



PRINCE WILLIAM SOUND
OIL SPILL RECOVERY INSTITUTE

Prince William Sound Oil Spill Recovery Institute

Graduate Research Fellowship

Program Description and Application Packet

**Graduate Research Fellowship Program of the
Prince William Sound Oil Spill Recovery Institute
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Graduate Research Fellowship Program of the Prince William Sound Oil Spill Recovery Institute

I. Introduction

The Oil Spill Recovery Institute (OSRI), at the Prince William Sound Science Center (PWSSC) in Cordova, Alaska will annually solicit proposals for the Graduate Research Fellowship Program subject to available funding. Grants are available on a competitive basis to students admitted to or enrolled in a full-time doctoral or masters program at accredited colleges and universities. Fellowships may be funded for up to two years to support masters or up to three years to support doctoral level research.

OSRI's mission is to fund research, demonstration, and education projects designed to deal with oil spills in Arctic and sub-Arctic marine environments. For more information about OSRI see <http://www.pws-osri.org/>.

II. Funding Opportunity Description

A. Program Objective:

The OSRI funds are provided to support research projects connected to OSRI's mission that will enhance scientific understanding of the marine ecosystem, provide information needed by managers and decision-makers for oil spill response and recovery, and improve public awareness and understanding of marine and estuarine ecosystems. The OSRI Graduate Research Fellowship (GRF) Program offers qualified masters and doctoral students the opportunity to address scientific questions of significance to Arctic and sub-Arctic regions.

B. Research Focus Areas:

The Oil Spill Recovery Institute is focusing on research within Arctic and sub-Arctic areas at risk from oil and gas activities. The following suggested focus areas should be addressed in proposed research projects:

1. Observations and modeling

- seasonal and interannual variation of oceanic or atmospheric circulation, stratification, and mixing;
- quantitative ecology of marine and estuarine habitats.

2. Technology development

- mechanisms for removing oil from water, sediments, and oil in and under ice;
- quantifying the fate and effects of oil spills and oil spill recovery techniques in Arctic and sub-Arctic marine waters;

3. Socio-economics

- economic, sociological, and/or anthropological research applicable to the effects of oil spills on coastal communities;
- application of ocean observing system products for coastal communities.

III. Award Information

A. Funding Availability

The Prince William Sound Oil Spill Recovery Institute provides funding for a Graduate Research Fellowship (GRF) program. The GRF will be competitively awarded to qualified graduate students whose research on a physical, chemical, geological, biological, or interdisciplinary components of Arctic and sub-Arctic marine ecosystems, or engineering, or social science is relevant to oil spill response or recovery. The amount of the fellowship is \$25,000 with a match requirement of at least 25% of the total project cost provided by the applicant (i.e. to obtain the full \$25,000 in OSRI funds, the project would need to total \$33,333, and a match of \$8,333 would be required). Up to 10% of the OSRI funded portion may be used for indirect costs.

B. Project Award Period

This program announcement is for projects to be conducted by students enrolled in an accredited college or university graduate school program. Masters candidates can apply for up to two years of funding, and doctoral students are eligible to apply for up to three years of funding. Annual renewal of fellowships will be granted contingent upon the

applicant's successful progress in the degree program and compliance with other OSRI GRF Program requirements in Sections IV.C and VII. Applicants should state the maximum number of years in their original proposal for which they might require support (1, 2, or 3 years). If applicants apply for fewer than the maximum allowable period of support and decide in later years that they need further support up to the maximum allowable period (2 or 3 years), their renewal application becomes competitive with other new applicants in subsequent years.

C. Funding Instrument

The funding instrument for the OSRI graduate research fellowship awards will be a grant.

IV. Eligibility Information

A. Eligible Applicants

Funds are to be available on a competitive basis to qualified graduate students for research leading to a graduate degree. Applicants must be admitted to or enrolled in a full-time masters or doctoral program at an accredited college or university in order to be eligible to apply. Applicants should have completed a majority of their graduate course work and have an approved thesis research program. Therefore, applicants are encouraged to apply after their first year of course work is completed.

