Use of genetic techniques to determine sex ratio of commercial landings and assess population structure in Pacific halibut: progress in 2011

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Abstract

The eastern North Pacific halibut resource is presently managed under the assumption that a single, fully-mixed population exists from California through the eastern Bering Sea. This theory rests largely upon studies that indicate there is northwest larval drift balanced by migration of juveniles and adults to the southeast, over broad geographic expanses, together with tag recovery data showing extensive movement of fish. In 2002, a project was initiated to investigate genetic population structure in the northeast Pacific, including spawning groups from British Columbia, the central Gulf of Alaska, southeast Bering Sea, and eastern Aleutian Ridge. In the course of these investigations, a suite of microsatellite alleles was also discovered to show significant linkage to sex, providing a potential method for identifying gender of sampled individuals. Results of preliminary population analysis based on 16 microsatellite loci screened from samples collected in the eastern Pacific Ocean were presented in 2009, along with an analysis of sex-linked markers, and will not be repeated here. Work in 2010 and 2011 was focused upon collection of samples amenable to a formal comparison of genetic versus survey-based sex discrimination techniques, adding additional loci to the existing microsatellite analysis, broadening the spatial scope of the work to include the western Aleutians and the Sea of Okhotsk (Russia), and acquiring additional mitochondrial DNA (mtDNA) sequences to represent a similar geographic scope. Statistical analyses of the resulting data have not yet been completed; as such, the present report simply represents an accounting of commercial sampling and laboratory activities consisting of the collection of over 30,000 microsatellite genotypes and 185 mtDNA sequences.

Introduction

Presently, the eastern North Pacific halibut resource is managed under the assumption that a single, fully-mixed population exists from California through the eastern Bering Sea. While this assumption rests on the best available information regarding movements and spatial population structure, its validity remains questionable. Research using nuclear DNA microsatellites (Bentzen et al. 1998) supported the hypothesis that eastern and western Pacific stocks are genetically separate, but also suggested that the eastern Pacific population may be structured in distinct reproductive groups. Results of past genetic analyses are difficult to interpret due to a number of study limitations, and the true nature of the relationship between population components within the Bering Sea and Gulf of Alaska remained elusive.

In 2002 the IPHC embarked upon a renewed effort to examine genetic population structure in halibut using markers (nuclear microsatellites) that are theoretically more powerful than those previously employed, and to seek to remedy sampling problems that have hampered historical studies. Analyses have been conducted on samples collected from winter spawning aggregations distributed from British Columbia through the southeastern Bering Sea and eastern Aleutian Ridge, employing both nuclear microsatellites and mitochondrial DNA (mtDNA). In addition, during the course of our investigations we identified three loci which exhibit significantly different allele frequencies in males and females within the same sample populations (Galindo et al. 2011). Sex-specific genetic markers have been found for some teleost species (reviewed in Devlin and Nagahama 2002), but to our knowledge none have been applied on the scale of managing an entire fishery. Development of such genetic marker systems is hindered by the complex nature of sex determination and sex differentiation in fishes. Recent reviews have revealed a wide diversity of mechanisms extending across the entire spectrum from genetic to environmental (Devlin and Nagahama 2002, Mank et al. 2006, Penman and Piferrer 2008, Piferrer and Guiguen 2008). Currently, sex composition of the commercial halibut catch is estimated using a sex-at-length-and-age algorithm (Clark 2004), with some uncertainties regarding the accuracy of the method because it is sample-based rather than individual-based. Sex-linked microsatellites are potentially easier to apply and more accurate, and would be valuable in managing a species with highly sex-specific growth rates and exploitation patterns. Thus, beginning with the 2010 intership program (see Galindo et al. 2010) we began collecting samples aboard commercial longline vessels suitable for a formal analysis of the accuracy of genetic sex identification relative to that of the current survey-based method. Collections continued in 2011, with genotyping and cross-comparison of partitioning methods scheduled for late summer of 2012. Here, we provide an accounting of samples collected to date.

A genetic population analysis performed by Galindo et al. (2010) revealed little population structure using either nuclear microsatellite loci or mtDNA. However, these results were in contrast to a recent analysis conducted by Nielsen et al. (2009), in which significant genetic divergence of an Aleutian subpopulation was reported. Fundamental differences existed between the latter study and ours; namely, the use of some different markers in Nielsen at el. (2009) as well as inclusion of summer samples collected along the western Aleutian Ridge to the west of Amchitka Pass. Our work included only samples collected in the eastern Aleutians due to an inability to secure wintertime vessels for charters farther to the west, along with a desire to restrict analysis solely to samples collected during the winter spawning season, thereby avoiding the potential for sampling individuals from multiple breeding components that were mixed on common feeding grounds. Still, the results of Nielsen et al. (2009) suggest the possibility that either halibut in the western Aleutians are significantly isolated throughout the year, or that some of the markers used in their study had greater ability to resolve population structure than those used in ours. As such, we have since expanded the suite of markers used in our population and have increased the geographic scope to include both the western Aleutian region and the Sea of Okhotsk. Laboratory analysis of the required samples has been completed, but statistical analyses are incomplete and no new results are available at this juncture; completion of statistical treatments and an update of the population analysis is expected to be ready for peer-reviewed publication in 2012. Here, we provide a final accounting of all laboratory analyses conducted during the course of the population genetic project.

Summary of progress to date

Collection of commercial samples

In total 1,783 samples representing six regulatory areas (2B, 3A, 3B, 4A, 4C, 4D) have been collected (Table 1). For each fish sampled, sex was determined via macroscopic gonad examination, the fish was measured to the nearest centimeter, and its otoliths and a tissue sample were collected. An unknown proportion of sampled fish will be unavailable for comparison of genetic (Galindo et al. 2011) versus survey-based (Clark 2004) sex discrimination techniques due to lost, broken, and crystallized otoliths; that proportion will be unknown until all fish have been aged, scheduled for early in 2012. Of samples aged to-date (n = 1087), loss due to these factors has been approximately 4%.

Population analyses

Microsatellite screening conducted through 2011 comprises 30,000 genotypes representing 61 microsatellites (23 traditional microsatellites, and 38 microsatellites linked to coding genes (ESTs)) screened for ~1700 halibut from eight collection sites (Queen Charlotte Islands, Portlock Bank, Pribilof Canyon, Andreanof Islands, Attu, Petrel Bank, and two vessels in the Sea of Okhotsk; Fig. 1) and five sampling periods (1995, 1998-1999, 2004, 2005, 2007; Table 2). The 23 traditional microsatellites included the loci used by Nielsen et al (2009). Given previously detected genetic differentiation between sexes, samples were equally divided into males and females. Historical samples (pre-2000) were only screened at the 15 traditional loci originally used for this study.

In addition, a smaller collection of Atlantic halibut (*Hippoglossus hippoglossus*) samples (40 individuals) collected during 2007 and 2008 on the Scotian Shelf and provided to us by researchers at the Department of Fishes and Oceans' Bedford Institute of Oceanography, has been screened at 15 microsatellite loci comprising a subset of the loci used for full population analysis.

Analyses are still ongoing; however, we detected high variability at most of the EST loci with an average expected heterozygosity of 0.78 and an average of 13 alleles per locus (Table 3). Two loci showed significant linkage disequilibrium in all 16 samples (EST50 and EST58), suggesting physical proximity of these loci on the chromosome. In contrast, tests for linkage disequilibrium in all other locus pairs were significant for only three or fewer of the 16 samples, and thus probably represent Type I errors. Significant deviations from Hardy-Weinberg genotype proportions ($P<0.05$) were observed in 11% of tests, and seem to be concentrated in some loci. Using Fisher's combination of probabilities over all samples from both sexes identified the following loci whose genotype frequencies significantly deviate from Hardy Weinberg proportions: (EST14, EST26, EST60, Hhi56, Hhi58, Hhi59, HhiI29, Vmo17). We will evaluate these loci further to decide whether they need to be excluded from further analyses.

Mitochondrial DNA (mtDNA)

Five mitochondrial DNA regions (ATPase, ND5, control region, and two COI regions) representing ~2,160 base pairs (roughly 1/8th of the mtDNA genome) were sequenced for 30 Pacific halibut each from five collection sites (Russia, Attu, Adak, Queen Charlotte Islands) and from 35 Atlantic halibut collected from the central Scotian shelf. Preliminary examination suggests that some resequencing may be required before formal statistical analyses are possible; completion of this project component is anticipated in spring of 2012.

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Table 1. Sampling dates and number of Pacific halibut sampled from commercial vessels, by Regulatory Area, in 2010 and 2011. Each fish was sexed, measured to the nearest centimeter, and otoliths and a fin clip collected.

Regulatory Area	Collection dates	Fish sampled
2B	Jul 1-4, 2010	254
2B	Mar 15-17, 2011	266
3A	Jul 20-21, 2010	225
3B	Sep 17 - Oct 01, 2011	380
4A	Sep 10-17, 2011	280
4C	Aug 11-13, 2010	34
4D	May 10-16, 2011	344
	Total	**1,783**

Table 2. Sampling locations, dates, and number of mature male and female halibut sampled at each of the sites depicted in Figure 1. For Atlantic and Russian halibut samples, the locations listed are the mean central latitude and longitude of all samples received.

Site	Collection Date	Longitude	Latitude (N)	Female	Male	Unsexed
Pacific halibut						
RUS95	Jun 17 – Jul 24, 1995	145.453 E	49.798	159	49	0
RUS95 total				*159*	*49*	*0*
QCI98	Dec 2-7, 1998	133.628 W	54.181	36	12	0
QCI98	Dec 7-12, 1998	133.129 W	54.317	45	24	0
QCI98 totals				*81*	*36*	*0*
QCI04	Jan 12, 2004	130.616 W	51.860	40	60	0
QCI04	Jan 15, 2004	130.722 W	51.682	23	40	0
QCI04 totals				*63*	*100*	*0*
PTL99	Dec 12, 1998	151.886 W	56.606	3	2	0
PTL99	Dec 13, 1998	149.925 W	58.803	7	4	0
PTL99	Jan 6-10, 1999	149.273 W	57.929	49	46	0
PTL99	Jan 9, 1999	148.346 W	58.725	2	6	0
PTL99	Jan 12-14, 1999	146.420 W	59.049	8	4	0
PTL99	Jan 13, 1999	148.852 W	58.839	6	2	0
PTL99 total				*75*	*64*	*0*
PTL04	Jan 30-31, 2004	149.660 W	57.807	90	104	0
PTL04 total				*90*	*104*	*0*
PBC04	Feb 10, 2004	170.757 W	56.133	15	9	0
PBC04	Feb 11-15, 2004	169.538 W	56.132	9	18	0
PBC04	Feb 11-14, 2004	169.445 W	56.121	18	50	0
PBC04	Feb 13, 2004	169.287 W	56.191	14	24	0
PBC04 total				*56*	*101*	*0*
WAL05	Jul 25-29, 2005	174.000 E	52.667	38	62	0
WAL05 total				*38*	*62*	*0*
ANI07	Feb 22-23, 2007	175.907 W	52.142	7	11	0
ANI07	Feb 23-26, 2007	175.300 W	52.147	97	93	0
ANI07 total				*104*	*104*	*0*
Atlantic halibut						
SCS07	July 3-5, 2007	60.67 W	43.40	0	1	11
SCS08	May 29-30, 2008	59.34 W	44.22	57	43	0

Table 3. Vital statistics of ~1700 halibut at 61 microsatellite loci. There are 38 EST linked microsatellite loci (listed first, ESTxx) and 23 traditional microsatellite. Sample size per sample and locus (N), number of alleles (Na), observed (Ho) and unbiased expected heterozygosity (UHe), F_{IS} (F) and P-values of exact tests for deviations from Hardy Weinberg equilibrium (P) are provided. Significant tests (before Bonferroni correction) are bolded. Average values for all samples are provided at the end of the table, together with Fisher's combination of probabilities for HWE tests. Finally, data for traditional microsatellites in historical samples and Atlantic halibut are shown at the end of this table.

