PSRG-2016-08: CA Swordfish Drift Gillnet Fishery Bycatch Estimates
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Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery:1990-2014.

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Abstract

Estimates of marine mammal, sea turtle, and seabird bycatch are generated for the California swordfish drift gillnet fishery for the 25-year period 1990-2014, using random forest regression trees. These estimates are compared with traditional intra-annual ratio estimates generated from the same data. Bycatch estimates generated using sample-based methods, such as ratio estimates, are generally unbiased when fishery observations are representative of overall fishing effort and observer coverage is high. However, in the case of rare-event bycatch, small-sample bias usually results in annual estimates that are either too low or too high, because low observer coverage prevents the detection of rare events, or conversely, observed bycatch rates are positively-biased due to few observations. For rare species, which often pose the greatest management concerns, annual ratio estimates are volatile. In contrast, random forest regression tree models result in more stable annual estimates with better precision, because estimates are informed by all available data. Even in years with zero observed bycatch, estimates from regression trees are usually positive (sometimes fractions of animals), where corresponding ratio estimates would be zero. This is more in the spirit of a probabilistic approach to bycatch estimation, compared to annual ratio

estimates which are limited to estimates of zero (no observations) or discrete values tied to the number of annual observations and observer coverage.

Regression tree models include a suite of oceanographic, location, and gear variables that were identified through a variable selection approach validated with a simulated bycatch dataset. For both simulated and real bycatch data, our variable selection approach forced models to choose between actual and permuted (random noise) variables, which provided insights into sample size thresholds needed for robust models.

Introduction

The California large-mesh drift gillnet fishery for swordfish and thresher shark (hereafter referred to as 'the fishery') began in the 1970s as an experimental fishery targeting pelagic sharks and by the mid-1980s, expanded to 200 vessels and 10,000 annual fishing sets (Hanan et al. 1993, Holts et al. 1998). Fishing effort has steadily declined since then, with current annual levels of about 500 sets. Between 1990-2014, fishery technicians observed 8,637 sets from an estimated 54,622 sets fished, or 15.8% observer coverage (Carretta and Barlow 2011, NMFS unpublished data). Previous estimates of marine mammal, sea turtle, and seabird bycatch, based on ratio estimates, are published in Julian and Beeson (1998), Carretta et al. (2004), and also a series of annual bycatch reports (Carretta and Enriquez 2006, 2007, 2012a, 2012b, Carretta et al. 2005, 2014). Acoustic pingers designed to reduce marine mammal bycatch were experimentally introduced into the fishery in 1996 and became mandatory in 1997, resulting in statistically significant bycatch reductions, driven largely by lower bycatch rates of short-beaked common dolphin (*Delphinus delphis*) (Barlow and Cameron 2003, Carretta and Barlow 2011). In 2001, a large season/area closure called the Pacific Leatherback Conservation Area (PLCA) was implemented between 15 August and 15 November in the northern part of the fishing grounds to reduce leatherback sea turtle (*Dermochelys coriacea*) bycatch (Federal Register 2001, Figure 1). In addition to reductions in leatherback sea turtle bycatch, the main effect of this closure has been to limit fishing effort largely to the southeast portion of the California Current ecosystem.

Methods

Modeling approach

Bycatch models were constructed using a two-step process, first using random forest classification trees for variable selection. Variables selected for inclusion in bycatch models were then used in a regression tree random forest to estimate bycatch. Classification and regression trees (Breiman 2001) are partitioning algorithms that recursively split training data (2/3 of all data) into subsets, where data in each 'daughter node' has reduced variance if variables have predictive value. Splits are chosen through a bootstrap procedure where a subset of variables are randomly selected for splitting at each node and the variable that minimizes the variance in resulting daughter nodes is selected for splitting. In classification trees, the number of variables considered at each node is the square root of the number of variables available. Splits proceed until all data are contained in terminal nodes, although trees can be effectively 'pruned' by limiting the number of nodes, resulting in simpler models and reduced processing time. The resulting tree architecture represents $1/n^{th}$ of the data model of n trees. Many bootstrap trees (= a random forest) are generated, with each tree uncorrelated to others due to the bootstrap construction procedure. This method prevents overfitting of data and provides good generalized predictive models when variables are informative (Breiman 2001). Novel data (those not used to build trees) are introduced to the forest and resulting predictions are based on which terminal nodes novel data are assigned to.