B. Cost Sharing or Matching Requirement

Requested OSRI funds must be matched by at least 25 percent of the TOTAL cost of the project (i.e. \$8,333 match for \$25,000 in OSRI funds for a total project cost of \$33,333). Waived indirect costs, in-kind match of salaries, and services may be used as match. OSRI recommends that all applicants work with the applicant's institution during the development of their budget to ensure concurrence on budgetary issues (e.g. the use of salary and fringe benefits as match).

C. Other Requirements

The fellowship is intended to provide any combination of research support, salary, tuition, supplies, or other costs as needed. Graduate student fellows who are selected for

funding will be expected to: 1) coordinate with the OSRI Research Program Manager to develop a plan to participate in relevant OSRI programs; 2) submit quarterly financial statements and annual progress reports to OSRI; and 3) acknowledge OSRI support in all relevant scientific presentations and publications; 4) publish their results in peer-reviewed literature and make presentations at national and international scientific meetings.

V. Application and Submission Information

A. Address to Request Additional Information

For additional program and application information, contact W. Scott Pegau, OSRI Research Program Manager at (907) 424-5800 ext. 222 or via internet at wspgau@pwssc.org. Information on other OSRI programs can be viewed at: www.pws-osri.org.

B. Content of Application Submission

1. Proposals

Applications must be submitted by the date on the request for proposals to OSRI Research Program Manager Prince William Sound Science Center; P.O. Box 705, 300 Breakwater Ave, Cordova, AK, 99574. If there are specific questions about the program and/or application process, applicants may contact W. Scott Pegau at wspgau@pwssc.org or (907) 424-5800 ext.222.

Receipt of all applications will be acknowledged via email. Upon receipt of the proposal, the OSRI Research Program Manager will ensure the application is complete and coordinate a technical peer review of the proposal.

2. Required Elements

1. **Academic resume or *curriculum vitae*** that includes all graduate and undergraduate institutions (department or area of study, degree, and year of

- graduation), all publications (including undergraduate and graduate theses), awards or fellowships, and work/research experience.
2. **Cover letter** indicating current academic status, research interests, career goals, and how the proposed research fits into their degree program. It is strongly suggested that the results of discussions with the OSRI Research Program Manager regarding potential contributions to the OSRI focus research areas be included in the letter.
 3. **Unofficial copy of all undergraduate and graduate transcripts.**
 4. **Signed letter of support** from the applicant's graduate advisor indicating the advisor's contribution (financial and otherwise) to the applicant's graduate studies, and an assurance that the student is in good academic standing and capable of the proposed research.
 5. **Two signed letters of recommendation** from other than the applicant's graduate advisor sent directly from their source. Signed electronically transmitted letters of support, on university letterhead, are acceptable.
 6. **Research proposals** must be double-spaced in 12-point Times New Roman font with one inch margins. The proposal must follow the instructions in the Grant Application Packet (Grant Policy Manual Appendix D). In addition the application must include a title page as described below. A more detailed description of the materials that should be included within the proposal are described below.
 - a. **Title page** which must include the items below in the following order:
 - i. project title;
 - ii. name, address, telephone and fax number, email address, date, and signature of applicant;
 - iii. amount of funding requested;
 - iv. name of institution providing matching funds and amount of matching funds;
 - v. degree being sought;

- vi. name, address, telephone number and fax number, email address, date, and signature of graduate advisor;
 - vii. number of years of requested support;
 - viii. focus area that research proposal is addressing
- b. **Abstract.** The abstract must state the research objectives, the connection to OSRI's mission, scientific methods to be used, and the significance of the project to a particular research focus. The abstract must be limited to one double-spaced page.
- c. **Project Description.** The main body of the proposal must include a detailed statement of the work to be undertaken and the following components:
- i. **Introduction.** This section should include a brief review of pertinent literature and describe the research problem. This section should explicitly identify the primary hypotheses, as well as any additional or component hypotheses that will be addressed by the research project. It should also clearly articulate the connection between the proposed research and OSRI's current mission statement and Science Plan.
 - ii. **Methods.** This section should state the method(s) to be used to accomplish the specific research objectives, including a systematic discussion of what, when, where, and how the data are to be collected, analyzed, and reported. Field and laboratory methods should be scientifically valid and reliable and should be accompanied by a statistically sound sampling scheme. Methods chosen should be justified and compared with other methods employed for similar work.
 - Techniques should allow the testing of the hypotheses. Methods should be described concisely and techniques should be reliable enough to allow comparison with those made at different sites and times by different investigators.

