will be funded entirely by NHCAP, with the exception of in-kind donations by our members.

IX. IN-KIND CONTRIBUTIONS

Included under Crew Training Coordinator proposal

1990-1994 Budget Overview

	1990	1991	1992	1993	1994
II. Canoe Construction					
1) Voyaging Canoe					
A) Canoe Design	5,000	3,000	2,000	2,000	0
B) Other Canoe Parts	20,000	20,000	15,000	15,000	0
C) Harvesting/Replanting Olona	20,000	10,000	10,000	10,000	0
D) Sennit & Olona Cordage/Lashing	13,000	10,000	10,000	10,000	0
E) Assembling Canoe	2,000	0	7,000	10,000	5,000
F) Canoe Accessories	0	0	7,000	5,000	0
2) Traditional Coastal Sailing Canoe					
A) Research & Design	4,000	0	0	0	0
B) Collection of Materials	10,000	0	0	0	0
C) Construction of Tools	6,000	0	0	0	0
D) Construction of Canoe	0	20,000	0	0	0
E) Appropriate Ceremonies	0	5,000	0	0	0
3) Administrative Costs					
A) Salaries-Office Manager	0	10,500	11,025	11,576	0
B) Operating Expenses	0				0
a) General Office Supply	0	500	525	552	0
b) Telephone Services	0	500	525	551	0
c) Miscellaneous Expenses	0	50	53	55	0
TOTALS PER YEAR	80,000	79,550	63,128	64,734	5,000

1990 Budget

II. Canoe Construction

1) Voyaging Canoe		
A) Design		5,000
a) Complete technical line drawings & sail plan	3,000	
b) Lofting	1,000	
c) Monitor hull construction	1,000	
B) Other Canoe Parts		20,000
a) Produce 4 each of iako, mast and spars; and mast steps and sweeps	20,000	
C) Harvesting/Replaning Olona		20,000
a) Complete site assessment and resource availability	20,000	
D) Sennit & Olona Cordage/Lashing		13,000
a) Determine total lasing requirements	0	
b) Produce samples for lashing	10,000	
c) Test samples at sea and in lab	3,000	
E) Assemble Canoe		2,000
a) Lash samples & rig Hokule'a	2,000	
F) Canoe Accessories		0
2) Traditional Coastal Canoe Construction		
A) Research and Design		4,000
a) Traditional materials, tools, and methods	3,000	
b) Basic design drawings	1,000	
B) Collection of Materials		10,000
a) For canoe and tools	10,000	
C) Construction of Tools		6,000
3) Administrative Costs		0

1991 Budget

II. Canoe Construction

1) Voyaging Canoe		
A) Design		3,000
a) Monitor hull construction	3,000 out	
B) Other Canoe Parts		20,000
a) Produce all other canoe parts required to complete construction of the voyaging canoe	20,000	
C) Harvesting/Replanting Olona		10,000
a) Complete first harvest/replant	5,000	
b) Monitor sites	5,000	
D) Sennit & Olona Cordage/Lashing		10,000
a) Produce samples for lashing tests	4,000	
b) Produce lashing dordages as required	6,000	
E) Assemble Canoe		0
F) Canoe Accessories		0
a) Produce initial testing of all accessories included in sea trials		
2) Traditional Coastal Canoe Construction		
A) Construction of Canoe		20,000
B) Appropriate Ceremonies		5,000
a) To research and conduct appropriate ceremonies necessary for all aspects of construction and launching	5,000	
3) Administrative Costs		11,550
a) Salaries - Office Manager	10,500	
b) Operating Expenses		
General Office Supplies	500	
Telephone Services	500	
Miscellaneous Expenses	50	

