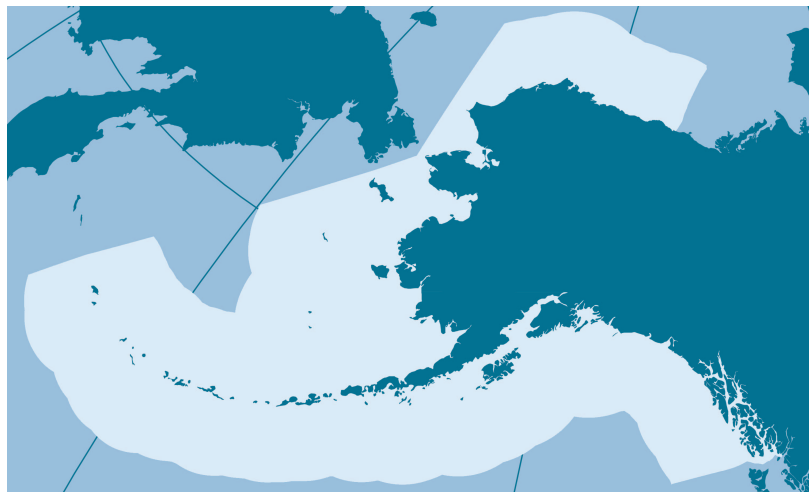


# Ecosystem Considerations 2015

## Status of Alaska's Marine Ecosystems



*Edited by:*

Stephani Zador

Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA  
7600 Sand Point Way NE  
Seattle, WA 98115

*With contributions from:*

Kerim Aydin, Sonia Batten, Nick Bond, Kristin Ciciel, Annette Dougherty, Miriam Doyle, Lisa Eisner, Ed Farley, Emily Fergusson, Nissa Ferm, Lowell Fritz, Jeanette Gann, Angie Greig, Dana Hanselman, Colleen Harpold, Al Hermann, Kirstin Holsman, Jim Ianelli, John Joyce, Kathy Kuletz, Elizabeth Labunski, Carol Ladd, Bob Lauth, Jean Lee, Mike Litzow, Ann Matarese, Kathryn Mier, Jamal Moss, Franz Mueter, Jim Murphy, John Olson, Joe Orsi, Ivonne Ortiz, Jim Overland, Sigrid Salo, Kalei Shotwell, Elizabeth Siddon, William Stockhausen, Kathryn Sweeney, Scott Vulstek, Muyin Wang, Alex Wertheimer, Andy Whitehouse, Tom Wilderbuer, Matt Wilson, Ellen Yasumi-ishi, and Stephani Zador

*Reviewed by:*

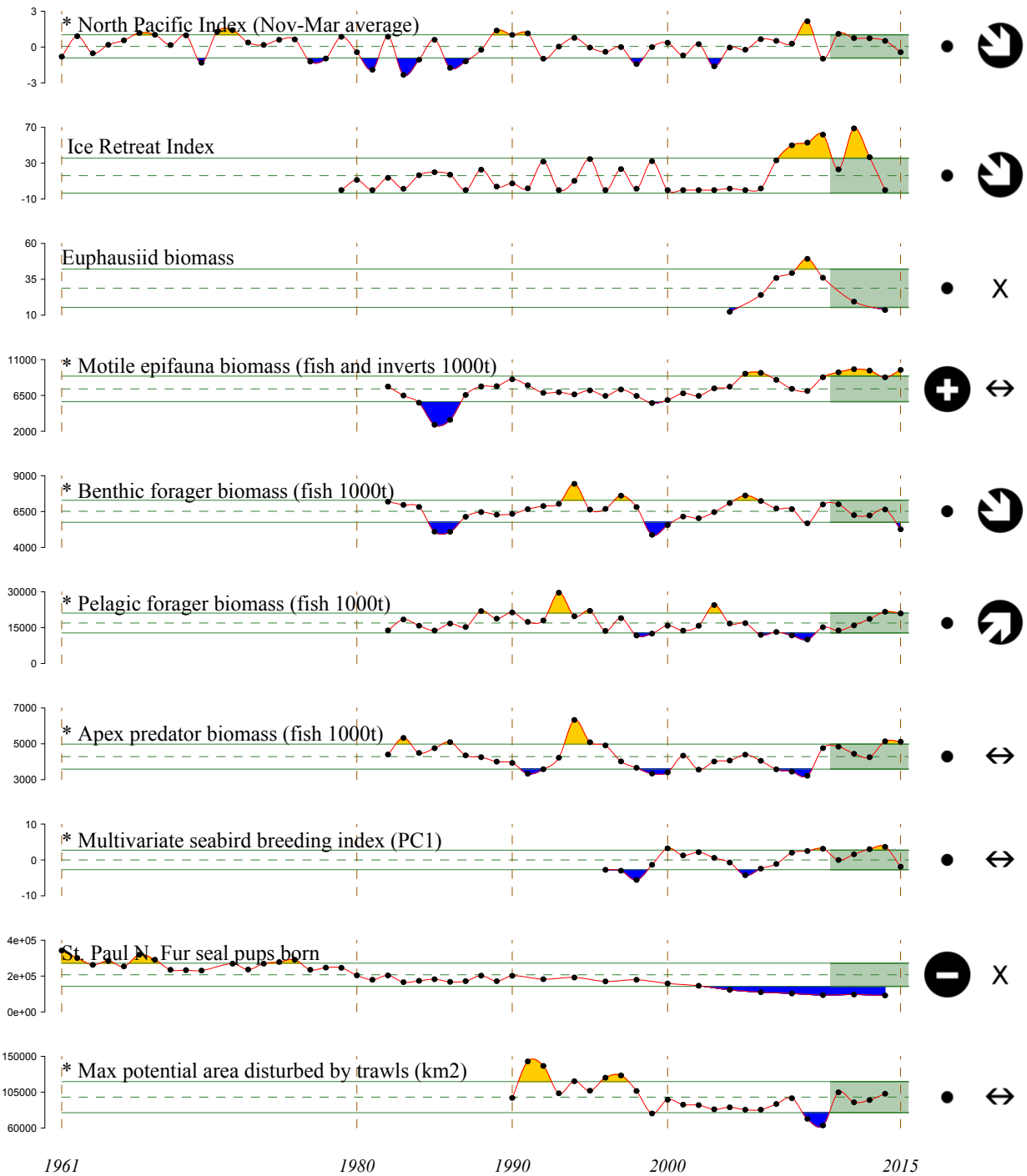
The Plan Teams for the Groundfish Fisheries of the  
Bering Sea, Aleutian Islands, and Gulf of Alaska

November 16, 2015

North Pacific Fishery Management Council  
605 W. 4<sup>th</sup> Avenue, Suite 306  
Anchorage, AK 99301

