

**PICES XIII GP-2184 Poster**

**Lipofuscin in the gonads of the sea urchin *Strongylocentrotus intermedius* inhabiting polluted coastal waters of Peter The Great Bay (Sea of Japan)**

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In histological sections from the gonads of the sea urchin *Strongylocentrotus intermedius*, morphological lipofuscin was demonstrated and fluorescent lipofuscin was quantified using epifluorescence microscopy and image analysis. In August 2002, sea urchins and sediment samples were collected at several stations from coastal zones of Peter the Great Bay (Sea of Japan): Stations 1 and 2 were located near Vladivostok City (“near city” zone). Stations 3, 4 and 5 were in the “island” zone of the bay, and a Reference Station 6 was in a remote area far from sources of pollution. Lipofuscin was visible as yellow pigment, yellow-brown globules and granules located mainly in the cytoplasm of nutritive phagocytes (NP); accumulations of the lipofuscin granules occurred in haemal sinuses and coelom. Upon gross inspection, the gonads of the sea urchins from “near city” zones contained much more lipofuscin than the gonads of the animals from “island” zones and Station 6. For fluorescence quantification, 5–8 males and females with immature gonads were selected within each animal sample. At  $\lambda=450$  nm, fluorescence intensity of 25 images of the gonad section occupied by NP was measured, and mean volume fraction (%) of lipofuscin was determined. Each animal sample contained from 1 (Station 6) to 7 (Station 1) sea urchins with high means (>1%) of lipofuscin volume fraction (LVF). High LVF means were attributed to NP containing a bulk of lipofuscin granules. In bottom sediments from Station 1, high concentrations of heavy metals and the organochlorine pesticide DDT were determined. Pollution appears to intensify the lipofuscin formation in the sea urchin gonads.

**PICES XIII GP-1780 Poster**

**Ecological investigations at the Far East State Marine Reserve Area**

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Initial studies at the Far East State Marine Reserve (FESMR) were carried out in the 1980s by the Institute of Marine Biology. These investigations provided a description of populations of benthic invertebrates and environmental factors in the southern part of FESMR. In 1993, the Expedition of Joint Company “Dalmorgeologia” and FERHRI investigated pollutant content in water and bottom sediments, as well as benthos distribution patterns in this area.

The first comprehensive ecological expedition to FESMR was organized by the Institute of Marine Biology in 1996. The main goal of this investigation was to study environmental factors, pollution levels, and the present status of benthic and pelagic ecosystems of the southern part of FESMR between the Tumangan River mouth and Furugelm Island (TREDA Project).

Analysis of data obtained showed that the FESMR study area was characterized by background pollution levels and high biomass, diversity and richness of benthic fauna. A total of 11 phyla and 211 species of macrozoobenthos were identified. Mean biomass of benthos exceeded 150 g/m<sup>2</sup>. Non pollution-tolerant species (echinoids, amphipod crustaceans and bivalve mollusks) were prevalent. It appears that this sort of distribution typifies the normal ecological state of the area. However, increasing content of chlorinated pesticide residues (*e.g.*, prohibited DDT) was recorded in some zones, where pollution-tolerant species were detected. This would appear to be evidence of anthropogenic impact, resulting in ecologically stressed conditions in some local zones in FESMR.

**PICES XIII GP-1962 Poster**

**New comprehensive oil spill modeling for potential sources near Sakhalin Island**

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Results of new comprehensive oil spill modeling for two potentially dangerous areas near Sakhalin Island are considered. Exploratory well drilling under the Sakhalin-5 Project is going to start in 2004 northeastward of the Sakhalin-1 and 2 Project sea areas. In addition, Phase II of Sakhalin-2 includes oil and gas pipeline transport to the south of Sakhalin Island and further export by sea. Thus, Aniva Bay and adjacent waters are the other area under study. New potential oil spill sources were identified and oil behavior was modeled, both statistically and diagnostically. For the Sakhalin-5 project, we calculated oil behavior for the well control loss, bunkering and flare test cases. For the Aniva Bay area, we simulated oil behavior for 5 potential oil release points, including a tanker loading unit and four tanker route points (Aniva Bay center, a point southward of Aniva Bay, La Perouse/Soya Strait and a point nearby Rebun Island in Japan Sea). Updated oil spill modeling techniques including preparation of output results for EIA/EP (Environment Protection Documents) and OSRP (Oil Spill Response Planning) consisted of: (1) statistical modeling (simulation over the numerous possible hydromet scenarios, and averaging of results followed by constructing probability patterns for the oil transport, location, shore impact, etc.) and (2) diagnostic modeling (simulation over specific hydromet scenarios to detail oil fate under specific weather conditions including both typical, to and/or most unfavorable conditions). With respect to exploratory well drilling on the northeastern Sakhalin shelf, we analyzed pressure fields that form unfavorable hydromet conditions causing very rapid shoreline impact or/and lengthy coastline contamination. Our analysis of the Aniva Bay area revealed hydromet situations which could result in very rapid impacts upon both Russian and Japan coasts.

**PICES XIII GP-1828 Poster**

**The diamond squid (*Thysanoteuthis rhombus*): A review of recent research and the fishery in Japan**

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This poster presents a review of the biology, ecology, fisheries, and resource status of the diamond squid (*Thysanoteuthis rhombus*) focusing on recent literature published in Japan. *T. rhombus* is a large nektonic squid distributed worldwide mainly in tropical and subtropical waters, including around central and southern Japan. Near Japan, spawning occurs widely around Okinawa and in other southern waters. Part of the population is transported by the Tsushima Current into the Sea of Japan, where it is targeted by a growing fishery, but details of this migration are not known. The vertical distribution of *T. rhombus* varies regionally; in Okinawa, it occurs mainly at 300-650 m depth during the day and 0-150 m depth at night, while in the Sea of Japan it occurs mainly at 75-100 m depth during the day and 0-50 m depth at night. The life span of *T. rhombus* is thought to be about one year, and squid larger than 30 cm ML grow about 7-10 cm mo<sup>-1</sup>. The main fishing grounds in Japan are the Sea of Japan, Okinawa Prefecture, and Kagoshima Prefecture, with most catches occurring in the Sea of Japan and Okinawa. In the Sea of Japan, it is fished with free-floating angling gear called “taru-nagashi” and in nearshore stationary nets. The fishery runs roughly from July through February, with peak catches occurring from September through December. Annual catches during 1998-2001 ranged between 1,900 and 3,800 tons. In Okinawa, it is fished primarily in the daytime using free-floating angling gear called “hata-nagashi”. The fishery runs mainly from November to April, with highest catches occurring in February-April. Annual catches were 2617 tons in 2000-01 and 2028 tons in 2001-02.

**PICES XIII GP-1903 Poster**

**Beyond biomass: Individual-based reproductive decisions of a planktivorous marine predator over 35 years**

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Evolutionary theory predicts that life history strategies, the way individuals allocate reproductive effort over their lifetimes, should maximize inclusive fitness. Reproductive investment and output varies between individuals, due to heterogeneity between individuals as well as environmental stochasticity. The purpose of this study is to investigate how individuals allocate resources to reproduction under varying ocean climate on an interdecadal time scale. We evaluate variation in life history strategies by long-term studies of a marine bird (Cassin's auklet, *Ptychoramphus aleuticus*) reproducing in the California Current system. This long-lived, pursuit-diving secondary predator forages primarily on *Euphausia pacifica*, *Thysanoessa spinifera*, and *Nyctiphanes simplex* along the shelf break front. Normally, there is only one breeding attempt annually.

However, some individuals may pursue a second reproductive cycle after a successful first attempt; this is an extremely rare life history strategy in marine birds. In the 1970s and early 1980s, we found that extra reproductive attempts were rarely successful and wasted reproductive effort. However, the frequency and success of this strategy increased in the late 1980s and even more in the late 1990s and early 2000s. Changes in reproductive effort and success began well before the hypothesized regime shift of the late 1990s (Peterson and Schwing 2003). This study highlights the importance of studies on individuals in long-lived iteroparous marine predators.

Long-term individual-based research is needed to understand the population level consequences of ocean climate change, as well as the evolutionary significance of specific life history attributes.

