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Steve Kaimmer
International Pacific Halibut Commission
P.O. Box 95009
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Dear Mr. Kaimmer:

This letter presents Pacific halibut sport fishery information for Alaska waters in support of the annual IPHC stock assessment for 2015. This year's letter provides:

1. Final 2013 estimates of sport fishery harvest by IPHC regulatory area,
2. Preliminary 2014 estimates (projections) of harvest by IPHC area,
3. Final 2013 and preliminary 2014 estimates (projections) of release mortality by IPHC area, and
4. Estimates of 2014 sport harvest prior to the mean IPHC longline survey date in Areas 2C and 3A, as requested by Dr. Webster.

Final Estimates of 2013 Sport Harvest

In November 2013, we provided preliminary estimates of the 2013 sport harvest for Areas 2C, 3A, 3B, and 4. This letter provides updated estimates based on final Alaska Department of Fish and Game (ADF&G) Statewide Harvest Survey (SWHS) estimates, in numbers of fish, and final estimates of average net weight in pounds. The final Area 2C and 3A estimates were also posted on the North Pacific Fishery Management Council web site in October of this year.

The Area 2C charter fishery regulations for 2013 included a one-fish daily bag limit and reverse slot (or "protected slot") limit that allowed harvest of halibut less than or equal to 45 inches and halibut greater than or equal to 68 inches. Charter captains and crew were not allowed to retain fish in Area 2C. Charter fishery regulations in the remainder of the state included a daily bag limit of two fish of any size, and there was no prohibition on retention of halibut by captains or crew. Noncharter (unguided) fisheries statewide were also managed under a two-fish bag limit with no size limit.

Methods:

For Area 2C and Area 3A, sport fishery yield (pounds net weight) was calculated separately for the charter and noncharter fisheries as the product of the number of fish and average weight of harvested halibut. Yield estimates do not include release mortality (provided later in this document). Estimates of the number of fish harvested were provided by the SWHS. Standard errors of the SWHS estimates were obtained by bootstrapping. The SWHS estimates were the preferred method for estimating charter harvest under GHL management and the only method available for estimating noncharter harvest. Average net weight was estimated by applying the IPHC length-weight relationship to length measurements of halibut harvested at major ports in Areas 2C and 3A. Ports sampled in Area 2C in 2013 included Ketchikan, Craig, Klawock, Petersburg, Wrangell, Juneau, Sitka, Gustavus, and Elfin Cove. Ports sampled in Area 3A included Yakutat,

Valdez, Whittier, Seward, Homer, Deep Creek, Anchor Point, and Kodiak. The estimate of charter average weight for Homer was stratified to account for differences in sizes of halibut cleaned at sea versus cleaned onshore. The SWHS estimates for charter harvest in the Glacier Bay reporting area were apportioned to Area 2C and Area 3A waters using spatial data contained in the mandatory ADF&G charter logbook. Likewise, charter average weights were calculated separately for charter-caught fish taken in Area 2C and Area 3A and landed at Elfin Cove and Gustavus.

Sampling at all ports followed a cluster design, where all fish from each cluster (vessel-trip) were measured. Two-stage bootstrapping was used to estimate the standard errors of average weight for all fish landed at Area 3A ports. Standard errors of average weight for ports in Area 2C were calculated using formulae for simple random sampling, then inflated by a factor of two, which was the approximate average inflation observed after bootstrapping Area 3A data.

Final estimates of sport yield for Area 3B and Area 4 are for the charter and noncharter sectors combined. Because ADF&G does not sample the sport harvest in these areas, we followed past practices of the IPHC and substituted the weighted mean of the Kodiak charter and noncharter average weights as a proxy for average weight in Areas 3B and 4. Anecdotal reports from the Dutch Harbor/Unalaska area suggest that average weight in these areas is higher than at Kodiak. As has been done historically, we included all harvest from SWHS Area R (Alaska Peninsula and Aleutian Islands south of Cape Douglas and the Naknek River) in the Area 3B estimate. In some years, Area R harvest estimates have included small harvests for sites that are actually in Area 3A. Since 1991, the estimated harvest of Area 3A halibut included in Area 3B estimates has ranged from 0 to 728 fish (average = 126). We continue to report these harvests in Area 3B because they are too small to apportion to the charter and noncharter sectors in Area 3A. This approach has more impact on the Area 3B sport harvest estimate than the Area 3A estimate, but the Area 3B sport harvest typically represents less than 0.5% of the total removals in that area.

