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**Memorandum For:** North Pacific Fishery Management Council

**From:** Lowell Fritz, Tom Gelatt, John Bengtson, NMML  
Douglas Demaster, AFSC

**Subject:** Survey of adult and juvenile Steller sea lions, June-July 2008:  
response to the Council's 19 December 2008 letter to Robert D.  
Mecum, Acting Administrator, NMFS Alaska Region

**SUMMARY:** This memorandum is in response to Council's request for more information on the 2008 aerial survey of Steller sea lions in Alaska and population trends since 2000. This request was made in a 19 December 2008 letter to Robert D. Mecum, Acting Administrator for NMFS Alaska Region. The Alaska Fisheries Science Center was asked by the Region to prepare a response to this letter.

An aerial survey to assess trends in numbers of adult and juvenile (non-pup) Steller sea lions (*Eumetopias jubatus*) in Alaska was conducted by NMFS from 7 June to 6 July 2008. We used a Twin Otter aircraft (operated by NOAA, Aircraft Operations Center, Tampa FL) equipped with a vertically-oriented, high resolution digital camera (with forward motion compensation) mounted in the plane's belly port to survey Steller sea lions on terrestrial rookery and haul-out sites from southeast Alaska through the Aleutian Islands. This was the first complete survey of the endangered western distinct population segment (DPS) in Alaska since 2004 (Fritz et al. 2008), and the first complete survey of the threatened eastern DPS in southeast Alaska since 2002 (Pitcher et al. 2007).

Trends in counts of adult and juvenile western Steller sea lions (wSSLs) in Alaska from 2000 to 2008 have not been consistent across the range nor for the entire period:

- During the first four years (2000-2004), Alaska wSSL non-pup counts increased 11%. Most of the 2000-2004 increase occurred in the core region from the Kenai Peninsula through Kiska Island (Kenai-Kiska); decreases west of the Kenai-Kiska region (western Aleutian Islands) were largely balanced by increases to the east (eastern Gulf of Alaska).
- During the second four years (2004-2008), Alaska wSSL non-pup counts increased 3% due to greater numbers counted in the eastern Gulf of Alaska. Kenai-Kiska counts were stable, but counts in the western Aleutian Islands continued to decline. Evidence suggests that movement of animals from southeast Alaska (eastern DPS) to haul-outs in the eastern Gulf of Alaska

(western DPS) prior to the 2008 survey contributed to higher counts in the eastern Gulf of Alaska and lower than expected counts in southeast Alaska. We do not have a precise estimate of the number of eastern DPS animals counted in the eastern Gulf of Alaska. However, if it as high as 1,000 (the approximate increase observed between 2004 and 2008 at a single eastern Gulf of Alaska haul-out, Cape St. Elias), then Alaska wSSL non-pup counts would have declined 1% between 2004 and 2008. As a consequence, we conclude that the recent (2004-2008) trend for adult and juvenile western Steller sea lions in Alaska is stable or declining slightly.

Pup production by Steller sea lions in the western DPS in Alaska has been largely stable between 1998 and 2005/07, despite overall increases in non-pup counts between 2000 and 2008. Throughout the western DPS in Alaska, pup counts declined 2% overall in this 7-9 year period, increased 4% in the eastern Gulf of Alaska and increased about 3% in the Kenai-Kiska core. Changes in non-pup counts since 2000 in the eastern Gulf of Alaska (+93%) were far greater than increases in pup counts in the last 8 or 4 years in the eastern Gulf itself (+4% or +22%, respectively) or the entire western DPS in Alaska (-2% or +4%, respectively). This supports the hypothesis that the large increase in non-pups in the eastern Gulf of Alaska is not due to local pup production but more likely a result of seasonal movements of animals from the population in southeast Alaska that has been consistently increasing since the late 1970s.

## **METHODS**

### **2008 Survey of Non-pups in Alaska**

Aerial surveys for non-pups are conducted in June, when the greatest proportion of adults is onshore to give birth and breed. The primary objective in 2008 was to survey all terrestrial rookery and haul-out sites within the range of the Steller sea lion in Alaska from Dixon Entrance in southeast Alaska (134°W) to Attu Island (172°E) at the western end of the Aleutian Islands (Figure 1); the single rookery (Walrus Island) and 9 haul-outs in the eastern Bering Sea region north of the Alaska Peninsula were not surveyed. In 2008, we successfully assessed sea lion numbers at 339 of the 356 (95%) known terrestrial rookery and haul-out sites in the survey region. Of the 339 sites successfully surveyed, 169 were photographed, 30 had so few sea lions (< 15) that they were counted visually by observers on the plane, and 140 had no sea lions. Of the 17 'missed' sites, 15 could not be surveyed because of poor weather conditions, while 2 (rookeries on Chowiet and Chirikof Islands) were incompletely surveyed.

In 2008, we began the survey in southeast Alaska, basing operations in Sitka, and surveyed the entire southeast area on 7-8 June. In the past, southeast Alaska surveys were usually conducted after the western DPS survey was completed, and as a consequence, have generally been conducted in late June or early July. The most recent survey of southeast Alaska sea lions was conducted on 4-5 July 2002, or approximately 1 month earlier in the year than in 2008. All other Steller sea lion surveys conducted in

southeast Alaska since 1996 were done on or after 20 June, or about 2 weeks later than the 2008 survey. Prior to 2008, the next earliest-in-the-year southeast Alaska survey was conducted on 12-13 June 1994. In 2008, we began the western DPS survey in the Prince William Sound area on the same day (9 June) as the non-pup survey conducted in 2007.

### **Trend Analysis**

NMML monitors the Steller sea lion population by surveying and counting animals at trend sites which have been consistently surveyed since the mid-1970s (N=85 1970s trend sites in the range of the western DPS in Alaska; N=19 in southeast Alaska including each of the sites that comprise the Forrester complex) or 1991 (N=161 1990s trend sites in the range of the western DPS in Alaska). In the rest of this report, only counts at 1990s trend sites are discussed, and these will be referred to simply as ‘trend sites’. The vast majority (> 90%) of all sea lions counted during surveys conducted since 2004 have been counted at trend sites. All trend sites in southeast Alaska (eastern DPS) and all but 5 of the 161 trend sites in the range of the western DPS were surveyed in 2008; of these, 3 could not be surveyed from the air because of bad weather (two rookeries on Ugamak Island and a haul-out located at East Cape on Amchitka Island), while 2 (rookeries on Chowiet and Chirikof Islands) were incompletely surveyed. For trend analyses, 2008 counts at these five sites were estimated using data from previous (2006 or 2007) aerial surveys or were obtained from land-based observers in 2008. (For details regarding the estimation and counting procedures for trend sites missed in non-pup surveys conducted in 2006-2008, see Memorandum to the Record, Fritz et al., 17 November 2008, NMFS, AFSC, NMML, <http://www.afsc.noaa.gov/nmml/pdf/SSLNon-Pups2008memo.pdf>).

Surveys conducted prior to 2004 used oblique 35 mm photography. Differences in resolution between oblique 35 mm and vertical high resolution photographs requires an adjustment factor of -3.64% be applied to all counts from vertical photographs in order to properly analyze regional time series that include counts from years prior to 2004 (Fritz and Stinchcomb 2005).

### **Analysis of Survey Timing in Southeast Alaska and E GULF on Non-Pup Counts**

Because the 2008 survey dates in southeast Alaska were earlier than in other years, we analyzed the effect that day of the year may have had on counts in the southeast Alaska and eastern Gulf of Alaska (E GULF) regions. We used generalized linear models and estimating equations (SAS procedure GENMOD; SAS 2002) to *a posteriori* analyze counts of adult and juvenile sea lions in 10 clusters of rookeries and haul-outs in both regions (Figure 2; for details regarding the analysis of movement between southeast Alaska and the E GULF, see Memorandum to the Record, Fritz et al., 17 November 2008, NMFS, AFSC, NMML, <http://www.afsc.noaa.gov/nmml/pdf/SSLNon-Pups2008memo.pdf>).

## **RESULTS AND DISCUSSION**

Counts of adult and juvenile Steller sea lions at trend sites within the range of the western DPS in Alaska in 2000-2008 are listed in Table 1. Counts at all sites in southeast Alaska within the range of the eastern DPS from surveys in 2002 and 2008 are shown in Table 2.

### **Non-Pup Trends in the Western DPS in Alaska**

Counts of adult and juvenile Steller sea lions at all trend sites within the range of the western DPS in Alaska increased 14% between 2000 and 2008, and most of this increase occurred in the first four years (11% increase between 2000 and 2004; Table 3 and Figure 3). In the core of the western DPS range in Alaska (Kenai-Kiska), all of the 2000-2008 increase of 10% occurred between 2000 and 2004. In the larger Kenai-Attu region, counts increased 7% in the first four years, but then dropped slightly between 2004 and 2008. Consequently, the overall increase of 3% observed between 2004 and 2008 in the western DPS in Alaska was due entirely to a 35% higher count in the E GULF (Table 3).