**PICES XIII GP-1784 Poster**

**Superoxide dismutase in the marine alga, *Dunaliella salina***

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The marine alga *Dunaliella* is commercially an important organism producing  $\beta$ -carotene and xanthophylls which are known to be quenching reactive oxygen species. In this work, we studied the relationship between antioxidant and the antioxidant enzyme; chloroplastic iron superoxide dismutase (Fe-SOD) from *Dunaliella salina*, under different physiological conditions. The enzyme superoxide dismutase (SOD) represents a first step in such ROS scavenging systems, catalysing the dismutation of  $O_2$  to  $H_2O_2$  and oxygen. Therefore this enzyme is critical in controlling the levels of reactive oxygen species in cell compartments. A cDNA-encoding Fe-SOD was isolated from *Dunaliella salina*. This Fe-SOD is nuclear-encoded; its deduced amino acid sequence is 67-75% identical to Fe-SOD isoforms from plants and cyanobacteria, respectively, and residues responsible for iron binding are fully conserved. We showed that the mRNA for Fe-SOD was induced in response to UV-B illumination and to growth under increasing light fluencies. Light-induced up-regulation of Fe-SOD expression and increments of antioxidant such as  $\beta$ -carotene and xanthophylls in *D. salina* are discussed in terms of algal mass culture.

**PICES XIII GP-2019 Poster**

**Multiyear changes of petroleum hydrocarbons in the marine environment near the operating oil producing platform *MOLIKPAQ***

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Over a four-year period (1998–2001), the impact of technological processes of the MOLIKPAQ platform (NE Sakhalin Island shelf) on pollution of water and bottom sediments by petroleum hydrocarbons was studied. Water was sampled at surface, intermediate, and bottom areas of the water column within a range of 500 m from the platform in September and October. Five subsequent samplings were carried out to analyze concentrations of petroleum hydrocarbons in bottom sediments from 1998 - 2001. Sediment samples were taken at distances of 125–5000 m from the platform. Maximum concentrations of petroleum hydrocarbons in bottom sediments of the study area were registered in June 1998 prior to the platform installation. Later, from October 1998 to 2000, significant reduction of petroleum hydrocarbon concentrations was observed. In 2001, the average concentration of petroleum hydrocarbons increased again somewhat, although this increase was slight, and statistically insignificant. Maximum concentrations of petroleum hydrocarbons in the water column near the platform were registered in October 1998 and, as in the case with concentrations of petroleum hydrocarbons in bottom sediments, then decreased continuously. Minimum petroleum concentrations were reached in October 2001. Moreover, vertical distribution of petroleum hydrocarbons changed from rather uniform for the water column in October 1998 to a significant decrease in concentrations with depth in 2000–2001. It is possible that the high concentrations of petroleum hydrocarbons with maximum values in the intermediate and bottom layers of water (both in mean and especially in extreme values) observed in October 1998 were caused by resuspension of petroleum products out of bottom sediments that took place because of high bottom hydrodynamic activity and disturbance of the sediment surface during the platform installation. The elevated concentration of petroleum hydrocarbons in sediments that was observed prior to the installation was likely to be related to natural oil seepage.

**PICES XIII GP-2132 Poster**

**Variability of global thermohaline circulation due to the Drake Passage**

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The global thermohaline circulation was simulated in an idealized ocean to verify its variability due to the presence of the shallow Drake Passage in the Antarctic Ocean. The model was represented by the NOAA/GFDL Modular Ocean Model, MOM, 3. We used a 2° by 2° latitude and longitude grid in the horizontal and used 20 vertical layers. The oceans were simplified as rectangular boxes linked together by the Antarctic Ocean. The bottom topography was almost ignored, the oceans being flat except in the Drake Passage. Wind over the surface layer had no zonal variation but varied only in the meridional direction. Temperature and salinity were restored to a symmetric distribution across the equator. There were no zonal variations in any surface boundary conditions. Due to the variation of bottom topography in the Drake Passage, almost changes of thermohaline circulation occurred in the North Atlantic but for the changes of the Antarctic Circumpolar Current directly affected by it. Especially in the cases with a shallow Drake Passage, the thermohaline circulations were strengthened in the Atlantic and Pacific Oceans. In this study, we explain how the effect of bottom topography in the Drake Passage on the thermohaline circulation propagates to the northern hemisphere and the reason why circulation changes were emphasized in specific areas.

**PICES XIII GP-2161 Poster**

**The effects of antibiotics on the photosynthetic apparatus and ammonium uptake in *Porphyra yezoensis***

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Modern integrated fish-seaweed mariculture has been tested as a means of reducing the environmental impacts of an intensive fed aquaculture. To obtain the best seaweed bioremediation performance, the effects on selected seaweed species of therapeutants used for fish disease control should be considered. As the selected seaweed, the photosynthetic activity of *Porphyra yezoensis* was tested with several commercial antibiotics such as Erysulfa, Oxytetracycline HCl, Doxycycline Hyclate, Erythromycin Thiocyanate, Pefloxacin, and Amoxicillin under batch incubation at a photon flux density of ca. 10  $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$  at 15°C. Among the tested antibiotics, Erysulfa, Oxytetracycline HCl, and Doxycycline Hyclate showed a decreased Fv/Fm and, in turn, the photochemical PSII efficiency of *P. yezoensis* in a dose-dependant and time-dependant manner. From a quenching analysis of chlorophyll fluorescence, three differential patterns were found in the antibiotics-treated *Porphyra*: (1) high NPQ and low qP in the case of Erythromycin Thiocyanate and Amoxicillin treatment; (2) high NPQ and high qP for Pefloxacin; and (3) low NPQ and low qP for Oxytetracycline HCl. These results indicated that each antibiotic, reflecting its unique differential lesion sites, affected the photosynthetic apparatus in various ways. In addition, the rates of ammonium uptake decreased in the antibiotics-treated *P. yezoensis* with a decreased Fv/Fm. Therefore, some antibiotics could affect the bioremediation capacity of the selected seaweed species in the integrated fish-seaweed mariculture system by decreasing, simultaneously, the photosynthetic activity and the ammonium uptake of this species.

**PICES XIII GP-2162 Poster**

**The effects of epiphytes on the photosynthetic apparatus of seagrass measured using the chlorophyll fluorescence imaging technique**

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The effects of epiphytes on seagrass (*Zostera marina*) were measured using the Pulse Amplitude Modulation (PAM) Chlorophyll (Chl) Fluorescence Imaging Technique (FluorCam, PSI, Czech Republic). The fluorescence images of seagrass leaves before and after the removal of epiphytes were compared according to the images of Fo, Fm, and Fv/Fm. The Fo images of the initial Chl fluorescence before receiving an actinic light, clearly revealed the distribution of epiphytes on the leaf surfaces. There were more epiphytes on the outside leaves than on the inside ones; and there were more in the distal leaf parts than in the lower parts. The Fm images of the maximal yield of Chl fluorescence showed a significantly low outcome. In the case of loosely-bound epiphytes, the recovery of the photosynthetic capacity of the leaves was clear but with tightly-bound epiphytes, it was not, which could have been the result of permanent damage to the leaf surface layer. Therefore, Fv/Fm images might reflect the coherent effects of epiphytes on seagrass. In addition, we examined the changes of the epiphytes' effects on the seagrass leaves. The amounts of epiphytes increased in spring and summer, but the photosynthetic activity of the seagrass decreased consistently during that period. We speculated that epiphytes on seagrass leaves may inhibit seagrass biology through the down-regulation of the photosynthetic apparatus, as deduced from observations using the PAM Chl fluorescence imaging analysis technique.