1992 Budget

II. Canoe Construction

1) Voyaging Canoe		
A) Design		2,000
a) Evaluate sailing performance of canoe	100	
b) Revise & modify design as required	1,000	
c) Monitor hull construction modifications	900	
B) Other Canoe Parts		15,000
a) Test & evaluate all canoe parts (twice)	0	
b) Modify & produce canoe parts as required	15,000	
C) Harvesting/Replanting Olona		10,000
a) Complete second harvest/replant	5,000	
b) Monitor sites	5,000	
D) Sennit & Olona Cordage/Lashing		10,000
a) Test samples at sea (twice)	2,000	
b) Produce lashing dordages as required (twice)	8,000	
E) Assemble Canoe		7,000
a) Lash/rig traditional canoe at Kualoa	5,000	
b) Lash samples & rig Hukule'a for Rarotonga	2,000	
F) Canoe Accessories		7,000
a) Test/evaluate all accessories (twice)	0	
b) Modify & produce canoe accessories for testing	7,000	
2) Traditional Coastal Sailing Canoe		0
3) Administrative Costs		12,128
a) Salaries - Office Manager	11,025	
b) Operating Expenses		
General Office Supplies	525	
Telephone Services	525	
Miscellaneous Expenses	53	

1993 Budget

II. Canoe Construction

1) Voyaging Canoe		
A) Design		2,000
a) Evaluate sailing performance	100	
b) Revise & modify design as required	1,000	
c) Monitor hull construction	900	
B) Other Canoe Parts		15,000
a) Complete testing and evaluation	0	
b) Modify & produce final canoe parts	15,000	
C) Olona Harvest/Replant		10,000
a) Complete third harvest/replant	5,000	
b) Monitor sites	5,000	
D) Sennit & Olona Cordage/Lashing		10,000
a) Test samples at sea	2,000	
b) Produce lashing dordages as required	8,000	
E) Assemble Canoe		10,000
a) Lash/rig traditional canoe at Kualoa	5,000	
b) Las traditional canoe for voyage	5,000	
F) Canoe Accessories		5,000
a) Test & evaluate all canoe accessories	0	
b) Modify & produce final/canoe accessories	5,000	
2) Traditional Coastal Sailing Canoe		0
3) Administrative Costs		12,732
a) Salaries - Office Manager	11,576	
b) Operating Expenses		
General Office Supplies	552	
Telephone Services	551	
Miscellaneous Expenses	51	

2-1991 SAIL

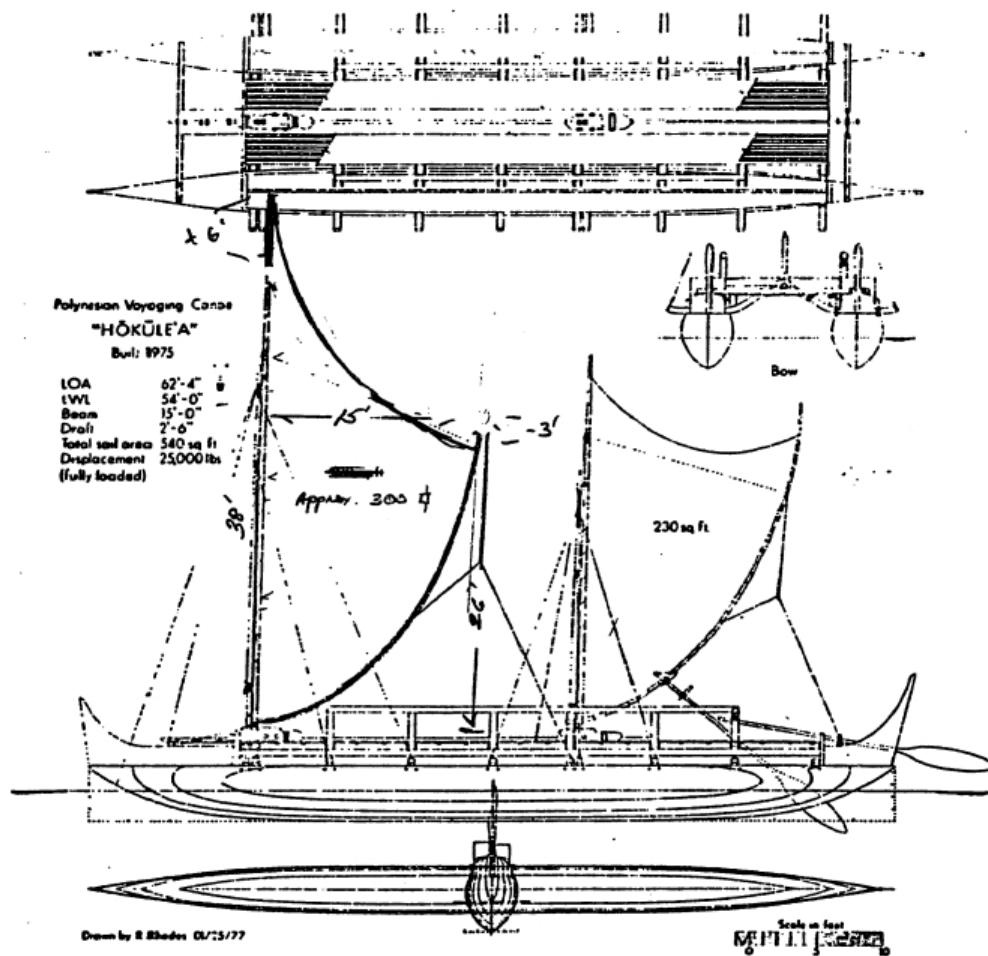
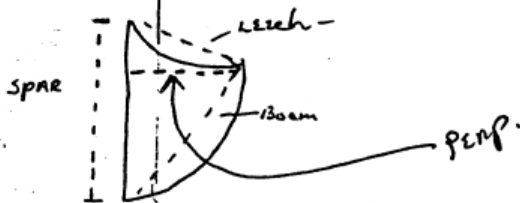