Variable selection and model validation

Observed bycatch events in the fishery are generally rare. The most commonly-entangled species (short-beaked common dolphin) is observed entangled in approximately 4% of all fishing sets (324 observed entanglements totaling 406 animals in 8,637 observed sets), while rarely-entangled species such as sperm whales (*Physeter macrocephalus*) are observed in <0.1% of all monitored sets (6 observed

entanglements totaling 10 animals). Due to the zero-inflated nature of bycatch data, determining which (or if) variables have explanatory power is challenging. Faced with potential high noise-to-signal ratios in bycatch data, the analyst must determine if variables selected for inclusion in bycatch models represent spurious correlations with bycatch events or true 'signal'. We evaluated variable importance for a simulated rare bycatch dataset using classification trees (Breiman 2001) in the R-package *randomForest* (Liaw and Wiener 2002), implemented in the programming language R (Hornik 2013). Simulated bycatch included 30 realizations of a rare event process that contained between 4 and 9 bycatch events, totaling 9 to 11 animals, from approximately 8,500 fishing sets. Simulations were generated using a logistic model such that the probability of bycatch increased as a function of one variable associated with the actual observer data. The important variable (*depth*) was unknown to the primary analyst assessing variable importance. The metric for success in assessing variable importance was the ability of *randomForest* to correctly identify the unknown variable in most realizations. Variable testing included 24 variables, 12 actual variables associated with the simulated bycatch and 12 permuted versions of the same variables to represent random noise (Table 1). Random variables were included as a benchmark to see how often *randomForest* identified them as important. Using permuted variables in this context can also be useful in testing correlated variable selection biases identified by Strobl et al. (2007, 2008). It is expected that real variables should be favored over random variables in cases where bycatch is truly related to the variables. Models that favor random variables at least as often as real variables would suggest that bycatch is not related to a given set of real variables or that observed sample sizes are insufficient to identify a bycatch-variable link.

The metric for variable importance was total decrease in node impurity (Gini index) from splitting on a given variable, averaged over all forest trees. In other words, the splitting variable that best discriminates between sets with and without bycatch is the one that yields the greatest increase in node purity (information gain) in daughter nodes. Simulated bycatch was coded as a binary factor of presence (Y) or absence (N) and trees were constructed by randomly sampling (with replacement) equal numbers of Y/N events using the *randomForest* function *sampsize* (available only in classification

mode). The number of Y/N events sampled for each tree was equal to the number of observed bycatch events (>=1 animal) in the data. This strategy essentially forces a uniform prior on the response classes (bycatch per set) and is necessary with zero-inflated data to allow potential identification of explanatory variables that would otherwise lost in the noise of zero-inflation. Trees were not fully grown, but were instead limited to 10 terminal nodes to generate simple bycatch models and to expedite processing time. One hundred random forests (of 500 trees each) were constructed for each of 30 bycatch simulations and the three most important (out of 24) variables from each forest were tallied. The number of trees constructed is a function of minimizing within-model cross-validation error, which is asymptotic as the number of trees increases. Three variables were chosen as a baseline to model bycatch events that could potentially be associated with at least 2 dimensions (location), with perhaps a third dimension involving an oceanographic or gear variable. The maximum number of times that a single variable could be represented amongst the three most important variables was 100, equivalent to the number of forests run.