**PICES XIII GP-1839 Poster**

**Death of the holothurian *Eupentacta fraudatrix* phagocytes treated with toxin of bacterium *Yersinia pseudotuberculosis***

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In view of the increased pollution of coastal seawaters with waste water, there is need to study the characteristics of possible bacterial influence on marine animals. The bacteria *Yersinia pseudotuberculosis* has been shown earlier to be relatively long-lived in seawater. The aim of the present study was to clarify a role of a novel thermostable toxin (TST) from *Y. pseudotuberculosis* in the bacteria-induced lethality of the Far-Eastern holothurian *Eupentacta fraudatrix*. We demonstrated that a TST concentration of 0.2 µg/mL, which was previously shown to increase oxidant stress in holothurian phagocytes *in vitro*, decreased cell viability by 30-44% compared to the control after 48 and 72 h incubation, respectively. The cell death was closely related to TST-induced apoptosis as assessed by measuring DNA fragmentation using electrophoresis on agarose gel and by Hoechst 33342 staining: after 72 h, apoptosis was 41% higher than that in the controls. In addition, TST (0.5 µg/mL) decreased concanavalin A (con A) binding to the phagocytes by 25 and 50% compared to the controls after 18 and 72 h, respectively, as evaluated by FITC-conjugated con A staining. The last fact, apparently, indicates a decrease in functional activity of phagocytes. The results obtained show that TST of bacteria *Y. pseudotuberculosis* can damage the immune cells of holothurians by decreasing their phagocyte functional activity and killing the cells via inducing apoptosis. These data suggest also the possibility of regulating phagocyte activity with con A, and may be important for antibacterial defense of animals in aquaculture.

**PICES XIII GP-2136 Poster**

**Abundances of planktonic foraminifera indicate decadal variability and a 20<sup>th</sup> century warming in the California Current**

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Microfossils of planktonic foraminifera in marine sediments offer one of the few means available to reconstruct changes in hydrographic structure and infer the mechanisms of change in ocean climate. Here, we develop a >250-year record of variations in upper ocean structure of the California Current, inferred from the abundances of planktonic foraminifera in annually varved sediments of the Santa Barbara Basin. Temporal variability in foraminiferal abundance follows two main patterns that are reflected in a Principal Components Analysis. The first pattern (PC 1) involves a substantial 20<sup>th</sup> century increase in the abundance of mostly tropical and subtropical species that indicate a warming of near-surface waters across the annual cycle of isothermal shoaling and deepening. The second pattern (PC 2) involves species with subpolar affinities that probably reflect decadal scale dynamics within the thermocline. There is a clear separation of the two PCs after 1975 that indicates a near surface warming and isothermal deepening that is distinct from all other time periods of the record. This change coincides with the well-known shift that occurred around 1977 in the North Pacific, where an intensification in the Aleutian Low caused a warming and depression of isotherms in the eastern North Pacific, particularly during winter. While decadal variability is prominent throughout the foraminiferal records, the patterns observed in the 20<sup>th</sup> century are distinct from those of previous centuries and suggest a response of the California Current to atmospheric warming that is attributed in part to anthropogenic activity.

**PICES XIII GP-2169 Poster**

**The seasonal distribution and quality of commercial fish species: Energy flow and sustainability on the Gulf of Alaska shelf**

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The importance of seasonal, spatial and ontogenetic variability of fish energetics in the context of trophodynamic interactions of commercially targeted fish has been noted but not well studied. This study targeted demersal and pelagic fishes within the coastal shelf of the Gulf of Alaska. Multiple fish species were collected for subsequent proximate analysis from the southeast side of Kodiak Island in March, May, July and November 2000-2002. Species composition, relative abundance and trophic linkages of fishes were assessed during acoustic-trawl surveys using 38 kHz bioacoustics on 250 nm parallel east-west lines 25 nm from shore. Midwater fish species included walleye pollock, capelin, eulachon, arrowtooth flounder, Pacific sandfish, Pacific cod and king salmon. The bottom trawls, based on depth and distance from shore strata, were dominated by arrowtooth flounder, flathead sole, walleye pollock, Pacific cod, rock sole and eulachon. The proximate composition of fish differed seasonally and annually. Lipid values ranged from 0.95 to 4.7 percent in May and from 1.9 to 11.6 percent in November over 30 fish species. Moisture ranged from 76.5 to 80.7 percent in May and 69.6 to 79.5 percent in November. Protein ranged from 13.9 to 21.0 percent in May to 14.9 to 17.7 percent in November. Ash ranged from 1.5 to 3.6 percent in both May and November. Knowledge of commercial fish energetics and their prey quality has allowed us to build bioenergetic models to understand the relative flow of energy in the coastal region as it pertains to the harvest and sustainability of commercial fisheries.

**PICES XIII GP-1914 Poster**

**The impact of the transition of consumption patterns and population development in China on fisheries in the next 20 years**

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In 1995, the total aquatic product of China had reached 25 million tons, making it the largest such producer in the world. This has caused calamitous consequences to ecosystems in China. For analyzing the effects of population development and the transition of consumption patterns on fisheries in the future, this paper presents a structural model to illuminate the future demands on aquatic products, using principles of economics, demography, and biology. In this model, a macro-economics method is used for determining the relationship between the consumption of aquatic products and income level; *Profamy*, a new method of population forecasting, is utilized to project the size of populations in the next two decades. Because of the obvious differences in consumption of aquatic products between urban residents and rural ones, urbanization which will process rapidly in the future is considered as a crucial factor. In addition, oceanographic methods are used to find the sustainable limit of fisheries. We propose that these two factors, in addition to some special uncertainty, constitute the decisive factors in forecasting the future demands on aquatic products in China. Our conclusions are: (1) the amount of the consumer demands on aquatic products will be 16.7 million tons in 2020; If this were to also include the various industrial and commercial demands, the sustainable limit would be exceeded if there is no effort at alleviating the pressure on natural resources. (2) Urbanization will play a more and more important role in the increasing demands on aquatic products; its net effect will be 4 times higher in 2020 than in 2000; (3) the transition in consumption patterns caused by economic development, will have a decreasing effect on fishery resources. Finally, some suggestions are proposed for correcting the situation, with the intent of enhancing the analysts' and policymakers' understanding of the important issues in this field.

**PICES XIII GP-1799 Poster**

**Stock enhancement policy for Japanese red sea bream, *Pagrus major*, by release of juveniles and fisheries management**

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Japanese red sea bream is a major target of commercial and recreational fishing, and millions of juveniles have been released each year for stock enhancement since the early 1980s. Recovery rates and expected catches of released juveniles were estimated to be 5-17% and 20-80 tons per million juveniles, respectively, in the case of the southern coastal area. In this paper, the effects of juvenile release on the sustainable yield from two local stocks, the southern coastal area and the Seto inland sea area, were evaluated.

Numbers of recruits and brood stock biomass during 1983-1993 were estimated with virtual population analysis (VPA) from data of age composition of landed fish. When the relationships between brood stock biomass and recruits followed the Ricker model, number of 1-year-old recruits in t year ( $R_t$ ) was

$$R_t = A * E_{t-1} * \exp(-B * E_{t-1}) + S_{t-1} * K$$

Here, A and B are the parameters of the Ricker model curve, and  $E_t$  is brood stock biomass.  $S_t$  and K are numbers of released juveniles and the survival rate of released juveniles until becoming 1-year-olds, respectively. A, B and K were estimated by the method of least squares. Using these parameters, the relationships among fishing mortality, number of releases and sustainable yield were calculated.

The increments of sustainable yield by stocking were estimated to be 20% and 2% in the two local stocks of the southern coastal area and the Seto Inland Sea area, respectively, under the current status of fishing mortality and number of released juveniles. Differences in increments were caused by differences in stocking impact and fishing mortality. The adequacy of the enhancement policy on the two local stocks is discussed.

**PICES XIII GP-2077 Poster**

**Using a generalized additive model to predict Bigeye (*Thunnus obesus*) CPUE at the Palmyra fishing grounds**

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The fishing grounds around the Palmyra Atoll can account for up to 20% of bigeye and over 55% of yellowfin tuna landed in the Hawaii Long-line Fishery since 1994. The observed availability of these two species of tuna appears to fluctuate based on environmental conditions, with catches around Palmyra dominated by yellowfin tuna, except in years of El Niño events. This variability in catch, when compounded with the travel time and cost for Hawaiian vessels, diminishes the desire to fish these productive waters. Modeling techniques were employed to attempt to decipher which parameters are important in determining the catch composition and to produce a basic prediction of the magnitude of bigeye catch. Generalized additive models (GAM) were used within a k-fold cross-validation framework to construct a predictive model of bigeye tuna (*Thunnus obesus*) catch rate on long-line fishing gear around Palmyra Atoll. This approach was contrasted with commonly used stepwise model construction techniques to examine the effects of overfitting. Preliminary results revealed that two environmental parameters with date and locations were sufficient to account for close to 70% of the bigeye CPUE. The main environmental parameter required by the model was an ecosystem indicator derived from an empirical orthogonal analysis (EOF) of altimetry data in the Pacific equatorial region. A parsimonious model using several predictor variables was also constructed and found to be satisfactory for predicting long-line fishing success.