### **Non-Pup Trends by Region within the Western DPS in Alaska**

There has been considerable variation between regions and periods (2000-2004 and 2004-2008) in non-pup count trends (Tables 3 and 4; Figures 4 and 5):

- Regions that increased between 2000 and 2008: eastern Aleutian Islands (E ALEU), western Gulf of Alaska (W GULF) and E GULF
  - The E ALEU was the only region where non-pup counts increased throughout 2000-2008, though more in the first half than the second.
  - While counts in the W GULF increased overall from 2000 to 2008, data from the incomplete 2007 survey (Tables 1 and 4) indicated that all of the increase occurred between 2000 and 2007, and counts declined slightly between 2007 and 2008.
  - Non-pup counts increased steadily in the E GULF between 2000 and 2006, dropped slightly in 2007, and then increased substantially (+47%) in 2008. We counted 1,090 more non-pups on E GULF trend sites in 2008 than in 2004 (Table 1), and 1,082 of these were at the easternmost haul-out in the range of the western DPS, Cape St. Elias.
  
- Regions that decreased between 2000 and 2008: western Aleutian Islands (W ALEU), central Aleutian Islands (C ALEU), and the central Gulf of Alaska (C GULF)
  - The W ALEU was the only region where non-pup counts declined throughout 2000-2008, and the decline was steeper in the second half than the first.
  - While the C ALEU decreased 11% overall from 2000 to 2008, non-pup counts increased 5% from 2000 to 2004 but then dropped 16% from 2004-2008 (Table 3). Within the C ALEU, there were different trends in the western than eastern halves of this region. In the C ALEU-W, counts dropped continuously between 2000 and 2008: -8% in the first half and -13% in the second (Table

- 4). By contrast, counts increased 15% in the C ALEU-E from 2000-2004, but then declined 17% in the next four years (Table 4).<sup>1</sup>
- While the C GULF decreased slightly (-3%) overall from 2000 to 2008, non-pup counts decreased 12% in the first four years and increased 10% in the second (Table 3; Figures 4 and 5). There was variability in the second four year pattern with an increase of 17% between 2004 and 2007 followed by a decline of 6% between 2007 and 2008 (Table 4).

Analysis of 2000-2008 trends in more detail (Table 4) reveals:

- The W GULF, E ALEU and C ALEU-E regions all increased substantially (+15-33%) during the first four years. During the second four years, increases continued but at a much slower rate in the W GULF and E ALEU, while counts dropped in the C ALEU-E.
- To the west in the C ALEU-W and W ALEU, counts dropped continuously,
- To the east in the C GULF, counts varied by year but overall dropped only slightly, and
- In the easternmost region (E GULF), counts increased substantially overall.

These trends indicate that the non-pup Steller sea lion population in the core of the range of the western DPS in Alaska (Kenai – Kiska) increased between 2000 and 2004, but has been stable overall between 2004 and 2008. Outside of this core, the W ALEU declined substantially while counts in the E GULF almost doubled.

### **Pup Production Trends Overall and by Region within the Western DPS in Alaska**

Regional total counts of Steller sea lion pups at trend rookeries within the range of the western DPS in Alaska from 1978-2007 are listed in Table 5 (this table is from Fritz et al. 2008; see this publication for other information regarding pup counts). Changes in pup counts between both 1998 and 2005-07, and between 2001-02 and 2005-07 are shown in Table 5. The earlier, longer period for pup counts (1998-2005/07) is discussed below with respect to 2000-2008 non-pup counts because these data indicate trends at an earlier life stage.

Pup production by Steller sea lions in the western DPS in Alaska was stable between 1998 and 2005/07, despite overall increases in non-pup counts between 2000 and 2008. Throughout the western DPS, pup counts declined 2% overall in this 7-9 year period, while in the Kenai-Kiska core, counts increased about 3%. By contrast, non-pup counts increased 14% and 10% between 2000 and 2008 in the two ranges, respectively (Figure 6).

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<sup>1</sup> Surveys conducted in the C ALEU in 2008 preceded the 7 August eruption of the volcano on Kasotochi Island, which greatly altered the physical structure of the island and deposited a thick layer of gravel, boulders and ash on the rookery area. The fate of the approximately 350 pups and 550 non-pups counted on the rookery on 21 June (approximately 6 weeks before the eruption) is not known. However, on 28 August, US Fish and Wildlife Service scientists observed approximately 250 non-pups and 2 pups on the southwest side of the island (J. Williams, USFWS, personal communication).

In the W ALEU and C GULF, both non-pup and pup counts decreased, but pup counts decreased faster. In the C ALEU, pups and non-pups declined at about the same rate (Figure 6).

In regions where non-pup counts increased overall (E ALEU, W GULF, E GULF and Kenai-Kiska), pup production also increased but at slower rates in all regions except the E ALEU. However, in the E GULF, there is a marked difference in these rates, with non-pup counts increasing 93% while pup counts increased only 4% (though 22% between 2001-02 and 2005-07); the other increasing regions had much smaller differences between rates of non-pup and pup increases (Figure 6). We conclude that it is unlikely that the large increase in non-pup counts observed in the E GULF between 2000 and 2008 is solely the result of pup production in either the E GULF or neighboring C GULF regions. By contrast, pup production increased at 3.2% between 1979 and 2005 at rookeries in southeast Alaska (Pitcher et al. 2007); movement of animals from this increasing population to the E GULF likely contributed to the recent increases in the latter region.

### **Movement of Non-Pups between Southeast Alaska and the E GULF**

Increases in non-pups in the E GULF between 2000 and 2008 occurred more at haul-outs than at rookeries (Figure 7). In particular, increases were greater on the easternmost haul-outs in the E GULF (e.g., Cape St. Elias and Cape Hinchinbrook) or in northern Prince William Sound (e.g., Glacier) than they were on haul-outs in southwestern Prince William Sound or in western portions of the E GULF (e.g., The Needle, Point Elrington, Seal Rocks (Kenai)). Where increases did occur, there has also been considerable inter-annual variability (Table 1).

The following observations:

- a substantial increase in non-pups in the E GULF,
- relatively stable pup production in the E GULF and C GULF,
- increasing pup production in southeast Alaska, at least through 2005, and
- greater increases (and high variability) in non-pup counts at eastern E GULF haul-outs than at western E GULF haul-outs or rookeries,

are consistent with the hypothesis that some fraction of the non-pups counted in the E GULF region in the last several surveys (particularly those from 2004-2008) are eastern DPS animals that were foraging in the northern Gulf of Alaska in late spring (through early June). If this hypothesis is true, we should count more sea lions in early June in the E GULF, particularly at the easternmost sites, and count fewer in late June-early July; in southeast Alaska, we should observe the opposite pattern: lower counts early and higher counts late. Total counts at southeast Alaska trend sites in 2002 and 2008 generally support this hypothesis (Table 2; Figure 8). The survey in 2002 was conducted 'late' (in early July), and resulted in a total count of 15,284 non-pups with 9,989 on trend sites. By contrast, the survey in 2008 was conducted 'early' (in early June), and 939 fewer non-pups were counted on all sites and 1,201 fewer on trend sites. There is no evidence to suggest that the southeast Alaska sea lion population declined between 2002 and 2008 (Pitcher et al. 2007; NMFS 2008). Instead, it may be the timing of the surveys in these

two regions in 2008 compared to previous years that gives the appearance of a decline in southeast Alaska and contributes to the apparent increase in the E GULF.

Results of analyses of E GULF and southeast Alaska non-pup counts from 1990-2008 using generalized linear models, though not statistically significant, generally support the proposed hypothesis of regional movement between the E GULF and southeast Alaska in June (Figures 2 and 9). Only at the easternmost E GULF haul-outs (cluster 1) does the model estimate higher counts early in the survey period (early June) than later (late June or early July; Figure 9C). At the western E GULF haul-outs (clusters 2-4), estimated counts late in the survey period were slightly higher than those early (Figure 9A), but the slope here was much smaller than that estimated for the southeast Alaska haul-outs (clusters 6-9; Figure 9D). Slightly increasing estimated counts at rookeries (clusters 5 and 10) during the survey period are not unexpected since adult females would be arriving at these locations to give birth and breed. These patterns of non-pup counts at haul-outs in the E GULF and southeast Alaska in June through early July are consistent with, but do not prove, the regional movement hypothesis.

In 2008, then, we may have counted animals on the four easternmost sites in the E GULF (surveyed 'early') that 'should' have been counted as part of the eastern DPS. Over 85% of the non-pups counted on Cape St. Elias and Cape Hinchinbrook during the 2006-2008 surveys (all of which were conducted 'early' prior to 14 June) were juveniles or adult females, the most likely age-sex classes to make such movements at this time. Based on the magnitude of the 'decline' in southeast Alaska between 2002 and 2008, and the 'increase' in the E GULF between 2004 and 2008, the number of non-pups that moved from southeast Alaska to the E GULF early in the survey period may be as high as 1,000. At this time, however, we have no precise estimate of the number of eastern DPS animals from southeast Alaska that were counted on haul-outs or rookeries early in the survey period in the E GULF. However, if it is as high as 1,000 (the approximate increase observed between 2004 and 2008 at Cape St. Elias alone), then 'true' Alaska wSSL non-pup counts would have declined -1% between 2004 and 2008.

In 2009, we plan on conducting a 'late' survey in the southeast Alaska and E GULF regions as part of the Alaska-wide sea lion pup assessment. If our movement hypothesis is correct, we expect to see lower non-pup counts overall in the E GULF, and on haul-outs in particular, and higher overall in SEAK than we did in 2008.

