PICES XIV S4-2609 Oral
Evaluating the climate-moderated fishing vulnerability of different life history strategists in Alaskan waters

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In the United States federally-managed groundfish fisheries of the Bering Sea, Aleutian Islands, and Gulf of Alaska, target species (commercially-landed catch) represent a limited range of life-history strategies when compared to the diversity of life history strategies found within non-target species catch (*e.g.* incidental catch). However, current incidental catch policies are relatively uniform regardless of life history or ecosystem considerations. These non-target policies should be carefully evaluated, as the Bering Sea and Gulf of Alaska are subject to regime-scale climate fluctuations which may differentially affect each species' climate-moderated sensitivity to fishing pressure, depending on that species' life history. Here, we present a system of management evaluation which combines survey trends, fishing history, and life history characteristics in order to pinpoint vulnerable non-target species within a fishery. We present some preliminary results of testing this evaluation system under simulated climate scenarios for a range of life history strategists.

PICES XIV S4-2279 Invited
Ecological regime shift events in the East China Sea

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Based on fifty-year catch data from Japan, the phase shift patterns of fish in the East China Sea (ECS) ecosystem are classified into five types: Sardine, Anchovy, Flounder, Seesaw and Round herring. Both biological and environmental evidence suggest that regime shifts did occur in the ECS. Sea surface temperature switched from a cold to cool regime in 1940 and then again from a cool to a warm regime in 1983. Ecological regime shifts have occurred in the ECS three times since 1950: in 1958-62, in 1976-82 and in 1988-93. The 1976-82 shift is the most significant. From 1959 to 1978, the ECS is considered a Jack/Anchovy regime. In 1978 it shifted to a Sardine dominated regime until 1997. Although the ECS is part of the Northwest Pacific, its regime shift pattern is similar to that identified in the Northeast Pacific.

PICES XIV S4-2514 Poster
Life history strategies of selected Gulf of Alaska fish species with reference to recruitment vulnerability under fluctuating environmental conditions

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The impact of climate on fisheries is highly variable, indirect and complex, and control of recruitment depends on the status of a continually changing ecosystem. Early life history dynamics of marine fish species represent a major portion of this complexity. Since 1972, ongoing studies in the Gulf of Alaska explore the complexity of northeast Pacific fish life history strategies. This study focuses on six species chosen for their dominance in the Gulf of Alaska ecosystem. Capelin (*Mallotus villosus*), Pacific sandlance (*Ammodytes hexapterus*), and northern lampfish (*Stenobrachius leucopsarus*) are ecologically important forage fish. Pacific cod (*Gadus macrocephalus*), arrowtooth flounder (*Atheresthes stomias*), and starry flounder (*Platichthys stellatus*) are important components of the groundfish resources in the Gulf of Alaska. These species have diverse life history strategies. Details of their life history and early life stages, and an evaluation of their individual adaptation and vulnerability to prevailing and fluctuating oceanographic conditions in the Gulf of Alaska is presented.

PICES XIV S4-2241 Oral

The relationship between atmospheric processes above the Asian continent and the North Pacific Ocean and the abundance of Asian chum salmon and pink salmon in 20th century

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This report examines statistics connecting atmospheric processes with the fluctuations in abundance of Asian chum salmon (*Oncorhynchus keta*) and pink salmon (*Oncorhynchus gorbusha*).

The most critical period for the salmon reproduction is winter. There was a statistical link between atmospheric pressure in January and catches of *O. gorbusha* the following year, and catches of *O. keta* three years later. The abundance of *O. keta* and *O. gorbusha* that grew up in the spawning regions is influenced by atmospheric processes over the continent. However in such areas as Sakhalin, Kurils islands and Eastern Kamchatka climate conditions and therefore salmon abundance are determined mostly by atmospheric processes over the Pacific Ocean. These relationships are examined for Amur River basin salmon.