For ecological data, a power analysis is highly recommended to show that objectives of statistical rigor can be achieved.

- Analytical methods and statistical tests applied to the data should be documented, thus providing a rationale for choosing one set of methods over alternatives. Quality control measures also should be documented (e.g., statistical confidence levels, standards of reference, performance requirements, internal evaluation criteria). The proposal should indicate by way of discussion how data are to be synthesized, interpreted and integrated into final work products.
- Social science applicants should describe the sampling and or data collection methods including surveys, evaluation research, interviews (focus group and/or personal), participant observation, questionnaires, etc. Applicants should also describe the research design (experimental and quasi-experimental) and methods for data analysis.

iii. **A map clearly showing the study location and any other features of interest must be included;** a U.S. Geological Survey topographic map, or an equivalent, is suggested for this purpose.

iv. **Project Significance.** This section must discuss the relation of the proposed research to the research focus areas stated in Section I. Applicability of research findings to other high latitude cold climate coastal areas should also be mentioned. In addition, if the proposed research is part of a larger research project, the relationship between the two should be described.

d. **Milestone schedule.** This schedule should show, in table form, anticipated dates for completing fieldwork, data collection, data analysis, reporting and other related activities in terms of the OSRI fiscal year: First quarter

(Oct-Dec), Second quarter (Jan-Mar), Third quarter (Apr-Jun), Fourth quarter (Jul-Sep).

- e. **Personnel and Project Management.** The proposal must include a description of how the project will be managed, including the names and expertise of faculty advisors and other team members. Evidence of ability to successfully complete the proposed research should be supported by reference to similar efforts previously performed.
- f. **Literature Cited.** This section should provide complete references for literature, research, and other appropriate published and unpublished documents cited in the text of the proposal.
- g. **Proposed budget and budget justification.** The applicant must match the amount of OSRI funds requested by at least 25% of the total project cost (i.e. \$8,333 match for \$25,000 in OSRI funds for a total project cost of \$33,333). Cash or in-kind contributions directly benefiting the research project may be used to satisfy the matching requirements. Waived indirect costs may also be used as match. Funds from other PWSSC staff salaries may not be used as match. Up to 10% of the OSRI funded portion may be used for indirect costs. OSRI encourages all applicants to work with their institution's sponsored programs office to develop their budget.

The applicant may request funds under any of the following categories as long as the costs are reasonable and necessary to perform research: personnel, fringe benefits, travel, equipment, supplies, contractual, construction, other, and indirect. The budget should contain itemized costs with appropriate narratives justifying proposed expenditures. Applicants must supply a table showing allocations using budget categories listed below. The OSRI and match portion should be listed side by side for each year of requested funding. Please see below for further details.

--**Personnel.** Salaries requested must be consistent with the institution's regular practices.

--**Fringe Benefits.** Fringe benefits (i.e., social security, insurance, retirement) may be treated as direct costs as long as this is consistent with the institution's

regular practices.

--Travel. The type, extent, and estimated cost of travel should be explained and justified in relation to the proposed research; the justification should also identify the person traveling. Travel expenses are limited to round trip travel to field research locations and professional meetings to present the research results and should not exceed 40 percent of total award.

--Equipment. Fellowship funds may be approved for the purchase of equipment only if the following conditions are met: (a) a lease versus purchase analysis has been conducted by the applicant or the applicant's institution for equipment that costs greater than \$5000 and the analyses indicate that purchase is the most economical method of procurement; (b) the equipment does not exist at the recipient's institution or at the PWSSC; and, the equipment is essential for the successful completion of the project.

The justification must address each of these criteria. It must also describe the purpose of the equipment and provide a justification for its use. Additionally, it must include a list of equipment to be purchased, leased, or rented by model number and manufacturer, where known. At the termination of the fellowship, disposition of equipment will be determined by OSRI.

--Supplies. The budget should indicate in general terms the types of expendable materials and supplies (items that cost less than \$5,000) required and their estimated costs.

