

**Seward Line CRUISE PLAN**  
**April 18 - May 5, 2018**

**Funding Source:** NSF, NPRB, EVOS, AOOS, UAF

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7 Lillian Tuttle	Zooplankton (days), UHawaii
8 Suzanne Strom	Phytoplankton/Microzoop, WWU
9 Kerri Fredrickson	Phytoplankton/Microzoop, WWU
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11 Hana Busse	Phytoplankton/Microzoop, WWU
12 Ana Aguilar-Islas	Chemistry (Nutrients, Iron), UAF
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18 Daniel Cushing	Seabirds/Mammals, FWS
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20 Michele Hoffman-Trotter	Media/Outreach
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22 Katherine Brennan	Media/Outreach
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**Scientific Purpose:**

This cruise represents a continuation sampling begun in fall 1997 under the NSF/NOAA NE Pacific GLOBEC program, and subsequently a consortium of the North Pacific Research Board (NPRB), the Alaska Ocean Observing System (AOOS), and the Exxon Valdez Oil Spill Trustee Council's (EVOSTC) Gulf Watch. This is the first cruise as part of the NSF's Northern Gulf of Alaska Long-term Ecological Program (NGA-LTER) and the recent a consortium adding AOOS and EVOS. The scientific purpose of the core Seward Line project is to develop an understanding of the response and resiliency of this marine ecosystem to climate variability. This cruise marks the 21<sup>st</sup> consecutive spring cruise for the Seward Line in the NGA, including Prince William Sound (PWS), and the 48<sup>th</sup> year of observations at GAK1.

## Cruise Objectives

1. Determine thermohaline, velocity, light, and oxygen structure of the NGA shelf.
2. Determine macro- and micro-nutrient structure of the NGA shelf.
3. Determine particle structure and flux rates of the NGA shelf.
4. Determine phyto- and microzooplankton composition, biomass distribution, and productivity.
5. Determine the vertical and horizontal distribution and abundance of zooplankton species (including macro-jellies).
6. Record multi-frequency acoustics for estimation of nekton
7. Conduct surveys of seabirds and Marine Mammals
8. Conduct shipboard experimental work on phyto- and zooplankton.
9. Determine carbonate chemistry (i.e. Ocean Acidification) at selected stations
10. Recover and redeploy the GAK1 mooring. Drag for lost mooring at GAK 4 and Gak8i.
- 11. Provide at-sea experience for students within the UAF system**
- 12. Share the experience through outreach/media activities.**

## SAMPLING

The overall approach of the cruise is to occupy 4 transect lines across the shelf and a circuit within PWS. Operations are generally divided into distinct day and night tasks, thus requiring each station to be occupied twice. This structure avoids each discipline needing to supply 2 shifts of scientists and ensures all organisms – especially larger diel-migrating zooplankton – are captured with minimal time-of-day bias. During each morning we will typically occupy a selected “intensive” station that involves a greater number and range of collections than other stations occupied that day. Stations profiles are supplemented by underway measurements.

### **DAYTIME ACTIVITIES:**

1. Occupy the various hydrographic stations and collect vertical CTD-fluorescence-PAR and particle profiles (see **Figures & Tables**).
2. Collect discrete bottle samples at these stations for nutrients, chlorophyll and microzooplankton. Chlorophyll Size Fractionation (20  $\mu$ m) will be done at all whole numbered Seward Line and most other stations. Macronutrients samples will be prefiltered prior to freezing. Chlorophyll will be extracted on fresh filters without freezing.
3. Measure the dissolved carbonate chemistry along the Seward Line and within Prince William Sound from bottle casts at selected intensive stations (GAK1, GAK5, GAK9, GAK13, PWS2).
4. CalVet Net casts will be done (CalVet frame has 4 nets) after most the CTD casts to 100m. (NO CALVETs at the “i” stations).
5. At intensive stations an additional CTD cast will collect water to be used for primary production incubations and carbonate chemistry
6. At intensive stations at trace-metal free CTD cast will collect water for determination of iron concentration (a key micronutrient in NGA).
7. We will deploy a tow-body for sampling near-surface iron during the day (and on long transits). Sampling will occur just prior arriving to or just after departure. (It is hoped that

this “fish” can simply be left in the water while on station rather than constantly retrieved and deployed). It is hoped this will not impact transit speed.