**PICES XIII GP-1862 Poster**

**Spatial comparison of ocean distribution and feeding habits of sockeye (*Oncorhynchus nerka*) and pink salmon (*O. gorbuscha*) in the western Gulf of Alaska during summer 2003**

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We investigate spatial differences in distribution and feeding habits of sockeye (*Oncorhynchus nerka*) and pink salmon (*O. gorbuscha*) in the western Gulf of Alaska (145-160°W, 50-58°N). Sockeye salmon were distributed in a more to the south (51-53°N, 155-160°W) than pink salmon (54-56°N, 155-160°W). Sockeye were immature and pink salmon were maturing. They consumed diverse prey, such as fishes, squids, amphipods, decapods, and pteropods. Sockeye salmon fed on larger prey (fishes and squids) consisting of higher energy at low CPUEs of both species. Sockeye and pink salmon did not show a shift from small to large prey with increasing body size. Results of cluster analysis on stomach contents showed that sockeye salmon fed dominantly on pteropods in coastal waters, decapods in middle waters, and hyperiid amphipods and squids in offshore waters despite unclear results for pink salmon. Sockeye and pink salmon had a high degree of overlap in feeding niche ( $C_H > 0.6$ ) and the same dominant prey, such as pteropods and decapods, in areas of sympatric distribution. These results suggest that sockeye and pink salmon should be omnivorous and opportunistic feeders, feeding on available and abundant prey according to intra- and inter-specific competitions, food composition and oceanic environment.

**PICES XIII GP-1889 Poster**

**Ichthyofauna of seamounts in the North Pacific**

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In 1967, the Russian trawler *Astronom* found accumulations of boarfish on the Emperor Seamounts. It generated much interest in such underwater features. Later, it was found out that such underwater features, as well as islands and island arches, play an important role in creating zones of increased efficiency (Kotenev, 1977; Neumann, Krylov, 1979; Darnitsky, 1980; Uchida, Hayas, 1986, Boehert, 1986, 1987, 1988). A. Andrijashev (1979) and N. Parin (1982) showed that seamounts form a specific ecological zone, "bathyal without a shelf" or talassobathyal zone, where various organisms can be concentrated, including benthic and pelagic ecological groups. The common attributes of ichthyofauna on seamounts and in surrounding waters is determined by geographical zone and other features, including distance from continents, islands and other seamounts, current systems, water depth at the top, area of the seamount, absence of a shelf, and weak development of the benthos.

Talassobathyal faunal communities develop by means of drift of larvae and pelagic juveniles in nearsurface currents. All abundant talassobathyal fishes have a pelagic stage in their ontogeny that can last a number of years. During the pelagic period, juvenile talassobathyal fishes serve as prey resources. They concentrate on seamounts only at upon attaining sexual maturity.

Most Northwestern and Central Pacific seamounts are located within the limits of subtropical circulation and eastern Pacific seamounts, as far as the Emperor and Hawaiian Seamounts, are populated on with Indo-West Pacific fauna. The distribution of benthonic representatives of this fauna further to the east is limited by interference by movement of quasi-meridional waters (Kozlov, 1971) and absence of large seamounts to the east. Southeast Pacific seamounts are located within the limits of northeast subarctic circulation and their fauna are typical of continental slopes of the subarctic region, northern seamounts of the Emperor Ridge, and Oregon. In the productive eddy-like zones above seamounts, high concentrations of epi- and mesopelagic fishes and even pulses of the neritic species, such as mackerel and sardine, are formed.

We report on ichthyofauna from the Emperor, Hawaiian, Kyushu-Palau, Bonin and Gulf of Alaska seamounts, as well as some oceanographic features near these different seamounts.

**PICES XIII GP-1891 Poster**

**Seamounts researches in the West Central Tropical Pacific  
Part II. Mid-Pacific and Necker Ridges**

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Vortical currents, including Taylor-column eddies, above seamounts concentrate epi- and mezopelagical plankton, leading to bioefficiency. Fishes, which attain high abundance at the base and near the top of seamount ecosystems, have long (in some cases, years) pelagic stages of development. The formation of large concentrations of fishes is connected to ocean currents and fronts, taking place near these seamounts. Mid-Pacific and Necker Seamounts are located in the western-central tropical Pacific between a subtropical convergence zone and the northern periphery of the Northern Trade Currents. A reconnaissance study was conducted on 22 of the 350 seamounts. Tropical, strongly stratified waters constitute the least productive zone in the ocean. Biogenic compounds are almost absent in the 0-250 m layer. At a depth of 300 m phosphate concentration is 0.01 mkg-at/l and silicate is about 1.0 mkg-at/l. The average weight of zooplankton was less than 15 mg/m<sup>3</sup> at depths greater than 500 m (February, 1985). Zooplankton included only tropical species: *Eucheta marina*, *Eucheta wolfendeni*, *Candacia aetiopica*, *Undinula darwini*, *Stilocherion affine*, *Sagitta enflata*, *Neocalanus gracilis*, and *Euphausia*. Trawl catches included only some species of sharks: *Squalidae*, *Gonostomatidae*, *Gempylidae*, *Myctophidae*, *Sternophychidae*, *Synaphobranchidae*, *Serrivomeridae*, *Nomeidae*, *Brotulidae*, *Chauliodontidae*, *Macrouridae*. Benthos on top of these underwater mountains included glass sponges, horn corals, and sea lilies. In some areas the density of sea lilies reached 2-3 per m<sup>3</sup>, but average density of the benthos was much lower (R/V *Odissey*, 1985). The eddy-like systems at tropical seamounts have a semi-flat profile, barely impinging on the vertical structure of the water column to effect deep water upwelling. For example, an oceanographic survey at Lamont Seamount did not find vertical movements caused by geostrophic eddies near the top of seamount (Darnitskiy, Kanevskiy, 1997).

**PICES XIII GP-2065 Poster**

**Optic-acoustic and bio-physical complex for the shelf water and seabed research**

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The 18m long yacht is supplied with navigational equipment that assumes maneuvering with 10-12 knots speed according to assigned trajectory with an error about 1 m. Application of two operating modes for work, *i.e.* with working engines and non-working ones (silent) admits to increase efficiency of the acoustic system use, operating in the mode of passive noise-hearing (listening) of acoustic radiation produced by any biological objects.

Optimal application of different measuring instruments deployed onboard yacht in the instrumental department complex is provided. This complex includes autonomous undersea self-moving vehicle equipped by side-looking sonar, sector scanning (narrow-beam) sonar, optical TV and photo set-up. Possibility to install quantum magnetometer, devices to determine transparency of water, chemical contents of water and other appliances is foreseen for implementation on this undersea vehicle. There have already been tested some devices for the Fishery Department in TINRO.

Usage of acoustic vectorial receivers, measuring low-frequency echo-sounders with 2-3 ranges of frequency are envisaged also to operate onboard yacht autonomously from the undersea vehicle. The pneumatic boats are available onboard that can work autonomously either. The obtained information on physical fields is transmitted from measuring instruments to onboard devices being processed in real-time scale also documented at the same time. It may help to compile a map of bottom microrelief, contents of bottom cover. It is planned to develop further trends of research operations. Deployment and exploitation of appliances onboard yacht results in decrease of financial expenditure for conducted explorations.

**PICES XIII GP-1774 Poster**

**The status of red king crab stocks in the Far Eastern Seas and their recovery by aquaculture**

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In recent years there has been a sharp decline in the stocks of red king crab in virtually all the conventional fishing areas in the Far Eastern seas. As a consequence, the recommended volumes of the allowable catch for the recent five years have been reduced nearly ten-fold: from 30,000 tons in 1999 down to 3,583 tons in 2003. This is why we should employ every possible method to promote the introduction of more optimum techniques in the use of red king crab resources. These objectives can be reached using techniques of commercial culturing of crab. Beginning from 2000, a recycling man-made sea water system has been operating at VNIRO aquaria to experiment in obtaining and rearing of red king crab larvae up to the viable stages. Optimum conditions for development, which might be absent or tampered with in natural habitats, are being maintained in the process, especially at the plankton larval stage. The following characteristics are being reviewed in addressing the major stages of the process.