Requests for PWSSC support services. On-site PWSSC personnel sometimes can provide limited logistical support for research projects in the form of manpower, equipment, supplies, etc. If applicable, any request for PWSSC support services, including any services provided as match, should be approved by the OSRI Research Program Manager prior to application submission and be included as part of the application package in the form of written correspondence. PWSSC resources are not eligible to be used as match.

Coordination with other research in progress or proposed. OSRI encourages collaboration and cost sharing with other investigators to enhance scientific capabilities and avoid unnecessary duplication of effort. Applications should include a description of how the research will be coordinated with other research projects that are in progress or proposed, if applicable.

Permits. The applicant must apply for any applicable local, tribal, state or federal permits. A copy of any permit applications and supporting documentation should be attached to the application as appendices. OSRI must receive notification of the approval of the permit application before funding can be approved. Please note if not applicable.

C. Submission Instructions

All materials must be submitted electronically by the date on the request for proposals. Proposals must be submitted to W. Scott Pegau, OSRI Research Program Manager at wspgau@pwssc.org. The electronic materials must be in PDF, MS Word, or MS Excel format.

D. Funding Restrictions

Up to 10% of the OSRI funded portion can be used for indirect costs for these awards.

VI. Award Administration Information

A. Proposal Review and Ranking Process

Once the OSRI Research Program Manager has received a full application, an initial administrative review is conducted to determine compliance with requirements and completeness of the application. No less than three reviewers representing the appropriate scientific discipline will evaluate all applications for scientific merit. The OSRI Research Program Manager will oversee the review process. Efforts will be taken to avoid conflicts of interest, therefore, it is permissible for applicants to suggest those people whom they feel would have a conflict of interest and are not appropriate to review their proposal. The merit reviewer's ratings are used to produce a rank order of the proposals based on the following criteria:

1. Academic record (5 percent)
2. Quality of the proposed research (85 percent)
3. Recommendations/endorsements (5 percent)
4. Reasonable and justified project costs (5)

B. Final Selection Process

The OSRI Scientific and Technical Committee (STC) will then be convened to select and recommend an award in the rank order unless the proposal is justified to be selected out of rank order based upon one of the selection factors identified below. The STC may choose a proposal out of rank order based on the following:

1. The project responsiveness to the research focus areas as stated in the OSRI Science Plan.
2. Will experienced and qualified personnel manage the project?
3. Is the project likely to achieve the identified milestones?
4. Is the project appropriate to the statement of career goals and objectives?
5. Is the degree type/level sought appropriate to the research topic?

VII. Fellowship Requirements

A. Developing the annual work plan

Projects related to the OSRI research program should be coordinated annually with the OSRI Research Program Manager. Therefore, by March 31 of each year, the fellow shall contact the OSRI Research Program Manager to coordinate any aspects of the project related to PWS or the PWSSC (if applicable), including, the location and establishment of sampling sites, projected field sampling dates, accommodation reservations, and the need and timing for personnel and logistical support. Fellows are responsible for meeting with other PWSSC staff as needed to coordinate this work plan. Information about developing the work plan component of the fellowship must be included in the annual progress reports.

B. Quarterly financial statements

Financial statements from the Grants and Contracting Office must be submitted to OSRI within 30 days after the end of each quarter: December 31, March 31, June 30, and September 30. A brief description or listing of milestones achieved should be included. Please explain any existing or potential problems and if a change in budget or scope of work is required. Include a budget summary report detailing expenses by categories explained in the original proposal, the amount remaining, and cumulative subtotals for project expenses and indirect costs. See **Appendix A** for an example format. Failure to submit this report by the last day of the quarter may result in:

1. Suspension of all future payments;
2. Close-out of expired grants based on previously reported disbursements; suspension of current grants; and
3. Suspension of review and processing of new proposals.

Quarterly financial statements must be sent to the OSRI Research Program Manager by email at wspgaw@pwssc.org, and copied to the PWSSC Finance Assistant at poswalt@pwssc.org.

C. Annual progress reports

Fellows are required to submit Annual Progress Reports (APR) to the OSRI Research Program Manager 30 days prior to the completion of every annual award cycle unless it is the last year of the award. Please use the formats explained below. Annual progress reports should be submitted to W. Scott Pegau at wspgaw@pwssc.org. Fellows must copy their advisor on all reports. Reports should be submitted electronically.