## **CONCLUSION**

Trends in counts of adult and juvenile western Steller sea lions (wSSLs) in Alaska from 2000 to 2008 have not been consistent across the range nor for the entire period:

- During the first four years (2000-2004), Alaska wSSL non-pup counts increased by 11%. Most of the 2000-2004 increase occurred in the core region from the Kenai Peninsula through Kiska Island (Kenai-Kiska); decreases in the W ALEU were largely balanced by increases in the E GULF.
- During the second four years (2004-2008), Alaska wSSL non-pup counts increased by 3% due to greater numbers counted in the E GULF. Kenai-Kiska

counts were stable, but counts in the W ALEU continued to decline. Evidence suggests that movement of animals from southeast Alaska (eastern DPS) to haul-outs in the E GULF (western DPS) prior to the 2008 survey contributed to higher counts in the E GULF and lower than expected counts in southeast Alaska. We do not have a precise estimate of the number of eastern DPS animals counted in the E GULF. However, if it as high as 1,000 (the approximate increase observed between 2004 and 2008 at a single E GULF haul-out, Cape St. Elias), then Alaska wSSL non-pup counts would have declined -1% between 2004 and 2008. As a consequence, we conclude that the recent (2004-2008) trend for adult and juvenile western Steller sea lions in Alaska is stable or declining slightly.

Pup production by Steller sea lions in the western DPS in Alaska has been largely stable between 1998 and 2005/07, despite overall increases in non-pup counts between 2000 and 2008. Throughout the western DPS in Alaska, pup counts declined 2% overall in this 7-9 year period, increased 4% in the E GULF and increased about 3% in the Kenai-Kiska core. Increases in non-pup counts since 2000 in the E GULF (+93%) were far greater than increases in pup counts in the last 8 or 4 years in the E GULF itself (+4% or +22%, respectively) or the entire western DPS in Alaska (-2% or +4%, respectively). This supports the hypothesis that the large increase in non-pups in the eastern Gulf of Alaska is not due to local pup production but more likely a result of seasonal movements of animals from the population in southeast Alaska that has been consistently increasing since the late 1970s.

### **ACKNOWLEDGMENTS**

We thank Mark Nelson and Nicole Cabana (pilots), Michael Merek (mechanic), and the entire NOAA Aircraft Operations Center for all their efforts to survey the entire range of Steller sea lions in Alaska. This was a tremendous accomplishment and we look forward to a continuing productive relationship with NOAA AOC. We also thank: Kathryn Sweeney and Carolyn Gudmundson (NMML) for their diligence in counting sea lions on hundreds of images; Morgan Lynn and Jim Gilpatrick (NMFS SWFSC), and K. Sweeney for their help in conducting the survey; Don LeRoi (Aerial Imaging Solutions, Old Lyme, CN) whose enthusiasm and skills are making our transition from film to digital photography possible; and Jan Bennett (Office of Aircraft Services) for being our 'eye in the sky' during the survey. This research was conducted under Steller sea lion research permits 782-1532 and 782-1768 authorized by NMFS under conditions specified by the Marine Mammal Protection Act and Endangered Species Act.



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Table 1. Counts of adult and juvenile (non-pup) Steller sea lions at trend rookeries and haul-outs in the range of the western distinct population segment (DPS) in Alaska from aerial surveys conducted in June-July 2000-2008. In 2000 and 2002, sea lions were counted off oblique 35 mm film images; in 2004-2008, sea lions were counted off high resolution vertical images. **This table contains raw unadjusted counts. For trend analysis, region totals from 2004-2008 must be multiplied by 96.36% to account for differences in counts due to photo orientation and resolution (Fritz and Stinchcomb 2005).** Rookeries labeled Y\* are 'new' rookeries: they have produced at least 50 pups since 1975, but were not included as rookeries in the designation of critical habitat (CH) in 1993. Rookeries labeled N\* are CH rookeries, but have not produced at least 50 pups since 1975.

SITENAME	REGION	Rookery	2000	2002	2004	2006	2007	2008
CAPE ST. ELIAS	E GULF		485	574	318	414	728	1,400
CAPE HINCHINBROOK	E GULF		106	107	496	237	95	229
SEAL ROCKS	E GULF	Y	749	768	841	1,119	803	1,024
WOODED (FISH)	E GULF	Y	396	396	523	619	282	603
GLACIER	E GULF		0	435	620	466	531	509
THE NEEDLE	E GULF		126	115	123	127	145	88
POINT ELRINGTON	E GULF		128	114	132	58	37	169
CAPE PUGET	E GULF		0	0	0	0	0	0
CAPE FAIRFIELD	E GULF		21	2	0	0	10	47
RUGGED	E GULF		3	0	0	0	0	8
AIALIK CAPE	E GULF		0	6	1	103	161	77
CHISWELL ISLANDS	E GULF	Y*	54	97	72	71	74	68
SEAL ROCKS (KENAI)	E GULF		34	1	3	4	2	0
OUTER (PYE)	C GULF	Y	262	226	222	251	268	249
GORE POINT	C GULF		0	0	0	0	0	0
EAST CHUGACH	C GULF		0	0	0		0	0
PERL	C GULF		48	99	49		241	144
NAGAHUT ROCKS	C GULF		10	1	1		2	21
ELIZABETH/CAPE ELIZABETH	C GULF		78	177	28		0	0
SUGARLOAF	C GULF	Y	706	736	667	733	662	849
USHAGAT/NW	C GULF		1	1	3	0	0	0
USHAGAT/SW	C GULF	Y*	98	116	101	141	74	96
USHAGAT/ROCKS SOUTH	C GULF		37	5	8	9	0	45
LATAK ROCKS	C GULF		100	145	56		115	108
SEA OTTER	C GULF		118	45	127		100	1
RK NEAR SEA OTTER	C GULF		0	0	10		0	47
AFOGNAK/TONKI CAPE	C GULF		1	0	0		0	16
SEA LION ROCKS (MARMOT)	C GULF		56	0	2		1	13
MARMOT	C GULF	Y	671	848	703	686	551	644
LONG ISLAND	C GULF		36	80	32			59
KODIAK/CAPE CHINIAK	C GULF		165	102	87		241	130
UGAK	C GULF		0	0	0		0	0
KODIAK/GULL POINT	C GULF		106	99	109		148	109
KODIAK/CAPE BARNABAS	C GULF		0	0	0		140	84

**Table 1 (continued)**

<b>SITENAME</b>	<b>REGION</b>	<b>Rookery</b>	<b>2000</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
TWOHEADED	C GULF		254	227	266		228	204
SITKINAK/CAPE SITKINAK	C GULF		160	91	80		104	115
KODIAK/CAPE UGAT	C GULF		182	104	2	167	248	285
KODIAK/STEEP CAPE	C GULF		0	28	0	14	61	38
SHAKUN ROCKS	C GULF		225	45	104	67	113	81
TAKLI	C GULF		33	79	85	157	92	67
PUALE BAY	C GULF		84	94	58	2	1	2
UGAIUSHAK	C GULF		2	2	0	0	2	0
SUTWIK	C GULF		114	114	206	114	127	93
CHOWIET	C GULF	Y	504	582	541		576	559
CHIRIKOF	C GULF	Y	276	320	303		300	300
NAGAI ROCKS	C GULF		228	231	330		449	234
CHERNABURA	W GULF	Y	496	496	828		1,228	1,281
LIGHTHOUSE ROCKS	W GULF	Y*	64	84	111	153	152	164
KAK	W GULF		70	108	17	24		1
MITROFANIA	W GULF		126	150	182	103	116	129
SPITZ	W GULF		6	0	1	0	11	1
KUPREANOF POINT	W GULF		12	64	53	116	53	72
CASTLE ROCK	W GULF		38	75	70	15	38	28
ATKINS	W GULF	Y	537	560	651	663	585	558
THE HAYSTACKS	W GULF		62	50	38	1	41	3
THE WHALEBACK	W GULF		162	116	102	99	83	102
NAGAI/MOUNTAIN POINT	W GULF		62	105	80	56	148	60
SEA LION ROCKS								
(SHUMAGINS)	W GULF		33	26	36	142	44	54
UNGA/ACHEREDIN POINT	W GULF		108	188	264	152	229	202
JUDE	W GULF	Y*	391	374	474	338	445	465
PINNACLE ROCK	W GULF	Y	868	1,034	1,011	1,167	1,057	1,094
CLUBBING ROCKS	W GULF	Y	712	830	911	1,037	1,063	952
CHERNI	W GULF		0	0	0	0	0	0
SOUTH ROCKS	W GULF		161	262	528	320	457	451
BIRD	W GULF		88	95	57	62	97	155
ROCK	W GULF		0	0	17	0	0	0
UNIMAK/CAPE SARICHEF	E ALEU		216	321	250	6	0	167
AMAK+ROCKS	E ALEU		946	563	733	410	220	265
SEA LION ROCK (AMAK)	E ALEU	Y	258	507	456	447	385	360
UGAMAK COMPLEX	E ALEU	Y	746	1,044	1,304	1,319	1,493	1,619
AIKTAK	E ALEU		92	75	101	111	43	42
TIGALDA/ROCKS NE	E ALEU		123	134	141	202	236	359
TIGALDA/SOUTH SIDE	E ALEU		42	38	46	83	105	91
ROOTOK	E ALEU		93	84	96	96	141	60
TANGINAK	E ALEU		8	3	4	6	4	1
AKUN/BILLINGS HEAD	E ALEU	Y	254	275	307	338	523	386
AKUTAN/REEF-LAVA	E ALEU		43	36	119	103	57	128
AKUTAN/CAPE MORGAN	E ALEU	Y	739	783	1,021	1,249	1,172	1,135
OLD MAN ROCKS	E ALEU		114	25	71	112	81	89
EGG	E ALEU		0	1	5	0	0	0
OUTER SIGNAL	E ALEU		2	0	0	0	0	10