From 30 simulated bycatch realizations and selecting from a suite of 24 variables, *randomForest* correctly identified water *depth* as the most important variable in 18 of 30 cases, with up to 95% of forests selecting it in some realizations. Depth was also identified as the second or third most important variable in 5 other cases and was present in the top 3 variables in 23 of 30 cases. The variable *longitude* (highly-correlated with *depth* in this dataset, Spearman correlation = 0.7) was most frequently identified as the second most important variable (13/30 cases) and appeared among the top three variables in 18/30 cases (Table 2). In 25 of 30 cases, either *depth* or *longitude* was identified as the first or second-most important variable from a competing suite of 24 variables (Table 2). A random variable was chosen as the most important variable in 2 of 30 cases. In one test, the variable *depth* was omitted from the data and this resulted in *longitude* being selected as the most important variable in 22 of 30 cases, highlighting its correlation with depth.

While *randomForest* was able to correctly identify the variable linked to simulated bycatch, this is not the expectation for all rare events. However, the simulation exercise did provide insight into sample size thresholds (in this case between 4 and 9 positive

events from over 8000 sets) for which *randomForest* was able to correctly identify a single variable important to the bycatch process. In cases where there are an insufficient number of bycatch events to generate 'signal' or none of the variables have explanatory power, it would be expected that random and real variables would be identified as important in nearly equal proportions.

Bycatch models

For models used to estimate bycatch in the fishery, the variable selection approach described for simulated data was used. Four additional variables were included as candidates for bycatch models (*sst*, *slope*, *days*, and *drift.km*, see Table 1). In addition, the variable *Year* was excluded from bycatch models, as it represents a proxy for oceanographic, fishing gear, regulatory regime, or animal abundance variables that are more important to the bycatch analyst. In addition, the variable month was replaced with a Julian day metric of *days* elapsed since 1 August, the traditional beginning of the fishing season.

After determining which three variables were to be included in species models, final bycatch models were constructed using regression trees, since the response (bycatch per fishing set) is a rate to be estimated (Watters and Deriso 2000, Walsh and Kleiber 2001, Jiménez *et al*. 2009). The number of terminal nodes in a tree (a measure of model complexity) was allowed to vary according to observed sample sizes. For species with 10 or fewer observations, trees were limited to 10 terminal nodes and fully grown otherwise. Regression tree models were based on a forest of 100 trees. Predicted bycatch per set was generated by building random forests with *n*-1 sets (= "leave one out cross-validation"), which were then used to predict bycatch in each of 8,637 omitted sets. Predicted bycatch in omitted sets is the mean bycatch rate predicted from all forest trees, with a unique prediction from each tree. The result is a distribution of 100 summed bycatch predictions for all 8,637 omitted sets from which the variance of the model predictions is calculated. The distribution of summed bycatch predictions was also compared with the observed bycatch to determine the ratio of observed to predicted bycatch, which provides insight into model performance and bias.

For a given species in year *y*, the annual mean predicted bycatch per set ($\bar{b}_{s,y}$), is the mean predicted bycatch for all observed sets in that year, where the random forest is based on data from all 25 years of data. Annual estimates of bycatch from regression trees (T_y) were calculated as the mean predicted bycatch per set ($\bar{b}_{s,y}$) in year(s) *y*, multiplied by the number of unobserved sets ($u_{s,y}$) in year(s) *y*, plus the sum of observed bycatch ($o_{s,y}$) in year(s) *y*:

$$(1) \qquad T_y = \bar{b}_{s,y} * u_{s,y} + \sum o_{s,y}$$

Extrapolation of predicted bycatch rates to unobserved fishing effort reflects an assumption that observer data are representative of the fishery. Coefficients of variation (CV) of bycatch estimates were calculated as:

$$(2) \quad CV(T_y) = \sqrt{var\ T_y}/T_y$$

where *var* T_y is the variance of the sum of predicted bycatch *for all unobserved sets* across 100 forest trees in year(s) *y*.

