Crab Research Update

June NPFMC Meeting – 06/05/25

Photo Credits: C. Lescher

- *Research Projects/Progress/Priorities*

BSFRF
Bering Sea Fisheries Research Foundation

Scott Goodman
Executive Director

Crab Plan Team Co-chairs
Mike Litzow (NOAA/AFSC)
Katie Palof (ADF&G)

- Current large scale field projects & related
- Recent summaries, publications, new information
- Synthesis to inform management & what's next

Photo Credits: C. Lescher

These updates are intended to share new information to help inform decisions, but to also note there is a lot of ongoing research

Projects BSFRF is working on:

- CPS surveys (BBRKC, CPSx)
- OPS survey (Opilio, OPS1 and beyond)
- CAMSLED2 – just completed (FV Early Dawn)
- Tags – continuing w/ partners (BBRKC)
- Summaries of May (‘24) Snow Crab Workshop
- Opilio MSE – plans are in works (steering)
- Substantial Disaster Relief Research Planning

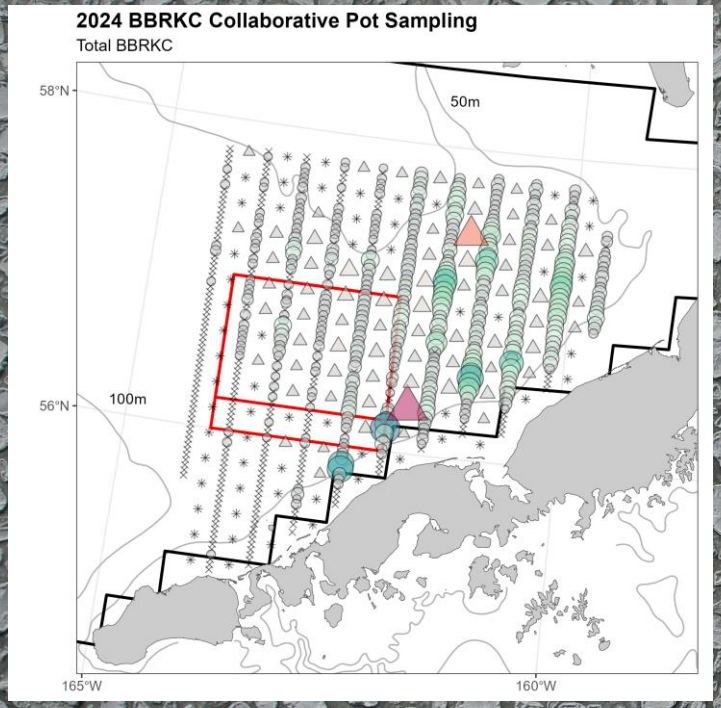
Winter Spring BBRKC surveys -

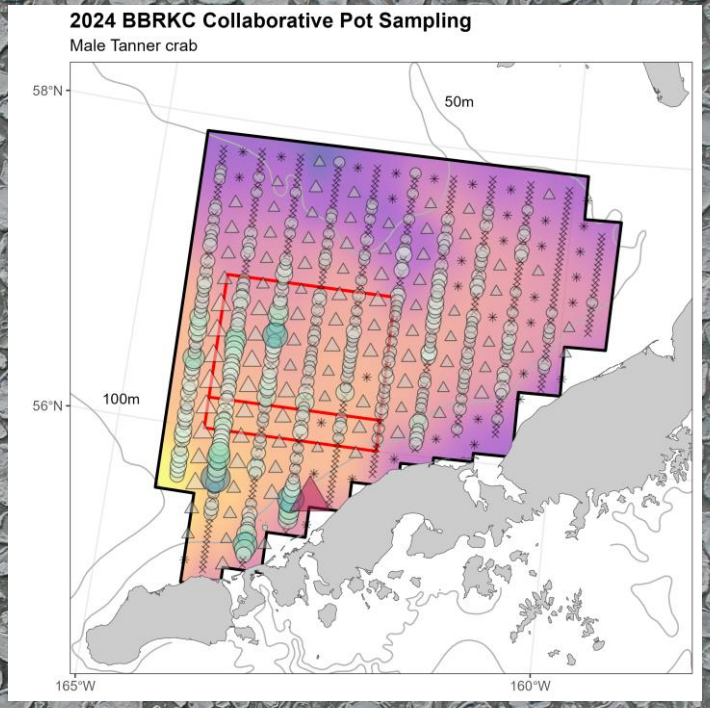
- Postponed this year's CPS3 based on funding uncertainty
- Plans going forward include 3 additional iterations

BBRKC Field Work

Year	Project	Vessels	Cost $m	Source
2023	CPS1	2	1.00	ADFG/NOAA
2024	CPS2	3	1.25	BSFRF CDS
2025				
2026	CPS3	3	1.25	BSFRF DR
2027	CPS4	3	1.25	BSFRF DR
2028	CPS5	3	1.25	BSFRF DR

