MINUTE ITEM
This Calendar Item No. C74 was approved as Minute Item No. 74 by the California State Lands Commission by a vote of 3 to 0 at its 05/10/07 meeting.

CALENDAR ITEM
C74

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Statewide

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05/10/2007
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C2006-068
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D. Brown

REQUEST AUTHORITY TO ENTER INTO AGREEMENT TO EXPAND INVASIVE SPECIES RESEARCH TO CHARACTERIZE THE TRANSFER OF ORGANISMS ON SHIPS' HULLS FOR SHIPS ARRIVING AT PORT SYSTEMS IN THE WESTERN U.S.

PARTY:

California State Lands Commission
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BACKGROUND:

Hull fouling has been a long-standing mechanism, or "vector" of species transfers throughout the world, and has led to numerous nonindigenous species (NIS) introductions. Fouling organisms attach to submerged hard surfaces, including the underwater portions of commercial ships. As vessels transit from place to place, they can also transport nonindigenous fouling organisms which can be introduced to regions where they do not occur naturally. In Hawaii, vessel fouling is believed to be responsible for more successful marine introductions than any other mechanism (Eldredge and Carlton 2002). For North America, one study estimated that fouling accounts for at least 36% of all shipping-related introductions of invertebrates and algae (Fofonoff et al. 2003).

Though the importance of ship fouling for species introductions has been well recognized, critical information gaps remain for determining the risk posed by commercial vessel movements and associated assemblages of fouling organisms. In particular, specific data for the U.S. Coastline is limited. A California State Lands Commission report put forward to the State Legislature last year stated, "The limited amount of scientific research on vessel fouling and NIS in California and the West Coast is the most prominent obstacle to a clear evaluation of the overall risk faced by the State" (Takata et al. 2006).

The Commission's Marine Facilities Division entered into an agreement in 2005 with Portland State University (PSU) to initiate a long term study to analyze the extent and composition of fouling among vessels operating along the U.S. Pacific coast. A portion of the first phase of the study (2005-2006) characterized the potential magnitude of species transfers using wetted hull surface area as an initial proxy. The "wetted surface area" (WSA) statistic provides a very rough approximation of vessel surface that has the potential to be colonized by fouling organisms.

Over a two year period, the study estimated that approximately 265 million square meters or 102 square miles of WSA arrived to the U.S. West Coast. Approximately 64% of vessels arrived from outside of the three western states (Davidson et al. 2006). The large WSA suggests that the potential threat for fouling invasions may be significant. However, field data on fouling levels across several vessel types and effects of environmental conditions must be examined in order to assess the actual threat and to determine appropriate management measures to reduce the threat.

The Act requires the State Lands Commission (SLC) to

"*. . .. identify and conduct any other research determined necessary to carry out the requirements of this division. The research may relate to the transport and release of nonindigenous species by vessels, the methods of sampling and monitoring of the nonindigenous species transported or released by vessels, the rate or risk of release or establishment of nonindigenous species in the waters of the state and resulting impacts, and the means by which to reduce or eliminate a release or establishment . . ..*" (Public Resources Code Section 71213).

PROPOSED ACTIVITY:

To meet this mandate, the Commission's Marine Facilities Division has determined that continued research to characterize the transfer of organisms on ships' hulls for ships arriving to key port systems in the western US is necessary. Utilizing funds from the Marine Invasive Species Control Fund budgeted for conducting necessary research, Staff proposes entering into an agreement with Portland State University (PSU) for $125,000 to compliment and continue work begun during the first phase of research. PSU proposes three components for this second phase. The first component will consist of a synthesis and reanalysis of existing data on hull fouling and hull mediated invasions to assess how studies may be compared through time and space, and how they may apply to California. Experiments conducted in the second component will evaluate the effect of changing environmental conditions on fouling assemblages, and assess if changing environmental conditions can induce organisms to spawn. The

third component will examine the extent and composition of fouling assemblages on a second commercial vessel type to complement surveys on containerships conducted during the first phase. This component will also compare vessel behaviors and hull maintenance practices with levels of fouling between vessel types. The long term goal of this last component is to steadily increase the types of vessels surveyed to provide essential data on how fouling is transferred on the wide range of vessel types that make up the contemporary commercial fleet. Per the California State Contracts Manual, Section 3.06, contracts with a state college or university, from California or any other state, are exempt from competitive bid requirements (PCC 10340).

STATUTORY AND OTHER REFERENCES:

A. Public Resources Code Section 6106 (Delegation to execute written instruments)
B. Marine Invasive Species Act of 2003, Chapter 491, Statutes of 2003
C. State Administrative Manual Section 1200
D. State Contracting Manual (rev 10/05)

OTHER PERTINENT INFORMATION:

1. Pursuant to the Commission's delegation of authority and the State CEQA Guidelines [Title 14, California Code of Regulations, section 15060(c)(3)], the staff has determined that this activity is not subject to the provisions of the CEQA because it is not a "project" as defined by the CEQA and the State CEQA Guidelines.