Results:

The 2013 Area 2C overall sport yield, excluding release mortality, was estimated at 2.123 million pounds (Table 1). The charter portion was 0.762 M lb (36%) and the noncharter portion was 1.361 M lb (64%). Estimated harvests (in numbers of fish) were 52,675 for the charter sector, 78,078 for the noncharter sector, and 130,753 overall. Average net weight was estimated at 14.5 lb for the charter harvest, 17.4 lb for the noncharter harvest, and 16.2 lb overall. Average weights were based on length measurements of 5,864 charter fish and 5,616 noncharter fish.

The Area 3A overall sport yield estimate was 3.966 M lb, with 2.514 M lb (63%) from the charter sector and 1.452 M lb (37%) from the noncharter sector (Table 1). Estimated harvests were 199,248 for the charter sector, 121,568 for the noncharter sector, and 320,816 halibut overall. Average net weight was estimated at 12.6 lb for the charter fishery, 11.9 lb for the noncharter fishery, and 12.4 lb overall. Average weight was estimated from length data from 5,725 charter halibut and 2,587 noncharter halibut.

All of last year's preliminary estimates of harvest were lower than the final estimates, but to varying degrees. Last year's charter yield projections were 5.1% lower than the final yield estimate in Area 2C and 9.7% lower in Area 3A. The noncharter projections were 33.6% lower than the final yield estimate in Area 2C but only 0.5% lower than the final estimate in Area 3A. Projection errors for the charter yield are due to variation in the relationship between SWHS estimates and the partial-year logbook data that were used to make the projection. Large projection errors are expected for the noncharter fisheries because those projections are time series forecasts based on fairly short and highly variable time series of unguided harvest.

The final harvest estimates for western areas were 1,246 halibut in Area 3B and 779 halibut in Area 4 (Table 1). Applying the Kodiak average weight of 11.8 lb resulted in yield estimates of 0.015 M lb in Area 3B and 0.009 M lb in Area 4.

Preliminary 2014 Estimates of Harvest

Methods:

Starting in 2014, sport charter harvest accounting for Areas 2C and 3A will be based on numbers of halibut reported harvested (and released) in ADF&G mandatory charter logbooks. The change from using SWHS estimates to logbook data was a component of the North Pacific Fishery Management Council's Catch Sharing Plan for Areas 2C and 3A, effective January 13, 2014. Harvest estimates from the SWHS are still used for all noncharter fishery estimates as well as total sport fishery estimates for Areas 3B and 4.

Neither complete logbook data nor SWHS estimates are available for the current year, and creel sampling is not designed to produce estimates of harvest. Therefore, preliminary harvest estimates were made using either logbook data for a portion of the year, or time series forecasts of trends in SWHS estimates. Because the preferred data sources vary by area and sector (charter/noncharter), a variety of methods were used to project harvest in numbers of fish.

Charter harvest for Areas 2C and 3A was projected from partial-year logbook data. As of mid-October, logbook data were only entered and available for trips taken through July 31. The subarea harvests through July were expanded to obtain the total harvests for the year using simple or double exponential time series forecasts of the proportion of harvest that occurred through July. Forecasts were based on the proportions of harvest reported taken through July in logbooks from 2006 through 2013. Simple or double exponential forecasts were selected using Akaike's Information Criteria, corrected for small sample size (AICc). The simple exponential forecasts were selected for all subareas in Area 2C and all but two subareas in Area 3A. An additional adjustment was made to these forecasts to account for late logbook submissions and reporting errors that will be resolved in the final logbook data. These adjustments were done by subarea using the average change in logbook data from October to the final state over the previous three years. These adjustments increased the harvest by about 1% in both areas.

Noncharter harvest in Areas 2C and 3A, and overall sport harvests for Areas 3B and 4 were projected from the existing time series of SWHS estimates using simple or double exponential time series forecasts. In all but one subarea the simple forecasts had AICc values that were either lower or not significantly different from the double exponential model. Therefore the simple exponential forecasts were used in all areas.