- abiotic conditions for the receipt and rearing of larvae and viable juveniles;
- stocking density and feeding regime;
- duration of the larval, post-larval and juvenile stages;
- survival and growth of larvae at each stage;
- behavioral reactions.

The results of these studies were basic in developing tentative biological standards for culturing the red king crab, and were used in designing experimental crab integrated facilities in Kamchatka, in the Far East and the Barents Sea.

**PICES XIII GP-1779 Poster**

**Distribution of contaminants in sediments of the Far East State Marine Reserve and adjacent area near Tumen River mouth, Sea of Japan**

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The southern area of the Far East State Marine Reserve (FESMR) is situated in the immediate proximity (about 15 km northward) of the Tumen River region, which is the adjoining point for the Russian, Chinese and North Korean frontiers. Last year under UN patronage, a project of accelerated industrialization was developed for this region. Realization of these plans will be accompanied by a corresponding increase in chemical contamination, and the present status of the environmental problems should be evaluated as a zero point.

The levels of various contaminants (trace metals - Cd, Cu, Zn, Pb, Ni, Co, Cr, petroleum hydrocarbons - PHC, and pesticides - sum of HCH isomers, and sum of DDT metabolites) were determined in sediments sampled from the south part of FESMR and adjacent sea area. The spatial variance of contaminants as well as grain size composition were analyzed to reveal quantitatively natural and anthropogenic controlling factors, and to assess the present status of contamination. The potentially toxic metal and PHC contents in the sediments studied do not exceed those in the background muds, and variability of them, excluding Cd, is determined by the dissipation of the fine river material. The maximum pesticide concentrations obviously exceed the background level, and their distribution is controlled by river run-off as well as by additional input associated with river-mouth wetlands.

**PICES XIII GP-1905 Poster**

**Biomarkers of energetic metabolism of marine shellfishes and echinoderms in the Far Eastern State Marine Reserve (Japan/East Sea)**

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The Far Eastern State Marine Reserve (FESMR) is located on Peter the Great Bay; this is the northwestern part of Japan/East Sea. The biodiversity of marine organisms in FESMR is very high, due to a favorable combination of natural conditions and background levels of pollutants in this environment. Molecular biomarkers of energetic metabolism were detected in somatic and reproductive organs of some species of marine shellfishes and echinoderms from FESMR and other areas of Peter the Great Bay. Carotenoids are respiratory pigments, which define the important parameters of energetic pathways. High carotenoid content allows marine organisms to protect themselves against harmful effects. The carotenoid concentration in ovaries and testes of the sea urchin *Strongylocentrotus intermedius* from FESMR was 2 times higher than in individuals from polluted areas near the large seaport of Vladivostok. In contrast, the lowest carotenoid level was obtained in mussels of *Mytilus trossulus* and *Crenomytilus grayanus* collected from FESMR. Thus, there are different regulatory energetic mechanisms in both “stable” (mussels) and “unstable” (sea urchins) species. The activity of Na<sup>+</sup>-K<sup>+</sup>-ATPase and Mg<sup>2+</sup>-ATPase was maximal in hepatopancreas of mussels from Kalevala Bay (FESMR) in comparison with mussels from other polluted bays. The metabolic processes in marine organisms from the Marine Reserve can be recognized as a “basal” level in comparison with organisms subjected to anthropogenic pollution from other areas in Peter the Great Bay.

**PICES XIII GP-1783 Poster**

**The role of the Kuril Island straits in forming the water characteristics of the Kuril-Kamchatka Current zone**

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The thermohaline structure and variability of the Kuril-Kamchatka Current zone in the Kuril Island Straits and Kamchatka peninsula border area of the Pacific ocean were studied.

For the purposes of this study we used the research vessel cruises of the POI, FEBRAS and recent hydrological and meteorological data (1989-1993) for the Kuril-Kamchatka Current zone, the 50-year synopsis (World Ocean Data Base, 1994, National Oceanographic Data Center, Washington, D.C.) together with all available atmospheric pressure, temperature and salinity data at the sea surface.

We will demonstrate the importance of the variability of the water exchange through the straits and atmospheric circulation variability was revealed for controlling the formation of water structure. New information about the variability of hydrological water characteristics will also be shown. We will show how zonations of the Kuril-Kamchatka Current area can be identified. Characteristic differences of various water modifications in the current zone will be shown.

The results can be used for developing forecasts of hydrological conditions in this area.

**PICES XIII GP-1848 Poster**

**Variation of the Japanese sardine population associated with SST in the Kuroshio Extension during the 20th century**

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Winter sea surface temperatures (SSTs) were reconstructed in the Kuroshio Extension and its southern recirculation area in the 20th century. Prior to 1948, SSTs were corrected by comparing nighttime SST and air temperature using the digitized Kobe-Collection and the COADS datasets. Periods of high SST occurred in 1911-1920, 1942-1956 and 1988-1995, and low SST occurred in 1921-1941 and 1970-1987. An abrupt increase in SST occurred in 1942 and 1988, associated with regime shifts. An empirical biomass model for the Japanese sardine with the corrected SST data reproduced the history of the sardine catch variations in the 20th century. This supports the hypothesis that the environment of the Kuroshio Extension, represented by winter SST, controls fluctuations of sardine populations.

**PICES XIII GP-1972 Poster**

**Quality control methods for chemical oceanographic data**

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Chemical oceanographic data include various kinds of values of dissolved matters in the sea water; dissolved oxygen (DO), nutrients, carbon species (DIC, TA, pH, x/f/pCO<sub>2</sub>), trace dissolved gases (CFCs, SF<sub>6</sub>, etc.), trace metals, and so on. Some biological data, such as chlorophyll-a, are used as carbon species from the viewpoint that biological processes can affect CO<sub>2</sub> distribution in the ocean. The integration of chemical oceanographic data is important for large spatial scale or long time scale studies of climate change; therefore, it becomes necessary to check for data that might be in error, which we define as statistically or oceanographically improbable values. To compare data sets obtained by different institutes/scientists in different decades, metadata can be valuable information sources. Since changes of observation methods can influence the accuracy and resolution of data directly, comparing metadata of original datasets supports data quality control during data integration. Namely, collection of metadata is an essential part of data quality control. We introduce a data quality control method applied for chemical oceanographic data in the western North Pacific. We hope that our method will be available for data observed in other basins. Our method will be edited and published as a manual by JODC. The manual will be available as a PDF file from JODC and IJCD web sites.

**PICES XIII GP-2144 Poster**

**Reconstructing the spatial exploitation of fishery resources in the Aleutian Islands**

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Using the REFM Observer Program database, we reconstruct the spatial distribution of fishing effort along the Aleutian Islands where sablefish, Atka mackerel, Walleye pollock, Pacific cod and Pacific Ocean perch were caught. We also analyzed the fisheries by gear, to evaluate their dynamics and preferred fishing grounds. The data analyzed is for the period 1990 to 2003, includes all gears (trawlers, hook and line, pots, and long-line) and covers the area

between 170°E and 166°W. In most cases, fishing effort has been steadily increasing towards the western Aleutians. The average catch per unit effort in some areas has decreased, indicating some local depletion might have occurred. Current spatial management is restricted to establishing closed areas, while the level of fishing pressure on a stock is controlled mainly by total allowable catches. The changes in the distribution of the fishing effort follow both changes in policy and availability of resources. One of the aims of this study is to elucidate the relative influence of each of these two factors (policy and availability), in order to better inform managers of the spatial response of fishing fleets and assess the need for increased spatial management.