**Table 1 (continued)**

<b>SITENAME</b>	<b>REGION</b>	<b>Rookery</b>	<b>2000</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
UNALASKA/CAPE SEDANKA	E ALEU		0	106	0	0	0	0
UNALASKA/BISHOP POINT	E ALEU		106	122	265	285	196	204
UNALASKA/MAKUSHIN BAY	E ALEU		79	7	20	88	154	115
UNALASKA/SPRAY CAPE	E ALEU		0	67	0	0	0	0
UNALASKA/CAPE IZIGAN	E ALEU		116	211	238	329	304	188
BOGOSLOF/FIRE ISLAND	E ALEU	Y	347	357	380	358	405	390
UMNAK/CAPE ASLIK	E ALEU		74	52	119	73		63
POLIVNOI ROCK	E ALEU		108	98	91	42	96	93
THE PILLARS	E ALEU		51	14	4	0	0	0
OGCHUL	E ALEU	Y	117	105	139	132	152	200
VSEVIDOF	E ALEU		46	34	48	41	35	50
ADUGAK	E ALEU	Y	270	201	259	429	473	636
ULIAGA	C ALEU		90	121	0	99		66
KAGAMIL	C ALEU		24	12	1	0		0
CHUGINADAK	C ALEU		23	62	129	79		53
CARLISLE	C ALEU		12	0	0	0		27
HERBERT	C ALEU		6	2	38	66		105
YUNASKA	C ALEU	Y	241	276	260	255	279	282
CHAGULAK	C ALEU		40	5	0	13		59
AMUKTA+ROCKS	C ALEU		38	42	2	18	56	35
SEGUAM/FINCH POINT	C ALEU		14	27	2		0	0
SEGUAM/SW RIP	C ALEU		23	50	40		31	39
SEGUAM/SADDLERIDGE	C ALEU	Y	570	666	923		668	835
SEGUAM/TURF POINT	C ALEU		82	84	58		8	3
SEGUAM/LAVA COVE	C ALEU		0	0	0		0	0
SEGUAM/LAVA POINT	C ALEU		0	10	5		0	0
SEGUAM/WHARF POINT	C ALEU		55	50	90		121	49
AGLIGADAK	C ALEU	N*	48	82	61		15	14
AMLIA/EAST CAPE	C ALEU		86	82	34		55	117
AMLIA/SVIECH. HARBOR	C ALEU		120	98	144		113	100
TANADAK (AMLIA)	C ALEU		74	32	1		0	30
SAGIGIK	C ALEU		22	40	30		10	14
ATKA/NORTH CAPE	C ALEU		76	224	383	279	140	32
ATKA/CAPE KOROVIN	C ALEU		12	1	4	0	30	39
SALT	C ALEU		0	0	0		0	4
KASATOCHI/NORTH POINT	C ALEU	Y	390	529	667	610	613	550
OGLODAK	C ALEU		66	76	86	111	58	99
IKIGINAK	C ALEU		0	8	0	8	16	0
FENIMORE	C ALEU		67	22	30	10	9	4
ANAGAKSIK	C ALEU		46	40	2	52	14	20
GREAT SITKIN	C ALEU		29	106	0	0	0	0
LITTLE TANAGA STRAIT	C ALEU		234	82	49		15	36
KAGALASKA	C ALEU		45	34	48	0	3	42
ADAK	C ALEU	Y	874	821	1,008		779	621
KANAGA/N CAPE	C ALEU		25	12	7	13	2	14
KANAGA/CAPE MIGA	C ALEU		1	0	0	0	0	0
KANAGA/SHIP ROCK	C ALEU	Y*	156	242	229		331	322

**Table 1 (continued)**

<b>SITENAME</b>	<b>REGION</b>	<b>Rookery</b>	<b>2000</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
TANAGA/BUMPY POINT	C ALEU		18	26	33		33	22
TANAGA/CAPE SASMIK	C ALEU		154	148	122		63	95
GRAMP ROCK	C ALEU	Y	580	600	679			593
UGIDAK	C ALEU		6	23	25			16
TAG	C ALEU	Y	301	279	242			255
KAVALGA	C ALEU		50	18	56			63
UNALGA+DINKUM ROCKS	C ALEU		50	46	19			0
ULAK/HASGOX POINT	C ALEU	Y	663	481	531			537
AMATIGNAK/KNOB POINT	C ALEU		0	0	1		0	3
AMATIGNAK/NITROF POINT	C ALEU		96	40	76	38		49
SEMISOPOCHNOI/POCHNOI	C ALEU	N*	65	70	55	41		32
AMCHITKA/CAPE IVAKIN	C ALEU		0	0	0	0	0	0
AMCHITKA/EAST CAPE	C ALEU	N*	101	186	178	103		103
AMCHITKA/ST. MAKARIUS	C ALEU		0	0	0	0	0	0
AMCHITKA/COLUMN ROCK	C ALEU	Y	92	71	85			71
AYUGADAK	C ALEU	Y	146	182	152			152
RAT	C ALEU		2	28	45			0
SEA LION ROCK (KISKA)	C ALEU		0	1	0			0
TANADAK (KISKA)	C ALEU		71	54	34			1
KISKA/SOBAKA-VEGA	C ALEU		152	54	101			52
KISKA/CAPE ST STEPHEN	C ALEU	Y	152	126	210		211	229
KISKA/LIEF COVE	C ALEU	Y	272	174	170		164	162
KISKA/PILLAR ROCK	C ALEU		0	3	0			0
BULDIR	W ALEU	Y	129	94	108			43
SHEMYA	W ALEU		54	34	17	18		4
AL Aid	W ALEU		156	158	125	86		86
AGATTU/CAPE SABAK	W ALEU	Y	480	307	325	282	203	202
AGATTU/GILLON POINT	W ALEU	Y	306	258	374	308		281
ATTU/MASSACRE BAY	W ALEU		0	0	0	0		0
ATTU/CHIRIKOF POINT	W ALEU		145	19	75	30		42
ATTU/CHICHAGOF POINT	W ALEU		52	62	54	13		25
ATTU/KRESTA POINT	W ALEU		1	0	0	0		0
ATTU/CAPE WRANGELL	W ALEU	Y	310	264	257	260		247

Table 2. Counts of adult and juvenile (non-pup) Steller sea lions at trend (Y) and non-trend haul-outs and rookeries (Y) from high resolution aerial photographs taken in July 2002 and June 2008 in southeast Alaska. Counts from trend sites labeled Y\* were omitted from the 'Total Trend Sites' since these sites were missed in 2002. The Brothers count is the sum of counts from The Brothers/SW and The Brothers/NW.

SITENAME	TREND	ROOKERY	2002	2008
LITTLE ISLAND				0
POINT MARSH			104	4
WEST ROCK			640	841
WOLF ROCK			207	300
SAKIE POINT				0
CAPE BARTOLOME			41	0
CAPE ADDINGTON			1074	718
GRINDALL			130	374
TIMBERED			442	288
HAZY	Y	Y	2,050	1,686
EASTERLY				255
CORONATION	Y		46	279
South of Cape Ommaney				102
CAPE OMMANEY			344	117
LARCH BAY				28
SEA LION ROCK (PUFFIN BAY)			264	0
ETOLIN				0
PATTERSON POINT				0
BIALI ROCK	Y	Y	626	408
FORRESTER COMPLEX	Y	Y	3,699	2,894
JACOB ROCK	Y		203	101
KAIUCHALI (BIORKA)			46	31
HORN CLIFF				0
YASHA			920	379
ST. LAZARIA				0
PINTA ROCKS				0
TURNABOUT	Y*			0
ROUND ROCK				0
THE BROTHERS	Y		981	765
SEA LION ISLANDS	Y*			137
POINT LULL				153
SAIL			0	3
FALSE POINT PYBUS			0	0
SUNSET			348	384
POINT LEAGUE (STEVENS PASSAGE)			0	1
WHITE SISTERS	Y	Y	1,156	1,132
TENAKEE CANNERY POINT				0

**Table 2 (Continued)**

<b>SITENAME</b>	<b>TREND</b>	<b>ROOKERY</b>	<b>2002</b>	<b>2008</b>
CAPE CROSS	Y		1	1
MIST				0
POINT MARSDEN				0
CAPE BINGHAM			0	0
CIRCLE POINT				0
THE SISTERS				0
DOROTHY				0
GRAVES ROCK	Y	Y	1,001	1,305
INIAN			206	116
VENISA			0	0
POINT CAROLUS			0	0
BENJAMIN			0	0
HARBOR POINT	Y		186	178
SOUTH MARBLE			238	786
CASE (TLINGIT) POINT				0
CAPE FAIRWEATHER	Y*			0
MET POINT				0
ELDRED ROCK				0
GRAN (LEDGE) POINT			331	583
<b>Total Trend Sites</b>			<b>9,949</b>	<b>8,748</b>
<b>Total Other Sites</b>			<b>5,335</b>	<b>5,597</b>

Table 3. Counts of adult and juvenile (non-pup) Steller sea lions observed at rookery and haul-out trend sites in eight sub-areas of Alaska during June-July aerial surveys from 1991 to 2008. Overall percentage changes between various pairs of years are also shown. \* For eastern Gulf of Alaska in 1998, counts made in 1999 were substituted for those sites not surveyed in 1998. Subarea count totals for 2004-2008 (\*\*\*) have been adjusted to account for film format-count differences. Kenai-Kiska is comprised of the central and western Gulf of Alaska and eastern and central Aleutian Islands sub-areas. Kenai-Attu is comprised of the Kenai-Kiska plus the western Aleutian Islands sub-areas.