Charter and noncharter yield were estimated by multiplying the subarea-specific harvest forecasts by the corresponding estimates of average weight. Average weights were estimated by applying the IPHC length-weight relationship to length measurements of harvested halibut obtained through sampling of the recreational harvest. No sampling was conducted in Areas 3B or 4 in 2014, so the Kodiak area average weight was again substituted for these areas.

These preliminary estimates will be updated after logbook data and SWHS estimates are finalized. Logbook data should be relatively clean and final by next May, and SWHS estimates should be available by next September.

Results:

The preliminary 2014 halibut yield estimates for Area 2C were 0.825 M lb for the charter sector and 1.114 M lb for the noncharter sector, for a total sport harvest of 1.940 M lb (Table 2). Estimated harvests (in numbers of fish) were 67,942 for the charter sector, 64,143 for the noncharter sector, and 132,085 for the overall sport fishery. For the charter fishery, 63% of the reported harvest was projected to have been taken through the end of July, though the percentages varied by subarea. Average weights were 12.1 lb for the charter sector, 17.4 lb for the noncharter sector, and 14.7 lb overall. Charter average weight dropped 2.4 lb and noncharter average weight was essentially the same relative to 2013. Average weights for Area 2C were based on length measurements of 4,772 charter halibut and 5,337 noncharter halibut.

The preliminary yield estimates for Area 3A were 2.139 M lb for the charter sector, 1.452 M lb for the noncharter sector, and 3.591 M lb overall (Table 2). Corresponding estimates of harvest were 181,947 charter

halibut, 122,663 noncharter halibut, and 304,610 halibut overall. Sixty-eight percent of the charter harvest was projected to have been taken through the end of July. Estimated average weights in Area 3A were 11.8 lb for the charter harvest and 11.8 for the noncharter harvest, based on length measurements of 5,683 charter and 2,270 noncharter halibut.

The 2014 projected harvest for Area 3B was 1,309 halibut, with a 95% confidence interval (CI) of 649-1,969. The projected harvest for Area 4 was 1,579 halibut, with 95% CI of 0-3,508. Applying the overall (charter and noncharter) average weight of 14.6 lb from Kodiak resulted in yield projections of 0.019 M lb in Area 3B and 0.023 M lb in Area 4 (Table 2).

Final 2013 and Preliminary 2014 Estimates of Release Mortality

Methods:

Release mortality (*R*) was calculated in pounds net weight for each subarea of Areas 2C and 3A as:

$$R = \hat{N} \cdot DMR \cdot \hat{\bar{w}}$$

where

$\hat{N}$ = the estimated (2013) or forecast (2014) number of fish released,

DMR = the assumed short-term discard mortality rate due to capture, handling, and release, and

$\hat{\bar{w}}$ = the estimated average net weight (in pounds) of released fish.

The numbers of halibut released ($\hat{N}$) in the charter sector were based on final SWHS estimates for 2013, and partial-year logbook for 2014. As with charter harvest estimates, the release numbers for trips through July 31 were expanded to the entire year using simple exponential forecasts of the proportion of releases through July 31 from 2006-2013 data. For the noncharter fishery, and the overall sport fisheries in Areas 3B and 4, the number of fish released in each subarea was based on the final SWHS estimate in 2013, and on simple exponential time series forecasts of projected SWHS numbers of released halibut in 2014.

Assumed mortality rates (*DMRs*) were 5% for Area 3A charter-caught halibut, 6% for Area 2C charter and Area 3A noncharter, and 7% for Area 2C noncharter halibut. These rates were developed by assuming a 3.5% mortality rate for halibut released on circle hooks and a 10% mortality rate for halibut released on all other hook types. The hook type data were collected in 2007 and 2008 in Area 2C, and every year since 2007 in Area 3A. These rates were applied to the reported number of fish released on each hook type to calculate a weighted mean mortality rate for each user group in each subarea. These weighted mean rates were then rounded up to the next whole percentage point to address uncertainty and account for possible cumulative effects of multiple recaptures. For Areas 3B and 4, in which no data on hook use were collected, a mortality rate of 6% was assumed.