D. Data management

OSRI participates in an annual project to catalog all research conducted in the PWS and Gulf of Alaska. OSRI fellows conducting research in these areas will be required to contribute metadata, along with a map of the project location to the OSRI Research Program Manager. In addition, any data or databases developed under this award will be transferred to a CD or DVD and provided free of charge to OSRI.

E. Published journal articles

Manuscripts resulting from the OSRI sponsored fellowship that are submitted to refereed scientific journals for publication in open literature shall acknowledge that the research was conducted under an award from the Prince William Sound Oil Spill Recovery Institute.

VIII. Guidelines for Preparing Annual Reports

Fellows are required to submit Annual Progress Reports (APR) to the OSRI Research Program Manager 30 days prior to the completion of every annual cycle unless it is the last year of the award. If the project is extended for a period less than 6 months, an additional APR should be submitted at the end of the extension period. APR's must use the format outlined below.

A. Address to submit annual reports

Submit annual reports 30 days prior to the anniversary date, with financial statements to follow within 50 days, to W. Scott Pegau, OSRI Research Program Manager, at (907) 424-5800 ext.222, or via email at wspgau@pwssc.org.

B. Required content elements

- 1. Principal Investigator(s)** printed name(s), signature(s), and date of APR. **Note:** fellows must copy their graduate advisor.
- 2. Address of P.I.(s).** Include additional updated contact information if applicable.
- 3. Grant number.**
- 4. Research Project Title.**
- 5. Starting and ending dates of reporting period.**
- 6. Statement of schedule** whether or not the project is meeting its milestone schedule and brief description of research activities. Please include whether any alterations to the procedures or focus of research as described in the funded proposal have occurred. If the

milestone schedule is not being met and/or if significant changes to the originally funded research procedures or focus have occurred, a brief explanation is required.

7. Research description and how it is being implemented.

8. List of manuscripts published during the year that resulted from or were relevant to this fellowship. Include author, title, date, journal/thesis/ dissertation, etc. Include copies of any articles published.

9. List presentations or seminars given during the year that resulted from or were relevant to this fellowship.

10. Other notable events, significant research accomplishments, etc. concerning this fellowship.

Please Note: Any subject or communications other than those given above (i.e. requests for extensions of research period) should not be included as part of the APR. The purpose of the APR is to inform OSRI: a) about the progress of the proposed research in terms of the milestones outlined in the original proposal, and b) what presentations, publications and/or significant benchmarks were completed.

IX. Guidelines for preparing final reports

Final reports are required for all research funded through grants from The Prince William Sound Oil Spill Recovery Institute. The purpose of the final report is to describe the activities and summarize the results of the project funded during the award period. These reports should be submitted to W. Scott Pegau; Prince William Sound Science Center, Oil Spill Recovery Institute; P.O. Box 705, 300 Breakwater Ave. Cordova, Alaska 99574. Reports must be submitted electronically via email, CD or DVD. **A copy of the student's thesis or dissertation, or a published manuscript may serve as the final report.** The final report is due 45 days after the expiration of the award. If the thesis or dissertation is not completed 45 days after the expiration of the award, then a final report must be submitted. Students are encouraged to submit a copy of their thesis or dissertation to the Prince William Sound Science Center upon graduation. Students are encouraged to submit publications resulting from their research fellowship at any time.

1. Title page: The title of the project should be followed by the name(s) and address(es) of the investigator(s)/author(s), the date (month and year) of submission, where the work was conducted, and the grant number. The title may be other than was given to the project upon application for funding, as long as it accurately describes the project.

2. Table of contents: The table of contents should list all the sections and sub-sections as they appear in the text, with the corresponding page numbers. Lists of figures and tables should also be provided.

3. Abstract and key words: A one paragraph abstract, of no more than 200 words, should be included on a separate page. The abstract should summarize the project, including the problem, the methods, the results, and any conclusions, particularly as they may be applied to oil spills. The author(s) should bear in mind that the abstract may be posted on the OSRI web page.