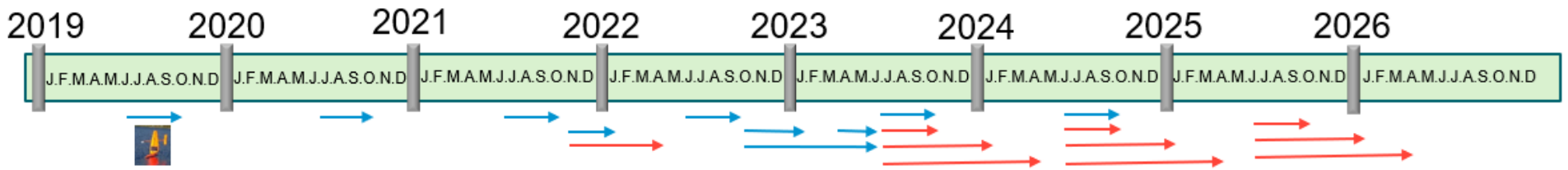
Winter Spring BBRKC surveys -





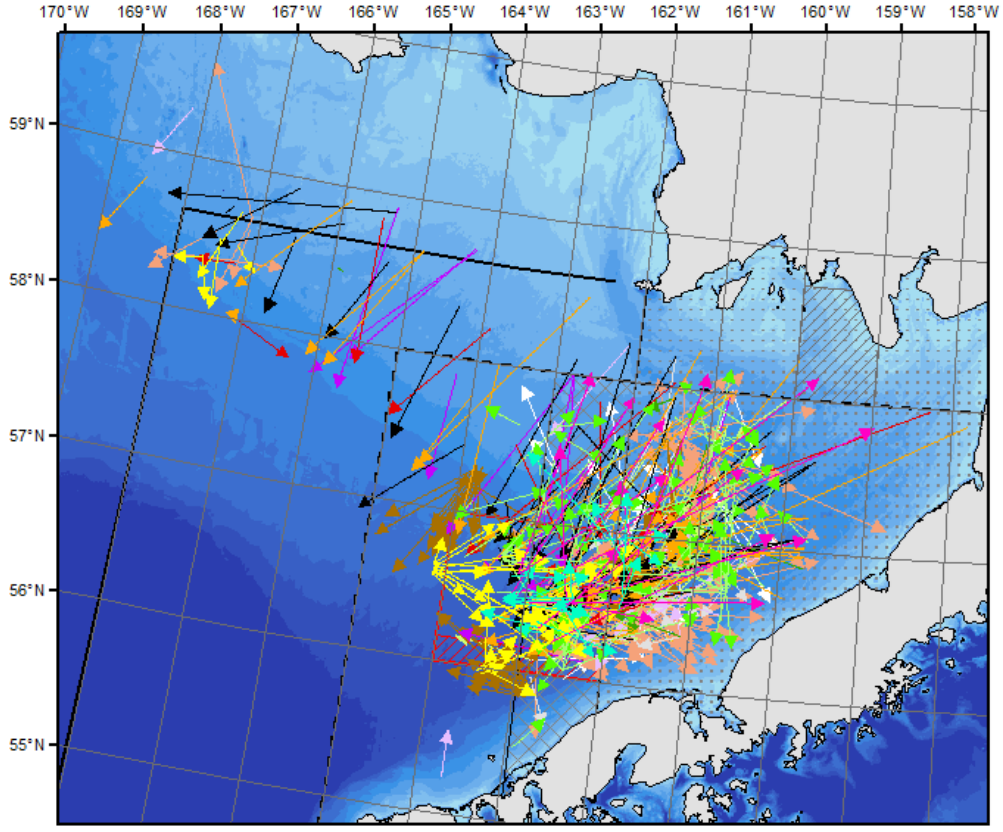
Summary Item	CPS1 - 2023		CPS2 - 2024	
	POT	TRW	POT	TRW
Pot Lifts/Tows	637	0	646	128
RKC Catch	10,191		6,415	496
RKC Sex Ratio (M/F)	77/23	<--->	76/24	44/56
Bairdi Catch	670		1,009	928
Bairdi Sex Ratio (M/F)	83/17	<--->	99/1	68/32

7 Years of RKC Tagging



All BBRKC Satellite Tags

- Jun to Oct 24 M (36)
- Jun to Oct 23 M (37)
- Jun to Oct 22 M (13)
- Jun to Oct 21 M (13)
- Jul to Oct 20 M (79)
- Oct 22 to Jan 23 M (20)
- Oct 22 to Jun 23 M (15)
- Oct 21 Jan 22 M (46)
- Mar/Apr to Jun 23 M (91)
- Oct 21 to Apr/May 22 F (116)
- Jun 23 to Oct 23 F (8)
- Jun 23 to Jan 24 F (15)
- Jun 23 to Apr 24 F (12)
- Jun 24 to Oct 24 F (19)
- Jun 24 to Jan 25 F (33)
- Jun 24 to Apr 25 F (21)



Tag Success

Sex	Time	Released	Recovered	Success
Male	*Jun to Oct 2019 (acoustic)*	*148*	*59*	*40%*
Male	Jul to Oct 2020	84	79	94%
Male	Jun to Oct 2021	15	13	87%
Male	June to Oct 2022	16	13	81%
Male	June to Oct 2023	40	37	93%
Male	June to Oct 2024	49	36	73%
Male	Nov 2021 to Jan 2022	90	46	51%
Male	Oct 2022 to Jan 2023	20	20	100%
Male	Oct 2022 to Jun 2023	20	15	75%
Male	March/April to Jun 2023	100	91	91%
Female	Nov 2021 to April/May 2022	225	116	52%
Female	Jun 2023 to Oct 2023	16	10	63%
Female	Jun 2023 to Jan 2024	25	16	64%
Female	Jun 2023 to Apr 2024	34	14	41%
Female	Jun 2024 to Oct 2024	37	19	51%
Female	Jun 2024 to Jan 2025	59	33	56%
Female	Jun 2024 to Apr 2025	73	21	29%
	Totals for Satellite Tags	**903**	**495**	**64%**

Tagging Summary for Males

Mature Male Movement

June/July to October

- Crab tagged in “core Bristol Bay” (east of ~164 ºW)
  - Consistent movement into deeper waters
  - Movement towards or into the Red King Crab Savings Area (some years further west)
- Crab tagged west of ~ 164 ºW
  - Consistent movement southwest, into deeper waters crossing the 50 m isobath

October/November to January

- Crab west of the Savings Area “turn around” and move back east
- Less consistent movement for crab within Savings Area, but generally crab do not continue to move west (into deeper waters)
- Potential transition period from movement into deeper water, to moving back into shallower waters

October to June

- Consistent movement from Savings Area to shallower waters to the north and east

Female BBRKC movement and distribution - Satellite Tagging

Project 23-09

- June 2023/24 Female BBRKC tagged throughout Bristol Bay
- Tags released the following October, January, and April, giving seasonal locations

