Environmental variables for SEAK Pink Salmon Preseason Forecast

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June 4, 2021

Contents

1 Objective

The overall objective is to optimize temperature variables by testing a variety of reasonable options using satellite data or Southeast Alaska Coastal Monitoring project (SECM) data within the forecast model framework. This would allow us to better evaluate our options and decide whether or not a variable change in the 2022 forecast model for SEAK pink salmon is warranted. This write-up is a summary of available sea surface temperature (SST) variables based on satellite data (average of May (May), the average over the months of May, June, and July (MJJ), the average over the months of April through June (AMJ), or the average over the months of April through July (AMJJ) from 1997 through 2020) over four regions of Southeast Alaska (SEAK); Icy Strait, Icy and Chatham Straits, northern southeast Alaska (NSEAK), and SEAK. This write-up also includes a summary of SECM survey data from various months (the average of May or the average over the months of May, June, and July), and depths (i.e., 3m, 10m, 15m, 20m) of the SECM transects (Icy Strait and Upper Chatham transects stations ISA, ISB, ISC, ISD, UCA, UCB, UCC, UCD or the Icy Strait transect stations ISA, ISB, ISC, ISD) from 1997 through 2020.

2 Methods

2.1 Satellite-derived SST data

Satellite-derived sea surface temperature (SST) data were pulled from the 'SST and SST Anomaly, NOAA Global Coral Bleaching Monitoring, 5km, V.3.1, Monthly, 1985-Present' time series (https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.html; full citation in references). This satellite-derived SST data set was then matched to pre-determined coordinates from four regions that corresponded with sixteen variables of interest (four regions; four variables per region).

2.1.1 Satellite-derived SST variables

Icy_Strait_SST_May: The Icy Strait region encompasses waters of Icy Strait from the east end of Lemesurier Island to a line from Point Couverden south to Point Augusta. This variable is the average SST in May.

Icy_Strait_SST_MJJ: The Icy Strait region encompasses waters of Icy Strait from the east end of Lemesurier Island to a line from Point Couverden south to Point Augusta. This variable is the average SST in May through July.

Icy_Strait_SST_AMJ: The Icy Strait region encompasses waters of Icy Strait from the east end of Lemesurier Island to a line from Point Couverden south to Point Augusta. This variable is the average SST in April through June.

Icy_Strait_SST_AMJJ: The Icy Strait region encompasses waters of Icy Strait from the east end of Lemesurier Island to a line from Point Couverden south to Point Augusta. This variable is the average SST in April through July.

Chatham_SST_May: The Chatham and Icy Straits region encompasses waters of Chatham and Icy Straits from Point Couverden (approximately 58.20 degrees latitude north and -135.06 longitude west) south to the approximate latitude of 56.025 degrees north (roughly Cape Decision off Kuiu Island) (Figure 2 and Figure 6a; Table 2). This variable is the average SST in May.

Chatham_SST_MJJ: The Chatham and Icy Straits region encompasses waters of Chatham and Icy Straits from Point Couverden (approximately 58.20 degrees latitude north and -135.06 longitude west) south to the approximate latitude of 56.025 degrees north (roughly Cape Decision off Kuiu Island) (Figure 2 and Figure 6b; Table 2). This variable is the average SST in May through July.

Chatham_SST_AMJ: The Chatham and Icy Straits region encompasses waters of Chatham and Icy Straits from Point Couverden (approximately 58.20 degrees latitude north and -135.06 longitude west) south to the approximate latitude of 56.025 degrees north (roughly Cape Decision off Kuiu Island) (Figure 2 and Figure 6c; Table 2). This variable is the average SST in April through June.

Chatham_SST_AMJJ: The Chatham and Icy Straits region encompasses waters of Chatham and Icy Straits from Point Couverden (approximately 58.20 degrees latitude north and -135.06 longitude west) south to the approximate latitude of 56.025 degrees north (roughly Cape Decision off Kuiu Island) (Figure 2 and Figure 6d; Table 2). This variable is the average SST in April through July.

NSEAK_SST_May: The NSEAK region encompasses northern Southeast Alaska from 59.475 to 56.075 degrees north latitude (approximately Districts 9 through 15, and District 13 inside area only; northern Southeast Inside subregion for Southeast Alaska (NSEI); Figure 3 and Figure 6a; Table 3). This variable is the average SST in May.

NSEAK_SST_MJJ: The NSEAK region encompasses northern Southeast Alaska from 59.475 to 56.075 degrees north latitude (approximately Districts 9 through 15, and District 13 inside area only; northern Southeast Inside subregion for Southeast Alaska (NSEI); Figure 3 and Figure 6b; Table 3). This variable is the average SST in May through July.

NSEAK_SST_AMJ: The NSEAK region encompasses northern Southeast Alaska from 59.475 to 56.075 degrees north latitude (approximately Districts 9 through 15, and District 13 inside area only; northern

Southeast Inside subregion for Southeast Alaska (NSEI); Figure 3 and Figure 6c; Table 3). This variable is the average SST in April through June.

NSEAK_SST_AMJJ: The NSEAK region encompasses northern Southeast Alaska from 59.475 to 56.075 degrees north latitude (approximately Districts 9 through 15, and District 13 inside area only; northern Southeast Inside subregion for Southeast Alaska (NSEI); Figure 3 and Figure 6d; Table 3). This variable is the average SST in April through July.

SEAK_SST_May: The SEAK region encompasses Southeast Alaska from 59.475 to 54.725 degrees north latitude (Figure 4 and Figure 6a; Table 4). This variable is the average SST in May.

SEAK_SST_MJJ: The SEAK region encompasses northern Southeast Alaska from 59.475 to 54.725 degrees north latitude (Figure 4 and Figure 6b; Table 4). This variable is the average SST in May through July.

SEAK_SST_AMJ: The SEAK region encompasses Southeast Alaska from 59.475 to 54.725 degrees north latitude (Figure 4 and Figure 6c; Table 4). This variable is the average SST in April through June.

SEAK_SST_AMJJ: The SEAK region encompasses Southeast Alaska from 59.475 to 54.725 degrees north latitude (Figure 4 and Figure 6d; Table 4). This variable is the average SST in April through July.

2.2 SECM survey temperature data

SECM survey temperature data were summarized by year (1997 to 2020), month (the month of May or over the months of May, June, and July), depth (3m, 10m, 15m, and 20m), and transect (the Icy Strait and Upper Chatham transects combined or only the Icy Strait transect).