8. At intensive stations there will be an extra Calvet collection, as well as a vertical deployment of the 150  $\mu$ m Multinet to 200m. Some of this material will be used for live sorting as well as post-cruise molecular analysis.
9. We will do one deep Multinet tow (to maximum 1000 m) near the end of the Seward Line and two at PWS2 (800m). This may be done at night in conjunction with Multinet work at those stations if time permits.
10. The mooring at GAK1 will be recovered and redeployed deployed at the start of the cruise (or end of the cruise is weather in unfavorable). A mooring was last lost at GAK4 in 2017 and at ~GAK8i in 2016 – weather and time permitting, we will drag for these instruments when sampling in their vicinity. Pete Shipton will be on board for GAK1 mooring activities and transferred to a water taxi once completed.
11. We will identify opportunities for concurrently towing the Acrobat, a towed undulating vehicle, and the iron fish. Priority regions for tows are in the vicinity of the Cooper River discharge plume, along the Seward Line, and over Albatross Bank.

#### **NIGHTTIME ACTIVITIES:**

1. A towed 505- $\mu$ m Multinet will be used to collect depth-stratified samples along the Seward Line, and at selected PWS Stations to 200m. Tandem Bongo nets will be used at all other stations to 200m. At intensive stations along the Seward Line and in PWS an additional collection will be taken with a Bongo net. When leaving intensive stations, a Methot Trawl will be deployed by crane for ~20 minutes while in route to the next station.
2. Deep-multinet tows may occur during the night shift as time permits.

#### **Sampling Strategy**

In general, we estimate 2 days to complete the Kodiak Line, 1.25 days for Cape Suckling, 2 days for Middleton Island Line, 2.25 days for PWS and 4 days for the Seward Line. It is important that all Multinet collections (with the exception of those to 600m) be completed during darkness to allow comparison to prior years. We anticipate that 4-5 Multinet collections can be conducted per night: sampling starts just after dusk and stops just before dawn, and can be extended slightly when overcast. In May, there is a greater period of light available than of darkness, so execution of daytime stations and activities are designed around being in position to commence Multinet sampling as soon as it is sufficiently dark.

#### **Sampling personnel requirements (and times):**

**CTD:** winch operator, 1-2 scientists (launch and recovery), 30m/min in upper 100m, 60m/min below 100m. Depending on schedule, casts may be limited to 1000m at deep-sea stations.

**TMC CTD:** winch operator, 2 scientists (launch and recovery), 30m/min in upper 100m, 60m/min below 100m. Casts are limited to 1000m at deep-sea stations.

**TMC towfish:** 1 Deck person and 1 scientist for launch and recovery (~15-20 min), A deck person (or martec) to watch towfish during towing and communicate with the bridge/science.

**Acrobat:** A-frame & winch operator, 2 scientists for launch & recovery. 1-2 scientists to communicate with bridge during towing operations. Ship speed 6-8 kts through water.

**Multinet or Bongo:** winch operator, 2-3 scientists (launch, recovery, wash-down, re-cock) – Ship speed: 2 knots, Wire speed: ~1 m/sec down, 0.5-1m/sec up (typically 30-40min per deployment). Stern A-frame deployment. Maximum depth on tows 200m. Both systems will

have depth transducers to ensure we get close to, but not on the bottom when depths are less than 200m.

**Calvets & Ring nets:** winch operator, 1-2 scientists (launch, recovery, wash-down) – Ship speed: station keeping, Wire speed: ~1 m/sec for Calvet, 0.5m/sec for Ring net (10 min/cast).