October and January

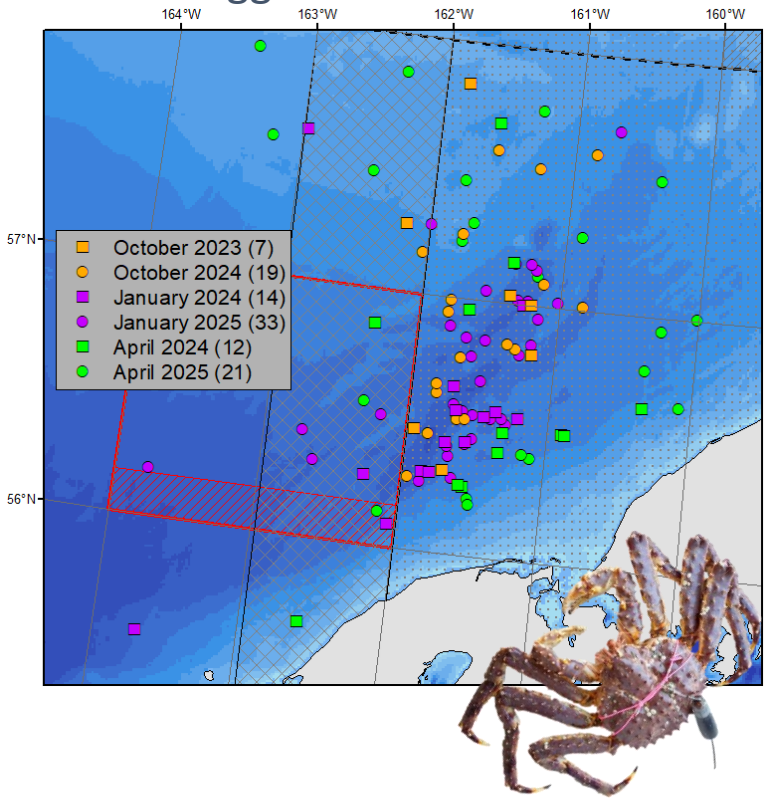
Females primarily in the deeper tongue of water east of the RKC Savings Area, with some further north and west

April

Females were in shallower waters along the AK Peninsula and in northern Bristol Bay

Year 3 of project underway, females are currently being tagged on EBS survey

Fall, winter, and spring locations of tagged female BBRKC

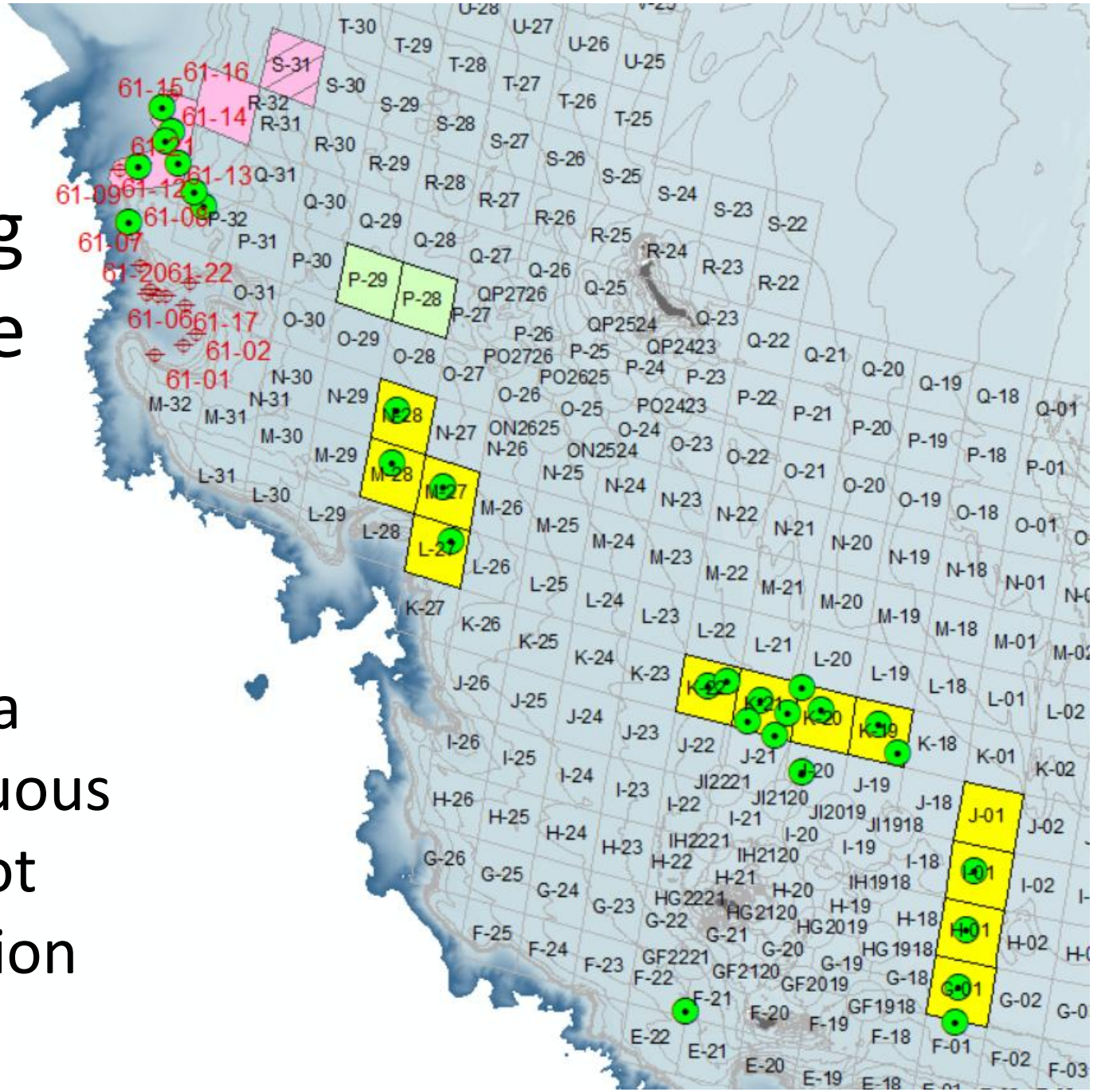


Opilio Pot Sampling 1 (OPS1)