PICES XIV S4-2412 Oral

Interannual response of fish growth to the 3-D global NEMURO output with realistic atmospheric forcing. Part II: Pacific saury growth

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The bioenergetics model of Pacific saury, a part of NEMURO.FISH (North Pacific Ecosystem Model for Understanding Regional Oceanography for Including Saury and Herring), was driven by zooplankton densities and water temperature from 3-D global NEMURO. Since saury migrate from the Kuroshio area (KR) to the Oyashio area (OY) through the mixed water region (MW), three points were selected along 155 E from a 3-D global NEMURO run. Since the model zooplankton densities were smaller than the observed values, the saury's growth was underestimated by the model. To overcome this problem, an automatic calibration program PEST was applied. Using the calibrated parameters, the model was integrated from 1950 to 2002 and the wet weight of adult saury showed several distinctive shifts. To elucidate the key factors for wet weight change of saury, an additional 17 experiments were conducted. Two of the eight major shifts were controlled by temperature effects and the six others by zooplankton densities. The temperature effect was most important in OY. In MW, prey density was the controlling factor, with predatory zooplankton density playing the most important role. The direct temperature effect is closely related to the migration of saury. In the case of warmer conditions in OY, the saury's residence time in the OY is lengthened and, hence, the saury growth is accelerated. However, if the winter-time temperature in OY is high, the zooplankton density is decreased. In this sense, the large migration range of Pacific saury may be a strategy to stabilize their growth.

PICES XIV S4-2612 Oral
Life history strategies: Applications to fisheries management

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Marine fish have evolved a wide range of life history strategies to deal with varying environmental conditions. In the Canadian Pacific region, fisheries target fish across all life history strategies, capturing migratory and other pelagics, anadromous species, demersal groundfish, and elasmobranchs. Biological traits of targetted species range from small sized, early maturing, short-lived species (less than 10 years) to large, late maturing, long-lived species (over 150 years). We used the life history trtaits of 42 marine fish to identify species groupings and life history strategies. We have linked life history strategies to generalized population dynamics, particularly long-term responses to climate and ocean changes. This allows us to build a conceptural framework of fisheries management options based on specific life history strategies and observed environmental conditions. Currently, over 400 species of fish are caught in Pacific commercial fisheries, however traditional stock assessments are undertaken for less than 50 species. One of the challenges facing fisheries management in the Pacific region, is the provision of management advice for species for which there is little or no abundance information. In such instances, fisheries scientists can use life history traits to identify a species' life history strategy and select appropriate management options from the conceptual framework.

PICES XIV S4-2257 Oral
Appearance and rapid increase of the exotic copepod *Acartia tonsa* on the British Columbia continental margin

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The copepod *Acartia tonsa* is morphologically similar to, but slightly larger than its congener *Acartia longiremis*, which has been until now the dominant *Acartia* species on the British Columbia continental shelf. *Acartia tonsa* is endemic to the mid-latitude Atlantic and European marginal seas, but in the past several decades has established Pacific-resident populations in San Francisco Bay and in the Southern California Bight. It has also been observed off Oregon in low numbers during warm years with anomalously strong northward. In our British Columbia continental margin samples *A. tonsa* appeared for the first time (at very low abundance) in 1992 and 1993. It subsequently disappeared, but reappeared at higher abundance and more broadly in 2003. In 2004, it showed a rapid, and approximately exponential increase in abundance and biomass. By early autumn its abundance had surpassed that of *A. longiremis.* In spring 2005, *A. tonsa* abundance has remained high, and at many locations *A. longiremis* abundance now appears to be depressed. This is the first clear evidence in our region of successful invasion of a non-estuarine environment by an exotic zooplankton species.

PICES XIV S4-2611 Poster
Contrast in life histories of commercially exploited marine fishes off the coasts of Canada and Korea and changes in ecosystem structure

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The history of commercial fisheries off the coasts of Canada and off of Korea are very different. These histories, in conjunction with different ecosystems, have resulted in disparate current species compositions. In Canadian waters, the dominant oceanographic domain is the coastal upwelling domain off of the west coast of Vancouver Island, the northernmost extent of the California Current System. This ecosystem is dominated by demersal species complexes, with an abundance of long-lived species such as flatfish, rockfish, sablefish, and halibut. During summer, migratory pelagics such as Pacific hake, Pacific salmon, and recently Pacific sardine, move into this area to feed. In the late 1970s, Canada declared jurisdiction for 200 miles from their coastline, and targeted major fisheries in Canada have been managed with a quota system. As such, fisheries off the west coast of Vancouver Island have been moderate. Off the Korean coast, a major oceanographic domain is the Tsushima