Queen Charlotte Islands			females						males			
Locus	N	Na	Ho	UHe	F	P	N	Na	Ho	UHe	F	P
EST12	34	7	0.412	0.458	0.087	0.257	25	9	0.520	0.473	-0.123	0.837
EST13	34	12	0.765	0.788	0.015	**0.014**	29	11	0.690	0.701	-0.001	0.752
EST14	35	22	0.943	0.940	-0.018	0.597	25	21	0.840	0.915	0.063	0.346
EST15	36	16	0.889	0.920	0.020	0.182	27	15	0.963	0.923	-0.063	0.732
EST17	33	14	0.909	0.894	-0.033	0.438	28	11	0.750	0.888	0.140	**0.022**
EST18	34	5	0.618	0.655	0.044	0.972	25	5	0.760	0.701	-0.106	0.765
EST20	34	32	0.971	0.962	-0.024	0.563	27	25	0.852	0.962	0.097	0.084
EST23	32	13	0.938	0.893	-0.066	0.707	29	13	0.759	0.903	0.145	0.130
EST24	36	12	0.806	0.755	-0.082	0.961	24	13	0.667	0.699	0.025	0.333
EST26	35	15	0.914	0.921	-0.007	0.107	27	14	0.852	0.899	0.035	0.427
EST27	35	17	0.886	0.904	0.005	0.481	27	19	0.963	0.929	-0.056	0.377
EST28	32	29	1.000	0.967	-0.050	0.304	27	25	0.963	0.967	-0.014	0.511
EST29	33	17	0.879	0.894	0.002	0.903	28	16	0.893	0.912	0.004	0.752
EST30	33	6	0.576	0.631	0.074	0.182	28	5	0.571	0.556	-0.047	1.000
EST33	34	5	0.382	0.337	-0.151	1.000	29	3	0.276	0.341	0.176	0.398
EST34	35	10	0.657	0.743	0.103	0.322	27	8	0.778	0.757	-0.047	0.408
EST36	36	18	0.944	0.922	-0.039	0.303	28	14	0.714	0.885	0.178	**0.003**
EST39	34	15	0.882	0.854	-0.048	0.490	27	13	0.889	0.861	-0.052	0.423
EST40	36	5	0.722	0.641	-0.142	0.507	29	4	0.586	0.587	-0.015	0.840
EST41	33	36	0.970	0.980	-0.004	0.685	27	31	1.000	0.973	-0.047	0.277
EST42	35	11	0.714	0.736	0.016	0.179	26	10	0.654	0.680	0.020	0.530
EST44	35	7	0.714	0.659	-0.100	0.155	28	9	0.429	0.641	0.319	**0.005**
EST46	35	6	0.686	0.609	-0.142	0.935	29	5	0.621	0.599	-0.055	0.848
EST47	36	5	0.667	0.630	-0.073	0.670	28	4	0.679	0.658	-0.049	0.527
EST48	34	9	0.794	0.818	0.015	0.581	28	7	0.786	0.821	0.025	0.375
EST49	35	14	0.943	0.897	-0.066	0.588	28	14	0.929	0.890	-0.063	0.348
EST50	36	6	0.833	0.683	-0.237	0.453	28	4	0.607	0.679	0.089	0.191
EST53	36	16	0.917	0.910	-0.022	0.222	27	14	1.000	0.919	-0.109	0.832
EST54	34	7	0.559	0.508	-0.117	0.964	28	8	0.679	0.658	-0.049	0.893
EST55	31	10	0.839	0.841	-0.013	0.232	26	7	0.769	0.742	-0.057	0.975
EST56	35	10	0.914	0.782	-0.186	0.161	27	9	0.852	0.854	-0.016	0.517
EST58	34	6	0.824	0.686	-0.219	0.521	28	4	0.607	0.679	0.089	0.191
EST60	21	24	0.619	0.971	0.347	**0.000**	20	19	0.650	0.955	0.302	**0.000**
EST62	24	8	0.417	0.465	0.084	0.480	22	7	0.409	0.433	0.034	0.182
EST63	23	11	0.870	0.883	-0.007	0.537	24	12	0.958	0.911	-0.074	0.985
EST64	22	24	0.955	0.945	-0.034	0.652	16	23	0.938	0.974	0.006	0.497
EST65	22	6	0.727	0.728	-0.022	0.369	22	4	0.636	0.587	-0.110	0.558
EST68	22	14	1.000	0.883	-0.159	0.599	23	16	1.000	0.928	-0.102	0.830
Hhi1	47	10	0.681	0.742	0.072	0.151	47	12	0.723	0.766	0.046	0.347
Hhi101IMB	48	24	1.000	0.920	-0.098	0.520	46	20	0.935	0.904	-0.045	0.194
Hhi102IMB	47	18	0.979	0.854	-0.159	0.155	46	20	0.891	0.925	0.026	**0.010**
Hhi120IMB	48	38	0.958	0.969	0.000	0.721	43	31	0.930	0.970	0.030	0.501
Hhi3	48	29	0.938	0.959	0.013	0.828	46	27	0.978	0.957	-0.033	0.785
Hhi51	22	12	1.000	0.743	-0.377	0.694	22	5	0.182	0.175	-0.060	1.000
Hhi53	47	37	0.979	0.974	-0.015	0.753	43	47	0.953	0.985	0.021	0.174
Hhi55	48	16	0.813	0.822	0.001	0.377	46	13	0.804	0.827	0.016	0.649
Hhi55IMB	47	6	0.809	0.652	-0.254	**0.005**	47	6	0.723	0.670	-0.091	0.309
Hhi56	21	8	0.619	0.712	0.109	0.076	22	9	0.682	0.717	0.027	**0.039**
Hhi57	47	27	0.915	0.903	-0.025	0.403	43	28	0.907	0.921	0.004	0.943
Hhi58IMB	48	34	0.854	0.966	0.106	**0.036**	44	31	0.932	0.960	0.018	0.442
Hhi59	47	5	0.915	0.636	-0.453	**0.000**	47	8	0.745	0.713	-0.056	0.829
Hhi63	47	34	0.979	0.969	-0.021	0.586	43	31	0.930	0.967	0.026	0.190
Hhi79IMB	48	26	0.979	0.955	-0.036	0.941	46	26	0.935	0.959	0.014	0.255
HhiA44	48	33	0.917	0.962	0.037	0.071	46	33	0.957	0.963	-0.004	0.442
HhiC17	46	32	0.978	0.969	-0.020	0.424	41	30	0.951	0.966	0.003	0.232
HhiI29	47	42	0.894	0.969	0.068	0.061	38	41	0.921	0.979	0.046	**0.019**
Hst14	20	13	0.950	0.890	-0.095	0.728	21	13	0.714	0.844	0.133	0.183
Hst17	23	11	0.696	0.843	0.157	0.550	22	11	0.955	0.852	-0.146	0.620
Hst7a	23	9	0.609	0.677	0.081	0.268	23	7	0.783	0.710	-0.127	0.542
Vmo17	22	3	0.091	0.173	0.463	**0.047**	23	5	0.304	0.466	0.332	**0.003**
Vva13	21	6	0.714	0.738	0.008	0.327	20	7	0.850	0.726	-0.201	0.846
Portlock Bank												
Locus	N	Na	Ho	UHe	F	P	N	Na	Ho	UHe	F	P
EST12	23	5	0.478	0.476	-0.026	0.105	22	4	0.409	0.349	-0.200	1.000
EST13	24	11	0.750	0.729	-0.051	0.166	20	9	0.800	0.783	-0.047	0.501
EST14	21	17	0.810	0.931	0.110	**0.048**	17	13	0.882	0.923	0.015	0.562
EST15	23	19	0.870	0.929	0.043	0.174	22	16	0.909	0.919	-0.013	**0.011**
EST17	20	9	0.800	0.853	0.038	0.781	16	9	0.688	0.893	0.205	0.055
EST18	22	5	0.500	0.641	0.201	**0.020**	23	7	0.739	0.733	-0.030	0.397