Following the pilot sampling…
…more complete survey
planning underway

Pilot Sampling Coverage

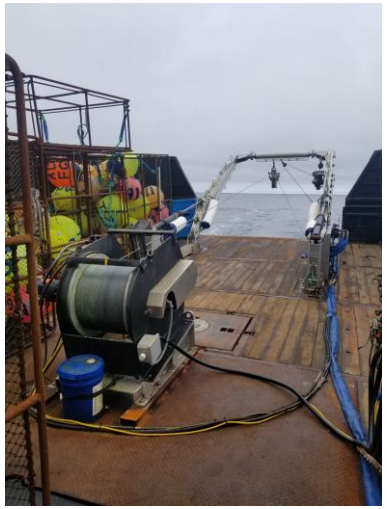
OPS1
will cover a larger, contiguous area but not full distribution



CAMSLED2

- Recently completed FV Early Dawn (BSFRF charter)
- Dr. Weems, Dr. Loher, others onboard sharing
- Generally covering what was done last year
- Expanding time/area to sample across opilio area

More to report soon…



Snow Crab MSE

- Mentioned by the SSC already (crab specs)
- BSFRF supports this, funding w/ collaborators
- Steering committee activity soon…
  BSFRF-ADFG-NOAA-Others
- Intending to be well-integrated with stakeholders
  Industry Ad-hoc Committee
- Follow the strategy used for bairdi MSE (2020)
- Should address biology, and other issues…

More to report soon…

Opilio Workshop

Clawing Their Way Back:
A *Comparative NL-AK Snow Crab Workshop*
Toward Sustainable Management in Uncertain Times

BSFRF Bering Sea Fisheries Research Foundation

Fisheries and Oceans Canada

NOAA

ALASKA Department of Fish and Game

Marine Institute

Memorial University

April 29 – May 1, 2024

Location: Fisheries & Marine Institute of Memorial University of Newfoundland
155 Ridge Rd. | St. John's, NL | A1C 5R3 | Industry Seminar Room

Chair: Gordon Kruse

Co-Chairs: Scott Goodman and Darrell Mullowney

Rapporteur: Raquel Ruiz-Diaz

Summary in Press:
Dr. Gordon Kruse et al.

Manuscript is near Completion…

Related publications and progress with partners…

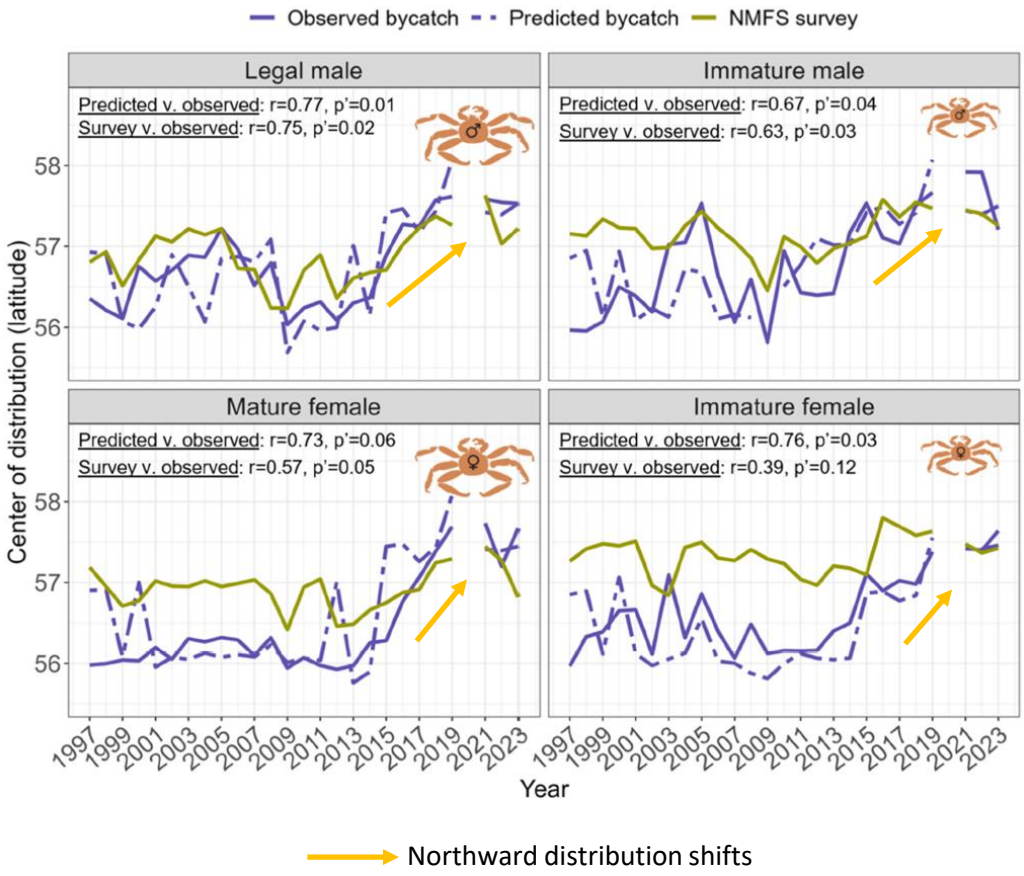
BBRKC bycatch distribution modeling

Goal

- Predict distribution of A80 BBRKC bycatch over 1997-2023, independent of changing fishing behavior

Conclusions

- Bycatch distribution can be predicted with a high level of skill, without accounting for fishing behavior
- BBRKC in NMFS survey and A80 bycatch have shifted north over time
- Provides the Council with new information on changing distribution relative to savings area