Authority: Public Resources Code section 21065 and Title 14, California Code of Regulations, sections 15060 (c)(3) and 15378.

EXHIBIT:

A. Research Proposal

RECOMMENDED ACTION:

IT IS RECOMMENDED THAT THE COMMISSION:

1. FIND THAT THESE ACTIVITIES ARE EXEMPT FROM THE REQUIREMENTS OF CEQA PURSUANT TO 14 CAL CODE REGS. 15060(c)(3) BECAUSE THESE ACTIVITIES ARE NOT PROJECTS AS DEFINED BY PUBLIC RESOURCES CODE SECTION 21065 AND 14 CAL CODE REGS. 15378.

2. AUTHORIZE THE EXECUTIVE OFFICER OR HIS DESIGNEE TO AWARD AND EXECUTE CONTRACT WITH PORTLAND STATE UNIVERSITY IN ACCORDANCE WITH STATE POLICIES AND PROCEDURES FOR INVASIVE SPECIES RESEARCH TO CHARACTERIZE THE TRANSFER OF ORGANISMS ON SHIPS HULLS ARRIVING AT KEY PORT SYSTEMS IN THE WESTERN U.S. IN AN AMOUNT NOT TO EXCEED $125,000.

EXHIBIT A

RESEARCH PROPOSAL

Assessing the risk of invasion from commercial vessel hull fouling on the California Coast: synthesis, experimentation and vessel sampling.

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Submitted to
The California State Lands Commission
Marine Facilities Division

Overview

Vessel hull fouling is a long-standing mechanism of species transfers throughout the world and has led to numerous non-native species introductions. Although its potency as a vector has been recognized, critical gaps remain in determining the inoculation risk associated with commercial vessel movements and their associated assemblages of fouling organisms. In particular, specific data for the U.S. coastlines are limited. In New Zealand, studies of vessel hull fouling are one of the major components of their 'biosecurity' efforts in an attempt to fill information gaps, reduce the risks of invasion and reduce the threat to their native coastal biodiversity. The recent California State Lands Commission report (Takata et al, 2006 [hereafter CSLC Report]) has highlighted the dearth of information that exists, particularly North America specific data, and demonstrates the need for research to resolve this.

Research

We propose three components of research that complement our previous CSLC-funded research and also address key topics of interest outlined in the CSLC Report:

1) **<u>A synthesis, re-analysis and review of existing data on hull fouling and hull mediated invasions</u>**

A critical appraisal and re-analysis of data from the hull fouling literature is an overdue assessment that will benefit both scientific study and possible management options in the future. One of the primary conclusions of the CSLC Report was to underscore the dearth of information

that exists on the hull fouling vector and how this limitation must be overcome if any sound determination of risk is to be reached. The scientific literature referring to hull fouling is relatively limited and is dispersed among the primary and gray literature. It is broadly agreed that a lack of information and study is constraining sound risk assessments for this vector; this is also compounded by a lack of review and synthesis of the data that is available. A re-analysis of existing data would provide a solid foundation over which spatial and temporal variability of fouling transfers could be assessed – these data have yet to be synthesized which is a hurdle to policy at present (CSLC Report). Some of the questions that could be answered from such an analysis include:

- What are the temporal and spatial patterns within the hull fouling literature (how many studies, how many vessel hulls have been sampled, have there been peaks of interest in the topic)?
- How can a wide range of methodologies be assessed to provide meaningful comparisons between studies?
- How do different methodologies compare in terms of characterizing hull biofouling (including replication, area covered, taxonomic resolution, etc)?
- What are the taxonomic trends throughout the hull fouling literature? If there are any, can they be correlated with changes in shipping practices (such as changes in antifouling paints or hull husbandry)?
- Can the effects of factors such as voyage duration, speed, hull maintenance, docking duration and others be recognized across studies and are these patterns consistent across time and space?
- What are the temporal and spatial trends for suspected hull-mediated introductions?
- For bays and harbors that have been well studied, are there differences in the strength of the hull fouling vector between regions relative to other transfer mechanisms (as has been suggested in a comparison of Port Phillip Bay, Australia and San Francisco Bay)?
- Can the risk of invasion from hull fouling to different ports be measured and do existing patterns of invasion reflect the relative vector strength between ports?
- How well can findings from modern studies of hull fouling in different regions of the globe be applied to the California coast?

2) <u>Experiments on the effects of salinity on hull fouling biota</u>

The ability of organisms to bridge the gap between vector and recipient region is one of the key questions in invasion biology. For shipping vectors and coastal regions, this is a complex process because the vectors act on whole assemblages rather than on individual species. One of the major differences between the hull fouling and ballast water vectors is the effect of

environmental conditions on biota. Ballast water organisms are contained within a ship protected from external sea conditions and are only delivered to the receiving waters if BW discharge takes place; hull fouling organisms can potentially remain on a ship for long time periods (years), must withstand all sea conditions through which the vessel passes, and have the potential to inoculate the receiving waters during each arrival. Among other factors, the risk of inoculation by a fouling species depends on the number and viability of individuals on a hull. Therefore, one of the important components of the hull-fouling vector is the effect of environmental variables on organism quality and quantity.