EST20	18	24	1.000	0.975	-0.055	1.000	18	24	0.889	0.975	0.062	0.097
EST23	23	10	0.870	0.869	-0.023	0.438	21	11	0.857	0.864	-0.016	0.412
EST24	21	11	0.762	0.744	-0.048	0.930	13	9	0.769	0.745	-0.074	0.845
EST26	24	12	0.958	0.907	-0.079	0.962	18	12	0.889	0.919	0.005	0.432
EST27	23	17	0.957	0.924	-0.059	0.209	19	14	0.842	0.905	0.044	0.196
EST28	18	26	0.944	0.979	0.008	0.414	16	21	1.000	0.970	-0.064	1.000
EST29	22	16	0.773	0.905	0.126	0.059	13	13	0.923	0.892	-0.076	0.737
EST30	24	4	0.792	0.630	-0.283	0.408	20	4	0.750	0.653	-0.179	0.332
EST33	23	3	0.304	0.329	0.056	0.620	19	2	0.316	0.341	0.050	1.000
EST34	22	6	0.545	0.665	0.161	0.632	23	7	0.696	0.650	-0.094	0.912
EST36	22	16	0.818	0.923	0.093	0.348	23	14	0.957	0.903	-0.082	0.657
EST39	18	8	0.944	0.832	-0.168	0.488	13	8	0.846	0.837	-0.051	0.873
EST40	23	5	0.739	0.592	-0.276	0.739	19	8	0.737	0.676	-0.120	0.430
EST41	19	26	1.000	0.980	-0.048	0.350	19	23	1.000	0.966	-0.063	1.000
EST42	22	10	0.773	0.706	-0.120	0.140	16	8	0.875	0.704	-0.284	**0.008**
EST44	23	8	0.739	0.659	-0.147	0.964	23	6	0.652	0.630	-0.058	0.752
EST46	24	4	0.208	0.424	0.498	**0.007**	21	4	0.619	0.580	-0.094	0.093
EST47	24	4	0.542	0.494	-0.120	0.910	20	3	0.800	0.609	-0.347	**0.042**
EST48	24	8	0.875	0.819	-0.091	0.598	21	10	0.857	0.805	-0.091	0.837
EST49	20	12	0.900	0.877	-0.053	0.840	15	9	1.000	0.897	-0.154	0.769
EST50	22	8	0.773	0.716	-0.105	0.365	23	6	0.652	0.680	0.020	0.231
EST53	23	15	0.913	0.920	-0.015	0.890	19	14	0.895	0.923	0.005	0.707
EST54	19	8	0.632	0.629	-0.032	0.399	20	6	0.500	0.487	-0.053	1.000
EST55	24	9	0.833	0.841	-0.012	0.351	19	11	0.895	0.859	-0.070	0.868
EST56	20	10	0.850	0.833	-0.046	0.857	18	9	1.000	0.867	-0.187	0.761
EST58	22	7	0.773	0.704	-0.123	0.242	18	4	0.667	0.678	-0.012	0.907
EST60	17	22	0.765	0.971	0.189	**0.006**	12	14	0.500	0.938	0.444	**0.000**
EST62	22	5	0.364	0.425	0.124	0.451	22	7	0.636	0.577	-0.128	0.845
EST63	21	11	0.905	0.907	-0.022	0.844	20	12	0.650	0.887	0.249	**0.005**
EST64	17	20	1.000	0.952	-0.082	0.818	16	20	0.938	0.972	0.004	0.474
EST65	24	6	0.708	0.621	-0.166	0.405	19	5	0.737	0.688	-0.099	0.741
EST68	17	11	0.882	0.865	-0.052	0.896	18	12	0.667	0.890	0.230	**0.020**
Hhi1	47	11	0.745	0.732	-0.029	0.409	42	12	0.810	0.744	-0.101	0.698
Hhi101IMB	47	21	0.979	0.899	-0.101	**0.008**	38	20	0.895	0.909	0.003	0.695
Hhi102IMB	48	16	0.938	0.803	-0.180	0.532	43	20	0.930	0.906	-0.039	0.490
Hhi120IMB	44	36	0.909	0.969	0.051	**0.002**	38	35	0.895	0.968	0.064	0.156
Hhi3	48	32	0.979	0.970	-0.020	0.595	43	31	0.977	0.967	-0.022	0.744
Hhi51	20	10	1.000	0.754	-0.361	0.552	22	2	0.045	0.045	-0.023	-
Hhi53	46	43	0.935	0.977	0.033	0.274	42	37	0.905	0.975	0.061	**0.017**
Hhi55	42	13	0.857	0.785	-0.106	0.828	35	13	0.857	0.829	-0.049	0.992
Hhi55IMB	45	6	0.622	0.637	0.012	0.926	36	4	0.667	0.636	-0.063	1.000
Hhi56	9	4	0.556	0.608	0.032	0.803	15	5	0.800	0.692	-0.196	0.452
Hhi57	47	24	0.915	0.913	-0.013	0.989	41	27	0.805	0.880	0.074	0.196
Hhi58IMB	48	36	0.854	0.973	0.113	**0.002**	41	32	0.927	0.957	0.020	0.081
Hhi59	48	7	0.896	0.638	-0.420	**0.000**	43	6	0.512	0.502	-0.031	0.562
Hhi63	45	35	0.956	0.973	0.007	0.158	39	38	0.949	0.977	0.017	0.206
Hhi79IMB	48	32	0.958	0.962	-0.007	0.147	43	31	0.953	0.958	-0.007	0.878
HhiA44	46	26	0.848	0.941	0.089	**0.048**	39	25	0.923	0.955	0.021	0.530
HhiC17	47	33	0.979	0.967	-0.023	0.792	39	33	0.949	0.968	0.008	0.781
HhiI29	38	40	0.974	0.981	-0.005	0.427	24	27	0.958	0.966	-0.013	0.251
Hst14	20	10	0.800	0.829	0.011	0.519	20	11	0.900	0.809	-0.141	0.814
Hst17	24	11	0.917	0.879	-0.066	0.766	22	8	0.864	0.837	-0.056	0.940
Hst7a	24	11	0.750	0.683	-0.122	0.203	22	4	0.682	0.662	-0.054	1.000
Vmo17	10	2	0.300	0.268	-0.176	1.000	15	2	0.133	0.129	-0.071	1.000
Vva13	9	4	0.556	0.575	-0.023	1.000	15	9	0.800	0.747	-0.108	0.106

Pribilof Canyon

Locus	N	Na	Ho	UHe	F	P	N	Na	Ho	UHe	F	P
EST12	21	6	0.429	0.535	0.180	0.071	15	7	0.733	0.600	-0.264	0.743
EST13	18	8	0.611	0.692	0.092	0.266	22	11	0.773	0.771	-0.026	0.055
EST14	20	13	0.700	0.849	0.154	0.074	17	17	0.824	0.941	0.098	**0.041**
EST15	23	16	0.957	0.929	-0.052	0.524	21	17	1.000	0.936	-0.094	0.856
EST17	19	10	0.895	0.875	-0.050	0.547	23	10	0.826	0.878	0.039	0.226
EST18	23	7	0.609	0.757	0.178	**0.049**	18	5	0.611	0.559	-0.125	0.654
EST20	21	20	0.762	0.916	0.148	**0.016**	19	26	1.000	0.980	-0.048	1.000
EST23	22	11	0.909	0.876	-0.062	0.689	23	11	0.826	0.879	0.040	0.359
EST24	20	6	0.800	0.745	-0.102	0.863	21	9	0.905	0.758	-0.222	0.469
EST26	18	12	0.944	0.908	-0.070	0.830	23	16	0.913	0.907	-0.029	0.318
EST27	22	15	1.000	0.904	-0.132	0.768	24	16	0.958	0.923	-0.061	0.913
EST28	20	26	1.000	0.971	-0.057	0.610	16	23	1.000	0.980	-0.053	1.000
EST29	22	17	0.909	0.911	-0.021	0.461	21	11	0.857	0.875	-0.004	0.224
EST30	20	4	0.600	0.583	-0.055	0.795	22	7	0.773	0.681	-0.161	0.941
EST33	21	4	0.381	0.331	-0.179	1.000	24	5	0.292	0.300	0.006	0.356
EST34	23	10	0.783	0.693	-0.155	0.797	24	6	0.792	0.661	-0.223	0.870
EST36	23	16	0.913	0.911	-0.024	0.823	21	15	0.714	0.926	0.210	0.095
EST39	19	10	0.842	0.841	-0.029	0.808	22	9	0.818	0.812	-0.031	0.154
EST40	21	5	0.571	0.571	-0.024	1.000	23	7	0.609	0.650	0.043	0.286
EST41	20	23	0.950	0.962	-0.013	0.358	18	22	1.000	0.967	-0.064	1.000
EST42	19	8	0.632	0.676	0.040	0.117	24	9	0.708	0.735	0.016	0.790
EST44	22	6	0.682	0.619	-0.126	0.430	20	5	0.700	0.642	-0.118	1.000
EST46	22	5	0.591	0.580	-0.042	0.657	24	5	0.792	0.607	-0.331	0.343
EST47	23	6	0.478	0.521	0.061	**0.047**	22	4	0.727	0.552	-0.349	0.139
EST48	21	7	0.810	0.729	-0.137	0.963	22	11	0.727	0.823	0.096	0.479
EST49	16	12	0.875	0.863	-0.047	0.818	16	10	0.813	0.800	-0.048	0.188
EST50	23	5	0.565	0.612	0.055	0.805	24	5	0.458	0.691	0.322	**0.009**
EST53	23	14	0.957	0.927	-0.055	0.623	20	13	1.000	0.919	-0.116	0.997
EST54	23	8	0.826	0.693	-0.219	0.421	24	5	0.417	0.510	0.165	0.157
EST55	23	9	0.826	0.848	0.005	0.610	23	8	0.913	0.825	-0.131	0.498