Warm Current Ecosystem in the East/Japan Sea. This ecosystem is currently dominated by short-lived pelagic and demersal fish. Historically, Korea has shared marine resources in this area with neighbouring countries, but stock assessment and quotas have only recently (since the late-1990s) been implemented for some major species. As such, fisheries can be described as intensive, and many stocks have been described as overfished. A joint Canada-Korea study has been initiated to compare these ecosystems as they relate to community composition and dominate fish species. Each ecosystem responded differently to climate impacts such as regime shifts under different exploitation histories. In the future, both countries will face the challenge of global climate warming, its impacts on ecosystems and both countries will need to develop adaptable fisheries and management of those fisheries. The challenges will be different for the two countries: Canada will need to conserve fish populations, while Korea will need to focus on rebuilding fish populations.

PICES XIV S4-2277 Oral

Spatial dynamics of small pelagic-fish populations in the California Current system on seasonal and interannual scales during the last warming regime (1980-1997)

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Reports of long-term changes of sardine landings have suggested that when they are scarce, sardines are relatively sedentary in refuge areas but change behavior to highly migratory and colonize cooler areas when they are abundant. In contrast, anchovies expand around a fixed geographic center. The causes of such different geographical dynamics are unknown. To better understand such long-term, large-scale spatial processes may require understanding critical, smaller scales of variability. To identify and propose possible oceanographic processes related to spatial dynamics of the coupled sardine-anchovy populations, we analyzed the seasonal variability in distribution of relative abundances of northern anchovy (*Engraulis mordax*) and Pacific sardine (*Sardinops caeruleus*) (with emphasis on juveniles) along the California Current system (CCS), and their interannual variability caused by environmental changes during the warming period 1980-1997. Seasonal and interannual patterns of distribution suggest that fronts may be the oceanographic processes in the CCS that define aggregation and forage habitat for young pelagic fish. We suggest that the central stock of *E. mordax* is related to the Ensenada front, a geographically fixed feature. The southern stock is related to a geographically dynamic front, where the equatorward California Current (CalC) and the North Equatorial Current converge along the southwestern of the Baja California peninsula. During El Niño conditions the predominance of warmer water masses weaken these fronts, and upwelling caused by bathymetric or coastal-shape characteristics become important oceanographic processes as refuge areas. We further propose the *S. caeruleus* population is related to a geographically dynamic front, where the equatorward CalC and the inshore California Countercurrent (CcC) converge parallel to the shore off California and Baja California. Progressive poleward changes in the latitudinal position of higher relative abundances of young sardine along the front suggest a progressive interannual increase of the northward CcC advection after the 1976-1977 regime shift, whereas the CalC southward advection weakened.

PICES XIV S4-2465 Oral

Long term variation of species and life stage composition of zooplankton in the western North Pacific: Introduction of the Odate project

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Since the 1950's, zooplankton have been routinely collected off north eastern Japan. Samples have been collected at fixed sampling lines, every month or periodically throughout the seasons, using a standard plankton net (0.33mm mesh size; 0.45m mouth diameter). More than 20000 of these plankton samples are located at the Tohoku National Research Institute. A report on the long term variation in wet weight of these samples was published by Dr. Kazuko Odate in 1994. This zooplankton biomass data set is known as the "Odate data". However, the wet weight data is not enough to reveal the relationship between zooplankton biomass and physical oceanographic data. Since information on interspecific relationships of zooplankton is necessary to analyze long-term variation of ocean ecosystems in relation to climate change, the species composition of the zooplankton samples used for Odate data were reinvestigated. A distinctive feature of this new data-set is the

study of dominant species life stages (instar of copepodite; *Neocalanus, Eucalanus, Calanus* and *Metridia* species). Using this new data-set, an interdisciplinary study on the long term variation of oceanic ecosystems, called Odate project, is being conducted. 1527 zooplankton samples have been examined and 206 species of copepods detected. During the 1970s in the Oyashio area, a high abundance of copepods was observed, with *Neocalanus* species especially dominant.