Published: Fisheries Research (2024)

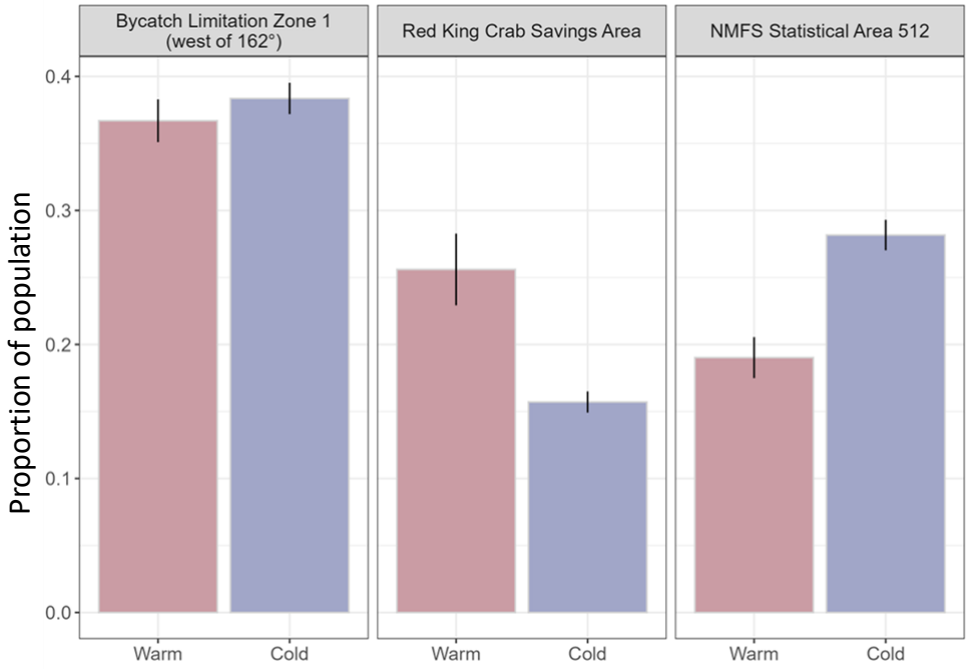
BBRKC directed fishery distribution modeling

Goal

- Predict legal male distribution from directed fishery data 1997-2023

Conclusions

- Bottom temperature drives legal male BBRKC distribution
- Proportion of population in protected areas changes between warm and cold years
- Provides the Council with new information on changing distribution relative to protected areas



Submitted: Progress in Oceanography

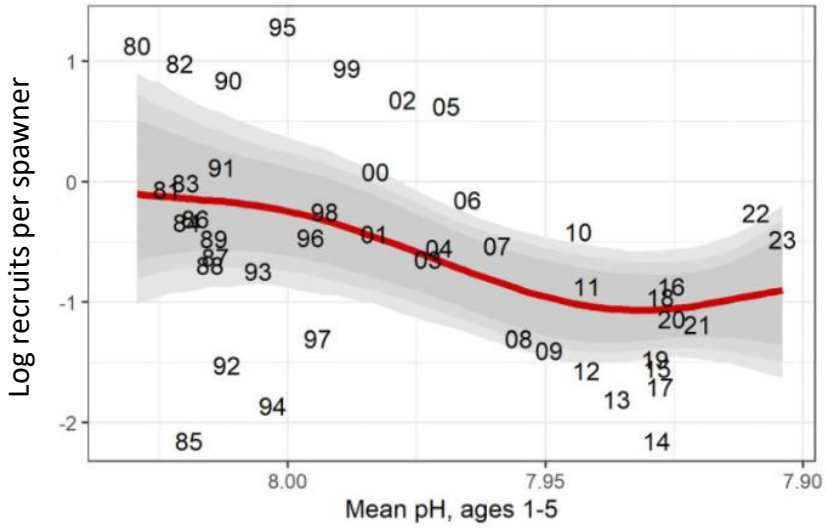
Ocean acidification and BBRKC recruitment

Goal

- Understand possible role of ocean acidification as a driver of declining BBRKC recruitment

Conclusions

- Acidification can explain ~45% of recruitment declines since 2000
- Results supported by lab studies of acidification effects on juvenile BBRKC
- Shows that acidification may *plausibly* (not definitively) play a role in poor recruitment
- Follow-up work in progress
  - pH sampling in Bristol Bay
  - Lab research to understand threshold pH effects on BBRKC



Published: Canadian Journal of Fisheries and Aquatic Sciences (2025)

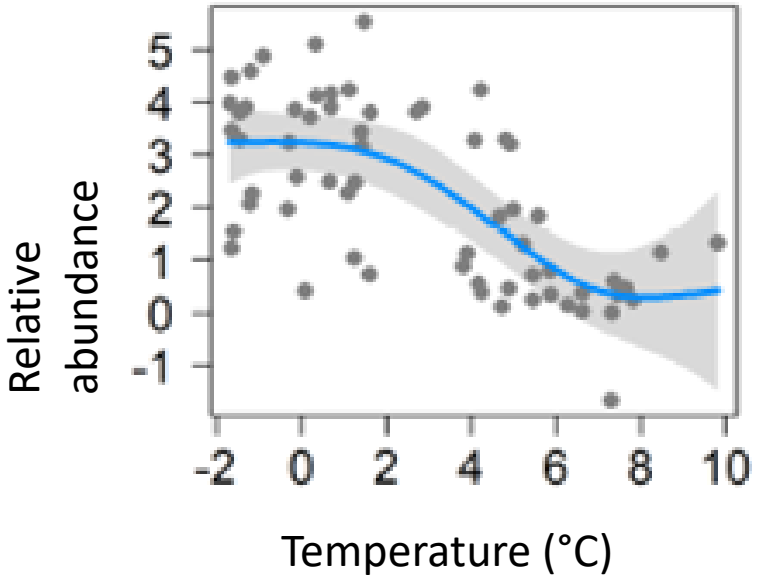
Juvenile snow crab and warming in the Chukchi Sea