EST56	21	10	0.762	0.889	0.122	0.143	23	9	0.826	0.842	-0.003	0.476
EST58	20	5	0.550	0.600	0.060	0.671	24	5	0.458	0.691	0.322	**0.008**
EST60	21	20	0.619	0.959	0.339	**0.000**	20	23	0.650	0.968	0.311	**0.000**
EST62	20	5	0.350	0.356	-0.007	0.572	22	9	0.682	0.553	-0.262	1.000
EST63	22	10	0.909	0.883	-0.054	0.608	23	12	0.870	0.901	0.014	0.178
EST64	18	23	0.944	0.971	0.000	0.484	12	19	1.000	0.978	-0.067	1.000
EST65	23	5	0.609	0.665	0.064	0.387	22	8	0.682	0.709	0.016	0.262
EST68	21	13	0.905	0.863	-0.074	0.918	19	14	0.947	0.927	-0.049	0.980
Hhi1	44	12	0.773	0.750	-0.042	0.705	46	11	0.804	0.766	-0.061	0.956
Hhi101IMB	42	23	0.952	0.893	-0.079	0.786	46	19	0.978	0.927	-0.067	0.938
Hhi102IMB	45	18	0.933	0.840	-0.124	0.084	47	19	0.894	0.890	-0.014	0.649
Hhi120IMB	43	31	0.930	0.963	0.022	**0.039**	44	36	1.000	0.974	-0.039	0.777
Hhi3	45	31	0.956	0.963	-0.004	0.358	47	30	0.957	0.964	-0.004	0.712
Hhi51	20	10	0.950	0.747	-0.304	0.709	15	3	0.133	0.131	-0.053	1.000
Hhi53	45	39	1.000	0.976	-0.036	0.983	47	39	1.000	0.973	-0.039	1.000
Hhi55	33	12	0.788	0.818	0.022	0.072	44	13	0.773	0.821	0.048	0.167
Hhi55IMB	44	5	0.682	0.676	-0.021	0.597	46	5	0.804	0.642	-0.267	**0.018**
Hhi56	10	4	0.500	0.616	0.145	0.622	12	5	0.583	0.667	0.087	0.150
Hhi57	45	31	0.867	0.911	0.038	0.409	47	28	0.957	0.920	-0.052	0.900
Hhi58IMB	45	37	0.956	0.971	0.005	0.410	45	33	0.933	0.965	0.022	0.343
Hhi59	45	6	0.933	0.612	-0.542	**0.000**	47	7	0.617	0.603	-0.035	0.903
Hhi63	44	33	0.909	0.967	0.049	0.153	47	39	0.957	0.972	0.004	0.389
Hhi79IMB	45	29	0.956	0.956	-0.011	0.885	46	28	0.957	0.952	-0.016	0.837
HhiA44	44	36	0.977	0.965	-0.025	0.848	47	31	0.936	0.960	0.014	0.611
HhiC17	45	32	0.933	0.967	0.024	0.394	47	34	0.979	0.967	-0.023	0.757
HhiI29	45	44	0.867	0.981	0.107	**0.000**	46	44	0.870	0.982	0.105	**0.000**
Hst14	20	11	0.750	0.871	0.116	0.190	14	11	0.714	0.778	0.048	0.199
Hst17	23	13	0.783	0.889	0.100	0.098	19	11	0.947	0.885	-0.100	0.927
Hst7a	23	8	0.826	0.700	-0.206	0.669	18	8	0.722	0.768	0.033	0.153
Vmo17	11	1	0.000	0.000	-	-	12	3	0.500	0.518	-0.007	0.182
Vva13	11	6	0.818	0.762	-0.125	0.571	12	7	0.833	0.754	-0.154	0.050
Andreanof Island												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	P	**N**	**Na**	**Ho**	**UHe**	**F**	P
EST12	40	7	0.525	0.535	0.007	0.203	37	11	0.568	0.568	-0.013	0.935
EST13	40	9	0.725	0.768	0.044	0.669	41	12	0.756	0.737	-0.038	0.811
EST14	39	23	0.821	0.938	0.114	0.096	33	19	0.727	0.937	0.212	**0.000**
EST15	43	17	0.977	0.890	-0.110	0.871	41	16	0.878	0.911	0.024	0.478
EST17	41	13	0.829	0.885	0.051	0.414	43	12	0.884	0.901	0.008	0.480
EST18	40	6	0.675	0.685	0.002	0.993	35	6	0.714	0.697	-0.039	0.419
EST20	44	34	0.909	0.969	0.051	**0.000**	45	36	0.978	0.967	-0.023	0.383
EST23	40	11	0.825	0.868	0.038	0.874	42	12	0.857	0.887	0.022	**0.024**
EST24	41	12	0.707	0.725	0.013	0.607	39	15	0.641	0.705	0.078	0.335
EST26	39	15	0.897	0.888	-0.024	0.900	39	16	0.872	0.916	0.036	0.588
EST27	44	24	0.932	0.937	-0.006	0.472	41	23	0.951	0.910	-0.059	0.591
EST28	35	31	0.971	0.962	-0.025	0.985	36	35	0.972	0.978	-0.008	0.756
EST29	38	16	0.895	0.888	-0.021	0.731	41	20	0.927	0.919	-0.021	0.927
EST30	39	7	0.538	0.702	0.223	0.236	41	6	0.488	0.615	0.196	**0.013**
EST33	43	2	0.209	0.226	0.062	0.519	40	6	0.400	0.406	0.003	0.899
EST34	40	9	0.700	0.829	0.145	0.176	43	13	0.581	0.758	0.224	**0.020**
EST36	42	19	0.833	0.911	0.075	0.598	44	18	0.886	0.914	0.019	0.153
EST39	44	13	0.750	0.836	0.093	0.840	43	15	0.907	0.880	-0.043	0.351
EST40	43	5	0.558	0.591	0.045	0.071	42	7	0.714	0.628	-0.152	0.074
EST41	41	36	0.951	0.973	0.010	0.346	35	37	0.971	0.976	-0.010	0.740
EST42	38	8	0.658	0.597	-0.116	0.525	35	8	0.543	0.673	0.182	0.093
EST44	41	6	0.561	0.603	0.058	0.074	35	7	0.457	0.612	0.242	0.240
EST46	44	6	0.614	0.546	-0.136	0.924	43	4	0.558	0.550	-0.026	1.000
EST47	42	4	0.667	0.641	-0.052	0.857	41	4	0.585	0.599	0.011	0.924
EST48	43	10	0.860	0.775	-0.123	0.309	43	11	0.884	0.811	-0.103	0.131
EST49	38	14	0.789	0.886	0.097	**0.016**	38	15	0.895	0.891	-0.017	**0.017**
EST50	42	5	0.619	0.675	0.072	0.156	44	9	0.750	0.719	-0.055	0.456
EST53	43	16	0.907	0.918	0.000	0.981	41	18	0.976	0.932	-0.060	0.760
EST54	40	8	0.600	0.567	-0.071	0.337	44	7	0.455	0.425	-0.082	0.897
EST55	38	8	0.658	0.778	0.143	0.109	38	9	0.763	0.796	0.029	0.712
EST56	41	10	0.805	0.808	-0.008	0.463	40	13	0.850	0.790	-0.090	0.633
EST58	44	6	0.636	0.686	0.062	0.189	43	8	0.744	0.714	-0.055	0.402
EST60	22	25	0.727	0.975	0.236	**0.000**	19	22	0.789	0.966	0.161	**0.005**
EST62	21	8	0.476	0.487	-0.002	0.366	20	8	0.750	0.628	-0.224	0.982
EST63	24	9	0.917	0.867	-0.080	0.293	24	10	0.875	0.893	-0.001	0.277
EST64	20	24	0.950	0.964	-0.011	0.306	19	22	0.895	0.960	0.043	0.266
EST65	22	5	0.455	0.571	0.185	0.076	19	6	0.684	0.606	-0.160	0.806
EST68	24	12	0.750	0.886	0.135	0.174	24	14	0.875	0.922	0.031	0.262
Hhi1	86	15	0.756	0.739	-0.028	0.883	82	13	0.829	0.763	-0.094	**0.042**
Hhi101IMB	84	27	0.976	0.912	-0.077	0.335	77	26	0.935	0.912	-0.031	0.180
Hhi102IMB	65	22	0.985	0.847	-0.171	0.346	80	21	0.888	0.908	0.017	0.458
Hhi120IMB	88	41	0.977	0.969	-0.014	0.923	83	40	0.940	0.968	0.023	**0.036**
Hhi3	88	35	0.966	0.964	-0.008	0.542	89	33	0.966	0.959	-0.013	0.328
Hhi51	20	11	1.000	0.771	-0.331	0.710	17	4	0.176	0.171	-0.062	1.000
Hhi53	88	52	0.977	0.979	-0.004	0.351	85	52	0.965	0.978	0.008	0.325
Hhi55	85	13	0.882	0.836	-0.061	0.936	92	15	0.859	0.861	-0.003	0.958
Hhi55IMB	90	6	0.556	0.640	0.128	0.123	88	5	0.614	0.624	0.011	0.623
Hhi56	24	8	0.542	0.703	0.213	**0.008**	21	6	0.619	0.706	0.102	**0.004**
Hhi57	76	37	0.947	0.922	-0.035	0.593	64	31	0.969	0.922	-0.059	0.689
Hhi58IMB	88	47	0.909	0.970	0.057	**0.013**	83	45	0.952	0.974	0.017	**0.009**
Hhi59	79	5	0.924	0.643	-0.447	**0.000**	85	7	0.565	0.610	0.068	**0.015**
Hhi63	88	40	0.852	0.972	0.118	**0.000**	87	44	0.897	0.970	0.070	0.088
Hhi79IMB	79	34	0.924	0.957	0.028	0.069	77	33	0.935	0.952	0.012	0.776
HhiA44	85	43	0.953	0.964	0.005	0.855	89	44	0.978	0.959	-0.025	0.991