PICES XIV S4-2267 Oral

Adaptive significance of spatial distribution patterns as reflection of life history strategy and density dependence in populations of some pelagic fish, squid and jellyfish species in Russian EEZ of North Pacific

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Based on pelagic trawl surveys, analysis of spatial distribution patterns are examined for pelagic fish, squid and jellyfish species throughout Russian EEZ (Bering, Okhotsk and Japan Seas) and adjacent waters of the North Pacific. Both CPUEs and biological parameters' spatial allocation are analyzed in relation to interannual and seasonal dynamics of overall species abundance. We show that spatial distribution patterns are of adaptive significance, depend significantly on type of life history strategy, and can serve as a measure of degree of density dependence. Increased species abundance results in better defined and more gradient spatial allocation of CPUEs, as well as in higher heterogeneity of species biological parameters throughout the area of its presence. During periods of lower abundance species seem to move towards "simplified" spatial structure and lower variability of biological parameters. We used different methods of spatial analysis (variogram, correlogram, SADIE analysis, *etc.*) in order to illustrate our conclusions.

PICES XIV S4-2502 Oral

East/West comparative responses of a piscivorous marine bird to oceanographic variability in the North Pacific Ocean: California versus Tsushima current systems

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We studied spatial and temporal variation in diet composition and reproductive ecology of a piscivorous seabird, Rhinoceros Auklet *Cerorhinca monocerata*, in relation to ocean climate variability in two different marine current systems. The California Current (CCS) is a seasonally upwelling-driven system, while productivity in the Tsushima Current System (TCS) is driven by seasonal warm water advection. Southeast Farallon Island and Año Nuevo Island in the central California Current (37° N) support populations of approximately 1500 and 300 birds and time series span from 1987–2005 and 1993–2005, respectively. Rhinoceros Auklets on Teuri Island (44° N) in the TCS number roughly 400,000-600,000 breeding birds and diet and reproductive data exist for 1984–1985, 1987, and 1992–2005. Anchovy are important prey in both systems, although influence of other prey species differs, with rockfish being more important in the CCS, while sandlance play a secondary role in diet in the TCS. Parallel trends in various parameters of reproductive performance (fledging success, *etc.*) are evident between colonies in the CCS and TCS, yet while linkages between diet, growth and fledging success are strong in the TCS, there is a disconnect between growth and fledging success in the CCS, indicating complex effects of food on reproduction. Relationships between diet, reproduction and marine climate at different spatial scales are compared between systems.

PICES XIV S4-2516 Oral

Interdecadal variability in body size of *Neocalanus* copepods in the Oyashio waters from 1960 to 2002 - A study of the Odate Project

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Interdecadal variability in the body size (prosoma length of copepodite V stage) of *Neocalanus* copepods were investigated by using Odate Collection in the Oyashio waters for 1960-2002. We investigate body size of *N. flemingeri* for May and the *N. cristatus* and *N. plumchrus* for July, because the former species and latter groups mainly appeared in surface layer in spring and summer, respectively. Body size of *N. flemingeri* had high value in mid 1960s and early-mid 1990s. *N. cristatus* and *N. plumchrus* also had high value in their body size in the 1960s and 1990s. It is known the body size of copepods has a negative relationship with ambient temperature. However temperatures in surface layers increased from the 1960s to the mid 1970s and in 1990s. The pattern of interannual variations in biomass of *Neocalanus* copepods corresponded with their body size except for *N. flemingeri* in 1960s. It was reported that the body size of copepod had positive relationship with food availability. If the variations in biomass are related to the food availability then the variation in body sizes may be related to the variations in their food availability. We discuss the interdecadal variations in body size of *Neocalanus* copepods by using more information of environmental variables such as hydrography and nutrient conditions.

PICES XIV S4-2405 Oral

Differing response patterns of pelagic and demersal fish assemblages to the late-1980s regime shift in the Japan Sea

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The fish community in the Japan Sea is characterized by diverse fishes from warm water pelagic species to cold water demersal species. Both fish community structure and biomass in the Japan Sea are largely affected by the Tsushima Warm Current (TWC) and the Liman Current. In the late 1980s, an oceanic regime shift indicated by an abrupt change from cold to warm water in the TWC occurred. Using various environmental and biological time series, and principal component analysis (PCA), we investigated the response patterns of fish assemblages corresponding to this regime shift.

The first two principal components (PC1-2) from the PCA of catch time series (invertebrates to large predatory fishes) from 1958-2003 show decadal variation patterns with evident changes around the mid-1970s and late-1980s. In the TWC, the PC1-2 show a significant correlation to water temperatures at depths of 50m (50mWT). This suggests the decadal variation in the fish community is forced to the oceanic regime shift in TWC. Pelagic indicator species such as yellowtail and horse mackerel are positively correlated to the 50mWT, while most demersal species show a negative correlation. This indicates different responses to the oceanic regime shift. Japanese offshore bottom trawl catch data from 1979-2003 showed a northward shift in the distribution of cold water demersal species such as Pacific cod with the late 1980s regime shift. Results suggest that the late-1980s oceanic regime shift in TWC had varying impacts on fish assemblages.

