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Introduction

With warming ocean temperatures, novel parasites are predicted to spread farther north and endemic parasites may increase in prevalence. During 2006–2015, ice-associated seals of four species (ringed (*Pusa hispida*), bearded (*Erignathus barbatus*), spotted (*Phoca largha*), and ribbon (*Phoca fasciata*)) were harvested for subsistence purposes in Alaska from the Bering and Chukchi Seas and sampled for internal helminth parasites.

Methods

Samples were collected from 141 ice seals (137 harvested and four stranded) in Alaska. Most were collected during spring and fall from subsistence harvested seals at coastal Alaskan communities in the Bering and Chukchi Seas (Fig. 1). Of the four stranded seals, two were ringed seals collected during the Unusual Mortality Event (UME) in 2011 near Utqiagvik, one was a ringed seal collected near Mekoryuk, and one was a ribbon seal collected near Adak Island (Fig. 1).

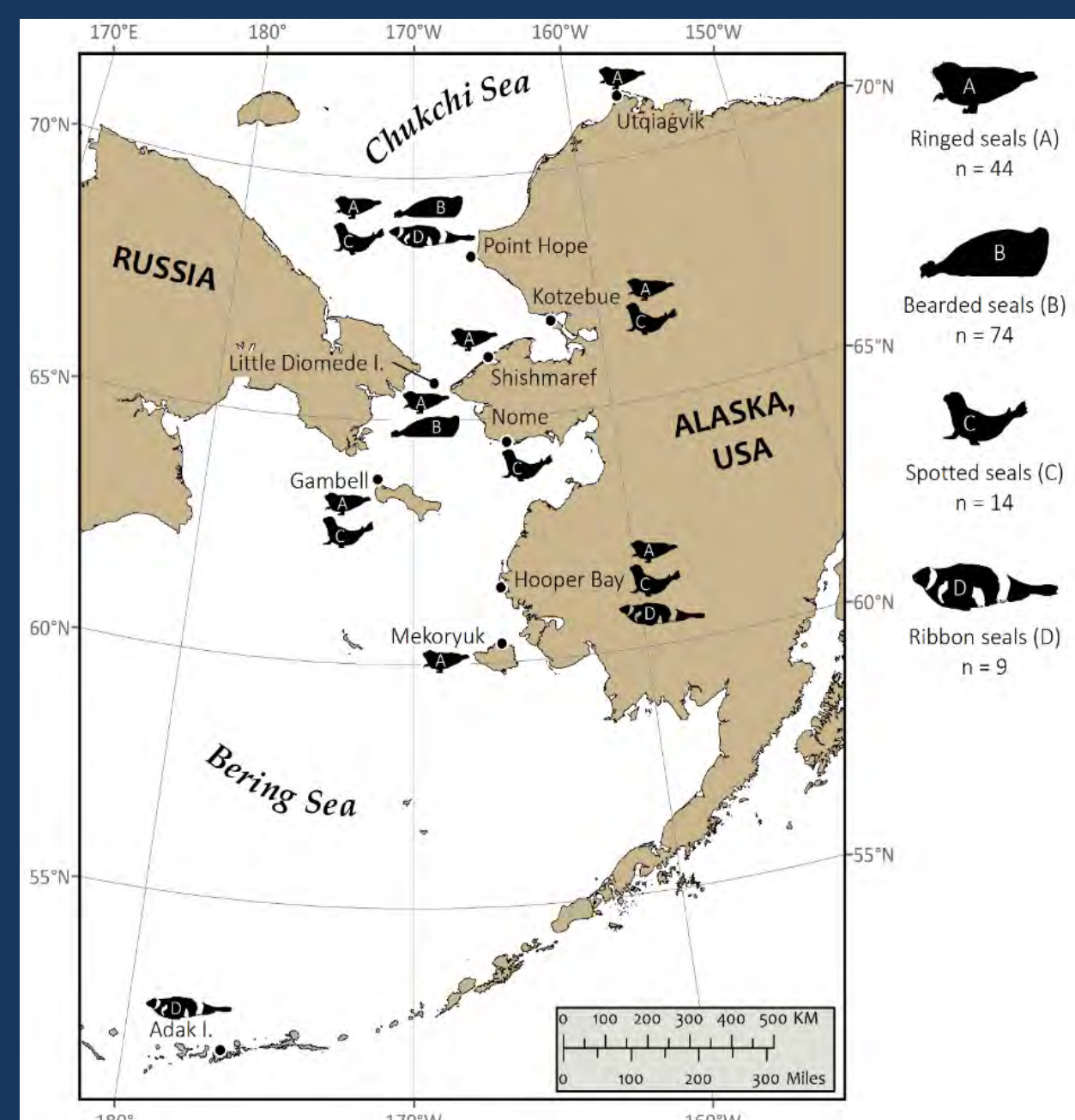


Figure 1. Locations where seals were sampled (2006–2015).