### ***PICES XIII GP-2181 Poster***

#### **Mixing processes of the Yangtze River water in the Yellow and East China Seas**

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A three-dimensional numerical model using POM (the Princeton Ocean Model) was established in order to understand the dispersion and mixing processes of the Yangtze River water in the Yellow and East China Seas. The circulation experiments for the seas were conducted first. Throughout this experiment, monthly mean values were used for the Kuroshio Current input in the southern boundary of the model domain, for the transport through the Korea Strait, for the river discharge, for the sea surface wind, and for the heat exchange rate across the air-sea interface. And then on the basis of the results dispersion experiments for the river water were executed. The dispersion experiment was conducted using POM-oriented Random Walk diffusion submodel. The circulation model computes velocity components, and horizontal diffusivities for any point of the model domain at every time step. The number of injected particles is changed proportional to the rate of Yangtze River water inflow to describe the dispersion of river water. For the experiments, we focus on tidal mixing effects and wind effects on these processes.

During the summer, generally, low-salinity water from the river tends to spread offshore as a result of energetic vertical mixing processes due to the strong tidal current, and to spread more eastward due to the southerly wind. Observed salinity distributions support these results. The winter dispersion of the Yangtze River water follows the circulation pattern flowing southward along the east coast of China due to the strong monsoon wind.

### ***PICES XIII GP-1945 Poster***

#### **Interannual variability of the sea surface heat fluxes in the North Pacific**

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The interannual variability of the sea surface fluxes is investigated using ship-borne observations from 1984 to 1998 north of 25°N. The latent and sensible heat fluxes, the radiation balance of the sea surface, as well as net sea surface heat flux, are calculated for each month of this period. According to the duration of the period of the accumulation and loss of heat through the sea surface, time of reaching their extreme values, four areas are allocated: northern (IN) and southern (IS) ones to the west of 180°; eastern (II) and Californian (III) areas to the east of 180°. The theory of interannual variability of the sea surface heat fluxes in different months is examined. We attempt to establish a relationship between the net sea surface heat fluxes in the different regions and that of the atmosphere circulation indexes (NPOI and SOI). We show that the largest variability of the net sea surface heat flux is observed in the fall-winter period: in the November (IN) and January (IS) - to the west of 180°, and in the September (II) and October (III) - to the east of 180°. The largest interannual amplitudes of the net sea surface heat flux (204 W/m<sup>2</sup>), latent heat flux (202 W/m<sup>2</sup>) and radiation balance (50 W/m<sup>2</sup>) are observed in the California (III) region, the sensible heat flux (59 W/m<sup>2</sup>) – in the southern (IS) region. Interannually, the monthly amplitudes of the net sea surface heat flux exceed 9-10 times the monthly averaged for the whole period its values in March (region IN, II), in September (region IS) and October (region III). Computation of variance shows that the temporal variability of the net sea surface heat flux is determined by the seasonal variations to the greatest extent. The latent heat flux mainly

determines the interannual variability of the net sea surface heat flux. The sole exception being the fall-winter season in the subarctic (IN) area, when the sensible heat flux variability takes the dominant role. There is close link between the sea surface heat fluxes in the allocated areas and that between the indexes of the atmosphere circulation during some time periods.

### ***PICES XIII GP-2050 Poster***

#### **Identifying population units and establishing a monitoring program for Pacific salmon conservation throughout their natural range**

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There is a clear need to address Pacific salmon (*Oncorhynchus* spp.) conservation at the global scale, but there is little coherency in the manner in which data are collected, analyzed and interpreted across political boundaries. Through a combined effort involving the State of the Salmon Consortium (jointly administered through the Wild Salmon Center and Ecotrust) and the IUCN Salmonid Specialist Group, we propose to take the first critical step in developing a conservation action plan for salmon throughout their natural range in North Pacific waters. The program involves a two-tiered approach: 1) building a consortium of leading scientists to develop an approach for identifying discrete population units and 2) establishing a multi-level international monitoring strategy. We will mark progress toward the development of a hierarchical scheme for defining population structure using relevant ecological and genetic data. We will present a summary of our effort to identify gaps in extant monitoring and to establish more rigorous sampling to help resolve status and trends. We feel this work will help foster international collaborations, stimulate interest in standardizing approaches used in delineating populations, and establish a coherent monitoring network to better serve the needs of the global conservation community.

### ***PICES XIII GP-2053 Poster***

#### **Interannual variability of oceanographic and hydrochemical environments in the Anadyr Gulf (Bering Sea)**

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To understand better the relationships between physical and biogeochemical processes on the shelf we consider the interannual variability of oceanographic and hydrochemical parameters in the Anadyr Gulf - Bering Sea system, taking into account climate variability in the North Pacific. The Anadyr Gulf is one the most productive zones in the North Pacific. The water mass distribution is under the strong influence of riverine discharge, ice melt processes and the Bering Sea water advection that in turn are closely connected with climate change.

This investigation was based on oceanographic and hydrochemical data of several cruises carried out in the 1989, July; 1992, June; 2000, September; 2002, August-September. Different water masses have been revealed based on T/S relations. In the surface layer they are: (1) freshened waters ( $S=19-31\%$ ,  $T$  up to  $10^{\circ}\text{C}$ ) that is under the influence of surface runoff and ice melt; (2) the Bering Sea waters ( $31.56-32.6\%$ ,  $6-8^{\circ}\text{C}$ ), which are carried by the Navarin current from the south to the open and central part of the Anadyr Gulf and define the Navarin frontal zone. In the bottom layers there are three types of waters: (1) originating from the Cross Bay, CBW, ( $S>33.5\text{psu}$ ,  $-1.99^{\circ}\text{C}<T<-1.5^{\circ}\text{C}$ ) (2) St. Lawrence Island region so called bottom shelf water, BSW, ( $S<33\text{psu}$ ,  $-1.7^{\circ}<T<-1.5^{\circ}\text{C}$ ) and Providenia Inlet as well, and (3) bottom shelf water from the deep part of the Bering Sea, BSBW, (high salinity and  $0^{\circ}<T<2-2.5^{\circ}\text{C}$ ). CBW and BSW are formed during the cold season prior to winter freezing and remain in the Anadyr Gulf during the summer.

The concentrations of nutrients increase from surface to bottom. The highest concentrations of silica, phosphate, and nitrate are found in the densest water originating from the Cross Bay. Low regression coefficient of nitrate-phosphate (N:P=10:12) suggests that nitrate limitation is occurring in the ecosystem of the Anadyr Gulf. The transformation of hydrochemical parameters in bottom waters demonstrate nitrate deficiency having occurred in

bottom layers because of denitrification in the upper layers of bottom sediments. Our estimation of the annual flux of organic matter to the bottom sediment is about 130 gC/m<sup>2</sup>.

Interannual variability of water structure is caused by Pacific Decadal Oscillations. During the warm phase of the PDO (cooling for the west Bering shelf) the Navarin front has a zonal orientation. The Navarin warm water was spread into the open and central part of the Gulf and there was a wide distribution of cold bottom water (CBW and BSW). During the cool phase of PDO (warming for the west Bering shelf) the frontal zone had a meridional orientation and Navarin waters in the surface layers penetrated to the north coast of the Anadyr Gulf. Bottom cold saline water occupied a much smaller region.

### **PICES XIII GP-1863 Poster**

#### **Molecular species identification and morphology of gonatid squid paralarvae from the North Pacific**

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We describe a method to identify gonatid squid paralarvae from the North Pacific. At least 16 gonatid species inhabit this region, where they are an important prey of many nekton, including salmon. However, studies of their paralarvae are hampered by identification uncertainties, particularly for specimens smaller than 5 mm in mantle length. Paralarval specimens were collected aboard the *Oshoro Maru* during three cruises in 2003-2004 and divided into five morphotypes based on physical characteristics (relative arm lengths, chromatophore patterns, and degree of head withdrawal into the mantle cavity). Polymerase chain reaction (PCR) was used to amplify the mitochondrial cytochrome oxidase I (COI) gene from each morphotype, and the PCR products were cloned and sequenced. These sequence data were then compared with data from adults to identify the paralarval morphotypes. Our five morphotypes were identified as *Berryteuthis anonychus*, *Gonatopsis borealis* and three undetermined *Gonatopsis* spp. When we complete this study, we will construct an identification key to the newly hatched stages of the gonatids for use in future field studies.