2.2.1 SECM survey temperature variables

ISTI3_May: Average temperature at 3m during May at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7a; Figure 8a; Table 6).

ISTI3_MJJ: Average temperature at 3m during May through July at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7b; Figure 8a; Table 7).

ISTI10_May: Average temperature in the upper 10m during May at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7a; Table 6).

ISTI10_MJJ: Average temperature in the upper 10m during May through July at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7b; Table 7).

ISTI15_May: Average temperature in the upper 15m during May at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7a; Table 6).

ISTI15_MJJ: Average temperature in the upper 15m during May through July at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7b; Table 7).

ISTI20_May: Average temperature in the upper 20m during May at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7a; Table 6).

ISTI20_MJJ: Average temperature in the upper 20m during May through July at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; Figure 7b; Table 7).

IS3_May: Average temperature at 3m during May at 4 stations in Icy Strait (Icy Strait transect only; Figure 7a; Table 6; Figure 8b).

IS3_MJJ: Average temperature at 3m during May through July at 4 stations in Icy Strait (Icy Strait transect only; Figure 7b; Table 7; Figure 8b).

3 Results

3.1 Satellite-derived SST data

Satellite sea surface temperature data were summarized by region and year for the month of May or over the months of May, June, and July from 1997 to 2020 (Tables 1 through 5).

Table 1: Satellite sea temperature data from the Icy Strait region from 1997 to 2020 for the month of May (May), May through July (MJJ), April through June (AMJ), and April through July (AMJJ). There are 70 satellite stations (latitude/longitude combinations) in the Icy Strait region.

year	Icy_Strait_SST_MJJ	Icy_Strait_SST_May	Icy_Strait_SST_AMJJ	Icy_Strait_SST_AMJ
1997	10.30	7.01	8.83	7.30
1998	9.97	7.34	8.85	7.56
1999	9.08	6.17	8.02	6.78
2000	9.94	7.02	8.67	7.35
2001	9.57	6.48	8.40	7.08
2002	9.34	6.26	8.02	6.60
2003	10.08	7.29	8.88	7.53
2004	10.68	7.53	9.25	7.69
2005	11.16	8.40	9.64	8.26
2006	10.19	6.84	8.86	7.49
2007	9.49	6.55	8.16	6.87
2008	8.85	6.43	7.72	6.68
2009	9.94	7.19	8.47	7.22
2010	9.87	7.71	8.68	7.81
2011	9.84	6.81	8.47	7.18
2012	9.23	6.92	8.10	7.07
2013	9.88	6.37	8.45	6.97
2014	10.23	7.90	8.81	7.62
2015	10.73	8.34	9.43	8.29
2016	11.65	8.81	10.37	9.14
2017	9.82	7.22	8.66	7.51
2018	9.99	6.92	8.74	7.43
2019	10.74	7.79	9.51	8.10
2020	10.40	7.83	9.05	7.86

Table 2: Satellite sea temperature data from the Chatham and Icy Straits region from 1997 to 2020 for the month of May (May), May through July (MJJ), April through June (AMJ), and April through July (AMJJ). There are 313 satellite stations (latitude/longitude combinations) in the Chatham and Icy Straits region.

year	Chatham_SST_MJJ	Chatham_SST_May	Chatham_SST_AMJJ	Chatham_SST_AMJ
1997	10.08	7.48	8.83	7.59
1998	9.85	7.83	8.91	7.88
1999	8.90	6.84	8.05	7.12
2000	9.70	7.34	8.62	7.52
2001	9.15	6.74	8.18	7.12
2002	8.97	6.39	7.85	6.64
2003	9.92	7.71	8.90	7.85
2004	10.43	7.94	9.22	7.96
2005	10.67	8.51	9.48	8.44
2006	9.78	7.16	8.68	7.58
2007	9.52	7.04	8.41	7.27
2008	8.65	6.77	7.69	6.83
2009	9.75	7.30	8.46	7.35
2010	9.65	7.97	8.66	7.93
2011	9.59	7.31	8.49	7.55
2012	9.17	7.07	8.18	7.22
2013	9.66	6.74	8.44	7.21
2014	9.98	8.17	8.76	7.77
2015	10.62	8.87	9.55	8.73
2016	11.04	8.92	10.03	9.07
2017	9.65	7.65	8.70	7.76
2018	9.87	7.40	8.75	7.61
2019	10.47	8.24	9.46	8.35
2020	9.99	8.09	8.84	7.86

Table 3: Satellite sea temperature from the northern Southeast Alaska (NSEAK) region from 1997 to 2020 for the month of May (May), May through July (MJJ), April through June (AMJ), and April through July (AMJJ). There are 1,344 satellite stations (latitude/longitude combinations) in the NSEAK region.

year	NSEAK_SST_MJJ	NSEAK_SST_May	NSEAK_SST_AMJJ	NSEAK_SST_AMJ
1997	10.02	7.35	8.71	7.40
1998	9.89	7.65	8.85	7.71
1999	8.93	6.70	7.98	6.95
2000	9.70	7.23	8.57	7.39
2001	9.22	6.66	8.17	7.01
2002	9.05	6.39	7.88	6.61
2003	9.86	7.57	8.76	7.60
2004	10.38	7.89	9.09	7.79
2005	10.63	8.42	9.35	8.26
2006	9.72	6.98	8.55	7.36
2007	9.44	6.90	8.24	7.03
2008	8.65	6.64	7.63	6.74
2009	9.77	7.32	8.40	7.24
2010	9.62	7.76	8.54	7.72
2011	9.67	7.25	8.44	7.44
2012	9.14	6.95	8.09	7.10
2013	9.67	6.59	8.36	7.04
2014	10.03	8.15	8.70	7.64
2015	10.81	8.92	9.56	8.65
2016	11.18	8.92	10.05	9.00
2017	9.82	7.75	8.77	7.78
2018	10.11	7.53	8.86	7.63
2019	10.87	8.42	9.65	8.44
2020	10.23	8.26	8.98	7.94

Table 4: Satellite sea temperature from the Southeast Alaska (SEAK) region from 1997 to 2020 for the month of May (May), May through July (MJJ), April through June (AMJ), and April through July (AMJJ).There are 2,669 satellite stations (latitude/longitude combinations) in the SEAK region.