# Eastern Bering Sea 2015 Report Card

- The **eastern Bering Sea in 2015 was characterized by warm conditions** that were first seen in 2014, and continued through the winter, during which the **PDO reached the highest winter value seen** in the record extending back to 1900.
- The extent of **sea ice during winter was reduced, as was as the size of the cold pool of bottom water** relative to the long term mean during the summer.
- While there was no acoustic survey of euphausiids during summer, rough counts of zooplankton during spring indicated that **small copepods were more prevalent than either lipid-rich large copepods or euphausiids**.
- **Jellyfish remained abundant** during summer, following a new peak fall biomass recorded in 2014.
- **Survey biomass of motile epifauna has been above its long-term mean** since 2010, with no trend in the past 5 years. There has been a unimodal increase in brittle stars since 1989 and for sea urchins, sea cucumbers and sand dollars since 2004-2005.
- **Survey biomass of benthic foragers decreased substantially in 2015, which contributed to the change in their previously stable recent trend to negative.** Recent declines could possibly be related to the consecutive years of springtime drift patterns that have been linked with poor recruitment of flatfish.
- **Survey biomass of pelagic foragers has increased steadily** since 2009 and is currently above its 30-year mean. While this is primarily driven by the **increase in walleye pollock** from its historical low in the survey in 2009, it is also a result of **increases in capelin during the cold years**, which have remained high during the past two warm years.
- **Fish apex predator survey biomass is currently above its 30-year mean**, although the increasing trend seen in recent years has leveled off. **The increase from below average values in 2009** back towards the long term mean is driven primarily by increases in Pacific cod from low levels in the early 2000s.
- **The multivariate seabird breeding index is below the long term mean**, indicating that seabirds bred later and less successfully in 2015. This suggests that **foraging conditions were not favorable for piscivorous seabirds**, a hypothesis further supported by large numbers of dead, emaciated birds observed at sea.
- **Northern fur seal pup production for St. Paul Island remained low** in 2014, indicating that fewer pups were produced in 2014 than during the year of the last survey in 2012.
- The maximum potential **area of seafloor habitat disturbed by trawl gear has remained stable since 2011**.



#### 2011-2015 Mean

- +** 1 s.d. above mean
- 1 s.d. below mean
- within 1 s.d. of mean
- X fewer than 2 data points

#### 2011-2015 Trend

- ↻** increase by 1 s.d. over time window
- ↺** decrease by 1 s.d. over time window
- ↔** change <1 s.d. over window
- ↔** fewer than 3 data points

Figure 1: Eastern Bering Sea ecosystem assessment indicators; see text for descriptions. \* indicates time series updated in 2015.

# Aleutian Islands 2015 Report Card

## Region-wide

- The state of the North Pacific atmosphere-ocean system during 2014-2015 featured the **continuance of strongly positive SST anomalies** that began in 2013-2014.
- The NPI was negative during the fall and early winter, implying a strong and often displaced Aleutian Low. The generally **negative values of the NPI are consistent with the positive trend in the PDO**.
- Some of the **abnormally warm water that developed in the NE Pacific during early 2014 appears to have made it to the Aleutians and through the eastern Aleutian passes** into the Bering Sea, presumably during the winter when the local winds were favorable for northward transports.
- During the period from fall 2014 to summer 2015, **upper ocean temperature anomalies** in the western Aleutians **cooled from above normal to near normal**. These anomalies remained generally above normal along the arc of the eastern Aleutian Islands
- In general, **schools in the Aleutian Islands have shown no recent trends in enrollment**, possibly indicating that communities with year-round residents that experience direct interactions with the ecosystem through residential and subsistence activities are stable.

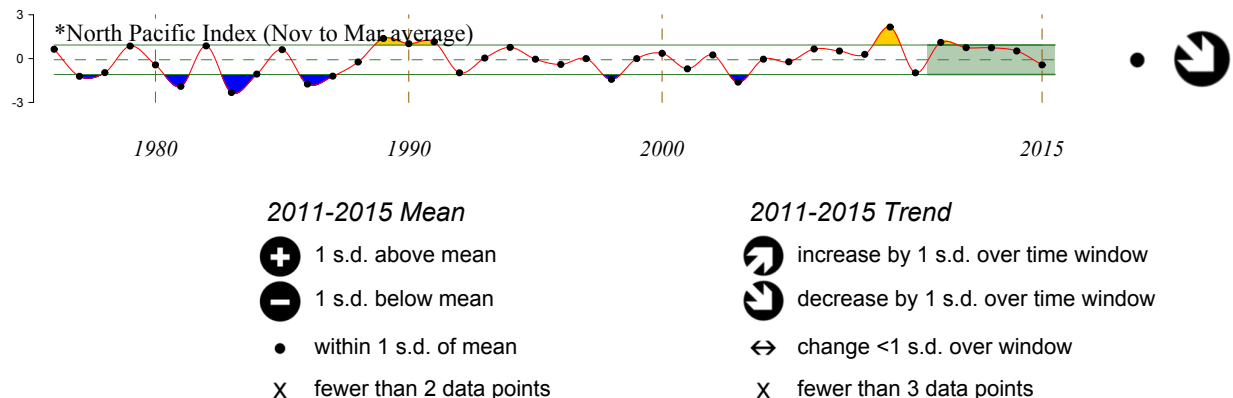
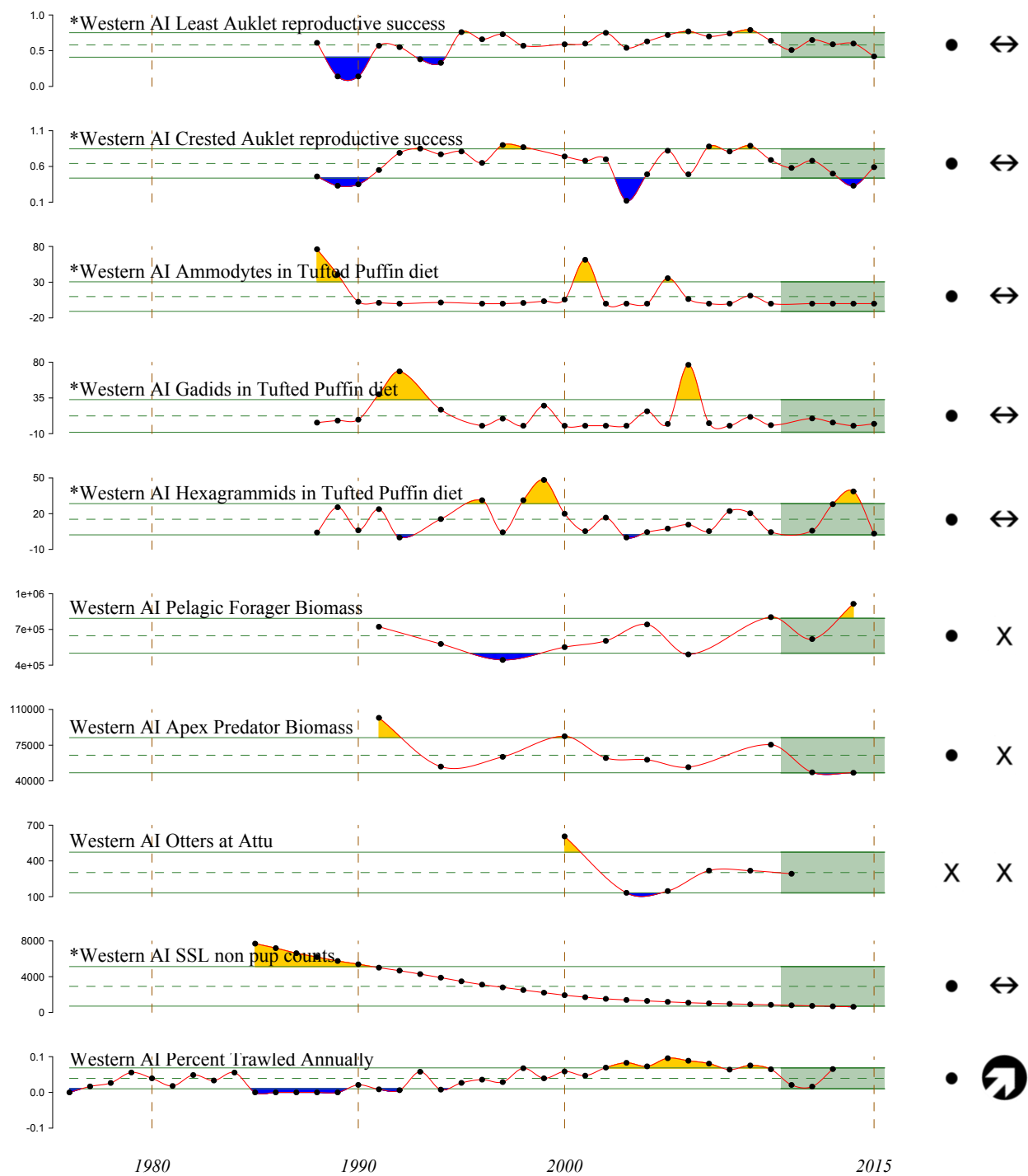