**Methot Trawl:** winch operator, 1-2 scientists, launch, recovery, wash-down) – Ship speed: ~4 Wire speed: ~1 m/sec for up and down tow-yo to 20m for 20 minutes.

#### **Ship's Science Equipment Needed:**

- CTD (science team will supply deep-SUNA, UVP and LISST for integration)
- Science Freezer for chlorophyll extraction
- -80 freezer for macro-nutrient and genetic samples
- Walk-in incubator set at surface ambient temperature.
- 150 and 75 KHz acoustic Doppler current profilers
- EK60 fisheries acoustics
- Underway sampling system (TSG, nav, met, etc)
- Access to uncontaminated seawater system
- Refrigerator for chemical and preserved sample storage
- Fume hood for filtration of preserved samples

#### **Scientist's Equipment Needed:**

- Trace-metal clean CTD system, block, winch and line (Baltic room storage).
- Trace-metal clean towfish system (access to compress air) (Deck storage 3 palettes)
- Wall-mounted racks for keeping TMC niskins during subsampling
- Positive pressure enclosure(s) near sinks
- ISUS unit attached to flow-through system water
- 300 KHz Teledyne RDI Workhorse ADCP mounted in centerboard (if all protocol for triggering from Ksync is worked out and if all wiring and mounting parts are available)
- CalVet and ring nets [nets, flow-meters, frames, swivels, weights, spares]
- 2 Multinet system (coarse and fine nets, spare cod ends/nets)
- Bongo nets
- Deckboard incubators (4) connected to ship's seawater system
- Filtration systems
- Fluorometers & Centrifuge
- Laptop computers
- 16 cases (24/cs) of 16-oz zooplankton sample bottles
- 5 cases (12/cs) of 32-oz zooplankton sample bottles
- Several coolers with nutrient and TMC bottles
- Microscopes and supplies for handling and incubation of copepods
- Incubators: 4 cu ft. required near work area
- Refrigerated Circulators
- Milk Chocolate

#### **Hazmat: (tentative)**

Formaldehyde – 2x20L carboy  
Rose Bengal Stain 50g  
Ethanol – 40L.

Acetone – 16L  
Lugol's solution (1L)  
Oxygen Fixation (Sodium hydroxide. Sulphuric acid, Manganous Chloride)  
Mercuric Chloride (for DIC fixation)  
3N HCl (25% v/v) (500 ml)  
Glutaraldehyde (10%) – 500 ml  
DAPI stain solution – 100 ml  
Liquid N<sub>2</sub> – one 30-L dewar

### **CRUISE ACTIVITY SCHEDULE**

- 4/15 Advance Science party leaves Fairbanks by air and arrives in Seward mid-day, overnight Breeze Inn.
- 4/16 Main science party leaves Fairbanks ~9am, picks up in Anchorage (~4-5pm), arrives Seward ~7pm, overnights Breeze Inn
- 4/17 Science party boards Sikuliaq ~8am, sets up, science party sleeps on board
- 4/18 Sikuliaq sails ~8am, first station is 1 hr transit from dock
- 5/5 Sikuliaq return to Seward by 4pm – some light demobilization & libations – van takes media team to ANC for midnight flights (driver may overnight in ANC)
- 5/6 Complete demobilization – van leaves for ANC mid/late afternoon – arrive Fairbanks after midnight
- 5/7 Any stragglers take bus to ANC (departure 9am)

### **Hotel (Breeze Inn)**

- 4/15-17 – Lenz/Tuttle  
Danielson/Statscewich  
Hoffman-Trotter/Belt  
Brennan/Pretty
- 4/16-17 – Hopcroft  
Strom  
Aguilar-Islas  
Kaufman/Fredrickson  
Bolt/Busse  
Maisch/Clayton  
Schuler/Smoot  
Coyle/Klejka  
Cushing/Burke?