year	SEAK_SST_MJJ	SEAK_SST_May	SEAK_SST_AMJJ	SEAK_SST_AMJ
1997	10.47	8.00	9.20	7.99
1998	10.36	8.37	9.38	8.37
1999	9.30	7.23	8.40	7.43
2000	10.02	7.71	8.95	7.86
2001	9.51	7.10	8.52	7.45
2002	9.44	6.92	8.33	7.14
2003	10.32	8.17	9.25	8.16
2004	10.98	8.58	9.74	8.51
2005	11.06	8.92	9.83	8.82
2006	10.19	7.63	9.07	7.96
2007	9.99	7.51	8.82	7.64
2008	9.18	7.22	8.17	7.28
2009	10.20	7.76	8.85	7.73
2010	10.09	8.28	9.05	8.23
2011	10.05	7.74	8.88	7.92
2012	9.68	7.47	8.63	7.61
2013	10.39	7.51	9.10	7.85
2014	10.57	8.62	9.26	8.17
2015	11.43	9.64	10.21	9.32
2016	11.67	9.61	10.59	9.59
2017	10.31	8.25	9.28	8.29
2018	10.79	8.28	9.54	8.30
2019	11.46	9.01	10.25	9.05
2020	10.70	8.90	9.52	8.53

3.2 SECM survey temperature data

SECM survey temperature data were summarized by year (1997 to 2020), month (the month of May or over the months of May, June, and July), and depth (3m, 10m, 15m, and 20m; Tables 6 and 7).

Table 5: The SECM survey temperature data were summarized by year (1997 to 2020), month (May), and depth (3m, 10m, 15m, and 20m). Icy Strait and Upper Chatham transects (stations ISA, ISB, ISC, ISD, UCA, UCB, UCC, UCD) are included in the ISTI_3May, ISTI10_May, ISTI15_May, and ISTI20_May variables. Only the Icy Strait transect is included in the IS3_May variable.

year	ISTI3_May	ISTI10_May	ISTI15_May	ISTI20_May	IS3_May
1997	8.33	7.97	7.60	7.23	8.38
1998	7.78	7.64	7.50	7.38	7.74
1999	6.77	6.66	6.52	6.39	6.97
2000	7.00	6.82	6.61	6.47	7.08
2001	7.28	7.10	6.94	6.78	7.10
2002	6.88	6.73	6.56	6.39	6.54
2003	7.86	7.76	7.59	7.42	7.73
2004	8.11	7.86	7.61	7.38	8.09
2005	9.74	9.28	8.72	8.32	9.26
2006	7.28	7.16	6.93	6.77	7.28
2007	8.22	7.70	7.36	7.05	8.14
2008	6.97	6.70	6.42	6.22	6.82
2009	9.24	8.65	8.26	7.92	8.95
2010	10.14	9.44	8.89	8.49	9.62
2011	7.07	6.89	6.68	6.51	7.01
2012	7.08	6.91	6.77	6.63	6.84
2013	7.17	6.90	6.72	6.55	7.30
2014	9.24	8.57	8.03	7.66	9.02
2015	8.18	7.93	7.78	7.63	7.99
2016	9.45	9.14	8.89	8.68	9.37
2017	8.45	8.05	7.84	7.69	8.20
2018	8.48	8.25	8.07	7.91	8.47
2019	8.79	8.50	8.18	7.92	9.02
2020	8.39	8.07	7.76	7.47	8.32

Table 6: The SECM survey temperature data were summarized by year (1997 to 2020), month (the months of May, June, and July; MJJ), and depth (3m, 10m, 15m, and 20m). Icy Strait and Upper Chatham transects (stations ISA, ISB, ISC, ISD, UCA, UCB, UCC, UCD) are included in the ISTI_3MJJ, ISTI10_MJJ, ISTI15_MJJ, and ISTI20_MJJ variables. Only the Icy Strait transect is included in the IS3_MJJ variable.

year	ISTI3_MJJ	ISTI10_MJJ	ISTI15_MJJ	ISTI20_MJJ	IS3_MJJ
1997	10.83	10.28	9.77	9.26	10.54
1998	10.82	10.31	9.84	9.44	10.69
1999	9.62	9.33	8.92	8.56	9.65
2000	10.40	9.78	9.21	8.76	10.30
2001	10.43	9.89	9.43	9.03	10.43
2002	9.50	9.02	8.57	8.20	9.35
2003	10.62	10.12	9.70	9.35	10.51
2004	11.40	10.52	9.80	9.27	11.40
2005	11.97	11.32	10.69	10.20	11.92
2006	10.04	9.55	9.11	8.77	9.99
2007	10.99	10.18	9.50	8.95	11.12
2008	9.35	8.76	8.28	7.92	9.29
2009	11.25	10.57	9.91	9.38	11.09
2010	10.98	10.39	9.83	9.40	10.80
2011	10.16	9.65	9.12	8.67	10.50
2012	10.51	9.69	8.98	8.51	10.64
2013	10.79	10.00	9.36	8.87	10.50
2014	10.90	10.17	9.55	9.09	10.59
2015	11.14	10.54	10.05	9.65	11.31
2016	11.52	11.08	10.67	10.30	11.18
2017	9.79	9.25	8.86	8.56	9.55
2018	10.30	9.76	9.30	8.92	10.11
2019	11.64	10.93	10.35	9.91	11.55
2020	10.15	9.68	9.25	8.89	10.04

4 Acknowledgements

Jordan Watson (NOAA) helped with the code to process the satellite data into a usable format. The data was accessed through NOAA's Coral Reef Watch (https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.html. Emily Fergusson summarized the SECM survey data by year, month, and depth. All code and associated data are located here: https://github.com/commfish/southeast_pink_salmon_preseason in the 2022_forecast folder.

5 References

NOAA Coral Reef Watch. 2021, updated daily. NOAA Coral Reef Watch Version 3.1 Monthly 5km SST and SST Anomaly, NOAA Global Coral Bleaching Monitoring Time Series Data, May 1997-July 2020. College Park, Maryland, USA: NOAA/NESDIS/STAR Coral Reef Watch program. Data set accessed 2021-04-09 at https://coastwatch.pfeg.noaa.gov/erddap/griddap/NOAA_DHW_monthly.html.