4. Text: The text should be divided into Introduction, Materials and Methods, Results, Discussion, Conclusion, Acknowledgments, and Literature Cited sections. Sub-sections may be used as needed. Technical terms, acronyms and abbreviations should be explained in full when first presented. Scientific species names should be given in full when first mentioned and underlined or italicized. All measurements should be expressed in SI units, as defined in *Standard 1000, SI Units and Recommendations for the Use of their Multiples and Certain Other Units*, available through the American National Standard Institute, 1430 Broadway, New York, NY 10018. The report should give a more complete and thorough presentation of the work than one would expect in a typical peer-reviewed scientific journal. Specifically, a full description of methods, in-depth literature review, and a greater elaboration of significance of results should be included. All text should be double spaced.

5. Literature cited: Referenced literature should be cited in the text by author and year of publication. Multiple citations at the same point in the text should be listed

chronologically (e.g. Burbank, 1967; Abbott, 1974; Crosby, 1985; Crosby et al., 1990; Crosby & Roberts, 1990; Golde et al., in review). Journal titles should be abbreviated as recommended in the *American Standard for Periodical Title Abbreviations*, available through the American National Standard Institute, 1430 Broadway, New York, NY 10018. Full citations in the Literature Cited section should be listed alphabetically using the *Ocean and Coastal Management* journal format

6. Figures and tables: Figures and tables should be used to clarify text and summarize data. Figures and tables should appear on separate pages (numbered in sequence with the rest of the text) immediately following the page where they are first mentioned. Each figure or table should be clearly labeled with an appropriate descriptive legend.

7. Appendices: Appendices should be used to present actual data and measurements made during the study. Only summaries of the data should be presented in the text. In addition, any additional materials not appropriate for inclusion in the main text, such as computer programs or models generated, should be appended to the report. Again, as much data as possible should be given.

8. Publication: To insure that the results of OSRI-sponsored projects reach as many interested parties as possible, OSRI strongly encourages fellows to submit the results of their work to peer reviewed journals for publication. Manuscripts submitted for publication must acknowledge that the work was supported by a grant from the Prince William Sound Oil Spill Recovery Institute, and a copy of each publication must be provided to OSRI at the address below. When submitting final reports, investigators should indicate that they are submitting a manuscript to a journal.

X. Additional information

Questions regarding submission of research reports should be directed to W. Scott Pegau at (907) 424-5800 extension 222 or wspgau@pwssc.org.

GRF Appendix A

**Graduate Research Fellowship Program of the
Prince William Sound Oil Spill Recovery Institute
Quarterly Financial Report Form**

This report shall be e-mailed to

wspgau@pwssc.org and poswalt@pwssc.org

Deadline for this report: OSRI Graduate Research Fellows shall submit this report within 30 days of the end of each fiscal quarter (e.g. Dec. 31, Mar. 31, Jun. 30, Sep. 30).

Today's date:

Name of Graduate Research Fellow and home institution:

Project title:

This report covers: Oct-Dec 1st quarter
 Jan-Mar 2nd quarter
 Apr-Jun 3rd quarter
 Jul-Sep 4th quarter

PART I - Progress Report on Activities

In a short paragraph (3-10 sentences), please describe project activities since your last report.

Describe any existing or potential problems with the project. If a change in budget or scope of work is required, please explain.

Part II - Budget Report

Quarter Cumulative Balance:

| Budget Category | Budget Expenses | Remaining |
|------------------------------|------------------------|------------------|
| Direct Costs | | |
| Personnel | | |
| Travel | | |
| Contractual | | |
| Commodities | | |
| Equipment | | |
| Subtotal Direct Costs | | |
| Indirect | | |
| Project Total | | |

GRF Appendix B

The Prince William Sound Environmental Setting

Prince William Sound (PWS) is located in the northeast corner of the Pacific at 60° N (Figure 1) and includes an intricate network of maritime glaciers, rain forests, offshore islands, and ocean. PWS is surrounded by the Chugach Mountains that reach 4,300 m and contains the most extensive system of valley glaciers in North America. Most of the land area is in or adjacent to the Chugach National Forest. With a shoreline length of over 4900 km, and a tidal range of 8 meters, PWS has an enormously varied shoreline habitat of seastacks, reefs, rocky headlands, mud flats, eelgrass beds, wetlands, kelp forests, and cobble beaches.