HhiC17	92	39	1.000	0.965	-0.042	0.591	90	41	0.989	0.968	-0.027	0.998
HhiI29	73	60	0.986	0.983	-0.010	0.823	76	57	0.974	0.978	-0.002	0.294
Hst14	20	12	0.850	0.832	-0.048	0.624	16	9	0.875	0.843	-0.072	0.939
Hst17	22	10	0.818	0.865	0.032	0.740	18	9	0.778	0.822	0.027	0.636
Hst7a	22	8	0.545	0.702	0.205	**0.018**	21	9	0.905	0.771	-0.202	0.865
Vmo17	24	3	0.250	0.441	0.421	**0.001**	22	4	0.318	0.425	0.234	0.066
Vva13	24	7	0.667	0.673	-0.012	0.374	21	9	0.905	0.792	-0.170	0.646
Petrel Bank												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	P	**N**	**Na**	**Ho**	**UHe**	**F**	P
EST12	19	5	0.368	0.504	0.249	0.253	20	6	0.500	0.423	-0.212	1.000
EST13	17	7	0.471	0.529	0.084	0.512	22	3	0.091	0.173	0.463	**0.047**
EST14	20	15	0.800	0.919	0.107	0.089	13	12	0.692	0.892	0.193	0.084
EST15	20	16	0.900	0.926	0.003	0.139	13	12	1.000	0.917	-0.134	0.927
EST17	16	12	0.875	0.909	0.007	0.363	10	9	0.800	0.884	0.048	0.645
EST18	19	5	0.737	0.708	-0.068	0.050	21	5	0.619	0.560	-0.133	0.928
EST20	17	19	0.941	0.952	-0.019	0.406	11	13	0.727	0.944	0.193	**0.041**
EST23	16	10	0.813	0.897	0.065	0.302	8	9	1.000	0.892	-0.196	1.000
EST24	22	8	0.545	0.646	0.136	0.154	15	10	0.667	0.802	0.140	**0.045**
EST26	21	2	1.000	0.512	-1.000	**0.000**	22	4	1.000	0.556	-0.840	**0.000**
EST27	18	17	0.944	0.921	-0.055	0.990	13	9	0.846	0.846	-0.040	0.470
EST28	17	19	0.882	0.955	0.049	0.339	16	22	1.000	0.976	-0.058	0.391
EST29	19	15	0.947	0.923	-0.054	0.659	15	12	0.867	0.908	0.013	0.563
EST30	19	4	0.789	0.570	-0.421	0.145	21	2	0.762	0.483	-0.615	**0.015**
EST33	22	4	0.545	0.437	-0.278	0.795	15	5	0.467	0.446	-0.082	0.549
EST34	21	6	0.524	0.657	0.184	0.154	20	6	0.650	0.746	0.107	0.276
EST36	22	11	0.636	0.872	0.253	**0.038**	22	17	0.864	0.921	0.040	0.384
EST39	18	9	0.722	0.797	0.068	0.284	10	11	1.000	0.884	-0.190	0.955
EST40	18	5	0.778	0.603	-0.326	0.712	21	4	0.810	0.626	-0.325	0.341
EST41	17	21	1.000	0.964	-0.068	1.000	19	26	0.947	0.979	0.006	0.078
EST42	18	7	0.556	0.638	0.104	0.719	20	13	0.850	0.858	-0.016	0.518
EST44	18	4	0.778	0.592	-0.351	0.284	21	3	0.476	0.553	0.118	0.225
EST46	17	3	0.706	0.563	-0.291	0.296	12	3	0.667	0.583	-0.193	1.000
EST47	23	4	0.435	0.608	0.269	**0.031**	22	5	0.591	0.646	0.064	0.238
EST48	18	7	0.833	0.825	-0.038	0.491	21	7	0.810	0.805	-0.030	0.202
EST49	20	12	0.900	0.896	-0.030	0.230	14	9	0.786	0.894	0.089	0.190
EST50	22	5	0.636	0.634	-0.027	0.350	19	4	0.632	0.609	-0.065	1.000
EST53	21	15	0.952	0.908	-0.074	0.613	19	14	0.947	0.937	-0.038	0.745
EST54	22	6	0.455	0.489	0.050	0.232	19	9	0.632	0.637	-0.018	0.526
EST55	20	6	0.750	0.745	-0.033	0.951	16	8	0.875	0.835	-0.082	0.725
EST56	20	11	0.900	0.873	-0.057	0.478	19	9	0.842	0.811	-0.067	0.733
EST58	21	5	0.667	0.627	-0.089	0.449	15	5	0.600	0.662	0.062	0.778
EST60	20	21	0.650	0.963	0.308	**0.000**	14	21	0.929	0.979	0.016	0.331
EST62	22	7	0.545	0.552	-0.011	0.715	20	4	0.400	0.453	0.093	0.229
EST63	17	11	0.882	0.909	0.000	0.258	11	10	0.727	0.857	0.111	0.654
EST64	19	20	0.895	0.956	0.039	0.150	11	18	1.000	0.983	-0.066	1.000
EST65	23	6	0.348	0.572	0.378	**0.044**	19	6	0.737	0.657	-0.152	1.000
EST68	17	11	0.824	0.900	0.057	0.339	10	13	0.900	0.953	0.006	0.487
Hhi1	23	10	0.652	0.726	0.081	0.380	21	10	0.619	0.761	0.166	0.081
Hhi101IMB	15	13	1.000	0.899	-0.151	0.885	11	13	1.000	0.935	-0.120	1.000
Hhi102IMB	14	11	1.000	0.828	-0.252	0.962	8	9	0.875	0.817	-0.143	0.600
Hhi120IMB	23	24	0.957	0.968	-0.010	0.353	19	24	1.000	0.974	-0.054	1.000
Hhi3	20	24	1.000	0.973	-0.054	0.561	9	10	1.000	0.928	-0.141	1.000
Hhi51	21	11	1.000	0.728	-0.407	0.687	21	5	0.333	0.340	-0.003	0.348
Hhi53	15	17	0.933	0.956	-0.010	0.679	13	22	1.000	0.988	-0.053	1.000
Hhi55	18	13	0.778	0.873	0.084	0.194	8	9	1.000	0.917	-0.164	0.726
Hhi55IMB	21	4	0.667	0.689	0.008	0.857	17	5	0.529	0.622	0.123	0.385
Hhi56	16	4	0.563	0.569	-0.021	1.000	15	7	0.467	0.756	0.362	**0.003**
Hhi57	17	18	0.941	0.927	-0.046	0.389	12	11	1.000	0.909	-0.147	1.000
Hhi58IMB	15	20	0.933	0.970	0.005	0.489	11	14	0.909	0.952	0.000	0.573
Hhi59	22	6	0.955	0.605	-0.615	**0.001**	16	4	0.375	0.429	0.099	**0.043**
Hhi63	13	22	1.000	0.988	-0.053	1.000	6	12	1.000	1.000	-0.091	1.000
Hhi79IMB	19	21	0.842	0.957	0.097	0.162	14	18	1.000	0.963	-0.077	1.000
HhiA44	18	21	1.000	0.965	-0.066	1.000	6	10	1.000	0.955	-0.143	1.000
HhiC17	21	28	0.952	0.976	0.000	0.122	16	21	1.000	0.972	-0.062	1.000
HhiI29	20	28	0.950	0.976	0.001	0.587	14	22	1.000	0.981	-0.057	1.000
Hst14	21	10	0.714	0.866	0.155	0.343	18	11	0.833	0.851	-0.007	0.166
Hst17	22	10	0.864	0.851	-0.039	0.279	20	10	0.950	0.853	-0.143	0.831
Hst7a	22	11	0.727	0.794	0.063	0.704	19	8	0.632	0.697	0.069	0.824
Vmo17	19	4	0.263	0.330	0.181	0.312	16	3	0.188	0.458	0.577	**0.003**
Vva13	19	6	0.474	0.482	-0.009	0.566	16	7	0.625	0.637	-0.013	0.519
Attu												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	P	**N**	**Na**	**Ho**	**UHe**	**F**	P
EST12	22	7	0.500	0.485	-0.054	0.124	20	6	0.350	0.359	0.000	0.588
EST13	14	6	0.786	0.638	-0.278	0.876	20	8	0.500	0.467	-0.099	0.789
EST14	23	13	0.739	0.915	0.174	0.095	15	15	0.933	0.952	-0.014	0.709
EST15	23	14	0.870	0.919	0.033	0.143	15	13	0.933	0.899	-0.074	0.666
EST17	21	8	0.619	0.882	0.281	**0.000**	11	9	0.909	0.861	-0.106	0.954
EST18	21	8	1.000	0.825	-0.242	0.161	21	6	0.714	0.666	-0.099	0.401
EST20	20	23	1.000	0.967	-0.061	0.701	13	17	0.846	0.966	0.089	0.108
EST23	22	11	1.000	0.882	-0.161	0.932	14	7	0.929	0.847	-0.138	0.937
EST24	21	7	0.667	0.660	-0.035	0.712	19	5	0.526	0.538	-0.005	0.319
EST26	18	2	1.000	0.514	-1.000	**0.000**	22	2	1.000	0.512	-1.000	**0.000**
EST27	23	16	0.913	0.903	-0.033	0.100	13	12	1.000	0.926	-0.123	0.522
EST28	18	23	1.000	0.970	-0.061	1.000	13	16	1.000	0.966	-0.076	1.000
EST29	22	12	0.864	0.902	0.020	0.169	16	15	0.875	0.931	0.030	0.313
EST30	18	4	0.667	0.649	-0.056	0.366	12	3	0.667	0.518	-0.343	0.742
EST33	20	6	0.600	0.564	-0.091	0.409	20	5	0.500	0.478	-0.072	1.000

EST34	23	9	0.739	0.690	-0.095	0.889	22	6	0.727	0.715	-0.041	0.939
EST36	24	16	0.750	0.922	0.169	0.152	22	12	0.727	0.887	0.161	0.142
EST39	20	10	0.950	0.850	-0.146	0.668	14	8	1.000	0.804	-0.289	0.304
EST40	23	5	0.696	0.634	-0.122	0.491	21	5	0.667	0.656	-0.041	0.936
EST41	19	23	1.000	0.969	-0.060	1.000	13	18	1.000	0.969	-0.073	1.000
EST42	24	12	0.583	0.749	0.205	0.058	15	4	0.667	0.524	-0.316	0.273
EST44	22	6	0.636	0.687	0.052	0.147	20	6	0.650	0.603	-0.106	0.742
EST46	23	5	0.696	0.580	-0.227	0.875	14	3	0.571	0.574	-0.032	1.000
EST47	23	3	0.522	0.503	-0.060	1.000	22	4	0.636	0.644	-0.011	0.314
EST48	23	9	0.870	0.754	-0.179	0.917	22	8	0.773	0.804	0.017	0.938
EST49	23	12	0.957	0.875	-0.117	0.051	17	12	0.882	0.916	0.008	0.627
EST50	23	5	0.652	0.706	0.056	0.294	21	4	0.571	0.624	0.061	0.701
EST53	24	17	1.000	0.934	-0.094	0.768	20	14	0.850	0.937	0.070	0.268
EST54	22	8	0.455	0.533	0.127	0.680	21	4	0.286	0.459	0.362	**0.023**
EST55	22	7	0.727	0.818	0.090	0.362	18	8	0.833	0.863	0.007	0.292
EST56	22	9	0.818	0.839	0.003	0.761	16	10	0.875	0.829	-0.090	0.701
EST58	21	5	0.714	0.717	-0.021	0.257	20	4	0.600	0.592	-0.039	0.766
EST60	23	23	0.522	0.967	0.449	**0.000**	14	16	0.500	0.955	0.457	**0.000**
EST62	24	7	0.375	0.402	0.046	0.677	21	4	0.190	0.182	-0.070	1.000
EST63	21	12	0.905	0.911	-0.018	0.305	14	9	0.929	0.857	-0.123	0.170
EST64	16	19	1.000	0.970	-0.064	1.000	12	12	0.917	0.909	-0.052	0.674
EST65	24	8	0.750	0.751	-0.020	0.260	22	6	0.591	0.596	-0.014	0.262
EST68	21	14	0.905	0.928	0.001	0.212	13	10	0.923	0.871	-0.102	0.140
Hhi1	24	7	0.708	0.720	-0.005	0.146	21	12	0.762	0.791	0.013	0.470
Hhi101IMB	18	13	1.000	0.860	-0.196	0.269	14	15	0.857	0.931	0.045	0.498
Hhi102IMB	15	10	0.867	0.782	-0.147	0.217	14	12	1.000	0.915	-0.133	0.738
Hhi120IMB	24	28	1.000	0.977	-0.045	1.000	17	24	1.000	0.979	-0.053	1.000
Hhi3	15	18	0.867	0.954	0.060	0.219	12	15	1.000	0.960	-0.087	1.000
Hhi51	23	11	0.957	0.698	-0.402	0.694	21	3	0.095	0.094	-0.037	1.000
Hhi53	17	26	1.000	0.982	-0.049	1.000	12	16	1.000	0.960	-0.087	0.504
Hhi55	18	13	0.833	0.848	-0.011	0.284	13	11	0.769	0.855	0.065	0.582
Hhi55IMB	23	5	0.522	0.546	0.023	0.874	20	5	0.700	0.649	-0.107	0.975
Hhi56	11	5	0.545	0.615	0.070	0.065	13	3	0.692	0.640	-0.125	0.628
Hhi57	20	16	0.950	0.908	-0.073	0.394	17	15	0.765	0.873	0.098	0.208
Hhi58IMB	18	19	1.000	0.948	-0.085	0.875	17	17	0.647	0.950	0.298	**0.000**
Hhi59	17	6	0.941	0.665	-0.458	**0.007**	16	4	0.563	0.538	-0.079	0.896
Hhi63	11	18	1.000	0.983	-0.066	1.000	6	11	1.000	0.985	-0.108	1.000
Hhi79IMB	20	17	1.000	0.944	-0.087	0.926	16	17	0.938	0.950	-0.019	0.411
HhiA44	15	15	0.867	0.943	0.049	0.454	12	14	1.000	0.946	-0.103	1.000
HhiC17	24	27	0.958	0.973	-0.006	0.233	16	21	1.000	0.978	-0.056	1.000
HhiI29	22	30	0.955	0.982	0.005	0.427	20	26	0.900	0.979	0.058	0.146
Hst14	23	13	0.739	0.891	0.152	**0.016**	20	13	0.850	0.879	0.009	0.676
Hst17	23	10	0.913	0.860	-0.085	0.907	23	8	0.696	0.819	0.132	**0.044**
Hst7a	24	12	0.750	0.775	0.011	0.258	22	10	0.727	0.737	-0.010	0.548
Vmo17	13	3	0.385	0.440	0.091	0.070	18	3	0.389	0.332	-0.206	1.000
Vva13	13	5	0.615	0.643	0.005	0.567	17	8	0.765	0.693	-0.136	0.329
Mansey Maru, Russia												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	P	**N**	**Na**	**Ho**	**UHe**	**F**	P
EST12	32	6	0.656	0.561	-0.189	0.678	14	4	0.214	0.206	-0.077	1.000
EST13	30	11	0.767	0.713	-0.094	0.562	14	8	0.714	0.733	-0.011	0.708
EST14	19	17	0.895	0.903	-0.017	0.292	9	10	0.444	0.941	0.500	**0.000**
EST15	31	18	0.903	0.931	0.014	0.237	13	13	0.923	0.938	-0.023	0.774
EST17	21	10	0.952	0.876	-0.114	0.752	13	7	1.000	0.862	-0.207	0.714
EST18	33	6	0.667	0.745	0.091	**0.023**	14	6	0.786	0.690	-0.180	0.691
EST20	29	29	0.931	0.969	0.022	0.180	14	17	1.000	0.963	-0.077	0.573
EST23	28	11	0.750	0.861	0.113	0.390	14	10	0.786	0.921	0.115	0.140
EST24	19	7	0.579	0.523	-0.136	0.827	11	7	0.818	0.753	-0.138	0.879
EST26	29	16	1.000	0.917	-0.109	0.927	14	12	0.929	0.913	-0.055	0.401
EST27	22	14	0.864	0.802	-0.101	0.791	10	7	1.000	0.874	-0.205	1.000
EST28	27	27	1.000	0.971	-0.050	0.749	14	20	1.000	0.979	-0.059	1.000
EST29	31	21	0.903	0.921	0.003	0.245	14	12	0.857	0.923	0.037	0.319
EST30	30	5	0.667	0.577	-0.174	0.873	14	3	0.643	0.561	-0.189	0.807
EST33	32	4	0.406	0.428	0.036	0.678	14	3	0.214	0.204	-0.091	1.000
EST34	33	10	0.788	0.744	-0.075	0.408	14	6	0.643	0.730	0.087	0.600
EST36	32	17	0.781	0.910	0.128	**0.028**	14	12	0.714	0.913	0.188	0.142
EST39	32	11	0.844	0.849	-0.009	0.781	13	6	0.615	0.760	0.158	0.082
EST40	26	6	0.692	0.602	-0.173	0.796	11	6	0.545	0.736	0.224	0.097
EST41	25	31	0.960	0.978	-0.002	0.555	13	20	0.769	0.982	0.185	**0.000**
EST42	27	12	0.704	0.713	-0.005	0.450	13	8	0.769	0.748	-0.070	0.430
EST44	33	6	0.636	0.615	-0.050	0.565	14	4	0.643	0.632	-0.054	1.000
EST46	27	3	0.519	0.519	-0.017	1.000	10	2	0.800	0.505	-0.667	0.173
EST47	32	6	0.563	0.623	0.083	0.244	14	4	0.500	0.577	0.101	0.874
EST48	27	9	0.852	0.822	-0.056	0.186	11	6	1.000	0.823	-0.274	0.318
EST49	28	12	0.964	0.908	-0.082	0.875	14	12	0.786	0.892	0.086	0.610
EST50	30	5	0.467	0.617	0.231	**0.003**	14	4	0.714	0.632	-0.172	0.684
EST53	32	16	0.906	0.922	0.002	0.420	14	15	1.000	0.934	-0.110	0.861
EST54	32	12	0.656	0.617	-0.081	0.886	14	5	0.357	0.381	0.028	0.495
EST55	28	10	0.786	0.864	0.074	0.323	13	9	0.692	0.862	0.164	0.137
EST56	29	11	0.862	0.861	-0.019	0.869	12	9	0.917	0.841	-0.138	1.000
EST58	32	5	0.531	0.596	0.095	0.054	14	4	0.714	0.632	-0.172	0.684
EST60	30	28	0.800	0.970	0.161	**0.016**	13	16	0.692	0.957	0.248	**0.003**
EST62	27	9	0.519	0.526	-0.004	0.403	14	6	0.571	0.606	0.022	0.890
EST63	31	12	0.742	0.901	0.163	**0.004**	14	8	0.786	0.865	0.058	0.480
EST64	25	27	0.920	0.974	0.036	0.213	14	15	0.857	0.944	0.059	0.368
EST65	32	8	0.688	0.664	-0.052	0.283	14	3	0.429	0.519	0.143	**0.050**
EST68	30	15	0.867	0.914	0.035	0.302	14	11	0.786	0.921	0.115	**0.046**
Hhi1	29	10	0.759	0.728	-0.061	0.221	13	8	0.692	0.769	0.064	0.498