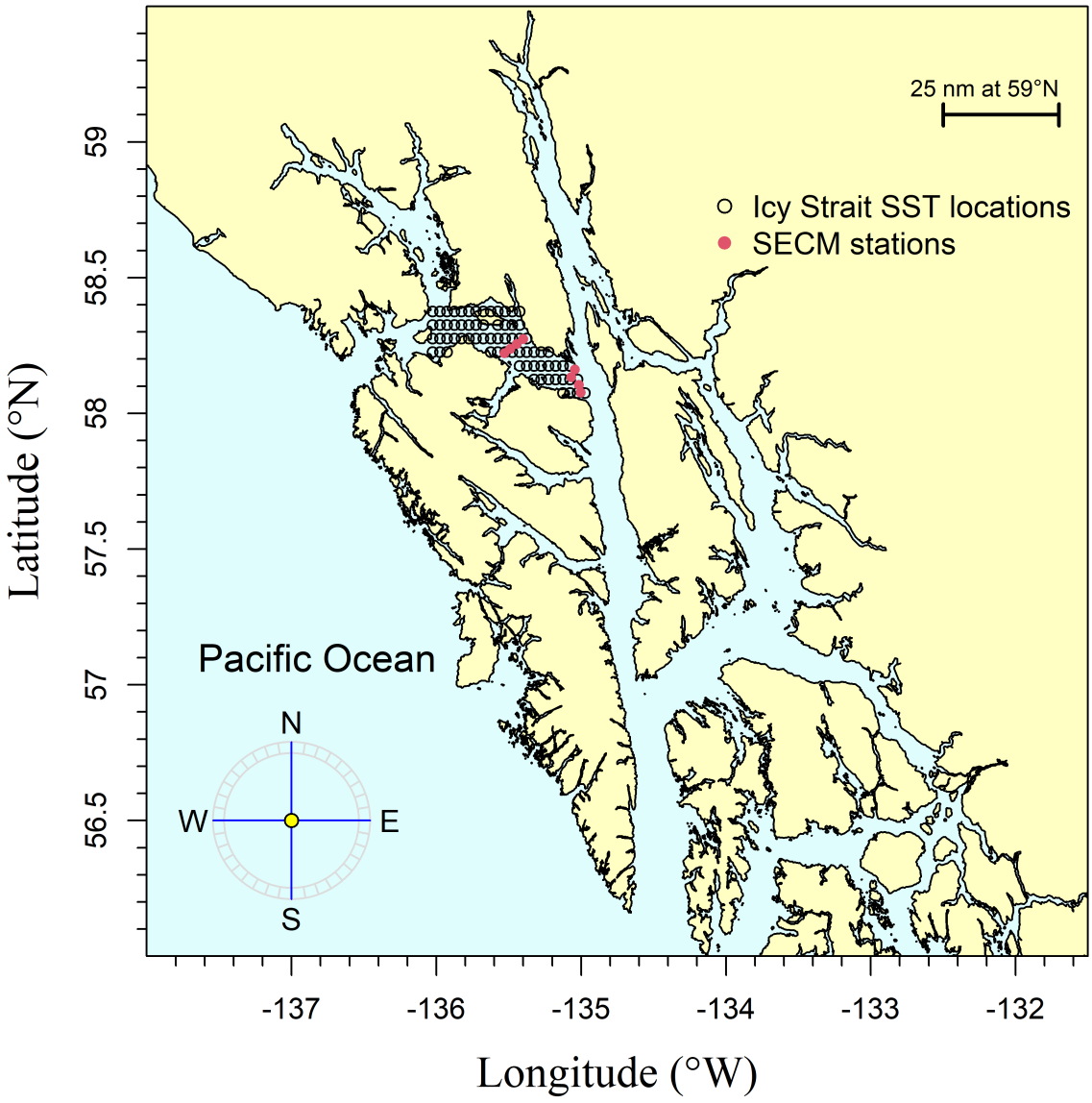

Figure 1: The Icy Strait region encompasses waters of Icy Strait from the east end of Lemesurier Island to a line from Point Couverden south to Point Augusta. The Southeast Coastal Monitoring (SECM) project transects (Upper Chatham Strait and Icy Strait) are shown as red points for comparison to the satellite stations (i.e., data points; black circles).

