CALFed Progress Questionnaire
California Sea Grant College Program

ConfirmationNumber: 20071221102908

Printed: 4/25/2008 1:16:30 PM

ProjectYear_2A: 1st Year
ProjectNo_2C: R/SF-15
TypeQuestionnaire_2B: Interim Questionnaire

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Project Information

ProjectNo_2C: R/SF-15
StartDate_3a: 01/01/07
EndDate_3b: 12/31/08
ProjectTitle_4: Prey selection of larval and juvenile planktivorous fish in the San Francisco Estuary

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Additional Research Mentors and Community Mentors

Additional Research Mentors_8

Additional Community Mentors_9

Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.

ProjectObjectives_10

The abundance and species composition of zooplankton in the San Francisco Estuary have undergone several changes in the last two decades. These changes have been correlated to declines in the abundance of planktivorous fish, including delta smelt. The main objective of this project is to quantify prey selection of larval and juvenile planktivorous fish in the San Francisco Estuary. Because growth and survival of larvae and juvenile fish depends on encounter with and consumption of appropriate prey items during development, information on prey selection and the mechanisms that control it will help determine how changes in the available prey translate into population success.

During this study, prey selection will be quantified with two different approaches: (1) laboratory feeding experiments and (2) video observations. First, prey selection will be measured in laboratory feeding experiments during which fish will be incubated with known concentrations of mixed copepods. Ingestion will be quantified using gut content analysis. Following the incubation experiments, the individual components of predation (encounter, attack, capture and ingestion) will be examined using video observations. Data regarding predation-prey interactions will be used to determine what controls prey selection.

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Summary of progress in meeting each of these goals and objectives

ProgressSummary_11

Laboratory feeding experiments: Incubation experiments to quantify prey selection were performed with larval striped bass and both larval and juvenile delta smelt. In total, 37 incubation experiments were conducted (31 with delta smelt; 6 with striped bass). Prey selection was quantified for both larval (naupliar) and juvenile (copepodid) copepods. Varying combinations of five different copepod species were used in experiments dependant on their temporal and spatial overlap with the early life history stages of delta smelt and striped bass (Eurytemora affinis, Pseudodiaptomus forbesi, Limnoithona tetraspina, Acartiella sinesis, Acanthocyclops vernalis). The samples resulting from the experiments are currently being processed. Sampling processing is anticipated to be completed by March 2008. Data analysis is ongoing. No more incubation experiments are planned.

Preliminary results: Larval delta smelt, 15 days post hatch (dph), feed selectively on copepod prey. More specifically, delta smelt (15 dph) consumed copepodites in higher proportions than nauplii for all three copepod species examined thus far (E. affinis, P. forbesi and L. tetraspina). Additionally, larval delta smelt (15 dph) consumed L. tetraspina copepodites in higher proportions than E. affinis or P. forbesi nauplii. And Delta smelt (15 dph) consumed E. affinis, P. forbesi and L. tetraspina copepodites in proportion to their abundance in the assemblage. Based on fish gape and copepod length measurements, the early copepodid stages of E. affinis and P. forbesi and the late copepodid stages of L. tetraspina are of optimal prey size for larval delta smelt (15 dph).

Video observations: Preliminary video observations were performed during June 2007. The remaining videographic studies are scheduled to begin in April 2008, in conjunction with the spawning season of delta smelt and striped bass. Data regarding predation-prey interactions observed during video observations will be used to determine which factors are controlling the above mentioned prey selection.

Preliminary results: Videographic techniques can be used to examine predation of larval delta smelt (15 dph).

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and how they were resolved. Describe any ancillary research topics developed.

Modifications_12

We originally proposed to examined prey selection of three species of planktivorous fish, striped bass (Morone saxatilis), longfin smelt (Spirinchus thaleichthys) and delta smelt (Hypomesus transpacificus). However, the abundance of longfin smelt in the San Francisco Estuary has greatly declined since the inception of the proposal and we were unable to obtain larvae for use in experiments. Consequently, more experiments were performed to examine prey selection of delta smelt. Although delta smelt are

also in low abundance in situ, they are successfully being cultured by the Fish Conservation and Culture Laboratory in Tracy, CA. Similarly, striped bass larvae were obtained from cultures at the Univesity of California, Davis.

We also proposed to examine the impact of different light and turbidity levels on prey selection. However, larval feeding of both delta smelt and striped bass was only stimulated under ideal environmental conditions. Therefore, the impacts differing light and turbidity levels on prey selection could not directly be examined.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see http://science.calwater.ca.gov/pdf/soemgmtcues.pdf).

BenefitsApplic_13

Preliminary results demonstrate that early larvae of delta smelt (15 dph) consume the copepods E. affinis, P. forbesi and L. tetraspina in approximately the same proportion to their abundance in the prey assemblage. This contradicts prevailing views that L. tetraspina avoids predation by planktivorous fish because of its small size, and suggests that L. tetraspina may be an important prey item for newly hatched larval planktivorous fish. Although all three species are consumed in similar proportions, the relative contribution of these copepods to the diet of larval fish differs greatly because L. tetraspina has approximately 1/10th the carbon content of E. affinis or P. forbesi. However, this difference in carbon content may be offset by the high numerical abundance of L. tetraspina, which are often 10X as abundant as all other copepod species combined. We expect selection patterns of later stage larval (≥60 dph) and juvenile delta smelt to shift toward larger prey items. This would match data collected from gut content analysis of field-collected delta smelt.

PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications_14

Sullivan, L. J., W. J. Kimmerer, T. I. Ignoffo and B. Baskerville-Bridges. 2007. Prey selection of larval and juvenile planktivorous fish in the San Francisco Estuary. State of the Estuary, Oakland, CA, October 16-18.

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COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15

Equipment, space and delta smelt were obtained from the FCCL. The FCCL is part of the Department of Biological and Agricultural Engineering, UC Davis. Bradd Baskerville-Bridges and Joan Lindberg of the FCCL and UC Davis provided guidance on experimental design, data analysis and presentation. Equipment, space and striped bass were obtained from David Ostrach at the Pathobiology, Conservation & Population Biology Laboratory (PCPBL), Department of Civil and Environmental Engineering, University of California, Davis. David Ostrach also provided advice essential for successfully working with larval striped bass.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16

NA

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17

striped bass, Morone saxatilis, delta smelt, Hypomesus transpacificus, larvae, prey selection, prey preference, copepod, copepodite, nauplii

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PATENTS: List any patents associated with your project.

Patents_18

NA

Additions: Additional information can be added here. Please begin the text with the number of the question you are adding to.

Additions_19