Figure 2.e - Outboard views and Lines of the Hokule'a
From Reference 17
Courtesy of Dodd, Mead Co., Publ.

Holker Co's Smith SAIL MEASUREMENTS -



moving

(415)

16' 3 1/2
29'

	# Perp.	Spar	Boom	18' 6"	Sq'	Condition
# 9	16'	38' 7"	32' 6"	18' 6"	330'	old worn - need to change
# 2	13' 8"	39' 0"	32' 0"	16' 6"	290'	old 100' - 11' Approx. 4 sq. holes - need patch
# 1	13' 7"	34' 8"	29' 9"	16' 0"	266'	Ratio condition, sq. hole / need patch
		39.0	32'	18'	400 sq'	

SAIL Area Formula = For Canvas Cloth
 $(\frac{1}{2} \text{ PERP} \times \text{SPAR}) + (\text{length of boom}) - \frac{1}{2} \text{ length of luff}$

$$\# 9 = (\frac{1}{2} 16 \times 38 \frac{7}{8}) + 32 - \frac{1}{2} 41 \frac{1}{2} = 294 \text{ sq'}$$

$$\# 2 = \frac{1}{2} 13.67 \times 39 + 32 - 8.25 = 291 \text{ sq'}$$

$$\# 1 = \frac{1}{2} 13.67 \times 34.67 + 30 - 8 = 259$$

Round

59'	230'
	270'
	266'

Straight Boom V.S. Curved Boom

Pros

Less strain on booms
Easier to fit sails to boom
Easier to repair boom and spar
Safer rig to triest in bad weather
Easier to sheet
Center of effort lower
Easier to stretch out sail
Boom is replaceable with rail
Easier and safer to lower in storms
Strain on boom equally distributed
Provide more sail area for length of boom and spar
Booms are easier to construct

Cons

Less support for leech
More strain on top of spar
Less asthetic
May not be traditional ? (All DEBATARE)

1 Sail vs 2 Sails

Pros

Lighter (reduce weight by 400#)
More space
Less weather helm
Less required gear
Rig less complicated
Easier and faster to triest or lower rig in bad weather
Easier to steer
Can lower full rig on deck
Require half the rigging material
Less costs
Easier to steer on different points of sail
Less pressure of sweeps on hulls -

Cons

- Less speed
- Less windward performance
- Need for 1 very large sail

INFORMA

ROBERT E. ARMSTRONG
NAVAL ARCHITECT
Marine Surveyors & Consultants, Ltd.
677 Ala Moana Blvd., Suite 812
Honolulu, Hawaii 96813

RED H...
= 14' LINES