Year	Gulf of Alaska			Aleutian Islands			Kenai-Kiska	Kenai-Attu	Western Stock In Alaska
	Eastern	Central	Western	Eastern	Central	Western			
1991	4,812	7,872	5,338	5,283	8,656	4,601	27,149	31,750	36,562
1992	3,981	7,358	5,112	5,707	7,633	4,199	25,811	30,010	33,991
1994	3,612	6,505	5,718	5,664	6,909	3,114	24,796	27,910	31,522
1996	2,450	5,400	5,356	5,967	6,368	3,334	23,091	26,425	28,875
1998*	2,158	4,806	5,367	5,774	7,017	2,786	22,964	25,750	27,908
2000	2,102	4,555	3,996	4,990	6,560	1,633	20,101	21,734	23,836
2002	2,615	4,594	4,617	5,261	6,547	1,196	21,018	22,214	24,829
2004**	3,015	4,028	5,233	5,991	6,885	1,286	22,137	23,423	26,438
2006**	3,101			6,031					
2007**	2,760								
2008**	4,065	4,420	5,558	6,405	5,817	894	22,199	23,094	27,159
<b>Percent change</b>									
1991-2000	-56%	-42%	-25%	-6%	-24%	-65%	-26%	-32%	-35%
2000-2008	+93%	-3%	+39%	+28%	-11%	-45%	+10%	+6%	+14%
2000-2004	+43%	-12%	+31%	+20%	+5%	-21%	+10%	+7%	+11%
2004-2008	+35%	+10%	+6%	+7%	-16%	-30%	0%	-1%	+3%



Table 4. Counts of adult and juvenile Steller sea lions at trend rookery and haul-out sites in the range of the western stock in Alaska by sub-area 1991-2008. Single trend sites were missed in the central and western Gulf of Alaska, and eastern Aleutian Islands during the 2007 survey, and in the western Aleutians Islands during the 2006 survey. The central Aleutian Island sub-area was divided into eastern (Uliaga through Tanaga) and western (Delarof Islands through Kiska) portions. Counts at sites within the Central-East Aleutian Islands sub-area in 2006 and 2007 were averaged and summed. Missed sites have been omitted from the entire sub-area time series to allow aggregation of counts at the largest number of consistently surveyed sites. \* For eastern Gulf of Alaska in 1998, counts made in 1999 were substituted for those sites not surveyed in 1998. Sub-area count totals in 2004-2008 (\*\*) have been adjusted to account for resolution differences between film formats.

Year	Gulf of Alaska			Aleutian Islands			Kenai-Tanaga	Kenai-Kiska	Total	
	Eastern	Central	Western	Eastern	Central-East	Central-West				
1991	4,812	7,741	5,166	5,253	3,989	4,667	4,014	22,149	26,816	35,642
1992	3,981	7,244	4,980	5,631	3,377	4,257	3,746	21,232	25,489	33,215
1994	3,612	6,364	5,534	5,575	3,431	3,478	2,769	20,904	24,382	30,763
1996	2,450	5,272	5,155	5,861	2,906	3,462	3,022	19,194	22,656	28,128
1998*	2,158	4,736	5,131	5,700	3,673	3,344	2,450	19,240	22,584	27,192
2000	2,102	4,519	3,926	4,916	3,761	2,799	1,504	17,122	19,921	23,527
2002	2,615	4,513	4,509	5,209	4,111	2,436	1,102	18,342	20,778	24,495
2004**	3,015	3,997	5,217	5,876	4,323	2,562	1,182	19,413	21,975	26,172
2006**	3,101			5,961	3,647		961	19,976		
2007**	2,760	4,663	5,632	6,033						
2008**	4,065	4,363	5,557	6,344	3,585	2,232	853	19,849	22,081	27,000
<b>Percent change</b>										
1991-2000	-56%	-42%	-24%	-6%	-6%	-40%	-63%	-23%	-26%	-34%
2000-2008	+93%	-3%	+42%	+29%	-5%	-20%	-43%	+16%	+11%	+15%
2000-2004	+43%	-12%	+33%	+20%	+15%	-8%	-21%	+13%	+10%	+11%
2004-2008	+35%	+9%	+7%	+8%	-17%	-13%	-28%	+2%	0%	+3%
2004-2007	-8%	+17%	+8%	+3%	-16%			+3%		
2007-2008	+47%	-6%	-1%	+5%	-2%			-1%		
<b>Missing Site</b>		Long	Kak	Umnak C. Aslik			Buldir			

Table 5. Counts of Steller sea lion pups at selected rookeries in seven sub-areas of the western stock in Alaska from 1978-1979 to 2005-2007. Blank cells indicate incomplete counts in the period and sub-area. Percentage change in counts between periods is also shown.

Years	Gulf of Alaska			Aleutian Islands			Kenai to Kiska	Western Stock in AK
	Eastern (n=2)	Central (n=5)	Western (n=4)	Eastern (n=5)	Central (n=11)*	Western (n=4)		
1978-1979	574	18,893	9,351					
1985-1989		10,254	5,879	4,778	9,382		30,114	
1990-1992		4,904	1,923	2,115	3,568		12,510	
1994	903	2,831	1,662	1,756	3,109		9,358	
1997	611					979		
1998	689	1,876	1,493	1,474	2,834	803	7,677	9,169
2001-2002	586	1,721	1,671	1,561	2,612	488	7,565	8,639
2003-2004	716	1,609	1,577	1,731				
2005-2007	715	1,683	1,707	1,955	2,555	343	7,900	8,958
Percent Change								
1978-79 to 2001-02	+2%	-91%	-82%					
2001-02 to 2005-07	+22%	-2%	+2%	+25%	-2%	-30%	+4%	+4%
1998 to 2005-07	+4%	-10%	+14%	+33%	-10%	-57%	+3%	-2%

\* 1985-89 CAI count does not include Amchitka/Column Rocks (n=10)  
 2005-2007 CAI count includes 2004 count from Yunaska

Figure 1. Terrestrial rookery and haul-out sites in the range of eastern and western stocks of Steller sea lions in Alaska surveyed in 2008 and used in the analysis of population trends. Boundaries of the eastern, central, and western regions of the Gulf of Alaska (GOA) and Aleutian Islands (AI) are shown. The eastern and western stocks breed on rookeries east and west of 144°W, respectively.