Tree estimates were also compared to annual ratio estimates for all years. Ratio estimates were calculated simply as the observed bycatch in year *y*, multiplied by the inverse of observer coverage in that year. The CV of the ratio estimate was calculated as $CV_{ratio} = \sqrt{n}/n$, where *n* is the number of positive bycatch events. This is equivalent to assuming that bycatch events follow a Poisson process, though variance can be underestimated for species where bycatch events are characterized by multiple animals per set (rare in this fishery). In addition to annual estimates, pooled multi-year bycatch estimates were generated for regression tree and ratio methods for three time periods: 1990-2000, 2001-2014 and 2010-2014. The years 1990-2000 represent the pre-closure period of the fishery, when effort was permitted year-round in the PLCA. The years 2001-2014 represent the 'current state of the fishery', with most fishing effort occurring

off of southern California (Figure 1). Finally, the years 2010-2014 represent the most recent 5-year period for which bycatch estimates are available and coincide with the number of years typically used to pool bycatch estimates in NMFS marine mammal stock assessment reports. Periods in excess of 5 years have been shown to be superior for pooling estimates when bycatch is based on annual ratio estimates and entanglements are rare (Carretta and Moore 2014). However, models such as regression trees which incorporate all available data reduce the need for such pooling.

Results

Annual and multi-year bycatch estimates by species and species group are presented in Tables 4-40. Estimates reflect the number of entanglements, some of which would not have resulted in the death of the animal, though most entanglements in the fishery result in death. The number of mortality events by species/group can be obtained by prorating estimated entanglements by the proportion of observations that resulted in death. Bycatch estimates from regression trees were more stable inter-annually and were more precise than ratio estimates in most cases. The lower variance from trees primarily results from the inclusion of all 25 years of observer data in tree construction, compared to ratio estimates that typically rely on one year of data.

Variable selection for final bycatch models was characterized by very few variables being identified as important when sample sizes were large and very few random variables being identified as important (Table 3, Figure 2). At one extreme, the variable selection model for short-beaked common dolphin (n=324 observations) included only 3 variables (*days* + *lat* + *lon*). Other models characterized by very few variables included northern elephant seal (*Mirounga angustirostris*) (n=111; *lon* + *n.ping* + *sst*+ *lat*) and northern right whale dolphin (*Lissodelphis borealis*) (n=54; *lat* + *lon* + *sst* + *r_drift.km*), with a random variable being identified only once out of a total of 300 possibilities (100 forests x 3 top variables). We included all species in the variable selection exercise, including species with only one observed entanglement (fin whale, striped dolphin, killer whale). Variable selection models for these species identified many more variables as important and frequently identified random variables as

important (Table 3, Figure 2). For species such as striped dolphin, fin whale, and killer whale, where only random variables were included in final bycatch models, resulting bycatch estimates are essentially based on a null model, reflecting nothing more than mean predicted bycatch rates scaled up to varying levels of annual fishing effort. Estimates for these species are valid, but no inference can be made with respect to the underlying factors related to the bycatch of these species.

Over the cross-validated data that included 8,637 fishing sets, ratios of observed to predicted summed bycatch were close to unity for most species. The largest deviations were seen for species with the smallest sample sizes. For example, the striped dolphin model (observed / predicted ratio = 1.94) predicted almost no bycatch, but the sample size for the model was a single entanglement. Humpback and killer whale models predicted 20% less bycatch on average when compared with summed observations over the same fishing sets. Such deviation is not surprising, given that humpback and killer whale sample sizes were three and one respectively. In contrast, species with greater sample sizes had observed / predicted ratios much closer to one. For leatherback sea turtles (n=25), predicted bycatch was 5% higher than observations from the fishery. Bycatch predictions for short-beaked common dolphin (n=324) averaged 4.5% higher than observations from the same sets, while sperm whale bycatch (n=6) was underestimated by approximately 3%. The ratio of observed to predicted bycatch ratios for all species is included in Table 3.