Figure 2: The winter North Pacific Index time series. \* indicates time series updated in 2015.

## Western Aleutian Islands Ecoregion

- While the reproductive success of planktivorous least auklets declined in 2015, that of crested auklets increased from the low level seen in 2014. Crested auklets rely more on euphausiids than the copepod-specialist least auklets, thus **we can speculate that copepod availability was poor in 2015**.
- Forage fish trends as indicated in tufted puffin chick meals have varied over the long term. In general, sand lance have been absent since 2010, and age-0 gadids uncommon. The **number of hexagrammids (likely age-0 Atka mackerel) declined relative to the past two years, possibly indicating poor recruitment**.
- Steller **sea lions remain below their long-term mean** in this ecoregion, although there has been no significant trend in the past 5 years. The 2014 counts were the lowest in the time series.



#### 2011-2015 Mean

- $\oplus$  1 s.d. above mean
- $\ominus$  1 s.d. below mean
- $\bullet$  within 1 s.d. of mean
- X fewer than 2 data points

#### 2011-2015 Trend

- $\curvearrowright$  increase by 1 s.d. over time window
- $\curvearrowleft$  decrease by 1 s.d. over time window
- $\leftrightarrow$  change < 1 s.d. over window
- X fewer than 3 data points

Figure 3: Western Aleutian Islands ecoregion indicators. \* indicates time series updated in 2015. See Figure 2 for legend.

# Central Aleutian Islands Ecoregion

- **Counts of non-pup Steller sea lions remain below the long term mean** although there is no significant trend in the past 5 years.
- **School enrollment has shown no trend** in recent years, following a decline since peak enrollment in 2000, and potentially indicating stability in the residential communities.