Hhi101IMB	30	21	0.967	0.933	-0.054	0.056	12	15	1.000	0.938	-0.112	0.070
Hhi102IMB	28	16	0.857	0.858	-0.017	0.181	14	9	0.786	0.884	0.078	0.817
Hhi120IMB	30	33	1.000	0.975	-0.043	1.000	13	17	1.000	0.972	-0.070	1.000
Hhi3	27	23	0.963	0.955	-0.027	0.530	15	20	1.000	0.975	-0.061	1.000
Hhi51	33	14	0.970	0.771	-0.278	0.882	13	2	0.077	0.077	-0.040	-
Hhi53	28	34	1.000	0.977	-0.042	1.000	10	19	1.000	0.995	-0.058	1.000
Hhi55	28	10	0.786	0.829	0.034	0.543	14	7	0.929	0.804	-0.197	0.809
Hhi55IMB	30	4	0.800	0.662	-0.230	**0.042**	15	4	0.667	0.678	-0.017	1.000
Hhi56	24	7	0.583	0.674	0.116	**0.012**	7	4	0.429	0.626	0.263	0.105
Hhi57	27	24	0.852	0.936	0.073	0.617	15	10	0.800	0.848	0.024	0.724
Hhi58IMB	25	32	1.000	0.983	-0.038	1.000	14	17	1.000	0.966	-0.074	1.000
Hhi59	30	7	0.867	0.662	-0.331	**0.012**	14	5	0.786	0.680	-0.198	0.825
Hhi63	23	27	1.000	0.972	-0.052	1.000	13	20	1.000	0.982	-0.060	1.000
Hhi79IMB	30	20	0.967	0.947	-0.038	0.792	15	13	1.000	0.936	-0.106	0.553
HhiA44	26	24	0.885	0.953	0.054	0.196	13	15	0.923	0.951	-0.010	0.672
HhiC17	31	30	0.935	0.968	0.018	0.195	14	18	1.000	0.960	-0.080	1.000
HhiI29	30	39	1.000	0.984	-0.033	1.000	13	18	1.000	0.972	-0.070	1.000
Hst14	33	17	0.788	0.877	0.088	0.205	13	8	0.923	0.858	-0.118	0.502
Hst17	30	10	0.867	0.848	-0.039	0.771	14	8	0.714	0.836	0.114	0.550
Hst7a	30	10	0.867	0.727	-0.213	0.793	14	4	0.643	0.585	-0.140	1.000
Vmo17	25	3	0.320	0.340	0.038	**0.032**	7	4	0.429	0.582	0.208	0.217
Vva13	25	8	0.680	0.725	0.043	0.702	7	5	0.857	0.670	-0.377	1.000
Fukudsu Mazu, Russia												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	**P**	**N**	**Na**	**Ho**	**UHe**	**F**	**P**
EST12	22	8	0.500	0.609	0.160	0.093	19	7	0.632	0.617	-0.051	0.603
EST13	20	9	0.650	0.704	0.053	0.537	22	10	0.773	0.662	-0.195	0.706
EST14	13	15	0.692	0.929	0.225	**0.040**	11	10	0.727	0.918	0.170	0.203
EST15	20	12	0.950	0.915	-0.064	0.852	21	12	0.952	0.870	-0.121	0.729
EST17	19	9	0.737	0.856	0.116	0.339	14	9	1.000	0.902	-0.150	0.586
EST18	23	4	0.478	0.590	0.172	0.207	20	7	0.500	0.636	0.194	0.194
EST20	17	19	1.000	0.959	-0.074	1.000	19	21	1.000	0.964	-0.065	0.727
EST23	20	12	0.900	0.918	-0.006	0.590	19	9	0.842	0.872	0.008	0.776
EST24	13	10	0.615	0.738	0.133	0.388	10	5	0.400	0.442	0.048	0.210
EST26	17	13	0.882	0.902	-0.008	0.507	21	11	0.857	0.902	0.027	0.126
EST27	18	15	0.944	0.922	-0.053	0.615	22	14	0.818	0.892	0.062	**0.036**
EST28	22	22	0.909	0.964	0.035	0.431	14	21	0.929	0.979	0.016	0.284
EST29	22	15	0.727	0.892	0.166	**0.003**	21	18	0.857	0.947	0.072	0.158
EST30	19	6	0.737	0.718	-0.053	0.220	21	6	0.619	0.696	0.088	0.660
EST33	23	2	0.348	0.294	-0.211	1.000	23	7	0.609	0.504	-0.234	1.000
EST34	22	8	0.727	0.707	-0.052	**0.040**	24	7	0.625	0.762	0.162	0.264
EST36	21	16	0.952	0.929	-0.050	0.686	22	14	0.864	0.923	0.042	0.640
EST39	21	9	0.762	0.862	0.094	0.514	19	13	0.895	0.881	-0.044	0.618
EST40	20	7	0.800	0.687	-0.194	0.901	20	5	0.850	0.651	-0.339	0.055
EST41	20	21	1.000	0.958	-0.071	0.443	19	24	1.000	0.974	-0.054	1.000
EST42	18	6	0.500	0.562	0.085	0.697	22	9	0.591	0.666	0.092	0.391
EST44	23	6	0.609	0.618	-0.006	0.980	21	7	0.619	0.662	0.042	0.433
EST46	20	5	0.700	0.605	-0.186	0.350	22	6	0.636	0.631	-0.032	0.262
EST47	21	4	0.571	0.603	0.029	1.000	23	4	0.696	0.630	-0.129	0.121
EST48	20	10	0.850	0.808	-0.079	0.981	20	11	0.850	0.851	-0.024	1.000
EST49	16	10	0.813	0.813	-0.032	0.724	20	13	0.900	0.910	-0.014	0.201
EST50	22	5	0.591	0.597	-0.012	0.601	24	3	0.458	0.595	0.213	0.349
EST53	21	10	0.905	0.886	-0.046	0.998	22	16	0.955	0.939	-0.041	0.834
EST54	22	6	0.545	0.478	-0.168	0.811	23	8	0.609	0.563	-0.105	0.889
EST55	17	10	0.941	0.845	-0.148	0.474	22	8	0.773	0.860	0.081	**0.025**
EST56	17	9	0.588	0.752	0.194	0.148	20	10	0.900	0.826	-0.118	0.870
EST58	22	5	0.591	0.597	-0.012	0.606	20	7	0.600	0.668	0.079	0.778
EST60	22	24	0.545	0.950	0.413	**0.000**	20	22	0.600	0.968	0.364	**0.000**
EST62	16	4	0.250	0.286	0.099	0.306	13	7	0.692	0.609	-0.182	0.839
EST63	19	11	0.895	0.892	-0.030	0.635	18	8	0.778	0.860	0.070	0.639
EST64	20	24	0.900	0.967	0.045	0.161	12	18	1.000	0.975	-0.071	1.000
EST65	22	5	0.682	0.671	-0.039	0.940	22	6	0.636	0.653	0.003	0.825
EST68	18	10	0.889	0.890	-0.027	0.796	20	14	0.850	0.892	0.023	0.200
Hhi1	22	10	0.818	0.810	-0.034	0.812	22	10	0.909	0.778	-0.196	0.505
Hhi101IMB	20	14	1.000	0.828	-0.238	0.984	23	21	0.870	0.942	0.056	0.574
Hhi102IMB	19	10	1.000	0.775	-0.325	0.632	22	15	0.909	0.899	-0.035	0.986
Hhi120IMB	23	26	1.000	0.973	-0.051	1.000	24	30	1.000	0.981	-0.041	1.000
Hhi3	20	21	1.000	0.960	-0.068	0.753	22	21	0.864	0.949	0.069	0.290
Hhi51	20	11	1.000	0.794	-0.292	0.246	22	3	0.091	0.090	-0.035	1.000
Hhi53	21	29	1.000	0.981	-0.044	1.000	19	28	1.000	0.979	-0.049	1.000
Hhi55	21	14	0.905	0.887	-0.045	0.488	23	11	0.826	0.757	-0.115	0.708
Hhi55IMB	22	5	0.500	0.631	0.189	0.351	24	4	0.583	0.575	-0.035	0.949
Hhi56	13	3	0.538	0.551	-0.017	0.773	19	4	0.579	0.597	0.005	0.575
Hhi57	18	18	0.778	0.894	0.105	0.127	22	17	0.909	0.904	-0.029	0.581
Hhi58IMB	20	23	0.950	0.968	-0.007	0.220	20	24	0.950	0.969	-0.005	0.598
Hhi59	22	4	1.000	0.618	-0.655	**0.000**	24	5	0.667	0.593	-0.148	0.286
Hhi63	17	23	1.000	0.970	-0.063	1.000	16	23	1.000	0.978	-0.056	1.000
Hhi79IMB	23	25	1.000	0.964	-0.060	0.750	24	20	0.958	0.940	-0.042	**0.049**
HhiA44	16	20	0.875	0.968	0.067	0.207	19	21	1.000	0.960	-0.070	1.000
HhiC17	18	22	1.000	0.956	-0.076	1.000	24	28	1.000	0.977	-0.045	0.593
HhiI29	22	27	1.000	0.975	-0.050	0.515	24	33	1.000	0.982	-0.040	1.000
Hst14	20	13	0.850	0.865	-0.007	0.397	19	17	0.895	0.935	0.017	0.796
Hst17	22	10	0.955	0.845	-0.156	0.565	22	11	0.909	0.864	-0.077	0.817
Hst7a	22	9	0.727	0.760	0.021	0.198	22	10	0.773	0.732	-0.081	0.641
Vmo17	13	2	0.231	0.212	-0.130	1.000	19	2	0.316	0.273	-0.187	1.000
Vva13	13	6	0.615	0.686	0.067	0.331	19	8	0.632	0.669	0.030	0.378