PICES XIV S4-2242 Oral
Diagnosis and prognosis of extreme natural phenomena in the Russian Far East

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The probable mechanism of atmospheric circulation forcing to abundance of *O. keta* in Avvakumovka river (South Primorye) is presented. The mechanism is associated with the localization of large anomalies in the baric fields immediately above the spawning area.

Interval recognition is used to forecast these phenomena, in particular, anomalous ice cover in the Tatar Straits (Japan Sea). The coefficient magnitudes of interval identification (n=r/(r+m)) within 30-55° N and 120-160° E (30 features) during the months prior to the extreme years of ice cover in the Tatar straits were estimated. Analysis of maximal and minimal ice cover showed that the most coefficients of identification were observed in summer and autumn. These results support previous studies that suggest that inter-annual fluctuations in water temperature and ice cover of Tatar straits were determined by advectional constituents. Our data indicates the usefulness of the method of interval identification for forecasting ice cover.

PICES XIV S4-2522 Poster
Annual changes of areas of trade of pollock in the Sea of Okhotsk and Bering Sea for the last thirty years

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Pollock (*Theragra chalcogramma*) is a major commercial fish in the North Pacific Ocean particularly in Sea of Okhotsk and Bering Sea. The pollock roe fishery in Sea of Okhotsk is very valuable. In this area, pollock is fished from December to April and in the western Bering Sea from May to December. Pollock undergo significant annual fluctuation in biomass in Russian waters. Annual fishing areas are related to the amount of sea ice, the number of storms and stock abundance. Recently stocks have dramatically declined as a result of ocean conditions and fishing.

In this study, we examine logbook data from Russian fishing vessels from 1970 on 2000. Using these data the spatial - temporal movement of pollock between the Sea of Okhotsk and the Bering Sea was determined. We constructed a fishing catch grid for the Sea of Okhotsk and the western Bering Sea based on average monthly catches (on a decadal scale). Use of this catch by grid matrix allows increased fishing efficiency with minimum cost.

PICES XIV S4-2295 Poster
Changes in abundance and fish species composition of the Aniva Bay and La Perouse Strait (Sea of Okhotsk) in connection with climate

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The retrospective observations in the 20th and early 21st centuries show that climate influence on ichtiofauna of the Aniva Bay and La Perouse Strait manifested itself in two trends: fluctuations in the abundance of different fish and changes in species composition. For example, from 1924-1934, herring catches reached 400.0 thousand tons, but declined in the 1950s, to 130.0 thousand tons. By the end of the 1980s commercial fishing of herring was closed. Biomass of spawning pink salmon in the 1960s was about 3.0 thousand tons, however during 1998-2002, the annual catches of this fish reached 33.0 thousand tons. There were abundant schools of Japanese anchovy in 1950s, which appeared again in the Aniva Bay after a 30-year interval. In the 1980s, an intensive commercial fishery for Far East sardine periodically took place. Annual catches of walleye pollock reached 60.0 thousand tons in 1960s, and catches of sand lance in 1970s were at the level of 100.0 – 165.0 thousand tons.

By the beginning of the 21st century, the abundance of these two species declined to very low levels. Trawl surveys conducted from 2000-2004 indicate that capelin, herring, arabesque greenling (young) among pelagic fishes, and saffron cod, flounders and sculpins, among bottom fishes were the most abundant species. During the last five years, such south latitude species as Scomber japonica*, Coryphaena hippurus, Takifugu porphyreus, Sebastes wakiyai* and some new coldwater species were observed to appear in the study area.