### **PICES XIII GP-2188 Poster**

#### **Heavy metals in seaweeds of the mining region of Santa Rosalía, Baja California Sur, Mexico**

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The town of Santa Rosalía is situated in the “El Boleo” mining district in the central part of the western coast of the Peninsula of Baja California. The extraction of copper mineral and the smelting of metallic copper by the “El Boleo” (1885-1938) and “Santa Rosalía” (1954 - 1985) companies have generated a huge quantity of solid wastes exposed to the air and seawater. The results of our previous studies in this zone have shown the presence of high concentrations of Cu, Zn, Co and Pb in the beach sands and coastal marine sediments of the adjacent part of the Gulf of California as a consequence of the above-mentioned anthropogenic activity. Nevertheless, the possible effects of these high levels of heavy metals, found in the sediments, on the marine biota are still unknown. For this reason, the following study was carried out with the objective of determining the concentrations of Cu, Zn, Co, Mn, Cd, Ni, Fe and some other trace elements in the tissues of the seaweeds, and to evaluate the possibility of using some of these species as bioindicators of metal contamination. The available seaweeds (*Colpomenia tuberculata*, *Dictyota dichotoma*, *Gracilaria sp.*, *Laurencia pacifica*, *Padina durvillaei*, *Pterocladia capillaceae*, *Sargassum sinicola*,

*Ulva lactuca*) were collected every 3 months between March 2000 and 1 March 2001 at 9 stations located along the shoreline of Santa Rosalía and its vicinities. Trace metal content in homogenized dry tissues of seaweeds was determined using flame atomic absorption spectrophotometry and instrumental neutral activation analysis. Seaweed samples collected in the area of major sediment contamination due to mining and smelting activities (especially near the marina of Santa Rosalía) displayed higher concentrations of some metals than those from non-impacted reference sites. In addition to the solid wastes deposited on the beach zone and adjacent sea, other important sources of the metals detected in the seaweeds include natural inputs from the mineralized areas (dry stream freshwater discharges after episodic heavy rains and wind transport) and possibly the discharge of municipal waste waters from the town and seafood reprocessing plant. In particular, the Cu concentrations in the seaweeds varied in the range of 25 mg/kg - 650 mg/kg for *C. tuberculata*, 30 mg/kg - 630 mg/kg for *D. dichotoma*, 16 mg/kg - 400 mg/kg for *P. durvilleae*, and 10 mg/kg - 110 mg/kg for *S. sinicola*, while the concentration of Pb oscillated between much lower values: 0.4 mg/kg - 1.0 mg/kg for *C. tuberculata*, 0.2 mg/kg - 0.9 mg/kg for *D. dichotoma*, 0.4 mg/kg - 1.0 mg/kg for *P. durvilleae* and 0.05 mg/kg - 0.7 mg/kg for *S. sinicola*.

Our findings indicate that the seaweed species *Colpomenia tuberculata*, *Dictyota dichotoma* and *Ulva lactuca* could be recommended for use in the permanent monitoring of the anthropogenic contamination of the impacted zone by heavy metals, such as Cu, Zn and Co.

### **PICES XIII GP-2024 Poster**

#### **The bubble injection effects on the concentrations of CFCs, N<sub>2</sub> and Ar in the Pacific**

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We examined a time series of CFCs (F-11 and F-12) concentrations in the North Pacific high latitude area (Funka bay, Hokkaido, 42°N 142°W) during the wintertime (Dec. 2001 – Mar. 2002). We found that CFCs were undersaturated (98% for F-12, 90% for F-11) in the wintertime, indicating that heat flux between air and sea was higher than CFCs flux at this time. If the air-sea gas exchange process follows the thick film model (Liss and Slater 1974), we cannot explain the large difference in saturations between F11 and F12 because F-11 and F-12 have similar values of the Schmidt number. Based on the air-sea gas exchange study ( $k_{F-12}/k_{F-11} = (Sc_{F-12}/Sc_{F-11})^{-0.5}$ , Nightingale et al., 2000) and the atmospheric concentrations of CFCs, we calculated the extent of bubble injection flux of CFCs ( $B$ ) to total gas flux of CFCs ( $T$ ).  $B_{F-11}$  and  $B_{F-12}$  were  $16.4 \pm 2.0$  and  $32.4 \pm 4.3$  pmol/m<sup>2</sup>/month from air to sea,  $T_{F-11}$  and  $T_{F-12}$  were  $64.4 \pm 8.4$  and  $37.4 \pm 4.2$  pmol/m<sup>2</sup>/month from air to sea. We also found that  $B_{F-12}/T_{F-12}$  (86.6%) was higher than  $B_{F-11}/T_{F-11}$  (25.5%). Therefore, it is possible that  $B$  is largely determined by weather conditions, and it enters the ocean interior when the water masses are formed during the wintertime. We will demonstrate the distribution of  $B$  for N<sub>2</sub>, Ar and CFCs in the North and South Pacific Ocean interior and will discuss these results.

### **PICES XIII GP-1990 Poster**

#### **Features of the interannual variability in elaboration of the season processes and their possible influence on fishing capacity**

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The problem of the influence of climate changes on ecosystem conditions and fish capacity is taking greater importance in recent decades.

We analyzed satellite weekly sea surface temperature maps for 1994 – 2004 years. The dominant interannual and regional differences between parts of the world ocean were described. In particular, during the most recent decade we can see faster and earlier beginning of the cold season in the North West Pacific, while the duration of this period

has increased. But in the Norwegian Sea we see a different situation. The duration and termination of the cold season has a great influence on the spring bioproductivity processes and, as a result, on the fishing capacity. We also compared our results with the hydrochemical conditions of the North West Pacific.

### **PICES XIII GP-1771 Poster**

#### **Marine environment pollution around the marine protected area in Peter the Great Bay**

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The marine protected area, Far Eastern State Marine Reserve (FESMR), is located in the southwestern part of Peter the Great Bay (Sea of Japan). The FESMR was established in 1978 and was the first marine protected area in Russia (at that time, in the USSR). There are several threats to the state of the marine environment of the FESMR: First, poaching of sea cucumber, scallop and other species used in Chinese medicine and also utilized as a delicious seafood. Second, pollutant discharges to the marine environment. Vladivostok, a major port and industrial center in the Russian Far East, is situated approximately 100 km to the NE from the FESMR. The annual volume of sewage discharged from Vladivostok to the sea is about 400 million cubic meters, with more than 80% of that amount untreated. During high floods and northerly winds, polluted water masses can be easily transported to the FESMR. The mouth of the Tumen river (the border river between the Russia and Democratic People's Republic of Korea (DPRK) downstream and between China and DPRK upstream) is only 17 km from the FESMR to the southwest. Annual discharge of some trace metals and pesticides via the Tumen river are as follows (tons): Fe – 59925, Mn – 2982, Cu - 128, DDT – 0.9. The distribution of different pollutants in bottom sediments in and around the Far East State Marine Reserve has been studied by FERHRI specialists during the last decades in collaboration with researchers from the Institute of Marine Biology, Far East Branch of the Russian Academy of Sciences. Elevated contents of DDT and its metabolites (DDD and DDE) as well as hexachlorocyclohexane (HCH) isomers were found in bottom sediments near the FESMR. While concentrations of DDTs (up to 9.7 ng/g) were comparable with other areas of Peter the Great Bay, contents of HCHs (up to 6.2 ng/g) were higher than elsewhere.

### **PICES XIII GP-1892 Poster**

#### **Features of ichthyofauna species composition at the Emperor and Hawaiian seamounts**

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Ichthyofauna of the Emperor and Hawaiian Seamounts are comprised of representatives from the North Pacific and Indo-West Pacific biogeographical zones. Distribution ranges of some species are restricted by seamounts within large-scale ocean gyres. Globally distributed and endemic species are also found upon some seamounts.

The northern part of the Emperor Seamounts (northward of 44°N) is within the subarctic circulation zone. Fish populating this area (30-45 species) are typical of continental slopes of the Northern Pacific. Subtropical species are practically absent here.

The central part (between 43-39°N) is located in the subarctic front. There are some subarctic, boreal (4 species of grenadiers, *Antimora microlepis*, *Alepocephalidae* spp.), subtropical and tropical (*B. splendens*, *Allocyttus verrucosus*) species. Up to 70-80 species reside here.