Discussion

Bycatch estimates from regression trees and ratio estimators were similar over multiple-year periods, but often deviated markedly year-to-year, especially for rarely entangled species such as sperm whales. Regression tree estimates were generally more precise than ratio estimates over multiple years, reflecting the use of all data to estimate mean bycatch rates. Some annual regression tree bycatch estimates have rather large CVs, which occurs when the estimated bycatch is close to zero. This is especially apparent for species with low numbers of entanglements such as striped dolphin and fin whale. CVs for regression tree estimates are also larger in years with

fewer observed sets, a consequence of having fewer observations from which to calculate the predicted mean annual bycatch per set. Regression tree estimate CVs also reflect the diversity of predictions from the random forest, which depends upon the set characteristics of 'novel' sets predicted upon. In the extreme, if all observed sets in year *y* had the same set characteristics (location, date, depth, etc.), then any random forest would predict the same mean bycatch rate for these sets, resulting in a zero variance.

Large differences between regression tree and ratio estimates of annual bycatch are sometimes due to rarely-observed events combined with low observer coverage. For example, in 2010, two sperm whales were observed entangled in one set, from only 59 observed sets that year. The resulting high annual bycatch rate, combined with observer coverage of only 12.5%, resulted in a ratio estimate of 16.7 whales. In contrast, the regression tree estimate of bycatch for 2010 was 2.25 whales (2 observed + 0.25 estimated in unobserved sets). Given the observed bycatch rate of sperm whales in this fishery over 25 years (1 animal for every 1,000 sets), it is highly improbable that the true bycatch (observed + unobserved) in 2010 was ~ 17 whales. The true bycatch in 2010 was much more likely to be close to (if not exactly) 2 whales, given that approximately 500 total sets were fished that year. Another shortcoming of intra-annual ratio estimates is that when zero bycatch is observed, resulting bycatch estimates are zero, even when undetected bycatch occurred. This is again demonstrated by the sperm whale example, where the bycatch risk to sperm whales was much higher in the early years of the fishery because fishing effort was more intense in deep-water habitat north of Point Conception. The first two years of the observer program (1990-1991) had zero observations of sperm whale bycatch during 648 sets, while total estimated fishing effort was over 9,000 sets. Resulting ratio estimates of sperm whale bycatch for 1990-1991 were unrealistically zero (Julian and Beeson 1998), given the long-term bycatch rate of 1 animal in every 1,000 sets (a rate that could not be known after the first two years of observation). In contrast, the combined 1990-1991 regression tree bycatch estimate is approximately 10 whales, which is more realistic, given the level of fishing effort. One result of applying regression trees to bycatch estimation is that they predict some amount of bycatch in most years, including fractions of animals. This is more in

the spirit of a probabilistic approach to bycatch estimation and moderates inter-annual volatility of estimates associated with rare bycatch events and low observer coverage.

Bycatch reduction measures implemented in the fishery in 1996 included acoustic pingers, which resulted in an approximate 50% decline in cetacean bycatch rates (Barlow and Cameron 2003, Carretta and Barlow 2011). Declines in bycatch were largely driven by reductions in short-beaked common dolphin bycatch, as most species lacked sufficient observations to definitively conclude that pingers reduce bycatch. While acoustic pingers are reported to be a significant factor driving reductions in short-beaked common dolphin bycatch (Barlow and Cameron 2003, Carretta and Barlow 2011), the current analysis did not identify pingers among the three most important variables (Table 3). Only three variables (*days, lat, lon*) were included in the bycatch model for short-beaked common dolphin, suggesting that season and area fished influenced bycatch rates more than pingers when all data years are considered. This is not surprising, since short-beaked common dolphin occur at much higher densities in the southern part of the fishery area (Becker *et al.* 2014), where fishing effort largely shifted to after the implementation of the PLCA. Also, since late 1997, pingers have been used on >99% of all fishing sets (Carretta and Barlow 2011), while paired experiments of sets with and without pingers occurred only in 1996 and 1997 (Barlow and Cameron 2003). Thus, it is not surprising that variables other than pingers are recognized as important to short-beaked common dolphin bycatch, because a lack of pingers (1990-1995) and full pinger use (1998-2014) in the fishery are essentially recognized as constants by models. If the same *randomForest* variable importance analysis is applied to data that includes only the 2 years of the pinger experiment (1996-1997), pingers are then ranked as the most important bycatch variable, because now there is enough 'contrast' in the data to recognize the importance of pingers. Two previous studies of bycatch reduction in this fishery attributed to pingers (Carretta *et al*. 2008, Carretta and Barlow 2011) identified 2 groups/species (beaked whales and northern elephant seals) with more statistically significant bycatch reductions than short-beaked common dolphin. In our present study, pingers were identified in all 100 random forest runs among the most important variables for both beaked whales and northern elephant seals (Table 3). Beaked whales and northern elephant seals (when at