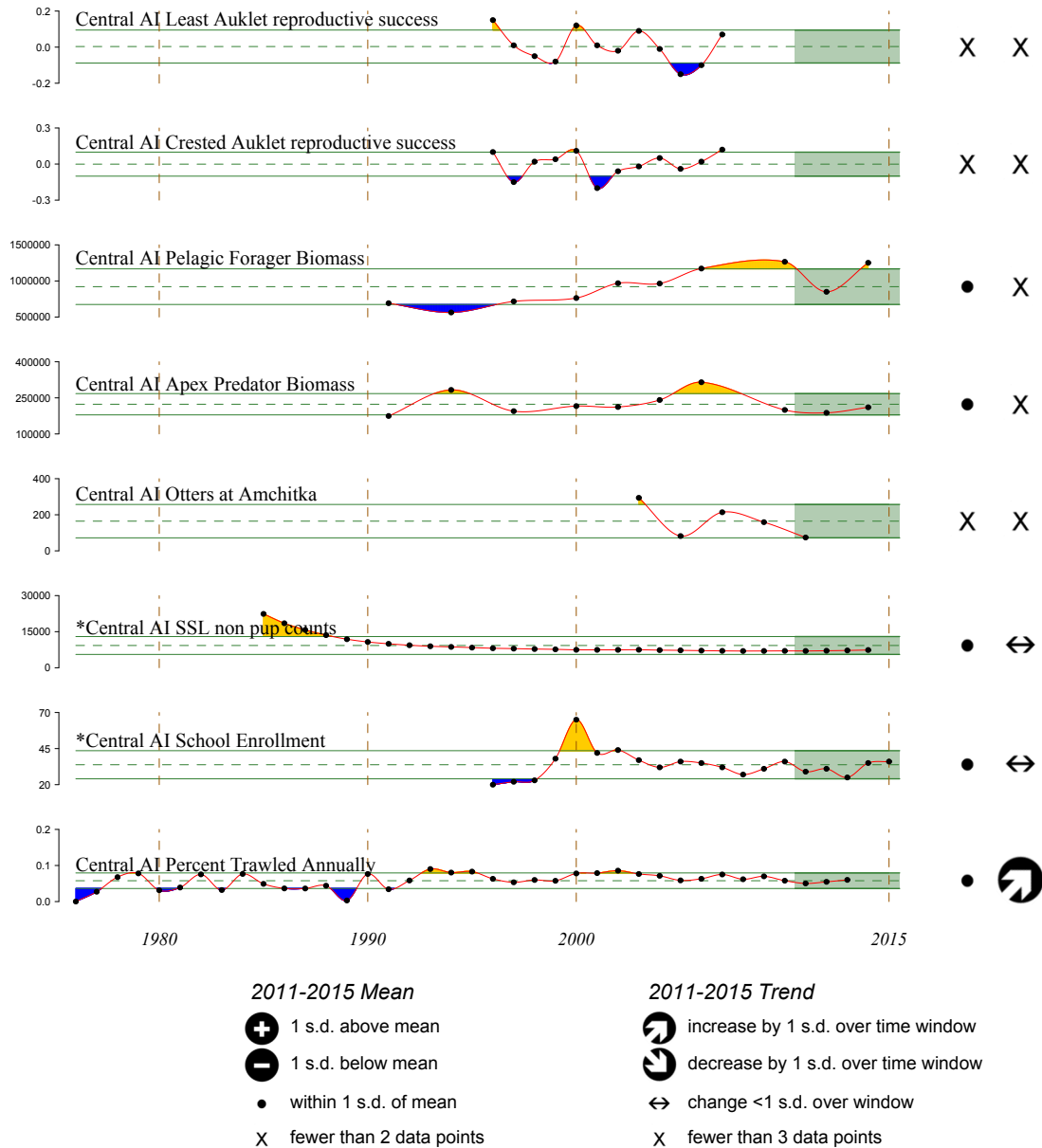


Figure 4: Central Aleutian Islands ecoregion indicators. \* indicates time series updated in 2015. See Figure 2 for legend.

## Eastern Aleutian Islands Ecoregion

- Relative abundances of **gadids and *Ammodytes*** in prey brought back to feed puffin chicks **have shown opposite trends, although both declined in recent years. Age-0 gadids were uncommon in 2015** Chick-provisioning patterns suggest puffins are responding to changes in forage fish availability.
- In contrast to the other ecoregions, **non-pup counts of Steller sea lions remained high** during the last count in 2014. Counts were largely stable through the 1990s, but increased at a rate of 3% per year between 2000 and 2008.
- **School enrollment has shown no trend in the past five years**, despite peak enrollment in 2014. These numbers suggest communities are stable in the eastern ecoregion communities.



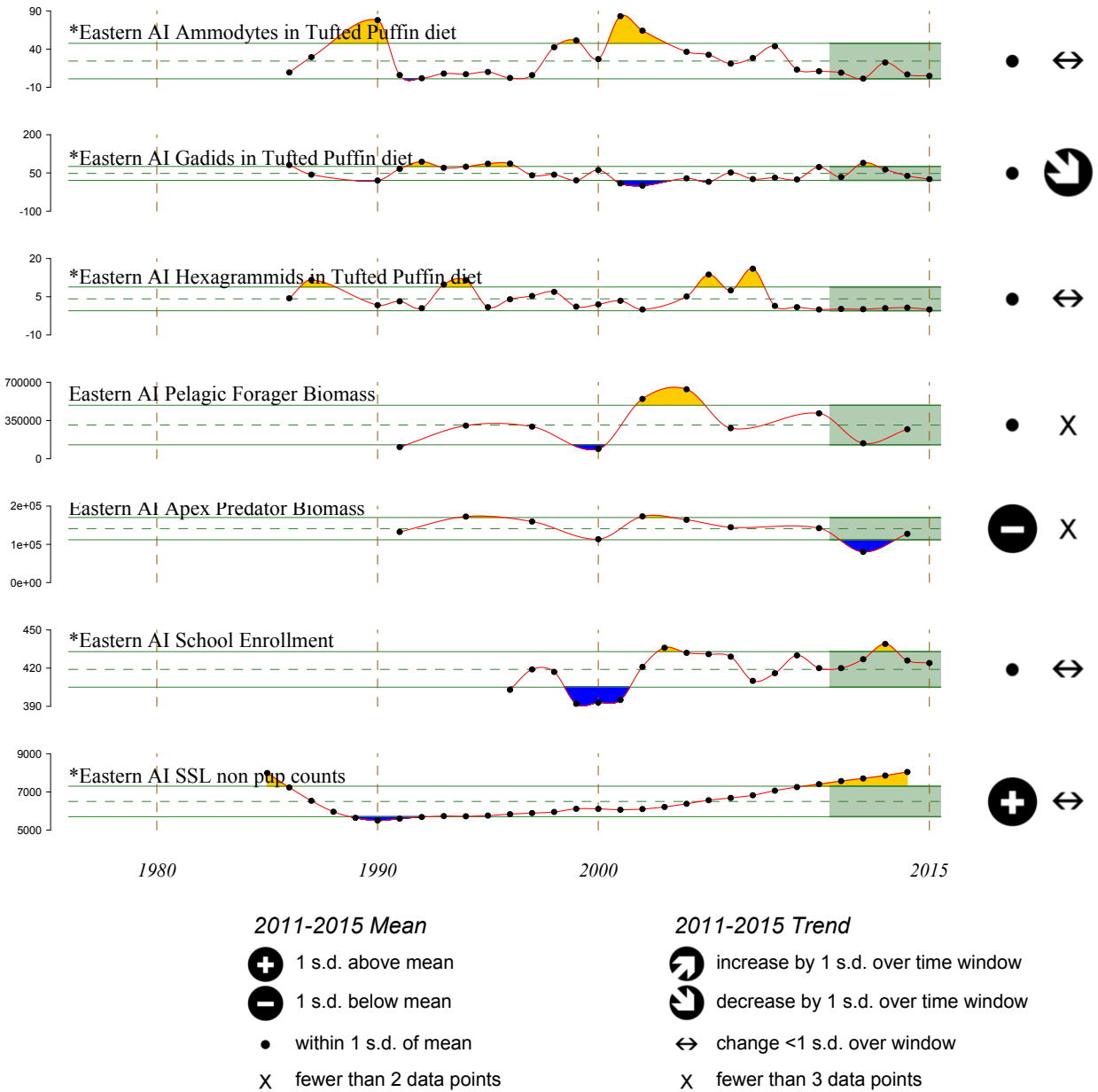
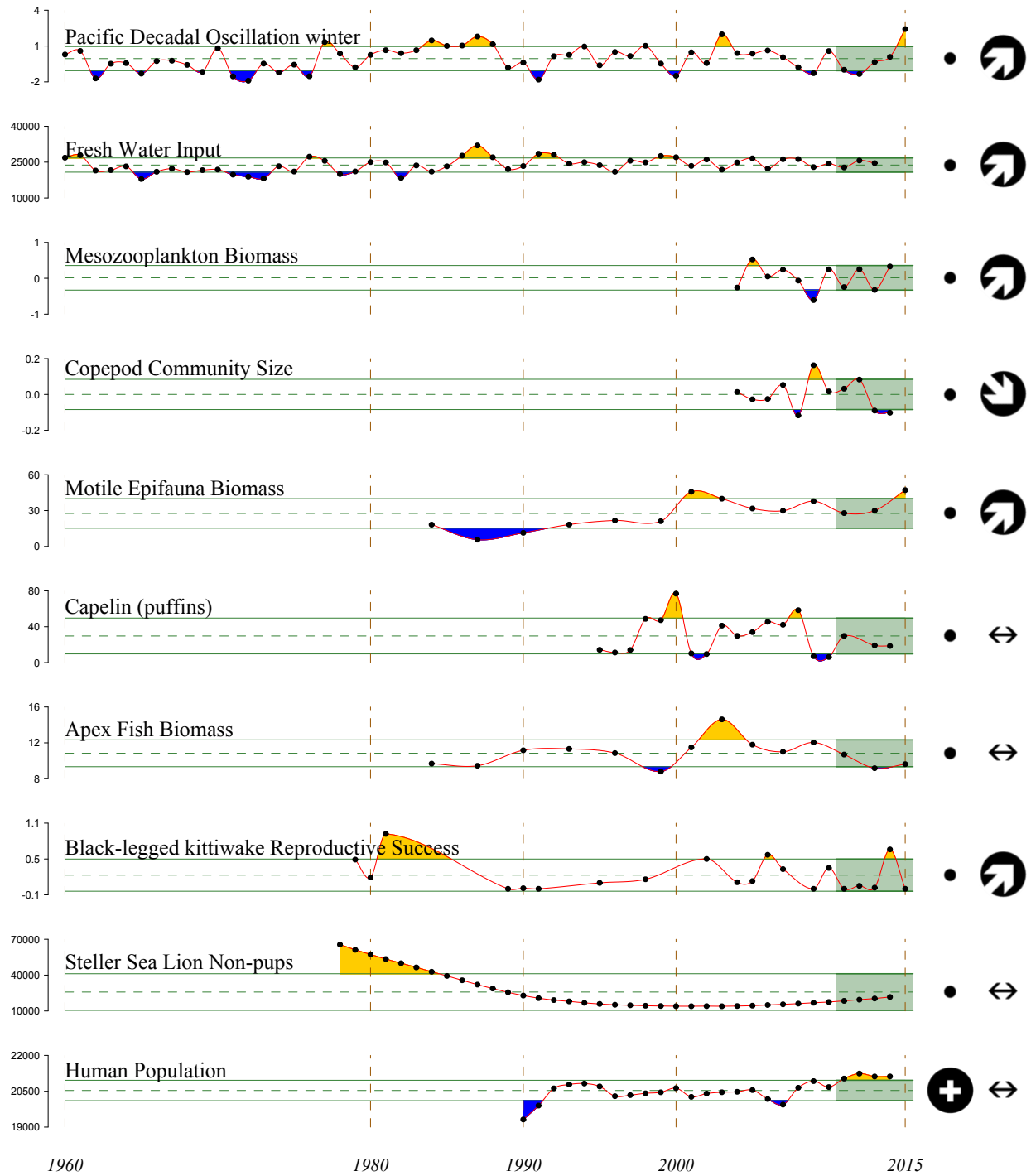