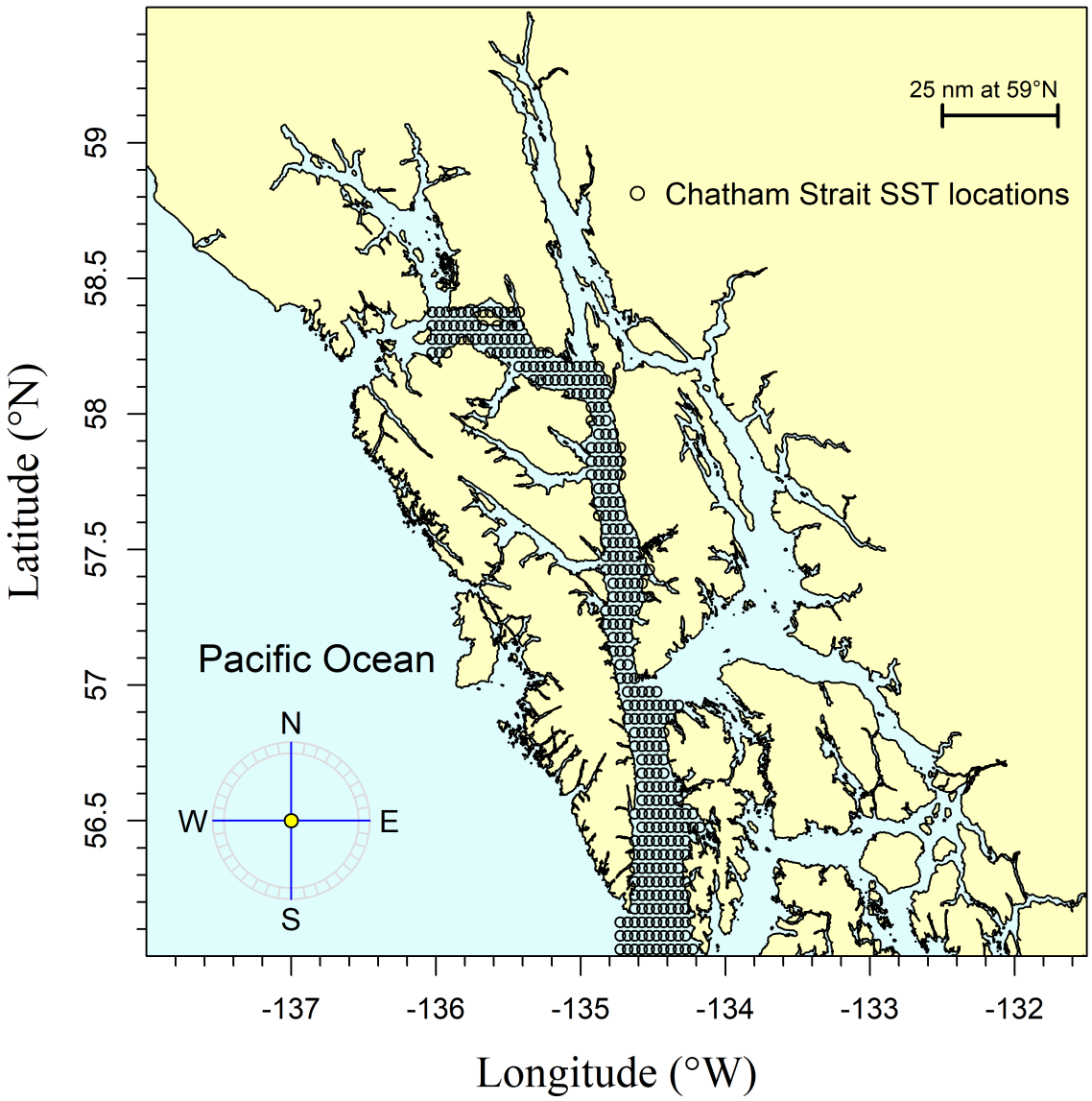

Figure 2: The Chatham and Icy Straits region encompasses waters from Point Couverden (approximately 58.20 degrees latitude north and -135.06 longitude west) south to the approximate latitude of 56.025 degrees north (roughly Cape Decision off Kuiu Island). The black circles are the satellite stations (i.e., data points).

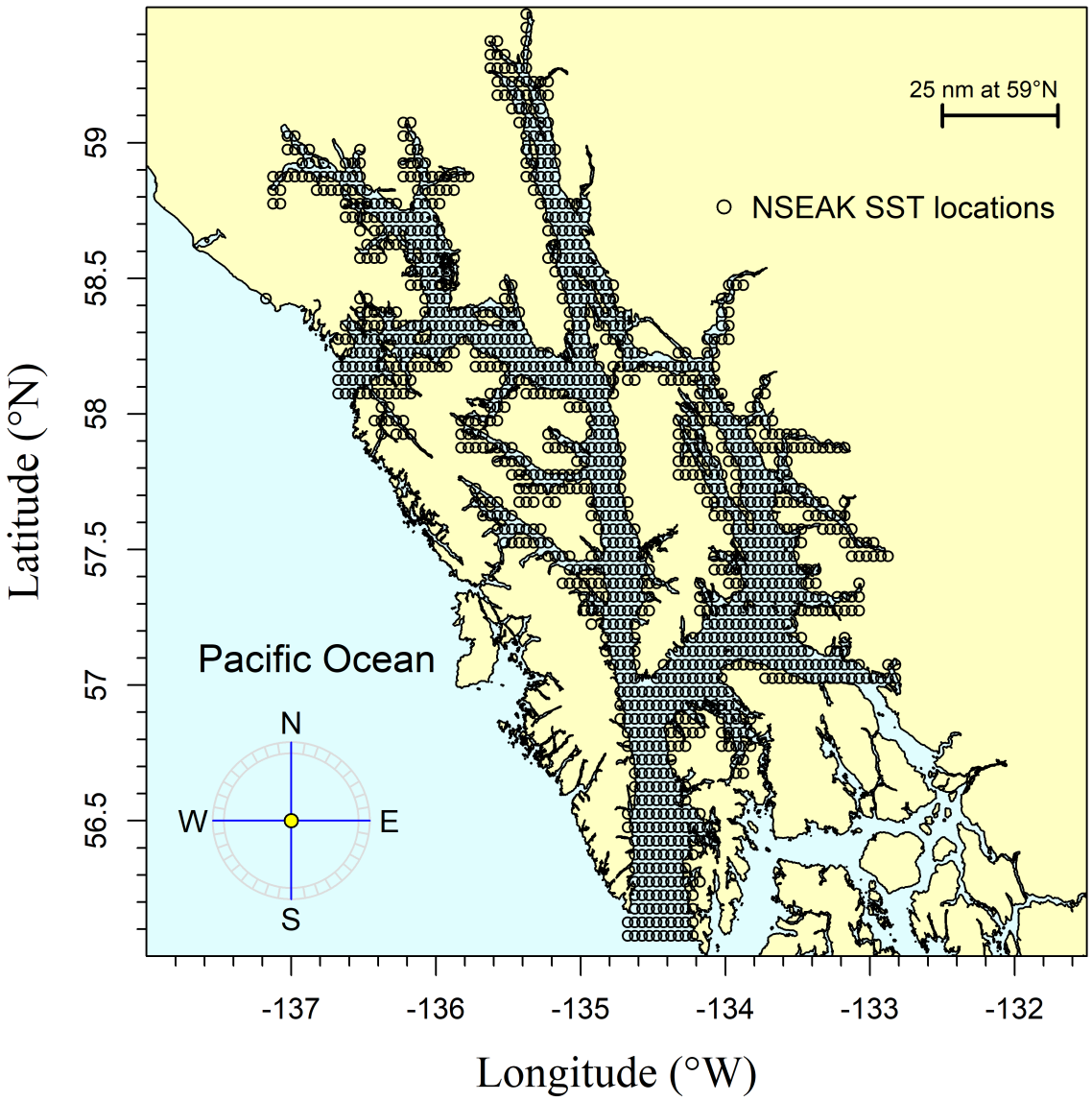

Figure 3: The northern Southeast Alaska (NSEAK) region encompasses northern Southeast Alaska from 59.475 to 56.075 degrees north latitude and from -137.175 to -132.825 degrees west longitude. The black circles are the satellite stations (i.e., data points).

