State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Aquatic Resources
Honolulu, Hawaii 96813

May 9, 2014

Board of Land and Natural Resources
Honolulu, Hawaii

REQUEST FOR APPROVAL TO AUTHORIZE THE CHAIRPERSON, BOARD OF LAND AND NATURAL RESOURCES, TO EXPEND *PORT ROYAL* TRUST FUNDS (NOT TO EXCEED $665,757.00) TO CONTINUE OPERATIONS IN FY 2015 AND FY 2016 OF THE SEA URCHIN HATCHERY AT THE DIVISION OF AQUATIC RESOURCES ANUENUE FISHERIES RESEARCH CENTER

Submitted herewith for your consideration is a request to authorize the Chairperson, Board of Land and Natural Resources, approval to use *Port Royal* trust funds to continue operations of the sea urchin hatchery at the Division of Aquatic Resources (DAR) Anuenue Fisheries Research Center (AFRC). Contractual staff conduct urchin hatchery operations via a collaborative project between DAR and the University of Hawaii's Pacific Cooperative Studies Unit. This funding request, not to exceed $665,757, will cover all staffing and operational costs required for operation of the urchin hatchery in FY15 and FY16.

DAR is seeking dedicated funding for this work, but currently none is fully secured. Without approval of trust funds, a lapse in work will result in an ecological decline of Oahu's coral patch reefs. Juvenile urchins are outplanted onto coral reefs to help curb the proliferation of invasive alien seaweeds.

Brief History:
The AFRC urchin hatchery project was initiated in October of 2009. By March 2010, a larval rearing facility was designed, and the first successful larval run was conducted in August. The first hatchery reared urchins were released in Kaneohe Bay in January 2011. In 2011, 5,000 urchins were released, 60,000 released in 2012 and 93,000 released in 2013. Over 200,000 hatchery-reared urchins have been released since the project's inception.

The Future:
Funds were secured in December 2013 to expand hatchery operations by an additional 20 tanks. Currently, these tanks are being fabricated, and all tanks are expected to be installed and

operational by the end 2014. Ongoing urchin propagation activities will continue during the installation period. The hatchery is expected to release approximately 120,000 urchins in calendar year 2014, and once all tanks are operational, it is projected the hatchery will release over 250,000 urchins each fiscal year.

The key objectives of this project are 1) to continue the successful operation and expansion of the AFRC sea urchin hatchery, achieving an annual production rate of 250,000 urchins by December 31, 2015; and 2) to support alien algae removal and coral reef restoration activities by providing urchins for ecosystem remediation. See Attachment A for FY15 and FY16 hatchery methods, activities, predicted deliverables, proposed spawn dates, and budget.

RECOMMENDATION:

"That the Board:

1. Authorize the BLNR Chairperson to expend Port Royal trust funds, not to exceed $665,757.00, to continue operations of a sea urchin hatchery at the Division of Aquatic Resources' Anuenue Fisheries Research Center during the period July 1, 2014 through June 30, 2016.

2. Require a Final Report and Briefing for the Board within three months of the end of the funding period. "

Respectfully submitted,

FRAZER MCGILVRAY, Administrator
Division of Aquatic Resources

APPROVED FOR SUBMITTAL:

WILLIAM J. AILA, JR.
DLNR Chairperson

ATTACHMENT A

ANUENUE FISHERIES RESEARCH CENTER SEA URCHIN HATCHERY PROGRAM

Hatchery Methods, Activities, Predicted Deliverables and
Proposed Spawn Dates for FY 2015 and FY 2016*

David L. Cohen
Aquatic Invasive Species Biocontrol Specialist
and Urchin Hatchery Manager

April 11, 2014

Methods for propagating *Tripneustes gratilla* have been developed by the Department of Land and Natural Resources over the last several years at the Division of Aquatic Resources (DAR) Anuenue Fisheries Research Center (AFRC).

Hatchery Methods:

Spawning and Fertilization:
Tripneustes gratilla is an external broadcast spawner. When this sea urchin is gravid it is stimulated by environmental cues to release its gametes. Agitation by wave action is believed to be a primary spawning stimulus in the wild. Fertilization rate is dependent on overall gamete quality, proximity of male and female urchins, water quality and other environmental conditions. For AFRC hatchery larval production broodstock are collected from the wild. Routinely, 30 adult animals are collected from the wild and brought back to the hatchery for gamete collection. Animals are gently shaken by hand to induce spawning. Eggs and sperm are collected separately. Gametes are mixed in temperature & pH adjusted UV filtered seawater. After 24 hours, free swimming larvae develop and larvae are moved to 200L conical bottom larval rearing tanks.