Figure 5: Eastern Aleutian Islands ecoregion indicators. \* indicates time series updated in 2015. See Figure 2 for legend.

# Gulf of Alaska 2015 Report Card

- The Gulf of Alaska in 2015 was **characterized by warm conditions** that were first seen in 2014, and continued through the winter, during which **the PDO reached the highest winter value seen** in the record extending back to 1900.
- **Fresh water input as estimated at the GAK1 station has been variable** over the long time series. The most recent data indicate an increasing trend.
- **Mesozooplankton biomass measured by the continuous plankton recorder has shown a biennial trend since 2009**, with higher biomass recorded during even-number years. Biomass trends can be influenced by ecosystem conditions and mean size of the community. This suggests that prey availability for planktivorous fish, seabirds, and mammals has been variable recently. The biennial patterns suggests a **possible link with biennially varying planktivorous pink salmon abundance**.
- **Copepod community size has been declining in recent years**. The prevalence of small copepods during 2014 fits predictions of warm conditions favoring small copepods. This suggests that **less lipid-rich prey were available to planktivorous predators**.
- **Survey biomass of motile epifauna** has been **above its long-term mean** since 2001. The increase from 1987 to 2001 was driven by hermit crabs and brittle stars, which dominate the biomass. Since 2001 their biomass has been stable. Record catches of octopus influenced the increased estimate in 2015.
- **Trends in capelin captured by tufted puffins at the Barren Islands have been variable** in the 20 year time series. **Capelin comprised the majority of chick diets in 2000 and were generally abundant from 2003 - 2008, but have been at or below the mean since that time**. It is unknown whether these trends reflect capelin abundance or prey preferences of the puffins.
- **Fish apex predator survey biomass is currently below its 30-year mean**, although the declining trend seen in recent years has leveled off. **The trend is driven primarily by arrowtooth flounder** which, along with halibut, had been declining since 2005. Both increased slightly in 2015. It is unknown whether these increases were due to distributional shifts in the warm water. **Pacific cod has declined from a peak survey biomass in 2009**.
- With the exception of 2014, **black-legged kittiwake reproductive success has been poor** in the Semedi Islands, indicating that conditions were not favorable for these surface-foraging piscivorous seabirds. This may reflect poor conditions prior to the breeding season, during, or both.
- Modelled estimates of total Gulf of Alaska **Steller sea lion non-pups counts are approaching the long term mean**. This slowly increasing pattern since 2000 reflects the combination of increasing trends in the eastern population with declining trends in the western population.
- Human populations in the Gulf of Alaska coastal towns of **Homer, Kodiak, Sitka, and Yakutat are above their 25 year mean**. Homer is the sole town with a steadily increasing trend. Kodiak saw declines until 2006 and has recovered slightly since then.



#### 2011-2015 Mean

- 1 s.d. above mean
- 1 s.d. below mean
- within 1 s.d. of mean
- X fewer than 2 data points

#### 2011-2015 Trend

- increase by 1 s.d. over time window
- decrease by 1 s.d. over time window
- change <1 s.d. over window
- X fewer than 3 data points

Figure 6: Eastern Bering Sea ecosystem assessment indicators; see text for descriptions. \* indicates time series updated in 2015.

# Executive Summary of Recent Trends

This section contains links to all new and updated information contained in this report. The links are organized by ecosystem within three sections: Physical and Environmental Trends, Ecosystem Trends, and Fishing and Fisheries Trends.