Goal

- Understand effects of climate change on juvenile snow crab in the Chukchi

Conclusions

- The smallest size classes (<10mm carapace width) are strongly negatively affected by warming
- Gives insight into potential warming effects on juveniles too small to be sampled by EBS / NBS NMFS survey



In Internal AFSC Review

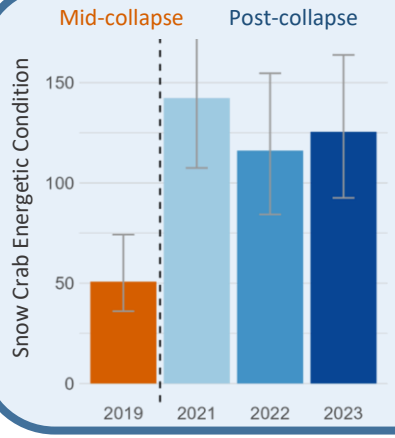
Snow Crab Energetics

METHODS

Juvenile snow crab hepatopancreas sampling on 2019-2024 NOAA bottom trawl surveys

Annual estimates of energetic condition mid and post-collapse

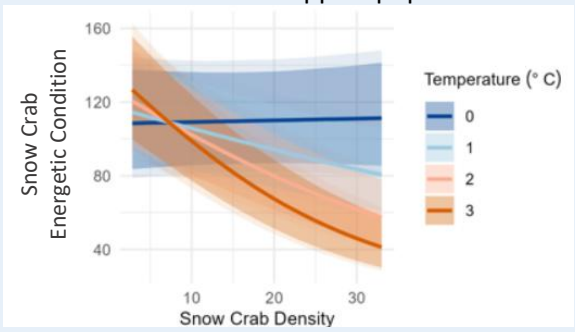
KEY FINDINGS



Snow crab energetic reserves declined below mortality thresholds during the 2018-2019 EBS snow crab collapse

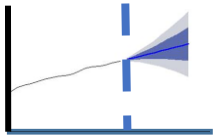
These energetic declines were driven by the absence of ice-associated spring blooms during a marine heatwave

Cold water habitat (≤ 0°C) and sea ice are critical for sustaining high snow crab densities to support population recovery



TACTICAL AND STRATEGIC MANAGEMENT ADVICE

Identifying drivers of mortality, collapse risk, and recovery potential



Forecasting snow crab responses to loss of sea ice

Direct integration of annual energetic condition estimates into ESPs and risk tables to provide early warning of mass mortality events

Fedewa et al., in revision
Copeman et al., in prep

PIs Erin Fedewa and Louise Copeman

Movement-informed projections of BBRKC skillfully predict seasonal distributions

Goal

- Combine NMFS survey data and satellite tagging data to estimate distribution from summer through fall-winter-spring

Conclusion

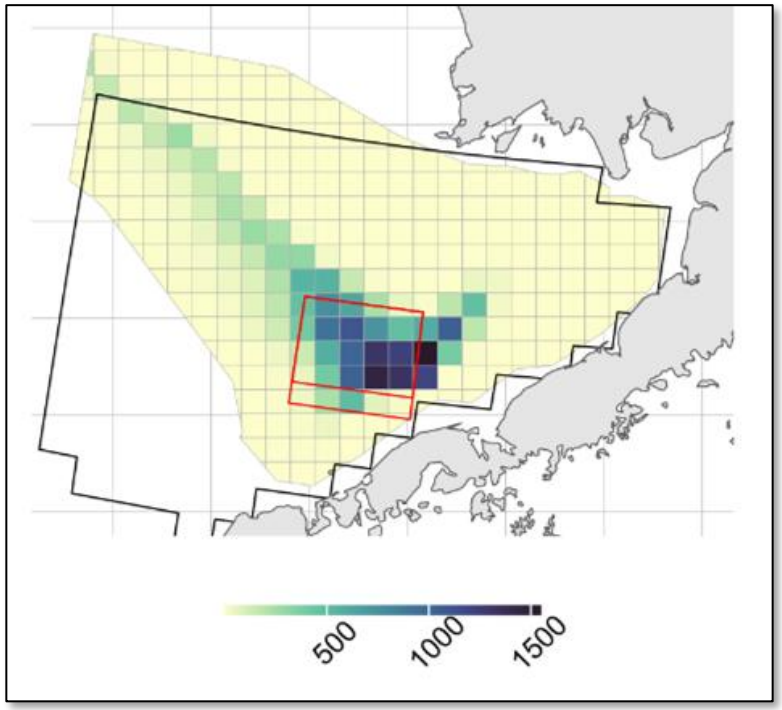
- Northwest shift in stock distribution during warm years
- Additional source of information for evaluating protected areas and overlap with fishing effort

Next step

- Improve understanding of overlap between BBRKC and pollock trawling

Paper in prep

October 2017 density (projected)