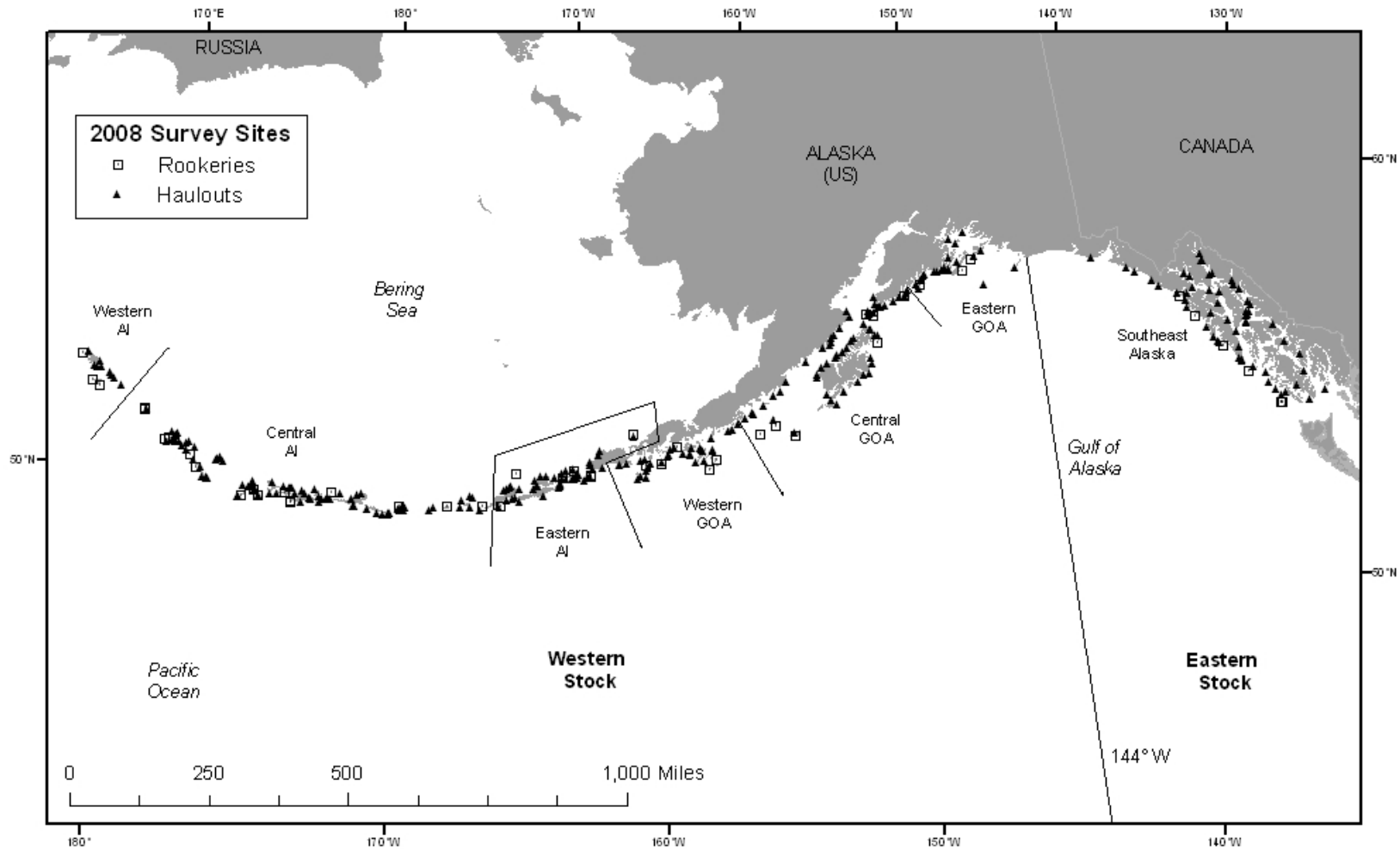
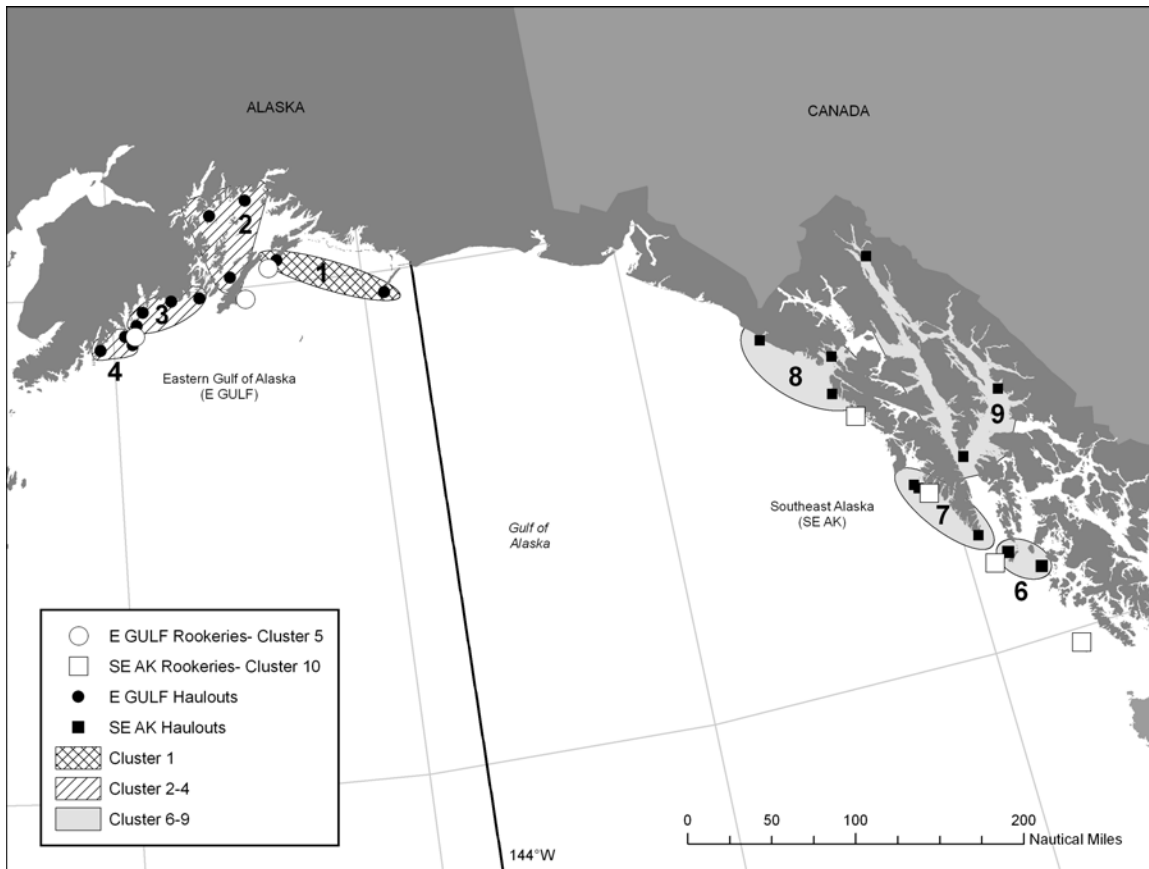


Figure 2. Clusters of haul-out and rookery sites used in analysis of non-pup Steller sea lion counts in the southeast Alaska and E GULF regions.



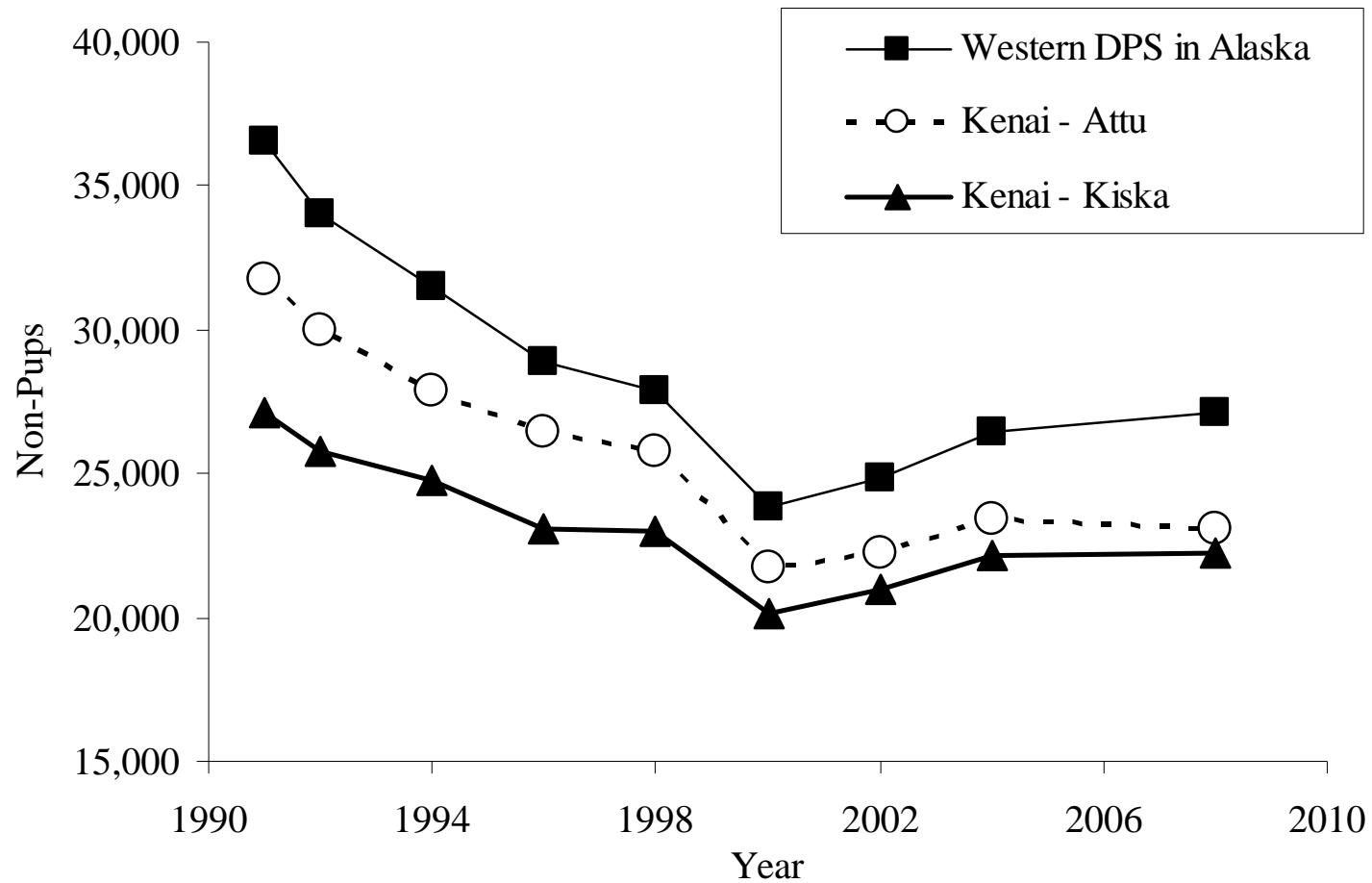


Figure 3. Total counts of adult and juvenile Steller sea lions at trend haul-out and rookery sites within the range of the western stock in Alaska, 1991-2008 (Figure 1). Data are from Table 3. “Kenai – Kiska” consists of the central and eastern Aleutian Island regions, and the western and central Gulf of Alaska. “Kenai – Attu” consists of the Kenai – Kiska region plus the western Aleutian Islands.