## Physical and Environmental Trends

- The state of the North Pacific atmosphere-ocean system during 2014-2015 featured the continuance of strongly positive SST anomalies that began in 2013-2014 (p. 90).
- The sea surface temperature patterns can be attributed to the seasonal mean sea level pressure and wind anomalies such as the cyclonic wind anomalies in the central Gulf of Alaska in fall 2014 and winter 2015, with a reversal to anticyclonic flow in the following spring and summer of 2015 (p. 90).
- The Pacific Decadal Oscillation (PDO) was positive during the past year, especially so during the winter months, and the North Pacific Gyre Oscillation (NPGO) was moderately negative. Both climate indices maintained their transitions in sign from the year before (p. 95).
- Anomalously positive sea surface temperatures are predicted throughout much of the north east Pacific during the upcoming winter (p. 97).
- The climate models used for seasonal weather predictions are indicating strong El Niño conditions for the winter of 2015-16, and its usual impacts on the mid-latitude atmospheric circulation, which should serve to maintain a positive state for the PDO (p. 97).

## Arctic

- The timing of the onset of ice in the Chukchi and coastal portion of the Beaufort Sea during fall 2014 was comparable to that of most recent years (p. 90).
- Air temperatures were systematically higher than normal from fall 2014 through spring 2015. It remained relatively warm in the Chukchi Sea through the summer of 2015, but temperatures were near normal in the Beaufort Sea where the ice was slow to retreat with a band of ice just off the coast east of Barrow that persisted through late summer (p. 90).
- The average September Arctic sea ice extent for 2015 was the fourth lowest in the satellite record. The seasonal daily minimum ice extent of 4.41 million square kilometers was likely set on September 11th (p. 99).

## Eastern Bering Sea

- The warm year of 2015 followed the warm year of 2014 in breaking the unusual sequence of seven years with cold winter-spring temperatures (2007-2013), following the seven warm temperature years (2000-2006) (p. 99).
- Sea ice maximum extent was reduced (p. 90 and 99).
- Anomalous warming was particularly prominent during spring 2015 (p. 90).
- November through June 2015 near surface air temperature anomalies in the southeastern Bering Sea were  $+3^{\circ}\text{C}$ , compared to  $+2^{\circ}\text{C}$  in 2014 and in contrast to 2013 at  $-2.5^{\circ}\text{C}$  and 2012 at  $-3^{\circ}\text{C}$  (p. 99).
- The summer cold pool during 2014 was mostly restricted to north of  $60^{\circ}\text{N}$  (p. 99).
- Summer was characterized by a return to long term climatological air temperatures with a typical amount of storminess (p. 90 and 99).
- Time series of temperature and salinities above and below the mixed layer depth show spatial and temporal variation among the BSIERP regions of the eastern Bering Sea (p. 107).
- The mixed layer depth was shallow in 2014 (p. 107).
- The 2015 springtime drift patterns on the southern Eastern Bering Sea shelf appear to be consistent with years of good recruitment for northern rock sole, arrowtooth flounder and flathead sole, following three years (2012-2014) of wind patterns that were not consistent with strong recruitment (p. 110).

## Aleutian Islands

- Some of the abnormally warm water that developed in the NE Pacific during early 2014 appears to have made it to the Aleutians and through the eastern Aleutian passes into the Bering Sea, presumably during the winter when the local winds were favorable for northward transports (p. 90).
- During the period from fall 2014 to summer 2015, upper ocean temperature anomalies in the western Aleutians cooled from above normal to near normal. These anomalies remained general above normal along the arc of the eastern Aleutian Islands and Alaska Peninsula (p. 90).
- Eddy energy in the region was low from the fall 2012 through July 2015, indicating that average volume, heat, salt, and nutrient fluxes through Amukta Pass were likely smaller during the this time (p. 112).

## Gulf of Alaska

- The upper ocean in this region was fresher than usual with a relatively strong pycnocline (p. 90).
- The coastal winds were upwelling favorable in an anomalous sense, which helped maintain relatively normal SST along the coast as compared with the much warmer than normal water offshore (p. 90).
- The sub-arctic front was farther north than usual, which is consistent with the poleward surface currents shown in the Ocean Surface Currents - Papa Trajectory Index (p. 116).
- Eddy Kinetic Energy (EKE) levels in the western Gulf of Alaska were particularly weak in summer of 2014. Thus, phytoplankton biomass were likely more tightly confined to the shelf in those years and cross-shelf transport of heat, salinity and nutrients were probably weak (p. 114).
- In the northern Gulf, relatively high eddy kinetic energy was observed in the summer of 2014 (p. 114).
- It now appears the filtered PAPA Trajectory Index may shift back to northerly flow, which would indicate that the recent period of predominantly southern flow (mid-2000s to present) will have been the shortest and weakest in the time series (p. 116).

# Ecosystem Trends

## Eastern Bering Sea

- EcoFOCI implemented a new spring zooplankton rapid assessment to provide within-year preliminary estimates of zooplankton abundance and community structure. Zooplankton are sorted and enumerated within coarse categories: small copepods, large copepods, and euphausiids (p. 126).
- Small copepods made up the majority of plankton at four of six stations; large copepods and juvenile euphausiids were more abundant near the ice edge (p. 126).
- Continuous plankton recorder observations indicated that the 2014 copepod community size was average in the southern Bering Sea regions; however, mesozooplankton biomass was below average and large diatom abundance remained above average for the second year (p. 137).
- Jellyfish biomass during fall 2014 BASIS surveys in the north remained consistent with a slight increase to previous years. The biomass in the south was the highest year on record for the 11 years of this survey. The dominant species in terms of biomass and abundance remained *C. melanaster* (p. 141).
- In 2015, aerial surveys of Togiak District herring recorded 228,022 tons, which is approximately the most recent 10-year average and 131% of the 20-year average (p. 151).
- The 2014 Bristol Bay sockeye salmon run of 41.1 million fish was 55% above the preseason forecast of 26.6 million, and was 19% above the recent 20-year average (1994-2013) of 34.7 million. Chinook salmon abundance in the Arctic-Yukon-Kuskokwim region has been declining since 2007 and no commercial periods targeting Chinook salmon were allowed in the Yukon Area during the 2014 summer season (p. 157).
- Young of year pollock energy density increased from values near 3.63 kJ/g in 2003 to 5.26 kJ/g in 2010. In 2014 the average energy content was intermediate (9.75 kJ/fish); thus the model predicts an intermediate level of recruits per spawner in 2017 (p. 171).
- For the 2003-2010 year classes of pollock, a positive significant linear relationship was found between mean abundances of large zooplankton at year  $t$  (when pollock were age-0), and age-3 pollock abundance at year  $t+3$ . A strong relationship was also observed for large zooplankton and age-3 pollock abundance ( $t+3$ )/ spawner biomass ( $t$ ). These results suggest that increases in the availability of large zooplankton prey during the first year at sea were favorable for age-0 pollock survival and recruitment into the fishery at age-3.
- The 2015 Temperature Change (TC) index value was above the long term average, therefore slightly above average numbers of pollock are expected to survive to age-3 in 2015. In the future, the TC values in 2015 indicate an expected below average abundance of age-3 pollock in 2017 (p. 174).
- Below average age-1 pollock recruitment is expected in 2015 based on 2014 biophysical indices indicating below average ocean productivity (chum salmon growth), warm spring sea temperatures (less favorable), and above average predator abundances (pink salmon) (p. 177).
- A new indicator reports trends in age-1 total mortality for pollock, cod, and arrowtooth flounder based on residual mortality inputs and model estimates of annual predation mortality produced from the multi-species statistical catch-at-age assessment model known as CEATTLE. Age-1 natural mortality (i.e.,  $M1+M2$ ) for pollock, cod and arrowtooth flounder was highest between 1980-2000 and has been marginally lower in the last 20 years. Predation by arrowtooth flounder has exceeded cannibalism as the largest source of predation mortality of age-1 pollock since 2007 (p. 179).
- Groundfish length-weight residuals (a measure of fish condition) have varied over time for all species with a few notable patterns. There has been a distinct negative trend in Pacific cod since a peak value in 2003. Age 1 walleye pollock and older walleye pollock are not well correlated in most years. Length-weight residuals for all species were lower in 2015 than in 2014 indicating smaller weight at length. Spatial trends in residuals were also apparent for some species (p. 182)