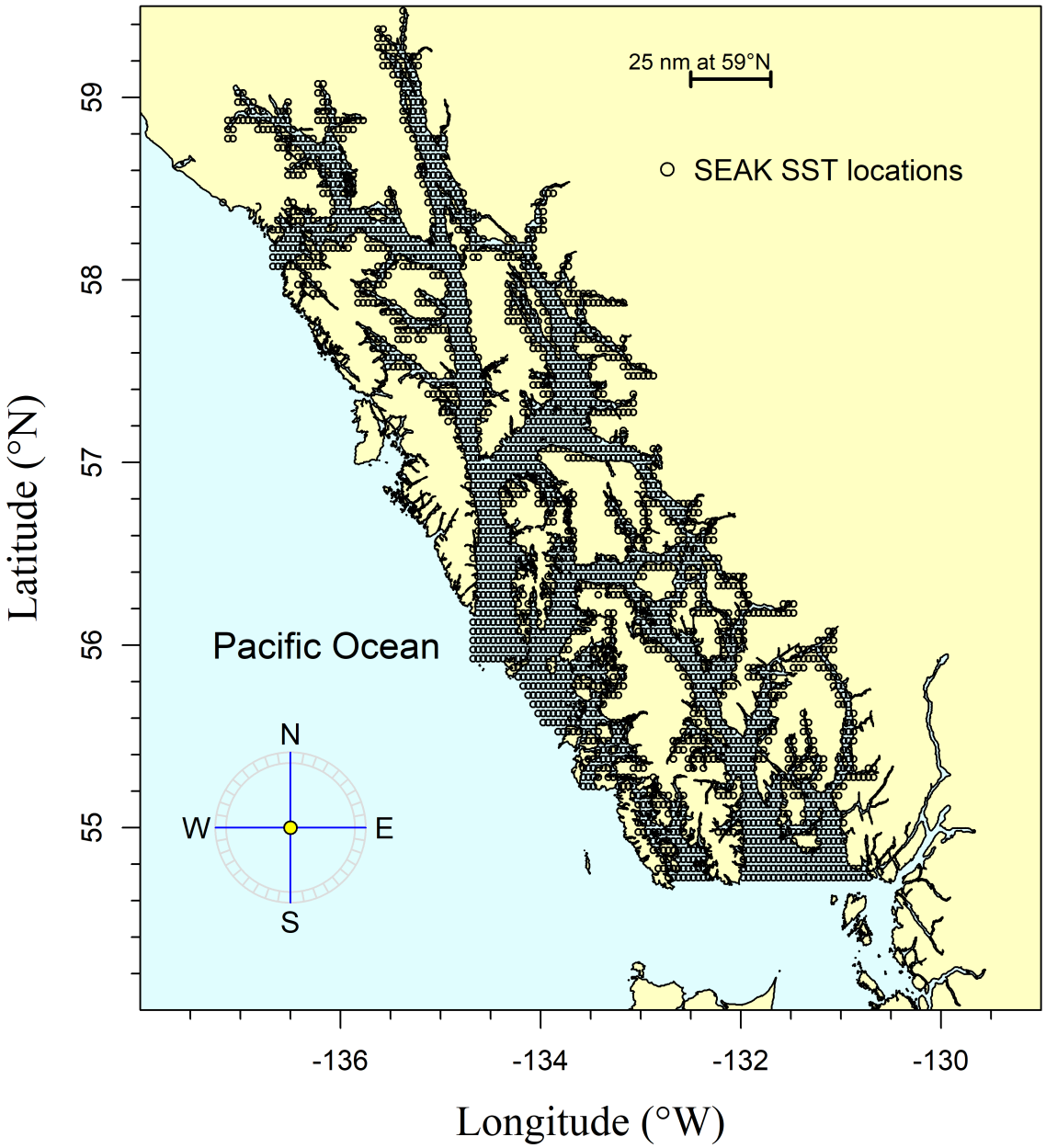

Figure 4: The Southeast Alaska (SEAK) region encompasses Southeast Alaska from 59.475 to 54.725 degrees north latitude and from -137.175 to -130.675 degrees west longitude. The black circles are the satellite stations (i.e., data points).