PICES XIV S4-2504 Oral

Interannual response of fish growth to the 3-D global NEMURO output with realistic atmospheric forcing. Part I: Latitudinal differences in Pacific herring growth

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Understanding ecosystem impacts of climate change at basin scales and across more than one species is one of the most important sampling and modeling challenges facing the ocean research community. A lower trophic level model (NEMURO) was embedded into a 3-D circulation model (3-D NEMURO) and used to simulate the daily dynamics of two groups of phytoplankton, three groups of zooplankton, and representations of nitrogen and silicate fluxes on a 3-D spatial grid for the Northern Pacific Ocean for 1948 through 2002. We used predicted water temperature and zooplankton densities from 3-D NEMURO for three locations (West Coast Vancouver Island, Prince William Sound, and Bering Sea) as inputs to a Pacific herring (*Clupea pallasii*) bioenergetics model to simulate predicted mean weight-at-age. Weight-at-age at the three locations showed shifts during the late 1970's that were also reflected in the 3-D NEMURO-predicted water temperature and zooplankton densities. The relative contribution of water temperature versus zooplankton densities to predicted herring growth response varied by location. Zooplankton were the major cause of predicted herring growth response for West Coast Vancouver Island, temperature dominated the response for the Bering Sea, and the Prince William Sound response was mix of temperature and zooplankton. Use of 3-D NEMURO output, computed in a consistent manner across broad geographic scales, allowed us to more rigorously compare predicted herring growth responses between locations. In a companion paper, the same methodology was applied to Pacific saury (*Cololabis saira*), allowing a cross-species comparison.

PICES XIV S4-2425 Invited

Responses of opportunistic, periodic, and equilibrium life history strategies to climate-induced environmental regime shifts

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The triangular model of life history strategies (Winemiller and Rose, 1992) predicts the manner in which different species respond to environmental variation. Opportunistic life history strategists respond with comparatively rapid demographic responses (high resiliency) and rapid evolution. Estuarine taxa may have limited vagility, and marine pelagic species may have considerable dispersal capabilities both in immature and adult stages. Periodic strategists often reveal episodic, pulse-like demographic responses to spatial and temporal variation expressed over relatively large spatial scales. High spatiotemporal recruitment variation is manifested in dominant annual cohorts or recruitment hot spots, such as larval retention areas and coastal nursery habitats. The periodic strategy also should be associated with slower rates of evolution and reductions in effective population size due to high fitness variance (Hedgecock effect). Most periodic strategists have high dispersal capabilities, especially for pelagic eggs and larvae, but also for vagile adults in some cases. Equilibrium strategists should have significant density-dependent recruitment and relatively low demographic resilience (*e.g.* many elasmobranchs). Both immature and adult life stages should be particularly sensitive to changes in ecosystem properties, including community structure. In these taxa, vagility of immature life stages is low, and adults of some taxa may have limited vagility and often are dependent on particular habitats.

Climate change and regime shifts in ecosystem dynamics are expected to affect all species, but spatial dynamics and speeds of response would differ. Opportunistic strategist should adjust rapidly to changes in environmental conditions at small spatial scales via demographic and evolutionary change, but these taxa may be vulnerable to rapid, large-scale shifts. Periodic strategists should have rapid demographic responses expressed over large spatial scales, and these may result in genetic bottlenecks, local extirpations, and range shifts. Equilibrium strategists with relatively low vagility and demographic resilience would be highly impacted by major regime shifts. Reductions in these populations would further change food web dynamics and reduce regional biodiversity. These theoretical predictions are supported by findings from several recent studies.

PICES XIV S4-2580 Oral

Distribution and population dynamics of Japanese sardine, anchovy and chub mackerel in the Kuroshio/Oyashio system: Seeking for mechanistic responses to regime shifts

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Decadal-scale species replacement or alternation of dominant species is evident among Japanese sardine (*Sardinops melanostictus*), anchovy (*Engraulis japonicus*), and chub mackerel (*Scomber japonicus*) in the Kuroshio/Oyashio System. Although they are short-lived (< 4 years for anchovy and < 8 years for sardine and mackerel) and basically zooplankton feeders, their life histories are different. For example, chub mackerel feed on anchovy larvae and adults. In general, sardine and mackerel spawn in the Kuroshio area during winter. Anchovy spawn from spring to autumn mainly in the Kuroshio but their spawning grounds extend to the Transition Zone when the stock is abundant. In order to determine mechanistic responses to regime shifts, we examined the historical data of distribution and abundance of eggs, larvae, juveniles and adults, and growth of juveniles in relation to environmental factors. Water temperature and prey density are responsible for early growth for these species. Abundance and spatial overlap with their common predators - skipjack tunas and common squids - may also play a role.