- New early warning indicators are designed to detect an increased risk of a tipping point to an alternate state in a population or community. Results of three types of early warning indicators are consistent with declining community resilience during the cold period, and recovered resilience with warming in 2014 (p. 209).
- Total trawl survey CPUE in the EBS shows an apparent long-term increase from 1982-2005, followed by a decrease from 2005 to 2009 increase in 2010-2013, and a substantial increase in 2014 to the highest observed value in the time series. Recent changes in CPUE in the EBS have been most pronounced on the middle-shelf, which is occupied by the cold pool during cold years. Higher CPUEs on the middle shelf during the 2001-2005 warm period appeared to be related to the increasing colonization of this area by subarctic demersal species (p. 211).
- Species richness and diversity on the Eastern Bering Sea shelf have undergone significant variations from 1982 to 2014. Richness tends to be highest along the 100 m isobath, while diversity tends to be highest on the middle shelf (p. 214).
- Both the latitudinal and depth distribution of the demersal community on the eastern Bering Sea shelf show strong directional trends over the last three decades, indicating significant distributional shifts to the north and into shallower waters. On average, there was a gradual shift to the north from 2001 to 2005, which reversed as temperatures cooled after 2006. From 2009 through 2014, the average center of gravity temporarily has shifted between deeper and shallower waters (SW-NE axis) and in 2014 was further NE and shallower than in most years (p. 218).

## Aleutian Islands

- The distributions of rougheye rockfish, shortspine thornyhead, and shortraker rockfish have been shallower in the most recent surveys of the Aleutian Islands (last surveyed in 2014). Northern rockfish have shown a significant trend in their mean-weighted distribution towards the Western Aleutians. Mean-weighted temperature distributions for all rockfish species were stable within about 1°C over the entire time series, although since 2000 the mean-weighted temperature distributions have decreased for most species ( 0.1 - 0.5°C)(p. 191).

## Gulf of Alaska

- EcoFOCI implemented a new spring zooplankton rapid assessment to provide within-year preliminary estimates of zooplankton abundance and community structure. Zooplankton are sorted and enumerated within coarse categories: small copepods, large copepods, and euphausiids (p. 127).
- Small copepods were more abundant than large copepods or euphausiids. Large copepods were more abundant east of the Shumagin Islands. Euphausiids were more abundant on the southeastern side of Kodiak (p. 127).
- The highest overall abundance of euphausiids observed during the summer acoustic survey was in 2011, with lowest euphausiid abundance in 2003. There was a small decline in 2015 relative to 2013 (p. 128).
- Total Icy Strait zooplankton density was anomalously low for all months during the 2014 summer survey. Density anomalies were mostly negative from 1997-2005, mostly positive from 2006-2013 (p. 132).
- Icy Strait zooplankton were numerically dominated by calanoid copepods. In 2014, large calanoids were anomalously low while small calanoids were anomalously positive (p. 132).
- In the Alaskan Shelf region sampled by the continuous plankton recorder, copepod community size anomalies remained negative, while mesozooplankton biomass anomalies became positive in 2014. Large diatom abundance anomalies was average (p. 137).

- Jellyfish CPUE in the bottom trawl survey remained low in the western GOA. In contrast, catches in the central GOA during the last two surveys have been the highest since 1990 (p. 144).
- Jellyfish biomass during 2014 GOA IERP surveys was the largest relative to the previous four years. In contrast to jellyfish catches in the EBS, the GOA catches are more diverse, with *Aequorea* and *Chrysaora* as the top two geni (p. 142).
- The ichthyoplankton abundance timeseries was extended to 2013, after no survey during 2012. The abundance of pollock larvae in 2013 was the largest since 1981. Rockfish and cod larvae also showed record high abundances during 2013 (p. 146).
- Although the estimated total mature herring biomass in southeastern Alaska has been above the long-term (1980-2014) median of 91,281 tons since 1997, a decrease in biomass has been observed since the peak in 2011. The most notable drop in biomass was observed in Hoonah Sound (p. 152).
- The total number of salmon harvested in 2014 was 44% of the record peak harvest in 2013. Marine survival of Prince William Sound hatchery pink salmon does not appear to have shifted after the 1988/89 or the 1998/99 climate regime shifts. Marine survival was 11.33% in 2013, an all-time high since 1979 (p. 157).
- A new indicator from the Auke Creek Weir in Southeast Alaska provides the longest-running continuous time series of coho salmon survival estimates available in the North Pacific. Trends provide an opportunity to examine annual variation in habitat rearing areas and conditions because ocean age-0 coho adults occupy only nearshore and strait habitats prior to returning to the creek. The historical trend shows marine survival of wild coho salmon from Auke Creek varies from 11.7% to 47.8%, with an average survival of 24.1% from smolt years 1980-2013. Marine survival for 2013 was 22.7% (p. 165).
- Ecosystem indicators predict a low 2015 pink salmon harvest in southeast Alaska of about 54 M fish, somewhat above the historical average. However, as of October 2015, harvests have been only 34 M fish, with lower than expected returns particularly in the southern portion (p. 161).
- A new Southeast Alaska Coastal Monitoring project Chinook salmon index is the abundance estimate of ocean age-1 fish sampled in Icy Strait, lagged two years later to their ocean year of recruitment as ocean age-3 fish, the age when most reach legal size. Based on this Chinook index, June 1-ocean abundance has been below average in 9 of the past ten years. Most recently, Chinook salmon fishery recruitment appears weak in 2014 and 2016, but strong in 2013, and particularly strong in 2015 (p. 167).
- Ecosystem indicators predict above average recruitment to age-2 sablefish in 2016 (p. 191).
- Length-weight residuals for most groundfish species were positive in the first two years of the survey (1985-1987). The residuals have been mixed for all species since then, but generally smaller and varying from year to year. Most species were generally in better condition in the Kodiak area, especially southern rock sole. Fish condition was generally worse in the southeastern area than other areas of the GOA (p. 187).
- The depth distribution of rockfish in the Gulf of Alaska has remained constant for each species over time. In the past, a shift in the distribution of rockfish from the eastern and SE areas of the Gulf of Alaska was noted; however, in the 2015 bottom trawl survey data this trend was not significant. Variability in rockfish distribution with temperature has been higher for most species across the time series than for the other variables (p. 191).
- Arrowtooth flounder, flathead sole, and other flatfish continue to dominate the biomass in the ADF&G trawl survey. A decrease in overall biomass is apparent from 2007 to 2014 from years of record high estimates seen from 2002 to 2005 (p. 197).
- In 2014, overall gadid biomass in the ADF&G trawl survey slightly decreased in offshore area of Barnabus Gully and in the inshore areas of Kiliuda and Ugak Bays. Below average anomaly values for arrowtooth flounder and flathead sole were recorded for both inshore and offshore areas, while was