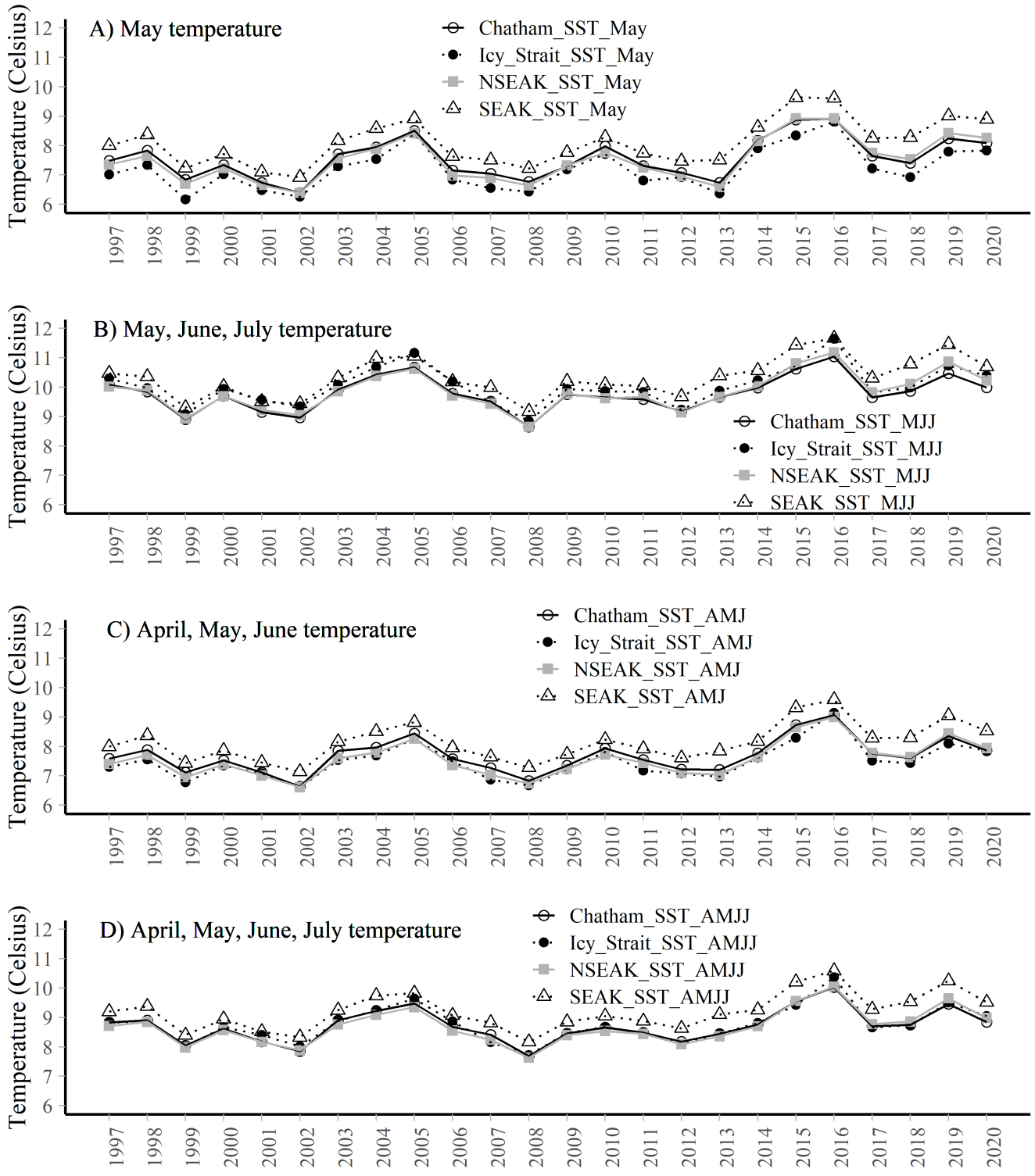

Figure 5: A. The May temperature averaged over each region (Chatham and Icy Straits, Icy Strait, NSEAK, SEAK) from 1997 through 2020. B. The May, June, and July temperature averaged over each region (Chatham and Icy Straits, Icy Strait, NSEAK, SEAK) from 1997 through 2020. C. The April through June temperature averaged over each region (Chatham and Icy Straits, Icy Strait, NSEAK, SEAK) from 1997 through 2020. D. The April through July temperature averaged over each region (Chatham and Icy Straits, Icy Strait, NSEAK, SEAK) from 1997 through 2020.

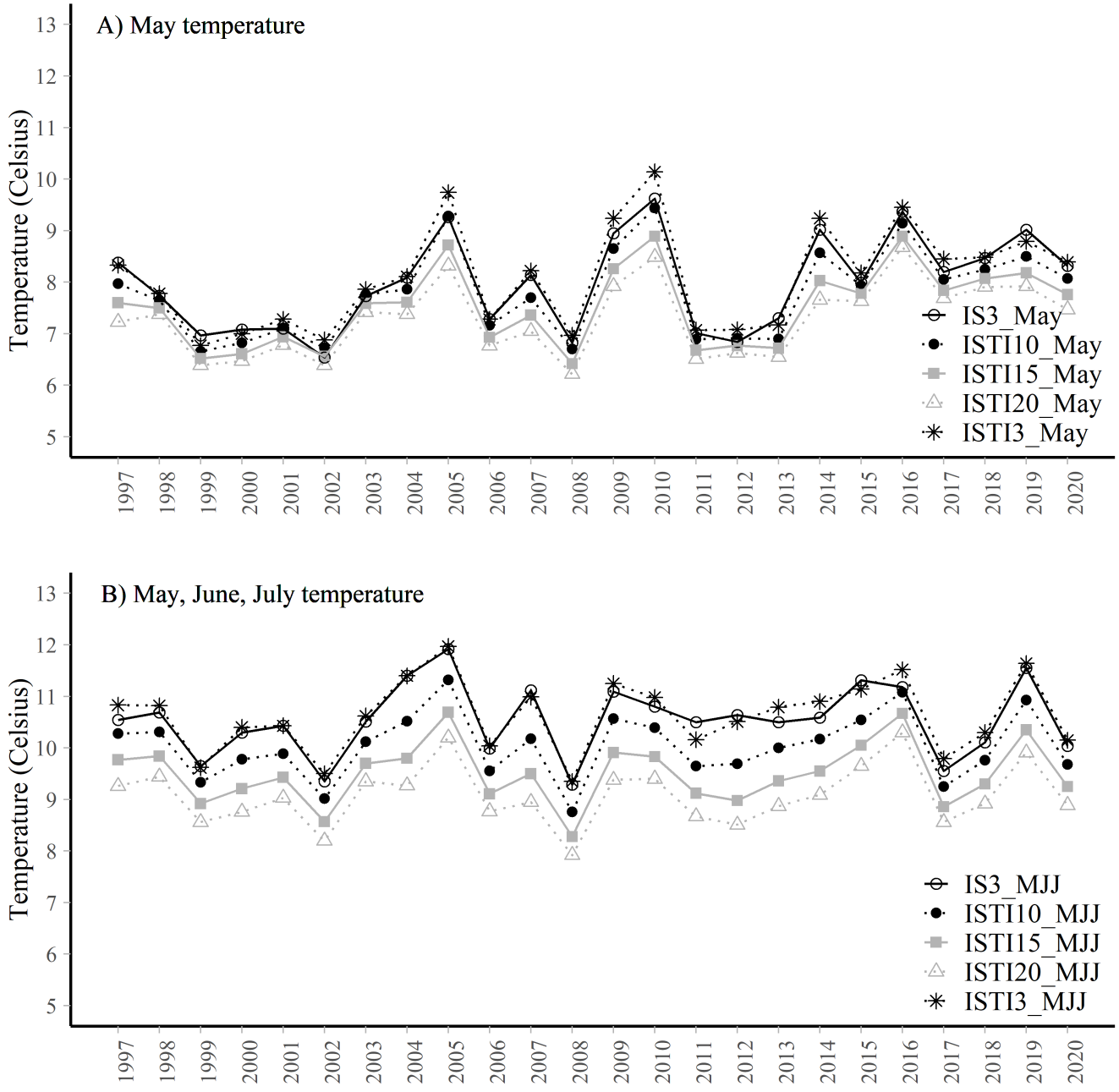

Figure 6: A. Average temperature (degrees Celsius) at 3m and in the upper 10m, 15m, or 20m during May at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; ISTI) or at 4 stations (Icy Strait transect only; IS3) from 1997 through 2020. B. Average temperature at 3m, and in the upper 10m, 15m, or 20m during May through July at 8 stations in Icy Strait (Icy Strait and Upper Chatham transects; ISTI) or at 4 stations (Icy Strait transect only; IS3) from 1997 through 2020.