**Table 1. STANDARD STATIONS** (intensive stations highlighted)

Latitude N (degrees, minutes)		Longitude W (degrees, minutes)		Station Name
Resurrection Bay Station				
60	1.5	149	21.5	RES2.5
Seward Line				
59	50.7	149	28	GAK1
59	46	149	23.8	GAK1I
59	41.5	149	19.6	GAK2
59	37.6	149	15.5	GAK2I
59	33.2	149	11.3	GAK3
59	28.9	149	7.1	GAK3I
59	24.5	149	2.9	GAK4
59	20.1	148	58.7	GAK4I
59	15.7	148	54.5	GAK5
59	11.4	148	50.3	GAK5I
59	7	148	46.2	GAK6
59	2.7	148	42	GAK6I
58	58.3	148	37.8	GAK7
58	52.9	148	33.6	GAK7I
58	48.5	148	29.4	GAK8
58	44.6	148	25.2	GAK8I
58	40.8	148	21	GAK9
58	36.7	148	16.7	GAK9I
58	32.5	148	12.7	GAK10
58	23.3	148	4.3	GAK11
58	14.6	147	56	GAK12
58	5.9	147	47.6	GAK13
57	56.6	147	39	GAK14
57	47.5	147	30	GAK15
Prince William Sound Stations				
60	7.5	147	50	KIP0
60	16.7	147	59.2	KIP2
60	22.78	147	56.17	PWS1
60	32.1	147	48.2	PWS2
60	40	147	40	PWS3
60	49.25	147	24	PWSA
60	45	147	14	PWSB
60	38.1	147	10	PWSC
60	31.5	147	7.6	PWSD
60	24.3	147	58.3	PWSE
60	24	146	45	PWSF

<b>Columbia Glacier</b>				
61	7.4	147	3.8	CG0
60	59.5	147	4.2	CG1
60	57.6	147	5.9	CG2
<b>Icy Bay</b>				
60	16.3	148	21.7	IB0
60	15.5	148	20.1	IB1
60	16.3	148	14	IB2
<b>Hogan Bay Line</b>				
60	11.57	147	42	HB1
60	10.754	147	38.5	HB2
60	9.855	147	34.508	HB3
60	8.807	147	30.04	HB4
<b>Montague Strait Line</b>				
59	57.257	147	55.602	MS1
59	56.6	147	53.7	MS2
59	55.9	147	51.4	MS3
59	55.2	147	49.7	MS4