sea) are also more widely-distributed in the study area than short-beaked common dolphin, and thus, variables associated with fishing location are less likely to be identified as strong explanatory variables. In the case of short-beaked common dolphin, the lesson on variable selection is that strong predictor variables such as pingers can be effectively masked by location and season variables when the species' distribution is not uniform, fishing effort is highly seasonal, and the number of concurrent sets with and without pingers represents a fraction of the overall data.

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Table 1. Variables tested in random forest models. Permuted versions of all variables were included in variable selection tests for simulated and actual bycatch events to represent random noise. The variable *month* appeared only in models used to test the performance of variable selection procedures from simulated bycatch data. The variable *month* was replaced with *days* elapsed since the beginning of the fishing season (August 1) in models used on actual bycatch data. The variable *Year* was not considered as a candidate variable for actual bycatch data for reasons given in the text. Variables shown in bold represent additional variables considered for actual bycatch data.

Variable Name	**Variable Description**	**Range of Values**
days	Number days elapsed since August 1	1 -365
depth.p	water depth when net was pulled (meters)	46 - 6584
drift.km	Drift distance (km) between set and retrieval	1 - 300
extnd	Depth that top of net was fished below surface in ft	3 - 99
height.net	Number of meshes from top to bottom of net	14 - 180
lat	Latitude	24.5 - 48
length.net	Length of net (meters)	50 – 2000
lon	Longitude	117 - 129
mei.index	Multivariate El Nino index(annual mean for Aug-Jan)	-1.3 to +2.1
mesh	Mesh size in cm	14 - 28
month	Month	1-12
n.ping	Number of acoustic pingers	0 - 49
slope	Bathymetric slope, in degrees	0 - 90
soak	Number of hours that net was left to soak overnight	1 - 62
sst	Sea surface temperature (C)	11.1 – 25.6
Year	Year	1990-2014

Table 2. Simulated bycatch realizations tested for variable importance. Variables that resulted in the largest reduction in node impurities based on 100 individual random forests are shown for each simulated bycatch data set. The percent of forests where a variable was identified as the most important does not necessarily add to 100 because only the three most frequently identified variables are shown. Variables preceded by the prefix "r_" indicate random (permuted) versions of actual variables. The variable linked to simulated bycatch, '**Depth'** is shown in bold.