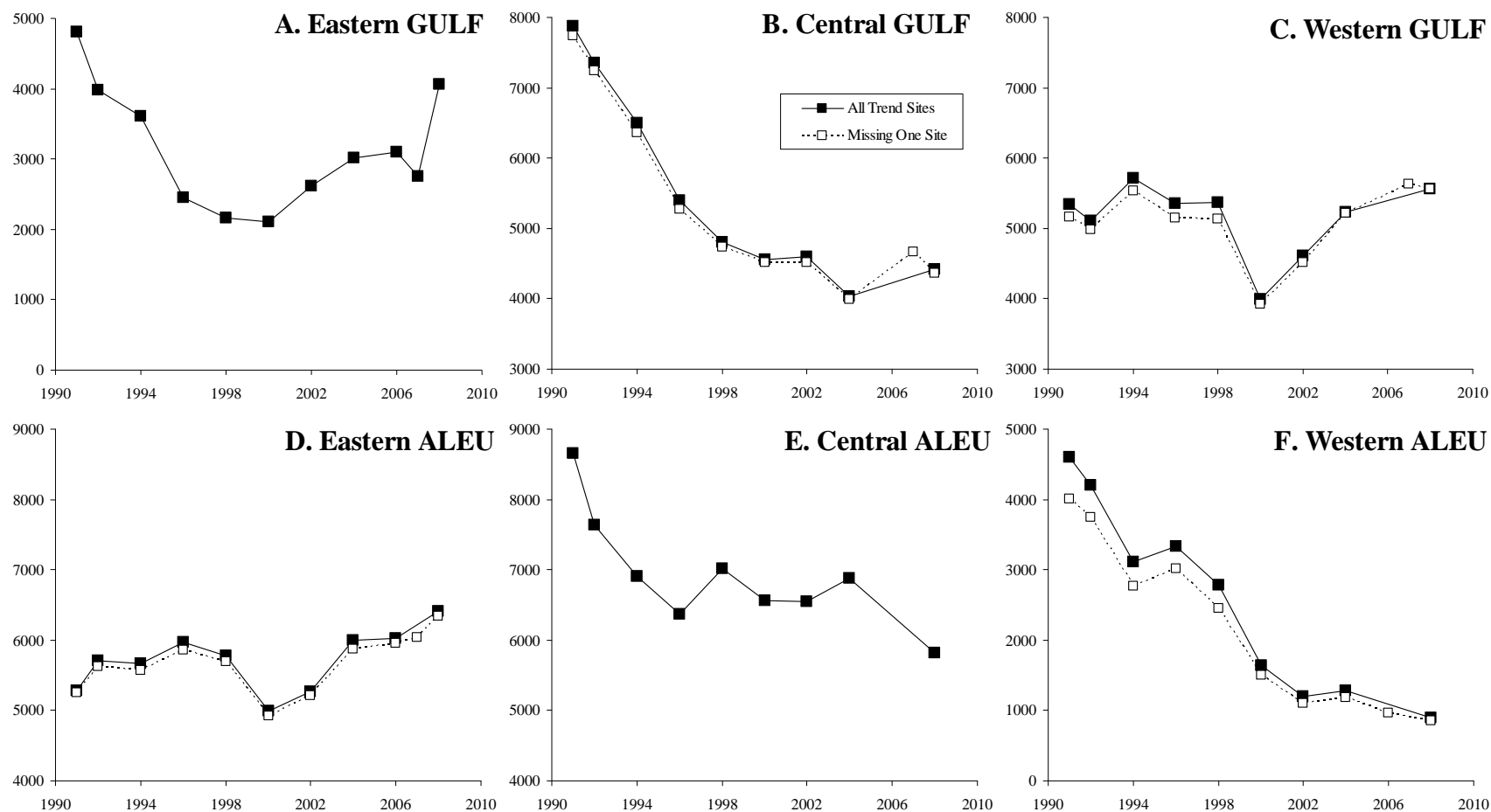


Figure 4. Total counts of adult and juvenile Steller sea lions at trend haul-out and rookery sites in 6 sub-areas within the range of the western stock in Alaska, 1991-2008. See Figure 1 for sub-area locations. Legend in B applies to all graphs. Data are from Tables 3 and 4. Missing sites are: Long Island in the Central Gulf (B), Kak Island in the Western Gulf (C), Umnak/Cape Aslik in the Eastern Aleutians (D), and Buldir Island in the Western Aleutians (F).

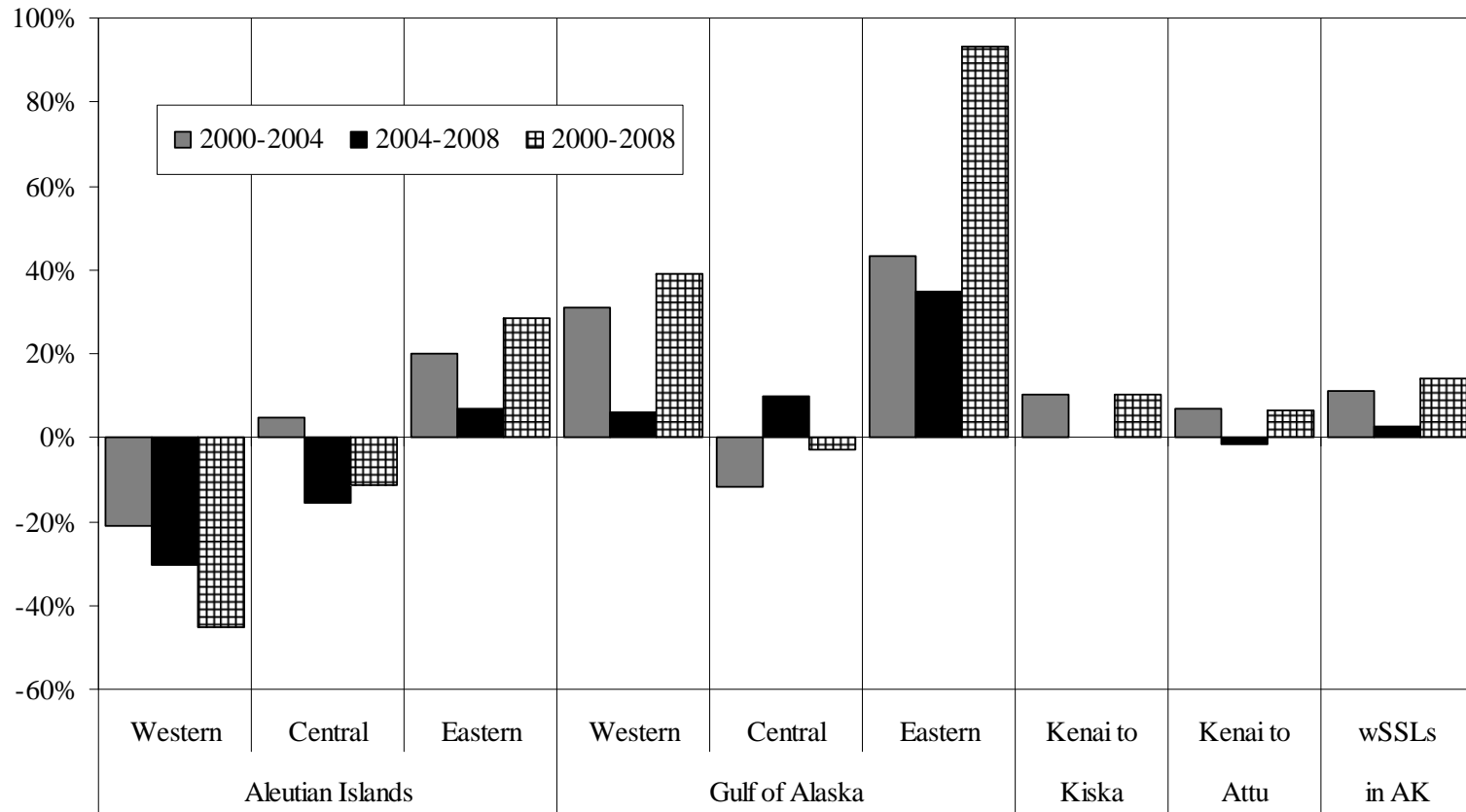


Figure 5. Percentage change in regional non-pup count totals between 2000 and 2004, 2004 and 2008, and the entire 2000-2008 period. Data are in Table 3.