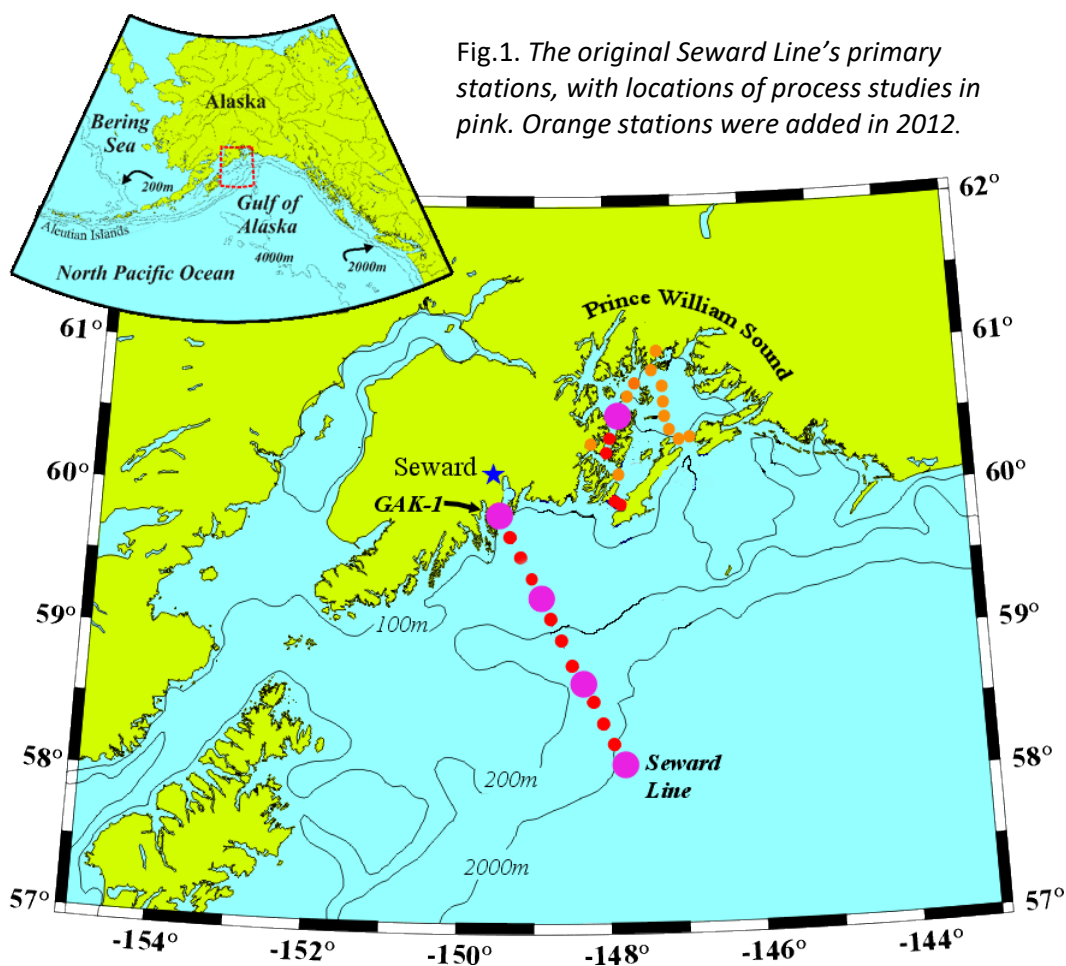


Fig.1. The original Seward Line's primary stations, with locations of process studies in pink. Orange stations were added in 2012.

**Table 2. New LTER Stations** (intensive stations highlighted)

Latitude N (degrees, minutes)		Longitude W (degrees, minutes)		Station Name
Kodiak Line				
58	14.7	151	35.4	KOD1
58	7.8	151	23.07	KOD2
58	0.9	151	10.74	KOD3
57	54	150	58.17	KOD4
57	47.1	150	45.6	KOD5
57	40.26	150	32.97	KOD6
57	33.42	150	20.34	KOD7
57	26.37	150	7.95	KOD8
57	19.32	149	55.56	KOD9
57	12.27	149	43.17	KOD10
Cape Suckling Line				
59	56.35	143	53.5	CS1
59	53.85	143	53.5	CS1e
59	51.35	143	53.5	CS1i
59	48.85	143	53.5	CS1n
59	46.35	143	53.5	CS2
59	41.35	143	53.5	CS2i
59	36.35	143	53.5	CS3
59	31.35	143	53.5	CS3.5
59	26.35	143	53.5	CS4
59	16.35	143	53.5	CS5
Middleton Island Line				
60	15	145	30	MID1
60	10.5	145	34.5	MID1i
60	6	145	39	MID2
60	1.5	145	43.5	MID2i
59	57	145	48	MID3
59	52.5	145	52.5	MID3i
59	48	145	57	MID4
59	43.5	146	1.5	MID4i
59	39	146	6	MID5
59	34.5	146	10.5	MID5i
59	30	146	15	MID6
59	23	146	18	MID7
59	18.267	146	15	MID7i
59	13.534	146	12	MID8
59	4.067	146	6	MID9
58	54.6	146	0	MID10