All populations												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	P	**N**	**Na**	**Ho**	**UHe**	**F**	P
EST12	26.63	6.38	0.484	0.520	0.052	**0.030**	21.50	6.75	0.491	0.449	-0.117	1.000
EST13	24.63	9.13	0.690	0.695	-0.017	0.240	23.75	9.00	0.637	0.628	0.006	0.443
EST14	23.75	16.88	0.800	0.916	0.106	**0.003**	17.50	14.63	0.759	0.927	0.155	-
EST15	27.38	16.00	0.914	0.920	-0.014	0.243	21.63	14.25	0.945	0.914	-0.062	0.633
EST17	23.75	10.63	0.827	0.879	0.037	-	19.75	9.50	0.857	0.884	-0.003	0.195
EST18	26.88	5.75	0.660	0.701	0.047	**0.005**	22.13	5.88	0.680	0.655	-0.065	0.811
EST20	25.00	25.00	0.939	0.959	-0.001	-	20.75	22.38	0.911	0.965	0.029	0.087
EST23	25.38	11.13	0.875	0.883	-0.013	0.920	21.25	10.25	0.857	0.883	-0.002	0.222
EST24	24.13	9.13	0.685	0.692	-0.015	0.942	19.00	9.13	0.674	0.680	-0.018	0.318
EST26	25.13	10.88	0.950	0.809	-0.287	-	23.25	10.88	0.914	0.816	-0.228	-
EST27	25.63	16.88	0.930	0.902	-0.054	0.695	21.13	14.25	0.922	0.901	-0.055	0.459
EST28	23.63	25.38	0.963	0.967	-0.019	0.887	19.00	22.88	0.983	0.974	-0.040	0.985
EST29	26.13	16.13	0.862	0.905	0.028	**0.041**	21.13	14.63	0.882	0.913	0.007	0.616
EST30	25.25	5.00	0.671	0.633	-0.093	0.340	22.38	4.50	0.659	0.595	-0.156	0.170
EST33	27.25	3.75	0.397	0.368	-0.095	0.994	23.00	4.50	0.384	0.378	-0.031	0.994
EST34	27.38	8.50	0.683	0.716	0.027	0.253	24.63	7.38	0.686	0.722	0.022	0.418
EST36	27.75	16.13	0.829	0.913	0.076	0.087	24.50	14.50	0.805	0.909	0.094	**0.011**
EST39	25.75	10.63	0.837	0.840	-0.018	0.922	20.13	10.38	0.871	0.840	-0.068	0.435
EST40	26.25	5.38	0.695	0.615	-0.152	0.865	23.25	5.75	0.690	0.651	-0.091	0.128
EST41	24.25	27.13	0.979	0.970	-0.032	0.875	20.38	25.13	0.961	0.973	-0.015	-
EST42	25.13	9.25	0.640	0.672	0.026	0.156	21.38	8.63	0.707	0.698	-0.047	0.096
EST44	27.13	6.13	0.669	0.632	-0.084	0.310	22.75	5.88	0.578	0.622	0.048	0.262
EST46	26.50	4.63	0.590	0.553	-0.068	0.455	21.88	4.00	0.658	0.579	-0.179	0.642
EST47	28.00	4.50	0.555	0.578	0.017	0.373	24.00	4.00	0.652	0.614	-0.089	0.163
EST48	26.25	8.63	0.843	0.794	-0.086	0.889	23.50	8.88	0.836	0.818	-0.048	0.638
EST49	24.50	12.25	0.893	0.877	-0.041	0.227	20.25	11.75	0.874	0.886	-0.014	0.125
EST50	27.50	5.50	0.642	0.655	0.004	0.066	24.63	4.88	0.605	0.653	0.052	0.181
EST53	27.88	14.88	0.932	0.915	-0.038	0.963	22.75	14.75	0.953	0.930	-0.050	0.993
EST54	26.75	7.88	0.591	0.564	-0.064	0.858	24.13	6.50	0.492	0.515	0.031	0.550
EST55	25.38	8.63	0.795	0.823	0.013	0.430	21.88	8.50	0.814	0.830	-0.007	0.392
EST56	25.63	10.00	0.812	0.830	0.000	0.486	21.88	9.75	0.883	0.832	-0.089	0.989
EST58	27.00	5.50	0.661	0.652	-0.031	0.247	22.75	5.13	0.624	0.664	0.034	0.361
EST60	22.00	23.38	0.656	0.966	0.305	-	16.50	19.13	0.664	0.961	0.288	-
EST62	22.00	6.63	0.412	0.437	0.041	0.755	19.25	6.50	0.541	0.505	-0.090	0.967
EST63	22.25	10.88	0.878	0.894	-0.006	0.142	18.50	10.13	0.822	0.879	0.038	0.104
EST64	19.63	22.63	0.945	0.962	-0.009	0.480	14.00	18.38	0.943	0.962	-0.018	0.938
EST65	24.00	6.13	0.621	0.655	0.041	0.129	19.88	5.50	0.641	0.627	-0.046	0.603
EST68	21.25	12.50	0.878	0.891	-0.010	0.670	17.63	13.00	0.868	0.913	0.019	0.058
Hhi1	40.25	10.63	0.736	0.743	-0.006	0.471	36.75	11.00	0.769	0.767	-0.020	0.291
Hhi101IMB	38.00	19.50	0.984	0.893	-0.124	0.130	33.38	18.63	0.934	0.925	-0.034	0.497
Hhi102IMB	35.13	15.13	0.945	0.823	-0.172	0.241	34.25	15.63	0.897	0.893	-0.030	0.510
Hhi120IMB	40.38	32.13	0.966	0.970	-0.011	0.159	35.13	29.63	0.971	0.973	-0.017	0.727
Hhi3	38.88	26.63	0.958	0.962	-0.013	0.826	35.38	23.38	0.968	0.957	-0.037	0.982
Hhi51	22.38	11.25	0.985	0.751	-0.344	0.954	19.13	3.38	0.142	0.141	-0.039	-
Hhi53	38.38	34.63	0.978	0.975	-0.021	0.987	33.88	32.50	0.978	0.979	-0.025	0.501
Hhi55	36.63	13.00	0.830	0.837	-0.010	0.441	34.38	11.50	0.852	0.834	-0.050	0.965
Hhi55IMB	40.25	5.13	0.645	0.641	-0.018	0.071	36.63	4.75	0.661	0.637	-0.056	0.647
Hhi56	16.00	5.38	0.556	0.631	0.081	**0.013**	15.50	5.38	0.606	0.675	0.066	**0.000**
Hhi57	37.13	24.38	0.896	0.914	0.003	0.634	32.63	20.88	0.889	0.897	-0.011	0.904
Hhi58IMB	38.38	31.00	0.932	0.969	0.019	**0.005**	34.38	26.63	0.906	0.962	0.037	-
Hhi59	38.75	5.75	0.929	0.635	-0.490	-	36.50	5.75	0.603	0.584	-0.047	0.244
Hhi63	36.00	29.00	0.962	0.974	-0.010	-	32.13	27.25	0.967	0.979	-0.025	0.656
Hhi79IMB	39.00	25.50	0.953	0.955	-0.014	0.569	35.13	23.25	0.959	0.951	-0.030	0.683
HhiA44	37.25	27.25	0.915	0.958	0.026	0.220	33.88	24.13	0.965	0.956	-0.040	0.997
HhiC17	40.50	30.38	0.967	0.968	-0.016	0.489	35.88	28.25	0.983	0.970	-0.035	0.996
HhiI29	37.13	38.75	0.953	0.979	0.010	-	31.88	33.50	0.953	0.978	0.003	-
Hst14	22.13	12.38	0.805	0.865	0.046	0.154	17.63	11.63	0.838	0.850	-0.017	0.645
Hst17	23.63	10.63	0.851	0.860	-0.012	0.785	20.00	9.50	0.852	0.846	-0.031	0.847
Hst7a	23.75	9.75	0.725	0.727	-0.020	0.151	20.13	7.50	0.733	0.708	-0.064	0.956
Vmo17	17.13	2.63	0.230	0.276	#N/A	-	16.50	3.25	0.322	0.398	0.110	**0.004**
Vva13	16.88	6.00	0.642	0.660	-0.006	0.838	15.88	7.50	0.783	0.711	-0.141	0.376