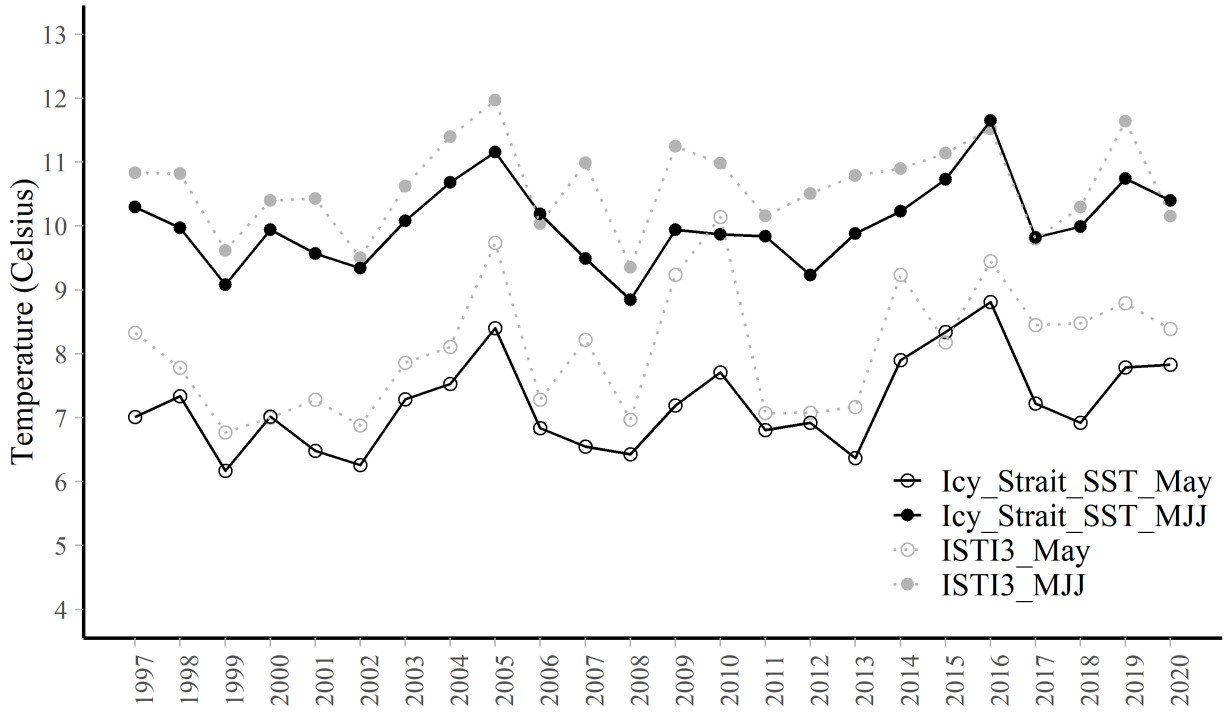

Figure 7: Average temperature data (degrees Celsius) from 1997 through 2020 for the month of May (May) and averaged over the months of May, June, and July (MJJ) for the Icy Strait region compared to the SECM survey region. The variable 'ISTI3 May' is the May Icy Strait Temperature Index (average temperature at 3m in the Icy Strait and Upper Chatham stations). The variable 'ISTI3 MJJ' is the average May, June, and July Icy Strait Temperature Index (average temperature at 3m in the Icy Strait and Upper Chatham stations). The variable 'Icy Strait SST May' is the satellite sea surface temperature data averaged over the entire Icy Strait region for the month of May. The variable 'Icy Strait SST MJJ' is the satellite sea surface temperature averaged over the entire Icy Strait region for the months of May, June, and July.

Piston, A. W., J. Murphy, J. Moss, W. Strasburger, S. C. Heinl, E. Fergusson, S. Miller, A. Gray, and C. Waters. 2021. Operational Plan: Southeast coastal monitoring, 2021. Alaska Department of Fish and Game, Regional Operational Plan No. ROP.CF.1J.2021.02, Douglas.

```
## R version 4.0.3 (2020-10-10)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 17763)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.1252
## [2] LC_CTYPE=English_United States.1252
## [3] LC_MONETARY=English_United States.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United States.1252
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] kableExtra_1.3.4   lubridate_1.7.10   yardstick_0.0.8    workflowsets_0.0.2
##  [5] workflows_0.2.2    tune_0.1.5         rsample_0.1.0      recipes_0.1.16
##  [9] parsnip_0.1.5      modeldata_0.1.0    infer_0.5.4        dials_0.0.9
## [13] scales_1.1.1       broom_0.7.6        tidymodels_0.1.3   gridExtra_2.3
## [17] knitr_1.33         forcats_0.5.1      stringr_1.4.0      dplyr_1.0.6
## [21] purrr_0.3.4        readr_1.4.0        tidyr_1.1.3        tibble_3.1.2
## [25] ggplot2_3.3.3      tidyverse_1.3.1    fs_1.5.0           here_1.0.1
##
## loaded via a namespace (and not attached):
##  [1] colorspace_2.0-1   ellipsis_0.3.2     class_7.3-19       rprojroot_2.0.2
##  [5] rstudioapi_0.13    listenv_0.8.0      furrr_0.2.2        prodlim_2019.11.13
##  [9] fansi_0.5.0        xml2_1.3.2         codetools_0.2-18   splines_4.0.3
## [13] jsonlite_1.7.2     pROC_1.17.0.1      dbplyr_2.1.1       png_0.1-7
## [17] compiler_4.0.3     httr_1.4.2         backports_1.2.1    assertthat_0.2.1
## [21] Matrix_1.3-3       cli_2.5.0          htmltools_0.5.1.1  tools_4.0.3
## [25] gtable_0.3.0       glue_1.4.2         Rcpp_1.0.6         cellranger_1.1.0
## [29] DiceDesign_1.9     vctrs_0.3.8        svglite_2.0.0      iterators_1.0.13
## [33] timeDate_3043.102  gower_0.2.2        xfun_0.23          globals_0.14.0
## [37] rvest_1.0.0        lifecycle_1.0.0    future_1.21.0      MASS_7.3-54
## [41] ipred_0.9-11       hms_1.1.0          parallel_4.0.3     yaml_2.2.1
## [45] rpart_4.1-15       stringi_1.6.2      highr_0.9          foreach_1.5.1
## [49] lhs_1.1.1          lava_1.6.9         rlang_0.4.11       pkgconfig_2.0.3
## [53] systemfonts_1.0.2  evaluate_0.14      lattice_0.20-44    tidyselect_1.1.1
## [57] parallelly_1.25.0  plyr_1.8.6         magrittr_2.0.1     bookdown_0.22
## [61] R6_2.5.0           generics_0.1.0     DBI_1.1.1          pillar_1.6.1
## [65] haven_2.4.1        withr_2.4.2        survival_3.2-11    nnet_7.3-16
## [69] modelr_0.1.8       crayon_1.4.1       utf8_1.2.1         rmarkdown_2.8
## [73] grid_4.0.3         readxl_1.3.1       reprex_2.0.0       digest_0.6.27
## [77] webshot_0.5.2      munsell_0.5.0      GPfit_1.0-8        viridisLite_0.4.0
```