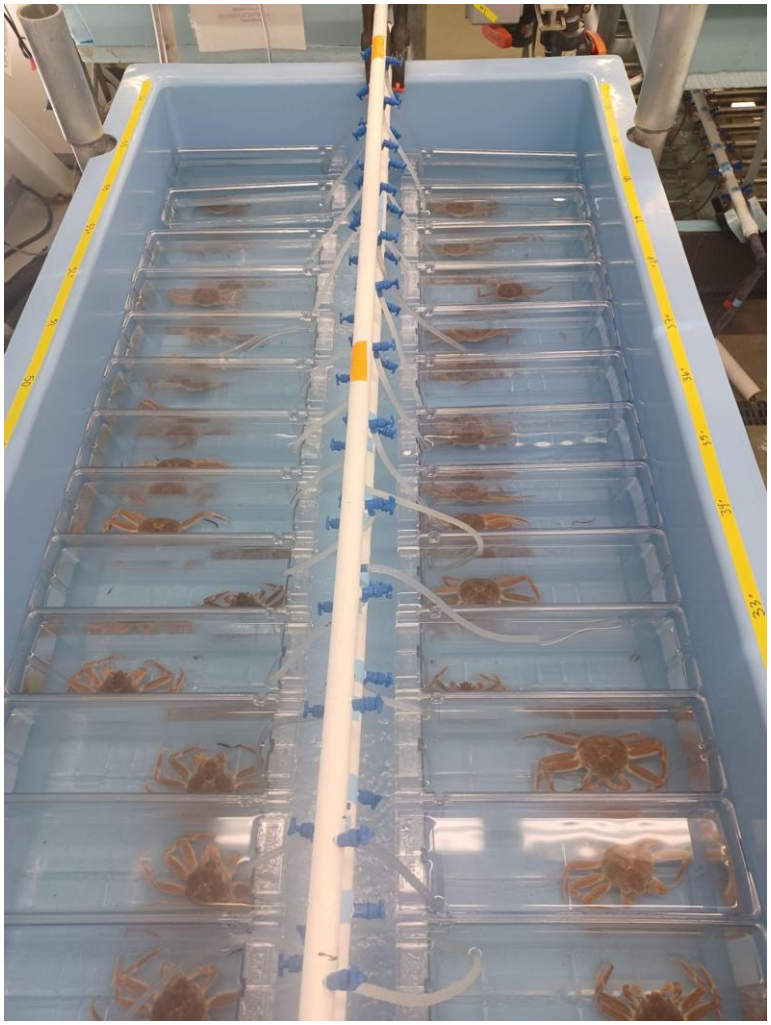
Ocean acidification, ocean warming and snow crab energetics

Goal

- Determine how pH and temperature affect energy allocation to growth and reproduction in snow crab

Management implications

- Will allow parametrization of an energetics model across pH/temperature space
- Can predict productivity and reproductive state for individuals under current or future conditions



In progress

Snow and Tanner Crab Disease Dynamics

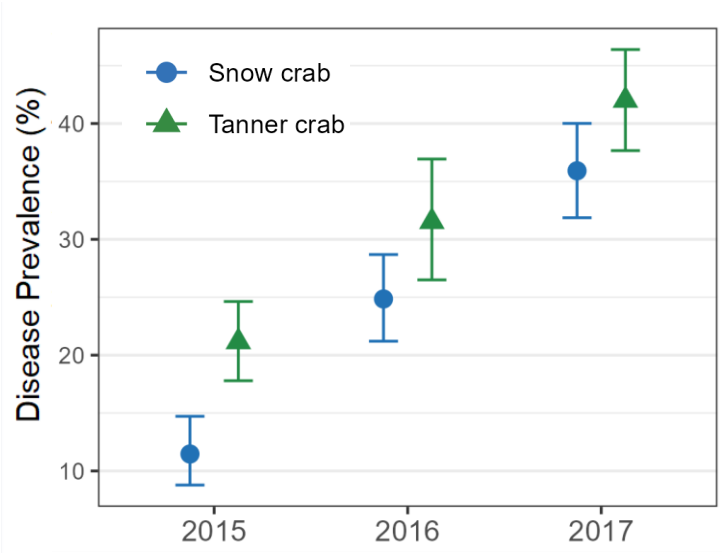
METHODS

Bitter crab disease prevalence monitored in the EBS using blood samples for molecular PCR assays

Published:
Fisheries Research (2025)

KEY FINDINGS

- Bitter crab disease much more common than previously known
  - Up to ~36% of snow crab
  - Up to ~42% of Tanner crab
- Disease monitoring is critical – high disease prevalence and future outbreaks have the potential to drive recruitment dynamics and snow crab recovery potential



Disaster Relief research planning with partners…

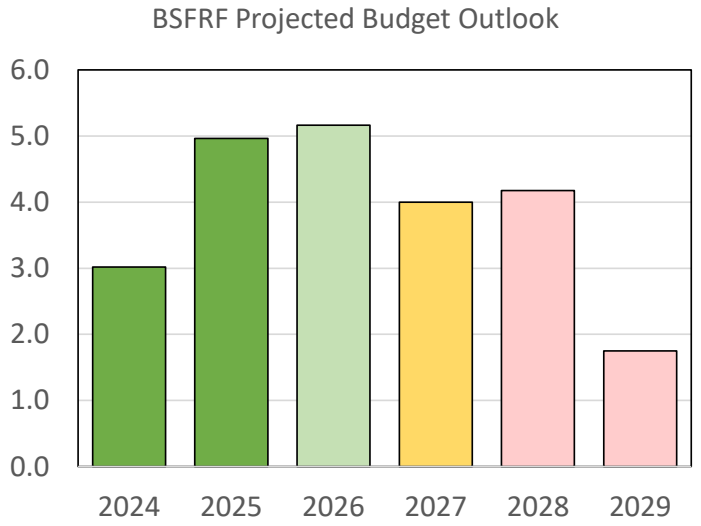
Disaster Relief Research Planning → Bairdi, Opilio and BBRKC

- Bairdi and BSS/BBR funds coming online

(ASAP)

- BSFRF Research Strategy for 2025-2028
  - Several projects/charters for opilio/BBRKC

Year	CPSx	OPSx	CAMSLED	Other
2025				
2026				
2027				
2028				



  - Coordinating w/NPRB, update slides (from C. Siddon)

Disaster Relief Research Planning → Opilio and BBRKC [through NPRB]