For most IPHC regulatory areas, the average weights of released fish in each subarea were estimated through modeling. For the noncharter fishery in Area 2C, and all fisheries in Areas 3A, 3B, and 4, the length distribution of released fish was estimated using a logistic model of the probability of keeping a fish as a function of length. The observed proportions of halibut harvest in each length group were divided by the predicted probability of keeping a halibut of that length to predict the catch and, by subtraction, the release numbers at each length. Modeling average weight for Areas 3B and 4 was problematic because no size data were available for the harvest. For these areas, the Kodiak estimates of size composition, weighted by charter and noncharter harvest proportions in Areas 3B and 4, were used as a proxy for harvest length composition in the model above. The charter and noncharter harvest proportions for Areas 3B and 4 were calculated for 2013 from logbook data compared to overall SWHS estimates. For 2014, the projected charter and noncharter proportions were based on the mean proportions from similar estimates for 2011-2013.

The fisheries literature was searched for empirical relationships that could be exploited to fit the logistic model. Data collected on a variety of saltwater and freshwater species suggested that, at the 10th percentile for length, an average of 22% of fish caught were retained. Likewise, at the 90th percentile for length, an average of 83% of fish were retained. Therefore, parameters of the logistic model were selected for each subarea and sector by minimizing the relative difference between these empirical data points and their predicted values, while imposing the constraint that the predicted total numbers of fish equaled the final estimates (for 2013) or forecasts (for 2014). Once these conditions were satisfied, the resulting length distributions of released fish were partitioned into U26 (<26 inch) and O26 (≥ 26 inch) components, and average weight was calculated using the IPHC length-weight relationship. The U26 and O26 separation was done for consistency with how these two size classes of waste have been handled by the IPHC. This model is a work in progress and the search is ongoing for additional size data to improve the empirical values used in fitting.

For the Area 2C charter fishery, additional steps were needed to estimate release mortality due to the reverse slot limits in place in 2013 and 2014. In 2013, charter anglers were prohibited from harvesting fish between 45 and 68 inches in length. The protected slot was 44-76 inches in 2014. This required partitioning the released fish into size categories as follows: in 2013 the size classes were U45 (≤ 45 inches), 45-68, and O68 (≥ 68 inches), and in 2014 the size classes were U44, 44-76, and O76. The proportions of fish in each size class were obtained from creel survey interviews where anglers were asked to classify their released fish by size class. The average weight of released fish in the U45 and U44 size classes was estimated using the modeling procedure described above. The average weights of released fish in the protected slot and above the upper limit were estimated as the average weight of fish in these size ranges in 2010, the most recent year without a charter size limit.

The North Pacific Fishery Management Council's Scientific and Statistical Committee reviewed the logistic modeling approach in 2007 and concluded that it provided "reasonable" estimates of average weight given the lack of data. One problem inherent in this method is that the size distribution of released fish is truncated at the size of the smallest fish measured in the harvest sample. Undoubtedly, some halibut are released that are smaller than the smallest halibut retained and measured. Therefore, the method may in effect underestimate the numbers of U26 fish released and overestimate their average weight. It may also overestimate the numbers of O26 fish released, but probably has little effect on their average weight. The net effect is unknown, but likely is a minor source of error given all the other uncertainties in this approach.

Results:

For 2013, estimated U26 release mortality was 0.008 M lb in Area 2C, 0.016 M lb in Area 3A, and virtually zero in Areas 3B and 4 (Table 3). Estimated O26 release mortality was 0.063 M lb in Area 2C, with 0.039 M lb of that coming in the charter fishery. The size class breakdown of the charter O26 release mortality indicates that while the majority of fish released were in the length range 26-45 inches, the poundage of release mortality was nearly equal between those fish and the 45-68 inch protected slot because of the differences in average weight (Table 4). Estimated O26 release mortality in Area 3A was, coincidentally, also 0.063 M lb, with 0.040 M lb from the charter fishery (Table 3). Areas 3B and 4 each had negligible amounts of release mortality from the sport fishery.

Preliminary estimates of release mortality for 2014 were similar in magnitude to 2013. Mortality of U26 halibut was 0.005 M lb in Area 2C, 0.017 M lb in Areas 3A, and virtually zero in Areas 3B and 4 (Table 5). Mortality of O26 releases in Area 2C was estimated at 0.066 M lb, with 0.046 M lb of that from the charter fishery. Of the 0.046 M lb of charter release mortality in Area 2C, about half was due to releases of fish in the 44-76 inch size class (Table 4). Mortality of O26 releases in Area 3A was also 0.066 M lb, with nearly equal portions from the charter and noncharter fisheries (Table 5). The O26 release mortality in Area 3B was negligible, and mortality in Area 4 was a little under 0.001 M lb.