The Southern Emperor and Northern Hawaiian Seamounts represent the eastern boundary of the distribution of talassobotyal Indo-West Pacific ichthyofauna in North Pacific. The faunistic barrier passes between 38-39°N. Exchange of fauna between the north-central (boreals species) and southern (benthic and meso- and bathypelagic representatives of subtropic faunas) seamounts is minimal. Approximately 23% of common species from the southern part are found in ichthyofauna of the northern and central parts (Kodolov, Kulikov, 1980; Novikov,

Kodolov, Gavrilov, 1981). Similarity between these fauna is only 0.19 (according to Preston); these fauna are nearly isolated.

Twenty five to 60 species of fishes are found in the deep sea area above the southern part of these seamounts, and more than a 100 species inhabit shallow-water seamounts. These seamounts are inhabited predominantly by mesobenthic subtropical (*Pseudopentaceros wheeleri*) and tropical (*B. splendens*) species.

### **PICES XIII GP-2089 Poster**

## **Interactions between bottom long-line fishery and seabirds in the western Bering Sea and Pacific waters of Kamchatka**

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A bottom long-line fishery has been conducted in the region since the early 1990s. Now, up to 15 catcher-processor vessels, equipped with an autoline system, operate year round, targeting Pacific cod (70% of the total catch), as well as halibut, rockfishes and other groundfish. In 2001-2003 the total mean annual catch was about 26,000 tons using 80 million hooks deployed annually. The long-line fishery causes incidental mortality of seabirds when birds swallow baited hooks and drown. In 2003, total estimated mortality in the region was 9,883 birds. Most of the seabirds taken were northern fulmars *Fulmarus glacialis* (65%), gulls *Larus* spp. (26%), and short-tailed shearwaters *Puffinus tenuirostris* (8%). One case of death of endangered short-tailed albatross *Phoebastria albatrus* was recorded. Also, seabirds may reduce gear efficiency. Estimated total economic loss in the long-line fleet from bait loss caused by seabirds and associated reduced fish catch may reach \$0.5 million per year. Attributes (*i.e.*, abundance, attack rate, distances from the vessel stern, which birds attack baits, etc.) of seabirds feeding on bait are compared between the western Bering Sea and the eastern Bering Sea and Gulf of Alaska. Paired streamer lines, the seabird avoidance gear using in Alaskan waters, may be useful to reduce both seabird bycatch and economic losses in the region. We plan to test this mitigation measure in the Kamchatka region.

### **PICES XIII GP-1794 Poster**

## **Climatic variability of water circulation under different pressure systems in NW Pacific**

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Using a diagnostic hydrodynamic model to estimate water circulation we calculated transports, from the surface to 200 m depth and from the surface to the bottom for the NW Pacific, taking into account the influence of various types of the atmospheric circulation: the “north-western”, “okhotsk-aleutian” and “cyclones over the ocean”. The study area is confined to 20°–50°N, 146°–180°E. This model allows us to consider the atmospheric influence, spatial distribution of the water density, variable coefficients of the vertical and horizontal turbulent exchange,  $\beta$ -effect, bottom topography and the coastal outline.

The general picture of the calculated transports, from the surface to 200 m and from the surface to the bottom is on the whole preserved. But, the influence of the atmospheric circulation dominates near the surface of the ocean, and the influence of the homogeneous layer dominates to 200 m, and the influence of bathymetry geomorphology dominates the deeper transports.

In summary, hydrodynamic structures depending on the atmospheric circulation types have their peculiarities in the spatial-temporal distribution.

**PICES XIII GP-1841 Poster**

**Horizontal distribution of larvae of the euphausiid, *Thysanoessa longipes*, around the subarctic gyre in the Japan Sea**

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Distribution of larvae of the euphausiid, *Thysanoessa longipes*, around the northern part of the Japan Sea in early summer was investigated to evaluate the influence of the passive transport of zooplankton in the subarctic gyre. *Thysanoessa longipes*, which is one of the most dominant zooplankton species in the northern part of the Japan Sea, was collected with NORPAC nets (0.33-mm mesh) or bongo nets (0.5-mm mesh) in June-July 2003 from 38°10' N to 45°40' N along the longitude of 138°E. Specimens were separated into eggs, larvae (calyptopis I-III and furcilia), juveniles and adults (males and females). Juveniles and adults were observed at all stations. However, larvae were observed in only two areas: around subarctic front (approximately 40°N) and north of 43°N. During early summer larvae of *T. longipes* are generally found north of 43°N along 138°E, the northwestern part of the Japan Sea. The spawning period of *T. longipes* matches the spring bloom. Hence, these results indicate that the strong eastward current established by subarctic front carries larval *T. longipes* to the eastern area where the spring bloom has already finished. This transport plays an important role in the diversity of growth of *T. longipes* in the northeastern part of the Japan Sea.

**PICES XIII GP-2153 Poster**

**Mapping the distribution of structure-forming invertebrates off the U.S. west coast**

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The increasing use of advanced survey technologies such as underwater camera sleds, submersibles, and ROVs, and several recent international symposia have drawn attention to structure-forming benthic invertebrates – especially cold-water corals. Although scientists are just beginning to understand the life cycles of these organisms, it is known that many species are long-lived and slow to recover from catastrophic disturbance. Cold-water corals (*e.g.*, Orders Scleractinia, Antipatharia, Gorgonacea) and other structure-forming invertebrates (*e.g.*, sponges) likely play important ecological roles in continental shelf and slope ecosystems and are indicators of long-term environmental conditions. Despite growing interest from researchers, conservation organizations, and policymakers, a debate continues as to whether or not these organisms provide a structural component to essential fish habitat. To date, there exist no regional surveys of structure-forming invertebrates off the U.S. west coast. However, an extensive database of observations on benthic invertebrates was compiled from ongoing regional bottom trawl surveys conducted by NOAA Fisheries over the past three decades. Although bottom trawls are not designed to target epibenthic invertebrates, over 9,000 catch samples of corals, sponges, and anemones have been recorded. Our objectives for this study are to map the distribution of structure-forming invertebrates off the U.S. west coast and use analytical results to assist in the design of comprehensive in situ surveys to investigate potential fish-invertebrate associations. Using multivariate statistics, we hope to identify correlations between the distribution of these invertebrates and various environmental variables (*e.g.*, latitude, depth, temperature, lithology).

**PICES XIII GP-2119 Poster**

**Vertical distribution of *Todarodes pacificus* (Cephalopoda: Ommastrephidae) paralarvae near the Oki Islands, southwestern Sea of Japan**

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Patterns of diel vertical distribution of Japanese common squid, *Todarodes pacificus*, paralarvae were examined using a MOCNESS in the southwest Sea of Japan near the Oki Islands, Japan, during five late-autumn surveys in 1998-2002. In total, 1511 *T. pacificus* paralarvae were collected at 63 of 68 stations. Most paralarvae were found in the thermocline in the upper 75 m. For all mantle sizes of paralarvae, weighted mean depth revealed no difference in vertical distribution between day and night. The hatchling-sized paralarvae were abundant above 25 m and mantle lengths increased with sampling depth. We concluded that *T. pacificus* paralarvae do not undergo diel vertical migration and that paralarvae gradually descend in the water column as they grow older.

**PICES XIII GP-2087 Poster**

***Gracilaria* cultivation practice and its ecological role in Chinese coastal waters**

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*Gracilaria* is a very important industrial material for making agar-agar, as well as good feed stock for growing marine animals. It is also a good ecomaterial for reducing eutrophication of coastal waters. *Gracilaria* seaweed cultivation has developed along the Chinese coast since the 1950s. Main cultivation species are *G. lemaneiformis* and *G. tenuistipitata* var. *liui* Zhang et Xia. Up to now, more than 30 *Gracilaria* species have been recorded in China. Nutrient loading is a widespread phenomenon in Chinese coastal waters. Cultivation of *Gracilaria* has very high rates of productivity, and it grows well in waters with high nutrient concentrations. This seaweed has been found to be very useful with respect to decreasing N and P nutrient loading, as well as in studying photosynthesis, controlling red tides and maintaining health integrated mariculture systems. The authors believe that large-scale cultivation of *Gracilaria* is one of the more effective ecological strategies in maintaining safe water quality conditions and a healthy ecosystem in the coastal environment.