HER98F												
Locus	**N**	**Na**	**Ho**	**UHe**	**F**	**P**	**N**	**Na**	**Ho**	**UHe**	**F**	**P**
Hhi1	45	11	0.800	0.779	-0.039	0.742	45	16	0.822	0.806	-0.031	0.936
Hhi101IMB	45	20	0.978	0.880	-0.123	**0.000**	46	21	0.978	0.934	-0.059	0.947
Hhi102IMB	45	19	1.000	0.824	-0.227	0.293	46	24	1.000	0.917	-0.103	0.623
Hhi120IMB	42	34	0.952	0.968	0.004	0.554	42	32	0.929	0.968	0.030	0.565
Hhi3	45	30	1.000	0.966	-0.047	1.000	46	32	0.935	0.961	0.016	0.304
Hhi51	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi53	45	48	0.956	0.981	0.015	0.333	45	48	1.000	0.982	-0.030	0.772
Hhi55	40	11	0.725	0.803	0.086	**0.006**	37	13	0.865	0.850	-0.032	**0.047**
Hhi55IMB	45	6	0.667	0.626	-0.076	0.750	46	5	0.565	0.647	0.116	0.361
Hhi56	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi57	45	29	0.889	0.939	0.043	0.089	46	28	0.935	0.916	-0.032	0.332
Hhi58IMB	45	39	0.978	0.978	-0.011	0.572	46	42	0.957	0.972	0.005	0.092
Hhi59	45	6	0.867	0.604	-0.452	**0.000**	45	9	0.578	0.610	0.042	0.212
Hhi63	44	38	0.955	0.976	0.011	0.207	44	36	0.955	0.968	0.003	0.576
Hhi79IMB	45	30	0.889	0.951	0.055	0.095	46	22	0.935	0.942	-0.003	0.641
HhiA44	45	34	0.911	0.965	0.045	0.280	46	31	0.935	0.957	0.012	0.705
HhiC17	41	32	0.951	0.973	0.010	0.206	46	31	0.957	0.958	-0.009	0.084
HhiI29	44	47	1.000	0.983	-0.029	1.000	45	43	0.978	0.981	-0.008	0.243
RYP98F												
Hhi1	52	12	0.635	0.785	0.184	0.182	26	12	0.885	0.769	-0.173	0.780
Hhi101IMB	52	22	1.000	0.906	-0.115	0.087	26	19	0.846	0.919	0.061	0.318

Hhi102IMB	52	24	0.962	0.831	-0.169	0.453	26	17	0.885	0.900	-0.003	0.465
Hhi120IMB	51	36	0.980	0.966	-0.025	0.947	25	25	0.840	0.971	0.117	**0.036**
Hhi3	52	29	0.942	0.956	0.005	0.680	26	24	0.962	0.965	-0.016	0.446
Hhi51	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi53	51	41	0.961	0.977	0.007	0.700	26	30	1.000	0.976	-0.045	0.698
Hhi55	39	11	0.744	0.787	0.043	0.882	19	11	0.947	0.856	-0.136	0.969
Hhi55IMB	52	6	0.673	0.661	-0.028	0.305	26	6	0.731	0.700	-0.065	0.223
Hhi56	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi57	52	30	0.942	0.913	-0.042	0.691	26	18	0.923	0.875	-0.076	0.870
Hhi58IMB	51	41	0.980	0.970	-0.020	0.766	26	29	1.000	0.970	-0.051	0.819
Hhi59	52	6	0.962	0.664	-0.462	**0.000**	26	7	0.769	0.682	-0.150	0.707
Hhi63	51	35	0.980	0.969	-0.022	0.158	26	27	0.923	0.971	0.030	0.426
Hhi79IMB	52	30	1.000	0.955	-0.057	0.266	26	26	0.923	0.947	0.006	0.621
HhiA44	52	31	0.962	0.958	-0.014	0.286	26	24	0.962	0.950	-0.032	0.434
HhiC17	52	34	0.904	0.972	0.061	**0.019**	26	24	0.962	0.962	-0.019	0.886
HhiI29	42	43	0.929	0.978	0.039	**0.027**	24	33	1.000	0.984	-0.038	0.515
Atlantic halibut												
Hhi1	38	2	0.184	0.287	0.350	0.052	55	2	0.145	0.136	-0.078	1.000
Hhi101IMB	43	27	0.953	0.928	-0.040	0.523	57	25	0.895	0.903	0.001	0.312
Hhi102IMB	43	10	0.814	0.799	-0.030	0.865	57	10	0.912	0.843	-0.092	0.476
Hhi120IMB	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi3	39	24	0.897	0.939	0.032	0.306	53	24	0.925	0.937	0.003	0.711
Hhi51	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi53	39	13	0.821	0.883	0.059	0.671	54	17	0.870	0.908	0.032	0.642
Hhi55	39	5	0.795	0.760	-0.059	0.830	55	5	0.800	0.780	-0.035	0.951
Hhi55IMB	39	6	0.795	0.677	-0.190	0.335	55	7	0.709	0.706	-0.013	0.764
Hhi56	0	0	0.000	0.000	-	-	0	0	0.000	0.000	-	-
Hhi57	39	11	0.821	0.842	0.013	0.558	56	11	0.821	0.841	0.015	0.103
Hhi58IMB	39	20	0.923	0.918	-0.018	0.648	55	22	0.873	0.907	0.029	0.165
Hhi59	41	5	0.122	0.119	-0.041	1.000	55	3	0.073	0.105	0.304	0.065
Hhi63	39	17	0.846	0.833	-0.029	0.940	54	21	0.944	0.923	-0.033	0.458
Hhi79IMB	39	16	0.795	0.853	0.057	**0.032**	56	15	0.768	0.862	0.102	0.159
HhiA44	39	20	0.872	0.889	0.006	0.334	56	27	0.875	0.875	-0.009	0.596
HhiC17	43	21	1.000	0.940	-0.076	0.953	57	24	0.965	0.943	-0.032	0.910
HhiI29	39	15	0.872	0.866	-0.019	0.839	56	17	0.875	0.871	-0.013	0.358

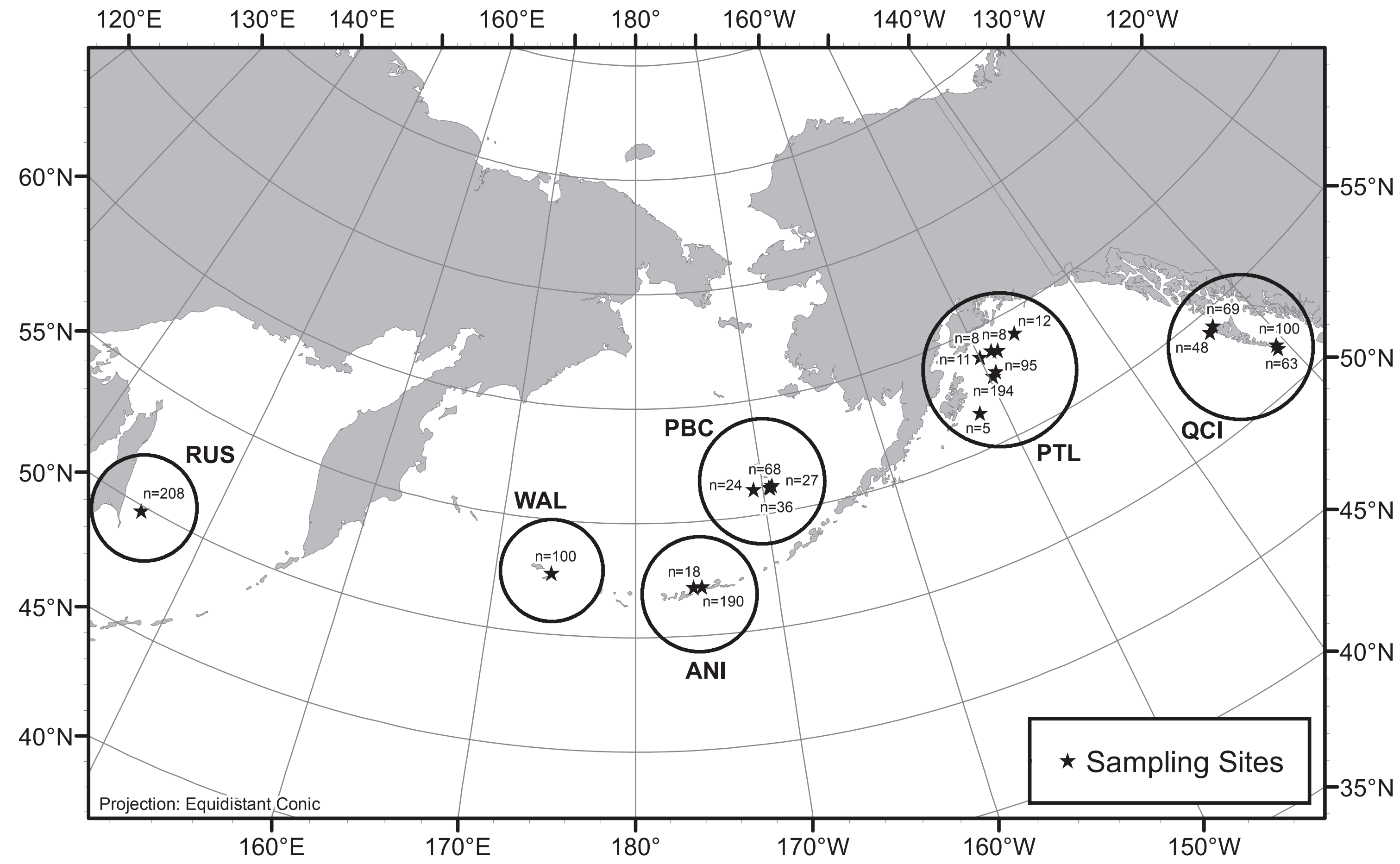

Figure 1. Collection sites for winter genetic sampling. Site abbreviations are as follows: QCI = Queen Charlotte Islands, PTL = Portlock Bank, PBC = Pribilof Canyon, ANI = Andreanof Islands, WAL = Western Aleutians, RUS = Russia (Sea of Okhotsk).