For 2013, total sport fishery removals, or harvest plus all sizes of release mortality, added up to 2.194 M lb in Area 2C and 4.045 M lb in Area 3A. Release mortality accounted for 3.2% of all Area 2C removals and 1.9%

of Area 3A removals. For 2014, total sport removals were 2.011 M lb in Area 2C and 3.674 M lb in Area 3A. Release mortality accounted for 3.6% of Area 2C removals and 2.3% of Area 3A removals in 2014.

Sport Harvest Prior to the Mean IPHC Survey Date in 2014 (Areas 2C and 3A only)

This information is provided to aid the IPHC's adjustment to survey CPUE that is used to apportion estimated exploitable biomass among regulatory areas. The mean survey dates for 2014 were July 1 in Area 2C and July 7 in Area 3A.

Methods:

The proportion of charter harvest taken prior to the mean survey date was averaged using logbook harvest data from the previous three years. The proportion of noncharter harvest taken prior to the mean survey date was based on harvest reported in dockside interviews. These proportions were calculated separately for each subarea of Area 2C and 3A and weighted by the 2014 projected harvest in each subarea to derive the overall proportion for the noncharter fishery. The total sport yield taken prior to the mean survey date was calculated by multiplying the charter and noncharter proportions by their respective projected yields for 2014 and summing.

Results:

An estimated 0.467 M lb of halibut were harvested by the sport fishery in Area 2C prior to July 1, and about 1.465 M lb of halibut were taken in Area 3A prior to July 7 (Table 6). About 24% of the overall sport harvest was projected to have been taken prior to the mean survey date in Area 2C, compared with about 41% in Area 3A. These preliminary estimates will be updated next year once logbook and SWHS data are finalized.

We hope this information satisfies the IPHC's needs. Please feel free to contact us if you require clarification or additional information.

Sincerely;

(sent via email)

Scott Meyer, Mike Jaenicke, Diana Tersteeg, and Barbi Failor
Fishery Biologists

Table 1. Final estimates of the 2013 sport halibut harvest (numbers of fish), average net weight (pounds), and yield (millions of pounds net weight) in Areas 2C, 3A, 3B, and 4. "NA" indicates no estimate is available.

IPHC Area	Sector	Harvest (no. fish)	Average Net Wt. (lb)	Yield (M lb)	95% CI for Yield (M lb)
Area 2C	Charter	52,675	14.47	0.762	0.690 – 0.835
	Noncharter	78,078	17.43	1.361	1.195 – 1.527
	Total	130,753	16.24	2.123	1.942 - 2.304
Area 3A	Charter	199,248	12.62	2.514	2.332 – 2.697
	Noncharter	121,568	11.94	1.452	1.285 – 1.619
	Total	320,816	12.36	3.966	3.719 – 4.214
Area 3B	Total	1,246	11.75[a]	0.015	NA
Area 4	Total	779	11.75[a]	0.009	NA

[a] – No size data were available from Areas 3B and 4, so the combined charter/noncharter average weight from Kodiak was substituted.

Table 2. Preliminary estimates of the 2014 sport halibut harvest (numbers of fish), average net weight (pounds), and yield (millions of pounds net weight) in Areas 2C, 3A, 3B, and 4. "NA" indicates no estimate is available.

IPHC Area	Sector	Harvest (no. fish)	Average Net Wt. (lb)	Yield (M lb)	95% CI for Yield (M lb)
Area 2C	Charter	67,942	12.14	0.825	0.776 – 0.875
	Noncharter	64,143	17.37	1.114	0.869 – 1.360
	Total	132,085	14.68	1.940	1.689 – 2.190
Area 3A	Charter	181,947	11.76	2.139	1.985 – 2.293
	Noncharter	122,663	11.84	1.452	1.195 – 1.710
	Total	304,610	11.79	3.591	3.291 – 3.891
Area 3B	Total	1,309	14.62[a]	0.019	NA
Area 4	Total	1,579	14.62[a]	0.023	NA

[a] – No size data were available from Areas 3B and 4, so the combined charter/noncharter average weight from Kodiak was substituted.