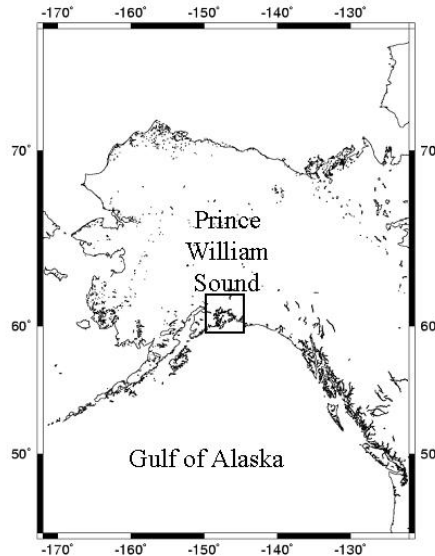


Figure 1. Location of the Gulf of Alaska and Prince William Sound.

The region is home to a rich and diverse marine ecosystem with large populations of birds, invertebrates, fish, and marine mammals. As part of the Pacific Flyway, PWS is a vital resting, feeding, breeding, and nesting area for more than 200 species of migrating birds that link PWS to regions as distant as Patagonia, the Gulf of California, and Hawaii. More than 100 bird species are year-round residents. Steller sea lions utilize the offshore rocks and reefs for haulouts, and 11,000 sea otters forage in the kelp beds. A resident Orca population of 360, and a smaller group of transient Orcas roam the Sound. The

region's 3,800 species of invertebrates, including red and brown king crab, Dungeness crab, pink, spot, and sidestripe shrimps, razor clams, scallops, octopus, squid, and sea urchins, represent 3.5% of known marine invertebrates in the world and provide rich food sources for the region's 306 species of fishes (FishBase 2002). Thousands of tons of Pacific herring spawn and are prey for many species of birds, mammals, and fish. PWS is also home to five hatcheries, which release a combined total of about 900 million pink, sockeye, and chum salmon fry into PWS each year. In 1999, over 50 million adult hatchery salmon were taken from PWS, the highest number on record. Average annual commercial harvest of rockfish is nearly 200,000 pounds; Pacific cod, 1 million pounds; sablefish, 225,000 pounds; and walleye pollock, nearly 4 million pounds. Recreational fishers, too, are drawn to the Sound's biomass. For example, over the last decade recreational fishers took up to 47 percent of the total regional rockfish catch.

While the PWS region was populated by small but numerous communities of Alutiiq peoples before contact with Europeans, it is largely uninhabited today. Southeast Indian, Athabaskan, Eskimo, and Aleut are among the indigenous cultures currently represented in PWS region. During the 2000 census, only 6,865 people lived in PWS. The two largest communities, Cordova (population 2,454) and Valdez (4,036), are predominantly non-Native. Of the three other communities, Chenega Bay (86) and Tatitlek (107) are Alaska Native villages, and Whittier (182) is mostly non-Native (U.S. Bureau of the Census 2001). Of the five PWS communities, only Valdez and Whittier have highway access to the main road system. The Alaska Marine Highway System (ferry) serves Cordova, Valdez, Whittier, Tatitlek, and Chenega Bay. The small local population of PWS is dependent on resource extraction for economic support (Fried & Windisch-Cole 1999). For example, the Cordova local economy is based on commercial fishing, primarily for pink and sockeye salmon, and the oil pipeline terminal supports the Valdez economy. Recent declines in both the volume of oil flowing through the pipeline and the value of fish landings have been a hardship to these communities.

The circulation and water mass properties of PWS primarily reflect large-scale ocean and atmospheric forcing. Atmospheric conditions are primarily established by the interaction of storms associated with the Aleutian Low with the coastal mountains surrounding the GOA (Wilson & Overland 1986, Royer 1998). As a consequence of this

interaction, the prevailing winds are cyclonic leading to positive wind stress curl over the basin and downwelling-favorable wind stress over the shelf throughout most of the year. Upon encountering coastal mountains, moist storm air masses are elevated and adiabatically cooled. This leads to very high rates of coastal precipitation along the coast. Much of this precipitation is presumed to enter the ocean relatively rapidly because of the steep terrain, except for in the winter season, when it is stored in mountain snowpacks. Downwelling-favorable winds are weakest in summer, build rapidly through fall to a winter maximum and decrease through spring. In contrast, coastal freshwater discharge is a maximum in fall, minimal in winter (when precipitation is stored as snow), and increases gradually through spring and summer due to melting.