Larval Rearing:
Proper husbandry of marine larvae calls for adequate attention to biological, chemical and physical environments. Each parameter must be monitored on daily basis and appropriate action must be taken to ensure larval health and survival. Free-swimming larvae are housed in 200L conical bottom tanks provided with gentle aeration. Aeration promotes gas exchange, prevents stratification and keeps the larvae in suspension. Animals are fed a base quantity of cultured phytoplankton after a daily water exchange. Phytoplankton cells in larval tanks are counted two to three times per day to determine feeding rate. More food (phytoplankton) is added as needed. Larval health and population size are assessed daily. A water exchange is performed on a daily basis using clean, pH adjusted, filtered, UV sterilized seawater. Over time, a film of bacteria and detritus collect on the sides and bottom of the larval rearing tanks. These films have a negative effect on larval health and population. To mitigate these effects, tank changes are performed every two to four days as required.

*Does not include R&D or outreach activities. Also, does not include ongoing labor for hatchery expansion.

Metamorphosis, Settlement and Post-Larvae:
At three to four weeks of age the free-swimming larvae are ready to undergo metamorphosis and settle. A unique set of observational metrics have been developed at AFRC to determine larval competency for settlement. As these changes in anatomy become evident, the larvae are transferred out of the larval rearing facility and into settling tanks. Settling tanks are prepared with ambient biofilms. Biofilms are cultured by running filtered seawater though tanks for two weeks prior to settlement. Tanks are exposed to ambient temperatures and sunlight. Clear plastic plates are placed in tanks to collect biofilms and act as settlement substrate. Each tank must be provided with appropriate aeration, filtration, water flow and removable shade. Tanks are monitored daily. Shades or shade cloth are added or removed to control temperature and biofilm growth.

Juvenile Urchins and Nursery Grow-out:
At an average age of 10 to 14 weeks, as the urchins achieve a size of 5mm to 7mm, they can begin eating seaweeds. Population densities are thinned to facilitate faster growth and improved hygiene. Some animals are moved to other tanks or floating downweller silos while some animals remain in settlement tanks until ready for harvest. Animals are monitored for growth and overall health. Water quality parameters are monitored. Animals are fed daily with cultured seaweeds. Tanks must be cleaned on a regular basis. As the fastest growing urchins reach a size of 15mm they are harvested and placed in floating downweller silos where they are prepared for outplanting to Kaneohe Bay. At an average of 18 to 20 weeks of age most urchins begin to achieve a size of 15mm, and can be transferred out to Kaneohe Bay.

At present urchins are released at a minimum size of 15mm. The urchins grow at a variable rate and reach 15mm sometime from 3 months to seven months of age, with the majority of the animals reaching 15mm at about 5 months.

Phytoplankton culture (in support of larval rearing activities):
Sea urchin larvae are fed a diet of cultured marine phytoplankton. An excellent description of standard culture methods may be found in the FAO Publication, *Manual on the Production and Use of Live Food for Aquaculture*, Edited by Lavens & Sorgeloos, Ch 2 by Peter Coutteau, http://www.fao.org/docrep/003/W3732E/w3732e03.htm#2.%20MICROALGAE.

The AFRC hatchery uses a batch method to culture to two species of phytoplankton under artificial light. The cultures terminate in 40L and 100L cylinders. These algae are fed to urchin larvae at a predetermined specific ratio. The hatchery produces about 720L of phytoplankton for harvest per week. That volume is adjusted up or down depending upon the rate of consumption of the urchin larvae. Culture transfers are performed three times per week. Harvestable phytoplankton is sampled and monitored daily for pH, density and cleanliness. Cells are counted daily using a hemocytometer.

Seaweed Culture (in support of nursery grow-out activities):
When juvenile sea urchins reach a size of 5mm to 7mm they are able to consume seaweed. At AFRC seaweed is cultured to feed juvenile urchins. Seaweed is grown in a variety of tanks under a variety conditions depending upon tank space availability. These macroalgae generally grow faster in summer months and slower in winter months as sunlight waxes and wanes.

The seaweed is grown in a tumble culture where heavy aeration is used to tumble the seaweed within a tank. Air tubes are run to the bottom or along the bottom of a tank. This creates a circular motion from the bottom of a tank, to the surface and down again. Tumble culture exposes the macroalgae to light and promotes maximum gas exchange.