We propose to conduct experiments on the effect of a major limiting physical factor – salinity - on fouling assemblages to imitate the transport of a well-fouled vessel entering port. We will use replicate tanks and controls to determine the fate of fouling assemblages exposed to a variety of changes in water salinity (and possibly the interacting effects of temperature/water flow). This will mimic the movement of a bulk carrier (say) arriving into San Francisco Bay and traveling to the ports of Sacramento or Stockton, or the possible influence of the Panama Canal on biofouling of inter-oceanic arrivals to California. Our previous work in the Lower Columbia River suggested that freshwater conditions probably provide this system with some resistance to marine propagules, allowing for fewer invasions than may have been expected given the history of shipping traffic. These experiments provide an opportunity to test this suggestion empirically using San Francisco bay as the model system. The marine fouling assemblages will be established on settlement panels that have been exposed to the same propagule pressure in San Francisco Bay. These experimental trials will be carried out at SERC's labs at the Romberg Tiburon Center.

In addition to examining the effect of environmental changes on the fouling assemblages, we will also be able to assess if fouling organisms are induced to spawn by the stress of changing conditions. This has been suggested previously (e.g. Minchin & Gollasch, 2002) but is only supported by indirect evidence (i.e. not from vessel hulls). Furthermore, the relationship between propagule pressure and inoculation is not fully understood and has received greater attention in terrestrial systems than marine ones. Our experiments will provide further insight into how natural levels of environmental variability encountered in California's port systems influences marine propagule pressure and potential inoculation by fouling species. The results will provide added data for the interpretation of observations we have made from ship-scale sampling of biofouling.

3) **<u>An examination of fouling on vessels</u>**

We have conducted hull-fouling surveys on containerships in Oakland in May 2006 using a Remotely Operated Vehicle (ROV). This was carried out to assess the extent and broad composition of fouling on commercial vessels that frequent Californian ports and augments another diver-sampled data set from the same location that we collected two years earlier. Containerships were selected because there may be a causal relationship between port duration and fouling accumulation such that vessels with short port durations (containerships) generally have lower levels of biofouling on their hulls than vessels with long port durations. To continue with this line of enquiry we propose to sample another vessel type, which will complement our existing data and allow us to assess within- and between- vessel types. The over-riding goal is to steadily increase the numbers of vessel hulls of all types to provide essential data on how biofouling is transferred on the contemporary commercial fleet. This sampling effort is fundamental to research on vessel hull fouling and significant because so few vessel arrivals are examined for fouling and NIS. It is also necessary for managers - as stated in the CSLC report, "baseline information on the fouling and NIS that arrive on commercial vessels will be critical for the formulation of future management actions".

We are currently analyzing shipping traffic data throughout California's ports and the ROV surveys of containerships and we will use these experiences and data to inform our decision making for the next vessel type. A preliminary analysis of vessel traffic, port conditions, logistics and other factors will determine the optimal strategy to conduct surveys of a new vessel type that maximizes the number of replicate vessels sampled and maximizes value for money and effort.

Deliverables

Each component of research outlined above will have a separate product.

1 – Report on the synthesis and re-analysis of hull fouling data. This report will include a reference list of all hull biofouling articles available in the literature and the report will be re-formatted for submission to a peer-reviewed scientific journal.

2 – Report on the experiments on the fate of fouling assemblages subjected to changes in environmental conditions. This report will also act as a pilot study for much needed (and logistically challenging) experiments on the relationship between propagule pressure and inoculation in marine systems.

3 – Report on the extent and composition of biofouling on a vessel type sampled in California ports with a comparison to fouling levels encountered on containerships. This report will also compare vessel behaviors (using our own data and CSLC data from surveys of vessels relating to

hull maintenance and port durations) and its possible effect on biofouling extent and composition within and between vessel types.

References

Minchin D & Gollasch S (2002) Fouling and ships' hulls: how changing circumstances and spawning events may result in the spread of exotic species. Biofouling. 19: 111-122.

Takata L, Falkner M & Gilmore S (2006) Commercial vessel fouling in California: Analysis, evaluation, and recommendations to reduce nonindigenous species release from the non-ballast water vector. California State Lands Commission, Marine Facilities Division. Sacramento, California.

Budget

Project duration: October 2006 to September 2008

Salary	$45000
Fringe benefits (53.9%)	$24255
Travel	$4952
Equipment	$5000
Subcontract for vessel sampling	$20000
Total direct costs	$99207
Indirect (26% of tdc)	$25793
Total project cost	$125000