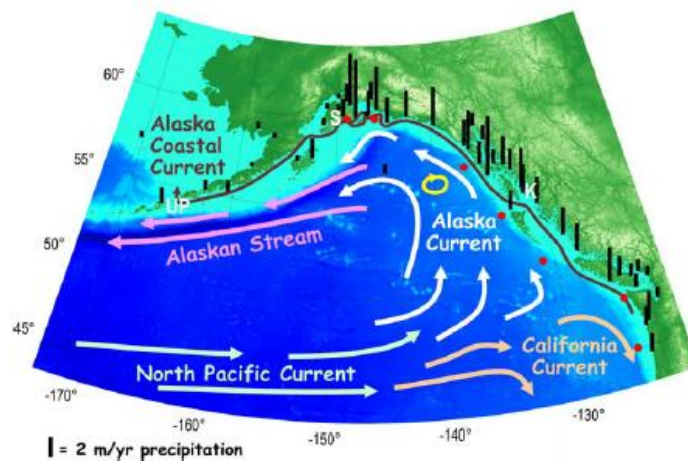


Figure 2. Circulation schematic of the Gulf of Alaska indicating the pathway of the Alaska Coastal Current over the shelf. Vertical bars show the relative precipitation amounts with K and S indicating locations of Ketchikan and Seward respectively (From T. Weingartner, University of Alaska Fairbanks).

PWS communicates with the shelf through Hinchinbrook Entrance in the east and through several passes in the west, with Montague Strait being the most prominent. Hinchinbrook Entrance connects the shelf with the Sound's central basin where depths exceed 350 m. The northern edge of the central basin extends into upper PWS through two bathymetric troughs. A 300 m deep trough extends to the northeast and terminates in Valdez Arm. A second trough curves to the northwest, where it broadens to form a smaller basin connecting the upper Sound to Knight Island Passage and the passes along the southwest portion of PWS. The Sound's maximum depths occur here; depths exceed

700 m in the northwest basin and range from 300 to 600 m in Knight Island Passage. By contrast, the shelf immediately south of PWS is shallower and bathymetrically simpler. Indeed, the shelf south of the entrance is relatively shallow (~120 m) and flat, with the exception of Hinchinbrook Canyon. This canyon, with depths exceeding 200 m, extends from the shelf break to Hinchinbrook Entrance and provides a conduit by which continental slope waters can reach PWS.

As the westward-flowing ACC encounters Hinchinbrook Entrance, a substantial fraction of it turns northward into PWS. The remainder of this current continues across the mouth of Hinchinbrook Entrance, thence southwestward along Montague Island and westward again after rounding the southern tip of the island. Once in PWS, the flow proceeds counterclockwise around the central basin, with some of the flow feeding the waters exiting through Montague Strait (and also perhaps along the western side of Hinchinbrook Entrance) and some of it continuing into the northern Sound (Niebauer et al. 1994, Gay & Vaughan 2001). Northern PWS waters flow southward through the Knight Island Passage and re-enter the shelf through passes in the western Sound. This outflow and the branch of the ACC that has rounded the southern edge of Montague Island merge southwest of PWS and continue westward along the Kenai Peninsula. This circulation pattern varies seasonally in accordance with the seasonal cycle of winds and runoff and appears to be strongest in late fall and winter and weakest in summer. Indeed, the counterclockwise circulation pattern might reverse occasionally, if not frequently during summer, with surface waters leaving through Hinchinbrook Entrance and entering through Montague Strait (Vaughan et al. 2001). As much as 40% of the volume of PWS above 100 m depth is exchanged in summer (May to September) and 200% is exchanged in winter (October through April) (Niebauer et al. 1994). Although these estimates are uncertain, they nevertheless suggest that exchange between the shelf and PWS is substantial and efficient, and should therefore profoundly influence circulation and ecosystem processes in PWS. Moreover, it is conceivable that the timing, frequency, and magnitude of the exchange of water between PWS and the ACC is somewhat episodic and may vary considerably from year-to-year. Such variability would presumably have strong ecological significance in terms of the delivery of inorganic and organic matter as well as planktonic larvae and algal spores.