- Heart, gall bladder, and stomach were collected whole.
- Intestine and lungs (including the tracheal bifurcation) were subsampled.
- Stomachs were sorted for prey analysis and helminths were removed at that time.
- The other tissues were examined individually and rinsed into a #50 standard sieve. Remaining material was back flushed in a glass container and the helminths were removed.
- Helminths were identified to the lowest possible taxonomic level using morphological characteristics.

Number of seals with helminths

Species	Number of seals with helminths	Percentage
Ringed seal	38 of 44	(86%)
Bearded seal	73 of 74	(99%)
Spotted seal	13 of 14	(93%)
Ribbon seal	9 of 9	(100%)

Nematoda (roundworms)

Nematodes	Ringed seal	Bearded seal	Spotted seal	Ribbon seal
Nematodes	47%	97%	93%	78%
Anisakidae	21%	96%	71%	67%
<i>Anisakid</i> sp.	7%	1%	14%	
<i>Anisakis</i> sp.	2%	4%	21%	44%
<i>Contracaecum</i> sp.		22%		22%
<i>Contracaecum osculatum</i> complex	2%	28%		22%
<i>Pseudoterranova decipiens</i> complex	9%	91%	36%	33%
<i>Phocascaris</i> sp.			7%	22%
<i>Phocascaris netski</i>				11%
Onchocercidae		1%	7%	
<i>Acanthocheilonema (Dipetalonema) spirocauda</i>		1%	7%	
Filaroididae	25%	18%	57%	11%
<i>Parafilaroides (Filaroides)</i> sp.	7%	10%		
<i>Parafilaroides (Filaroides) gymnurus</i>	18%	8%	57%	11%
Crenosomatidae	11%		7%	22%
<i>Otostongylus</i> sp.				11%
<i>Otostongylus circumlitus</i>	11%		7%	11%
Unidentified nematode	7%	18%		11%

- This is the first host record of the lungworm *Parafilaroides (Filaroides) gymnurus* in a ribbon seal.
- This is also the first report of the lungworm *Otostongylus circumlitus* in a ribbon seal and *P. (F.) gymnurus* in bearded seals from the Bering-Chukchi region (previously identified in the Sea of Okhotsk; Popov 1975 and Shults and Frost 1988).

Trematoda (flukes)

Trematodes	Ringed seal	Bearded seal	Spotted seal	Ribbon seal
Trematodes	5%	64%		
Campulidae	2%	64%		
<i>Orthosplanchnus</i> sp.		11%		
<i>Orthosplanchnus arcticus</i>	2%	51%		
Heterophyidae	2%			
<i>Phocitrema fusiforme</i>	2%			
Unidentified trematode		3%		

- No trematodes were found in spotted or ribbon seal tissues.

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Cestoda (tapeworms)

Cestodes	Ringed seal	Bearded seal	Spotted seal	Ribbon seal
Cestodes	9%	82%	29%	
Tetrabothriidae	2%		29%	
<i>Anophryocephalus</i> sp.	2%		29%	
Diphyllobothriidae	4%	78%	7%	
<i>Diphyllobothrium</i> sp.	4%	64%	7%	
<i>Diphyllobothrium cordatum</i>		8%		
<i>Diphyllobothrium lanceolatum</i>		19%		
<i>Pyramicocephalus</i> sp.		3%		
Unidentified cestode	2%	14%		

- We found a lower prevalence of the cestode genus *Pyramicocephalus* in bearded seals (2.7%) than reported previously for the species *Pyramicocephalus phocarum* (44–100%) in the Bering-Chukchi region (Delyamure et al. 1976, Fay et al. 1978, and Fay et al. 1979).

Acanthocephala (thorny-headed worms)

Acanthocephalans	Ringed seal	Bearded seal	Spotted seal	Ribbon seal
Acanthocephalans	61%	15%	64%	33%
Polymorphidae	61%	15%	64%	33%
<i>Corynosoma</i> sp.	2%	4%		22%
<i>Corynosoma hadweni</i> (syn. <i>C. wegneri</i> *)	39%	3%	36%	
<i>Corynosoma reductum</i>	9%		7%	
<i>Corynosoma semerme</i>	27%	4%	29%	22%
<i>Corynosoma strumosum</i>	32%	1%	50%	11%
<i>Corynosoma validum</i>	5%	4%		
Unidentified parasite	23%	3%	14%	22%

- The acanthocephalan genus *Bolbosoma* was not found, but was found previously in ringed, spotted, and ribbon seals (Adams 1988, Shults 1982, and Shults and Frost 1988).

Conclusions

- None of the helminths found in this study are new to the Bering-Chukchi region.
- As of 2015, no new parasite species were identified, and the prevalence of endemic parasites does not appear to have increased, although some may have decreased.
- New lungworm reports:
 - This is the first host record of *P. (F.) gymnurus* in a ribbon seal.
 - First report of *P. (F.) gymnurus* in bearded seals from the Bering-Chukchi region.
 - First report of *O. circumlitus* in a ribbon seal from the Bering-Chukchi region.

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