No.	Title	PI	Contact	Org	Requested	Funded
5056	CLRUP North- Chionoecetes Left-to-Right and Under Pressure in a changing NBS	Andrew Seitz	acseitz@alaska.edu	UAF	$1,423,255	$1,423,255
5063	Top-to-Bottom assessment of early life snow crab ecology in a melting northern Bering Sea	Jared Weems	jared.weems@alaska.gov	ADFG	$1,384,914	$1,384,914
5065	Understanding the link between Bristol Bay red king crab larval supply and recruitment strength	Ben Daly	ben.daly@alaska.gov	ADFG	$1,011,705	$750,000
5067	Understanding lost crab pot degradation and impacts on the Bristol Bay red king crab stock	Scott Goodman	sgoodman@nrccorp.com	BSFRF	$1,178,960	$1,178,960
5077	Metabolic costs of migration for Bering Sea snow crab in response to rapid regional warming	Trond Kristiansen	trondkr@faralloninstitute.org	Farallon Institute	$708,033	$708,033
5079	Population genomics of Bristol Bay red king crab for fishery management and enhancement	Kristen Gruenthal	kristen.gruenthal@alaska.gov	State of Alaska	550,968	$550,968
Total of Requested and Funded					**$5,706,867**	**$5,996,130**

Disaster Relief Research Planning → Opilio and BBRKC [through NPRB]

Reminders on process for the special crab RFP:

- all proposals went through the typical NPRB process:
- 2-4 anonymous peer reviews (these were mostly international folks)
- NPRB Science Panel review
- NPRB Advisory Panel review
- Final decision made by independent "Board" that consisted of people from:
  - DFO Canada
  - State of Maine
  - ADFG, NPFMC
  - NOAA RO, SSC
  - NEFSC, mid-Atlantic SSC

Top 12 Research Priorities, 2024-2028 – CRAB IN RED

(bullets are not in order, shortened summary text from actual)

- Reduce **western Alaska salmon bycatch** in Bering Sea groundfish fisheries
- Quantify **fishing gear impacts on crab** and their habitat – toward gear innovation
- Evaluate **marine mammal-fishery interactions** and potential mitigation measures
- Examine economic, social, and cultural **effects of fisheries and policy on communities** over time
- Actionable **ecosystem indicators** relevant to assessments that **address climate change impacts** to managed stocks
- Acquire **basic life history information** - emphasize improved estimates of **size/age at maturity** & related dynamics
- Spatial distribution, habitat requirements, and **movement of crabs relative to life history events & fishing**
- Predictive tools & **models that evaluate projected climate scenarios** on managed resources to inform options
- **Retrospective and meta- analysis** on 'efficacy and rationale' of fishery management plans perform over time
- **Norton Sound Red King Crab** case study as a pilot study for the **incorporation of Local Knowledge**
- Improve **surveys in untrawlable habitat**, particularly for rockfish, Atka mackerel, sculpins, and **snow crab**
- Improve **discard mortality rate estimates** for scallops, crab, and groundfish stocks by gear types

Research Priorities – Inter-Agency Crab Meeting 11/20/24

	November 20th, 2024 - held over Zoom	Zoom link: TBD		Chair
Time	Title	Speaker		Katie
9:00 AM	Welcome and introduction	Katie, Mike, Jan		
9:15 AM	Overview of crab fisheries by region: rationalized BSAI fisheries	Katie Palof		
	AYK region	Jen Bell		
	Westward region (Kodiak/Chignik/AK Peninsula/Eastern Aleutians Tanner and Dungeness)	cassie whiteside		
	Central region - Prince William Sound Tanner crab	Martin Schuster		
	Southeast region (presentations below will cover these in detail)	Region (presentations)		
9:45 AM	Dungeness history / management	Joe Stratman		
10:00 AM	Sea otter impacts on Southeast Alaska's Dungeness crab	Carter Johnson		
10:15 AM	temperature and molting - Southeast Dungeness	Zane Chapman		
10:30 AM	Break			
10:45 AM	Southeast Alaska GKC management	Adam Messmer		Jan
11:00 AM	Southeast Alaska Tanner crab management	Tessa Bergmann		
11:15 AM	Rebuilding the St. Matthew Island blue king crab stock	Caitlin Stern		
11:30 AM	Seasonal Movement of Red King Crabs in Bristol Bay	Leah Zacher		
11:45 AM	Distribution models to aid Bristol Bay red king crab management.	Emily Ryznar		
12 pm - 1pm	Lunch break			
1:00 PM	Red king crab stock enhancement: A review of release studies in Kodiak	Chris Long		Mike
1:15 PM	Snow crab energetics: monitoring, insights into the collapse, and plans for future research	Erin Fedewa		
1:30 PM	Temperature-dependent energy loss and development of condition metrics for juvenile snow crab.	Louise Copeman		
1:45 PM	Effects of increased temperature and ocean acidification on snow crab reproduction	Jennifer Gardner		
2:00 PM	Episodic drivers of Bering Sea snow crab	Cody Szuwalski		
2:15 PM	Tanner crab selectivity in the NMFS EBS trawl survey as inferred from BSFRF side-by-side trawl studies	Buck Stockhausen		
2:30 PM	Break			
2:45 PM	Investigating satellite tag effects on Tanner crab movement using acoustic telemetry	Andy Nault		Katie
3:00 PM	Crab Industry Skipper Surveys	Cory Lescher		
3:15 PM	Claws for Concern: Maximizing crab research opportunities during stock recovery and disaster relief	Scott Goodman		
3:30 PM	Rethinking management currency, stock metrics, and precautionary approaches	Ben Daly		
3:45 PM	Summary, concluding thoughts, plans for next year, feedback (TBD)	Steering committee		
4:30 PM	end of meeting			

To Keep in Mind

→ In person meetings are important ←

BSFRF
Bering Sea
Fisheries
Research
Foundation

ALASKA
BERING SEA
CRABBERS

Fall Crab Science Symposium – AGENDA

"Bering Sea Crab – Signs of Life, Disaster Relief, & New Research"

Date: Friday, September 13, 2024 [8:30 am – 1:30 pm] Seattle Time
IN-PERSON MEETING @ LEIF ERIKSON HALL, 2245 NW 57th ST. SEATTLE, WA 98107
Hybrid Meeting Options: Zoom Info Below

Plans for Fall 2025 Symposium starting soon…

Crab Research Update

June NPFMC Meeting – 06/05/25

Photo Credits: C. Lescher

- *Research Projects/Progress/Priorities*

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