above average. Skates and cod were above average for offshore areas, but below average inshore (p. 197).

- The bottom trawl survey catches the most echinoderms, eelpouts, and poachers in the central GOA. An exceptionally high catch of poachers occurred in 2015 in the western GOA. Few echinoderms are caught in the western GOA, while few poachers are caught in the eastern GOA (p. 203).
- Total trawl survey CPUE in the western GOA varied over time with lowest abundances in 1999 and 2001, but no significant trend over the 20-year time period from 1993 to 2013. The eastern GoA shows a significantly increasing trend over time (p. 211).
- “Mushy” halibut were reported during the 2015 fishing season (p. 221)
- *Ichthyophonus*, a non-specific fungus-like protozoan fish parasite, has caused epizootic events among economically important fish stocks including herring and salmon. Recent research found that of the fish sampled in lower Cook Inlet, 23% had *Ichthyophonus* in 2012, and 29% had *Ichthyophonus* in 2013. However, findings did not support the hypothesis that reduced halibut size-at-age may be caused by *Ichthyophonus* (p. 221).
- Species richness and diversity are generally higher in the eastern Gulf of Alaska than in the western Gulf. Both richness and diversity tend to be highest along the shelf break and slope, with richness peaking at or just below the shelf break (200-300m), and diversity peaking deeper on the slope. Other regions of locally higher richness and diversity include the banks and troughs off the Kenai Peninsula and nearshore areas of Kodiak Island and in Cook Inlet. (p. 214).

## Fishing and Fisheries Trends

### Alaska-wide

- With the Arctic FMP closure included, almost 65% of the U.S. EEZ of Alaska is closed to bottom trawling (p. 233).
- At present, no BSAI or GOA groundfish stock or stock complex is subjected to overfishing, and no BSAI or GOA groundfish stock or stock complex is considered to be overfished or to be approaching an overfished condition. The only crab stock considered to be overfished is the Pribilof Islands blue king crab stock, which is in year 1 of a new rebuilding plan. None of the non-FSSI stocks are subject to overfishing, known to be overfished, or known to be approaching an overfished condition (Table 15) (p. 259).

### Bering Sea

- Since 1993, discard rates of managed groundfish species in federally-managed Alaskan groundfish fisheries have generally declined in the trawl pollock and non-pollock fisheries in the Bering Sea/Aleutian Islands (BSAI). Discard rates in the BSAI fixed gear sector fell from around 20% in 1993 to 12% in 1996, and since then have generally fluctuated between 10% and 14% (p. 223).
- Trends in total non-target catch in the groundfish fisheries have varied in the EBS. The catch of Scyphozoan jellyfish peaked in 2014. HAPC biota catch decreased from 2003 to 2007 and has been generally steady since. Sea stars dominate the catch of assorted invertebrates (p. 226).
- There seems to be a generally decreasing trend in seabird bycatch since the new estimation procedures began in 2007, indicating no immediate management concern other than continuing our goal of decreased seabird bycatch. Estimated bycatch was lowest in 2014, although two endangered short-tailed albatross fisheries-related mortalities were observed (p. 229).

## Aleutian Islands

- Discard rates have declined over the past nine years. Discards and discard rates are much lower now than they were in 1996 (p. 223).
- Since 1993, discard rates of managed groundfish species in federally-managed Alaskan groundfish fisheries have generally declined in the trawl pollock and non-pollock fisheries in the Bering Sea/Aleutian Islands (BSAI). Discard rates in the BSAI fixed gear sector fell from around 20% in 1993 to 12% in 1996, and since then have generally fluctuated between 10% and 14% (p. 223).
- Trends in total non-target catch in the groundfish fisheries have varied in the AI. The catch of Scyphozoan jellyfish has been variable and shows no apparent trend over time. HAPC biota and assorted invertebrate catches reached new peaks in 2013, but dropped in 2014 (p. 226).
- Estimated seabird bycatch continues to be low in the Aleutian Islands (p. 229).

## Gulf of Alaska

- Discarded tons of groundfish have remained relatively stable in the past few years with the exception of fixed gear, in which discard rates jumped from 4% in 2012 to 14% in 2013 and remained high at 10% in 2014. Improved observer coverage on vessels less than 60' long and on vessels targeting IFQ halibut may account for the increase (p. 223).
- Sea anemones comprise the majority of non-target catch in groundfish fisheries in the GOA. The catch of Scyphozoan jellies in the GOA has been variable from 2003-2014. From 2007 to 2013, the catch of Scyphozoan jellies has alternated between years of low (odd years) to relatively higher catches (even years). The 2014 catch breaks from this pattern and remains at a low catch level, roughly equivalent to 2013 (p. 226).
- There seems to be a generally decreasing trend in seabird bycatch since the new estimation procedures began in 2007, indicating no immediate management concern other than continuing our goal of decreased seabird bycatch (p. 229).