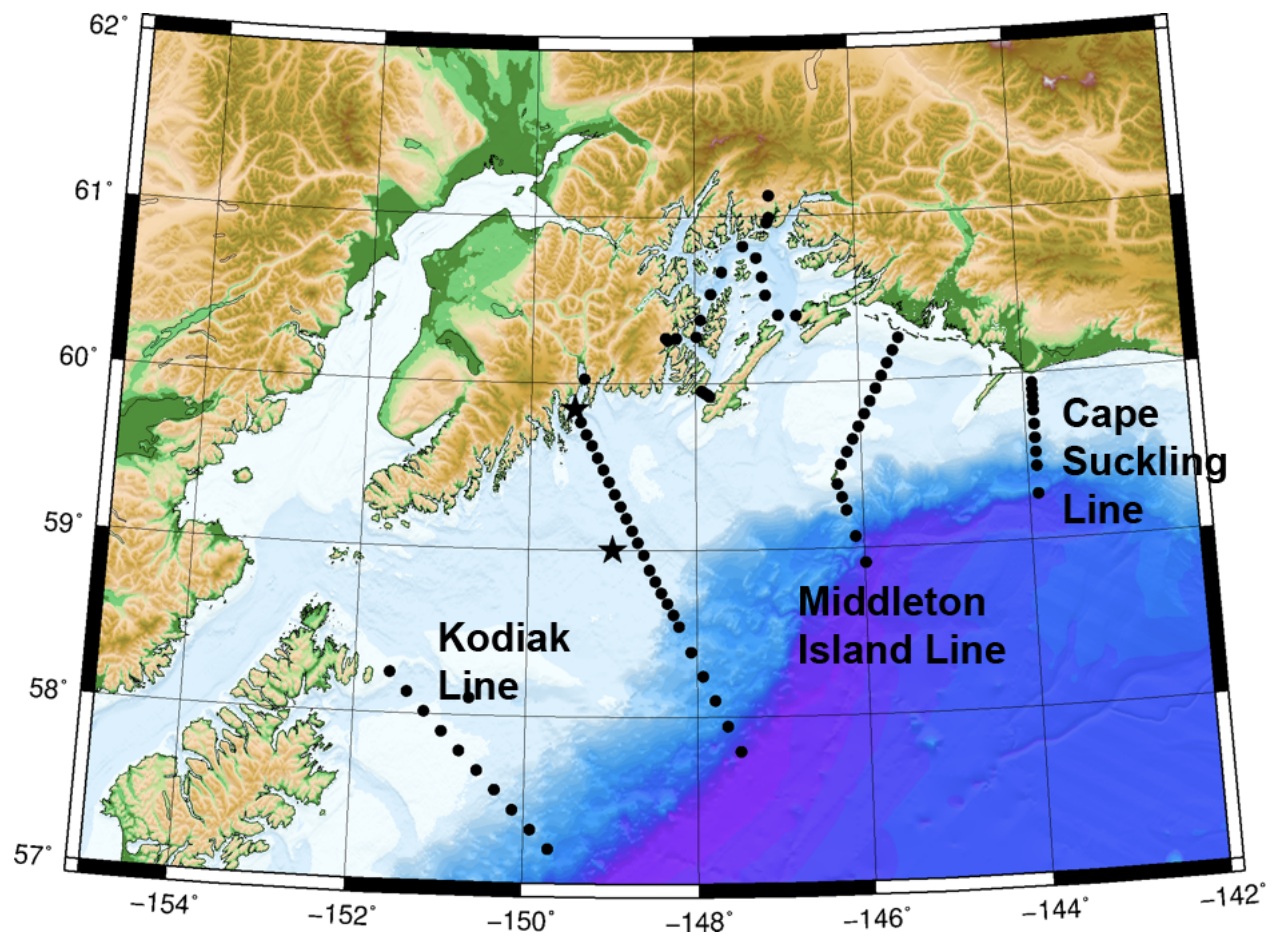


Fig. 2. NGA-LTER sampling stations highlighting 3 new transects line near Kodiak, Middleton Island and Cape Suckling