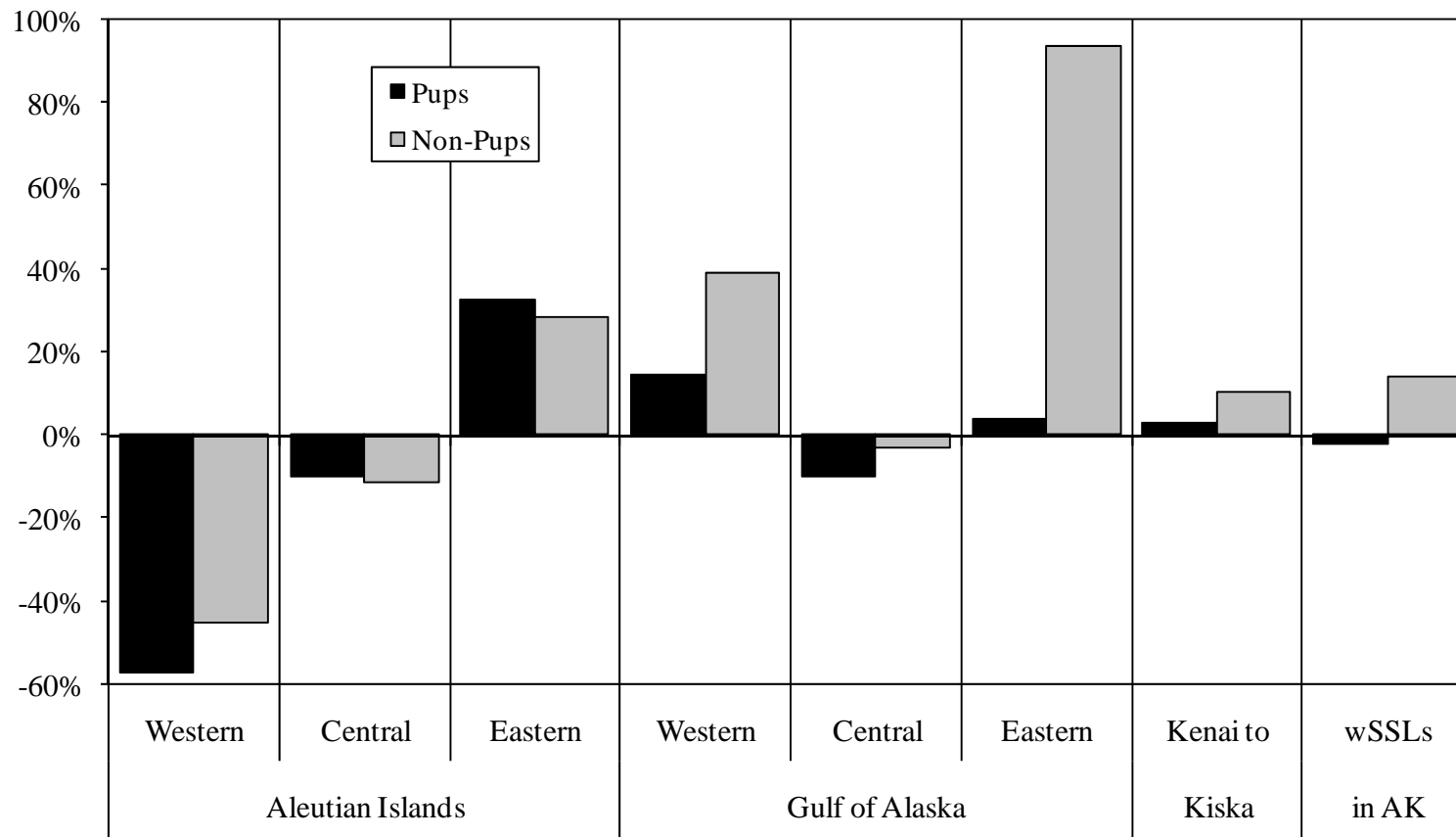


Figure 6. Percentage change in pup counts between 1998 and 2005/07 (Table 5) and non-pup counts between 2000 and 2008 (Table 3) by region within the range of the western stock of Steller sea lions (wSSLs) in Alaska.



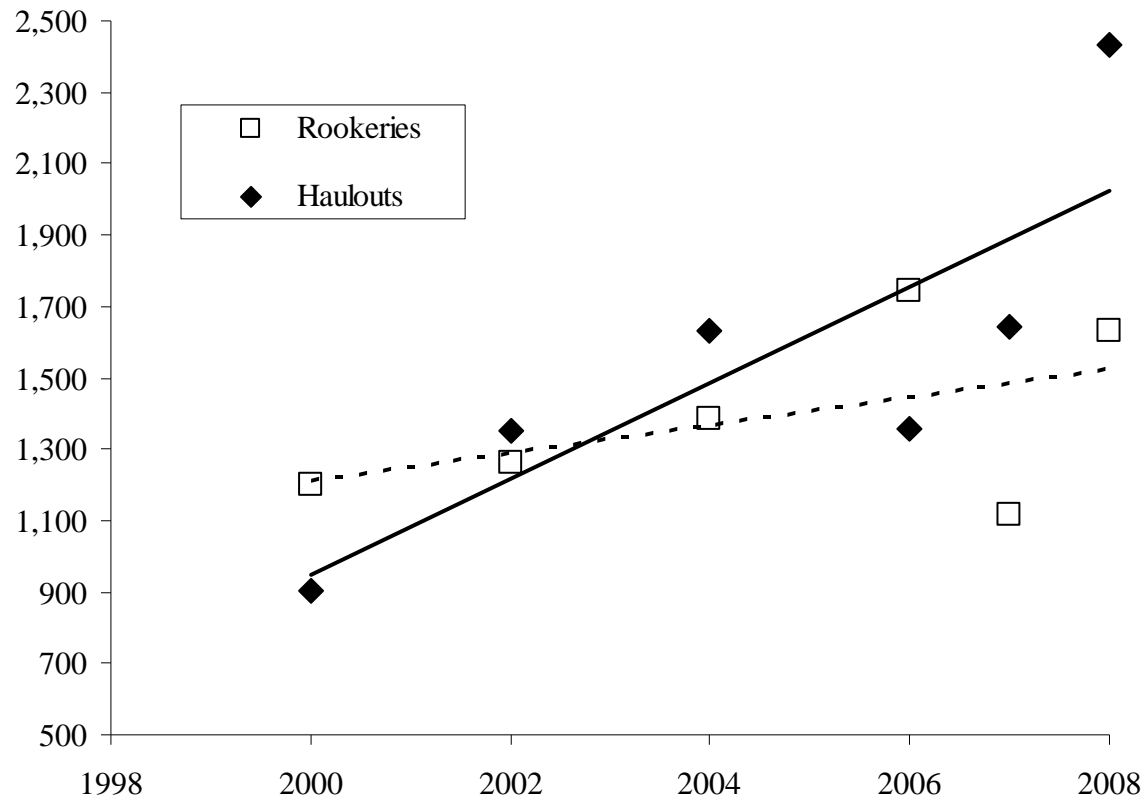


Figure 7. Counts of non-pup Steller sea lions in the eastern Gulf of Alaska on trend haul-out and rookery sites, 2000-2008. Counts at haul-outs increased significantly at 9% per year ( $P=0.03$ ), while the slope in trend rookery counts is not significantly different from 0 ( $P=0.35$ ).

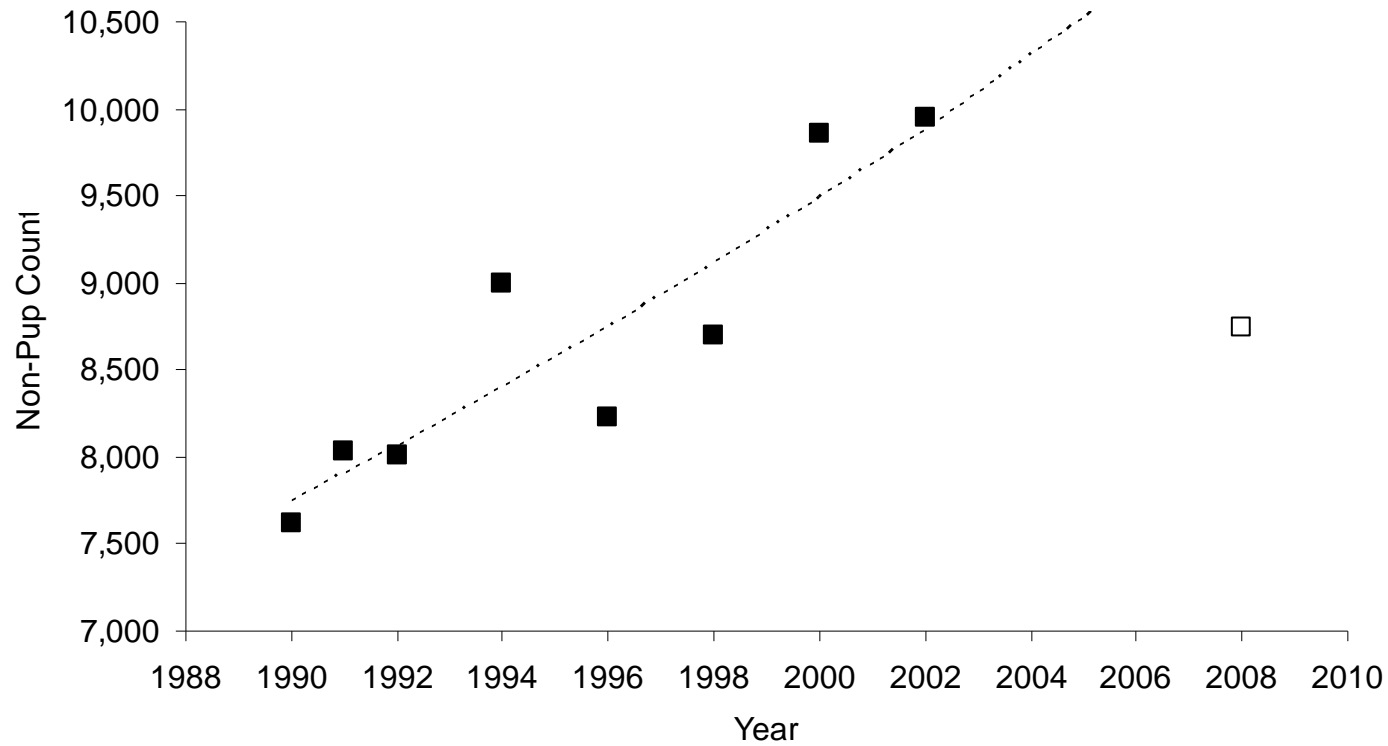


Figure 8. Total counts of adult and juvenile Steller sea lions at 10 trend haul-out and rookery sites in southeast Alaska, 1990-2008. Trend sites included Biali Rock, Cape Cross, Coronation, Forrester Complex, Graves Rock, Harbor Point, Hazy, Jacob Rock, The Brothers, and White Sisters. Regression line (dotted;  $r^2 = 0.81$ ) does not include 2008 data (open symbol); growth rate based on 1990-2002 non-pup counts was 2.1% per year.

Figure 9. Counts of adult and juvenile Steller sea lions in clusters of haul-outs and rookeries in the eastern Gulf of Alaska (E GULF) and southeast Alaska (southeast Alaska) in 2008 plotted against day of the year (1=1 June). Actual counts are plotted as points, and model estimates as lines with 95% confidence bounds. See text for details of model structure.