Table 3. Final estimates of release mortality for sport fisheries in Areas 2C, 3A, 3B, and 4 in 2013. Some columns may not appear to add correctly due to rounding.

IPHC Area	Size Class	Sector	Estimated No. Halibut Released	Assumed Mortality Rate	Number Released that Died	Estimated Average Weight (lb)	Release Mortality (M lb)
Area 2C	U26	Charter	11,994	6.0%	720	3.84	0.003
		Noncharter	20,013	7.0%	1,401	3.69	0.005
		Total	32,008	6.6%	2,121	3.74	0.008
	O26	Charter	37,001	6.0%	2,220	17.68	0.039
		Noncharter	35,131	7.0%	2,459	9.50	0.023
		Total	72,132	6.5%	4,679	13.38	0.063
Area 3A	U26	Charter	41,834	5.0%	2,092	4.12	0.009
		Noncharter	30,143	6.0%	1,809	3.86	0.007
		Total	71,977	5.4%	3,900	4.00	0.016
	O26	Charter	97,591	5.0%	4,880	8.22	0.040
		Noncharter	47,278	6.0%	2,837	7.94	0.023
		Total	144,869	5.3%	7,716	8.12	0.063
Area 3B	U26	Total	154	6.0%	9	3.89	0.000
	O26	Total	518	6.0%	31	8.52	0.000
Area 4	U26	Total	26	6.0%	2	3.85	0.000
	O26	Total	100	6.0%	6	9.65	0.000

Table 4. Breakdown of Area 2C estimates of charter release mortality by size class for 2013 (final) and 2014 (preliminary).

Year	Size Class (inches)	Estimated No. Halibut Released	Assumed Mortality Rate	Number Released that Died	Estimated Average Weight (lb)	Release Mortality (M lb)
2013	O26U45	31,500	6.0%	1,890	9.14	0.017
	O45U68	5,003	6.0%	300	57.65	0.017
	O68	498	6.0%	30	156.53	0.005
	Total O26	37,001	6.0%	2,220	17.68	0.039
2014	O26U44	31,329	6.0%	1,880	8.75	0.016
	O44U76	6,615	6.0%	397	61.33	0.024
	O76	339	6.0%	20	232.84	0.005
	Total O26	38,284	6.0%	2,297	19.82	0.046

Table 5. Preliminary estimates of release mortality for sport fisheries in Areas 2C, 3A, 3B, and 4 in 2014. Some columns may not appear to add correctly due to rounding.

IPHC Area	Size Class	Sector	Estimated No. Halibut Released	Assumed Mortality Rate	Number Released that Died	Estimated Average Weight (lb)	Release Mortality (M lb)
Area 2C	U26	Charter	8,851	6.0%	531	3.64	0.002
		Noncharter	13,116	7.0%	918	3.76	0.003
		Total	21,967	6.6%	1,449	3.72	0.005
	O26	Charter	38,284	6.0%	2,297	19.82	0.046
		Noncharter	31,918	7.0%	2,234	9.23	0.021
		Total	70,202	6.5%	4,531	14.60	0.066
Area 3A	U26	Charter	52,043	5.0%	2,602	4.00	0.010
		Noncharter	31,019	6.0%	1,861	3.41	0.006
		Total	83,062	5.4%	4,463	3.75	0.017
	O26	Charter	92,050	5.0%	4,602	7.49	0.034
		Noncharter	62,688	6.0%	3,761	8.50	0.032
		Total	154,738	5.4%	8,364	7.94	0.066
Area 3B	U26	Total	216	6.0%	13	2.69	0.000
	O26	Total	455	6.0%	27	9.64	0.000
Area 4	U26	Total	463	6.0%	28	2.80	0.000
	O26	Total	1,499	6.0%	90	9.69	0.001

Table 6. Estimated sport harvest prior to the mean IPHC survey date in 2014 in Areas 2C and 3A.

			Harvest Prior to mean Survey Date	
Area	Mean Survey Date	User group	Percent of Harvest	Harvest (M lb)
Area 2C	July 1, 2014	Charter	26.0%	0.215
		Noncharter	22.6%	0.252
		Total	24.1%	0.467
Area 3A	July 7, 2014	Charter	37.1%	0.795
		Noncharter	46.2%	0.671
		Total	40.8%	1.465