Seaweed cultures need to be maintained to prevent overgrowth of diatoms and infesting "weeds". Tanks need to be cleaned on a weekly basis to keep biofilm growth in check. Macroalgae is harvested as needed to feed juvenile sea urchins.

Hatchery Activities Summary:
The AFRC sea urchin hatchery is operated and staffed seven days per week. One full-time project leader, four full-time technical staff, and volunteer groups that assist with urchin harvest and routine maintenance staff the hatchery. Live animals and plant cultures require daily attention to avoid mortality and ensure success.

Eight or nine (8 or 9) spawning events per year with a targeted yield of 30,000 urchins per spawn:	25 hours per month (~6 hours per week)
Phytoplankton culture in support of larval rearing activities:	35 hours per week
Larval rearing:	70 hours per week
Hatchery Maintenance: Many activities take place between larval runs and during extended production breaks. Including reagent preparation, tank maintenance, facility repair, pump blower maintenance & rebuild.	

Nursery Activities:

Seaweed culture with a targeted yield of 125 Kg / per week in support of nursery grow-out activities:	5 hours per week
Feeding & monitoring animals:	18 hours per week
Sorting and preparing urchins for release:	50 hours per week
Nursery Maintenance - Including equipment care and maintenance, equipment fabrication, data entry:	40 hours per week

Activities and Time Budget:

Activity	Purpose / Comment	Outcome / Deliverable	Work hours per week
Larval Rearing Activities:			
8 or 9 Spawns / year	25 hours per event	4.8 million larvae per event	6
Phytoplankton Culture	Supports Larval Rearing	720 L algae per week	35
Larval Rearing	Feeding, monitoring, husbandry	200,000 Competent larvae per cycle	70
Grow-Out Activities:			
Seaweed Culture	Supports Nursery	125 kg / week max.	25
Feeding, monitoring, cleaning	General husbandry		18
Sorting, Harvest	Prep for release	5,000 – 7,000 per month	50
Maintenance	Supports Nursery		40
		Total Time Budget:	244

Number of Urchins per Year (Predicted):

Time Period	Predicted Harvest for Outplant
January – December 2014	120,000 Sea Urchins
January – December 2015	250,000 Sea Urchins
January – December 2016	250,000 Sea Urchins

Spawning Schedule, 2014 – 2016:

2014 Proposed Spawn Dates	**2015 Proposed Spawn Dates**	**2016 Proposed Spawn Dates**
February 18, 2014 - Completed	February 17, 2015	February 16, 2016
March 31, 2014 - Completed	March 26, 2015	March 21, 2016
May 5, 2014	April 27, 2015	April 25, 2016
June 9, 2014	June 1, 2015	June 6, 2016
July, 14, 2014	July 13, 2015	July 11, 2016
August 11, 2014	August 10, 2015	August 8, 2016
September 15, 2014	September 14, 2015	September 12, 2016
October 20, 2014	October 19, 2015	October 17, 2016
December 1, 2014 - *Tentative*	November 30, 2015 - *Tentative*	November 28, 2016

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PROPOSED FY 15 AND 16 SEA URCHIN HATCHERY BUDGET

Year 1 (FY 15)			
	Salary	Fringe (35%)	Total
Project Leader	57,880	20,258	78,138
Senior hatchery Tech	36,000	12,600	48,600
Hatchery tech	32,130	11,245	43,375
Hatchery tech	31,500	11,025	42,525
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Sub total	**189,010**	**66,154**	**255,163**
PCSU Direct			13,465
UH Indirect Cost			26,863
Subtotal salary, fringe and overhead			*295,491*
Equipment, Supplies, Travel			30,000
Total Project Cost			**325,491**

Year 2 (FY 16)			
	Salary	Fringe (35%)	Total
Project Leader	60,774	21,271	82,045
Senior hatchery tech	37,800	13,230	51,030
Hatchery tech	33,737	11,808	45,545
Hatchery tech	33,075	11,576	44,651
Hatchery tech	33,075	11,576	44,651
Sub total	**198,461**	**69,461**	**267,922**
PCSU Direct			14,138
UH Indirect Cost			28,206
Subtotal salary, fringe and overhead			*310,266*
Equipment, Supplies, Travel			30,000
Total Project Cost			**340,266**

Total Project Cost, Year 1:	325,491
Total Project Cost, Year 2:	340,266
Total Cost FY15 and FY16	**$665,757**