Simulation Trial (*n*=positive events)	Var 1	% Forests	Var 2	% Forests	Var 3	% Forests
sim1 (5)	**Depth**	62	longitude.pull	23	latitude.pull	8
sim2 (6)	**Depth**	95	r_Depth	1	r_longitude.pull	1
sim3 (6)	r_latitude.pull	17	r_mei.index	17	r_longitude.pull	13
sim4 (9)	latitude.pull	42	longitude.pull	22	**Depth**	13
sim5 (7)	latitude.pull	45	**Depth**	31	longitude.pull	24
sim6 (6)	latitude.pull	60	longitude.pull	22	r_longitude.pull	5
sim7 (6)	HeightNet	30	r_longitude.pull	14	r_mei.index	13
sim8 (7)	**Depth**	55	longitude.pull	25	latitude.pull	12
sim9 (7)	**Depth**	69	latitude.pull	16	longitude.pull	11
sim10 (5)	latitude.pull	18	r_longitude.pull	15	r_latitude.pull	10
sim11 (7)	HeightNet	56	**Depth**	30	mei.index	8
sim12 (6)	**Depth**	44	latitude.pull	40	longitude.pull	14
sim13 (8)	**Depth**	56	r_latitude.pull	11	r_longitude.pull	8
sim14 (7)	HeightNet	17	r_latitude.pull	16	r_mei.index	13
sim15 (7)	longitude.pull	48	mei.index	15	latitude.pull	10
sim16 (5)	**Depth**	79	longitude.pull	13	r_latitude.pull	3
sim17 (5)	**Depth**	33	mei.index	18	r_mei.index	12
sim18 (7)	**Depth**	29	latitude.pull	22	longitude.pull	13
sim19 (6)	**Depth**	78	longitude.pull	20	latitude.pull	2
sim20 (7)	**Depth**	95	Mesh	2	r_latitude.pull	1
sim21 (5)	HeightNet	53	Year	25	**Depth**	7
sim22 (6)	**Depth**	86	longitude.pull	11	r_Depth	1
sim23 (6)	**Depth**	92	longitude.pull	4	r_mei.index	2
sim24 (5)	**Depth**	33	longitude.pull	19	HeightNet	10
sim25 (6)	latitude.pull	23	longitude.pull	22	MM	21
sim26 (6)	**Depth**	69	longitude.pull	20	latitude.pull	5
sim27 (5)	r_mei.index	17	**Depth**	13	r_latitude.pull	11
sim28 (4)	**Depth**	26	r_latitude.pull	11	r_mei.index	11
sim29 (9)	**Depth**	72	longitude.pull	23	latitude.pull	5
sim30 (4)	**Depth**	44	longitude.pull	21	latitude.pull	15

Table 3. Variables identified (and number of times) among the three most-important variables from 100 classification tree random forests of 500 trees each, based on reduction in node impurity measures. Variables in **bold** represent the three most-frequently identified important variables and were used in final regression tree bycatch models. The number of observed bycatch events (≥1 entanglement in a set) and the fraction of 'important' variables identified represented by permuted versions of real variables is also given for each species. The ratio of observed to predicted bycatch from models over 8,637 observed fishing sets is shown in the last column.

Species (*n*= observed events)	Variables identified as important (number of forests identified in top three variables).	Fraction permuted variables	Observed/Predicted Bycatch Ratio
Minke whale (4)	**lat (92) + mei.index (34) + r_drift.km (20)** + r_days (19) + r_sst (17) + r_mei.index (15) + r_lat (14) + r_slope (13) + r_lon (12) + slope (11) + r_depth.p (9) + r_soak (9) + lon (8) + r_length.net (5) + r_mesh (5) + days (4) + r_n.ping (4) + r_extnd (3) + r_height.net (3) + depth.p (2) + sst (1)	0.49	0.983
Fin whale (1)	**r_mei.index (22) + r_depth.p (21) + r_lat (21)** + r_lon (21) + days (20) r_drift.km (19) + r_slope (17) + drift.km (15) + depth.p (14) + lon (14) r_days (14) + r_height.net (14) + lat (12) + r_sst (11) + slope (10) + sst (10) + mei.index (9) + r_length.net (8) + n.ping (6) + height.net (4) + r_n.ping (4) + r_soak (4) + r_extnd (3) + soak (3) + length.net (2) + mesh (1) + r_mesh (1)	0.60	1.04
Gray whale (4)	**days (76) + mei.index (35) + n.ping (33)** + r_lat (17) + r_depth.p (15) r_lon (15) + r_days (14) + r_drift.km (14) + r_sst (13) + slope (11) +r_mei.index (10) + r_slope (8) + drift.km (7) + lat (6) + r_mesh (5) +r_n.ping (5) + r_height.net (4) + r_length.net (4) + r_soak (3) + depth.p (2) + lon (2) + r_extnd (1)	0.43	1.00
Humpback whale (3)	**slope (97) + r_lon (23) + r_slope (21)**+ r_days (20) + r_drift.km (17) + r_sst (16) + r_depth.p (14) + r_mei.index (13) + n.ping	0.57	1.21

	(12) + r_lat (11) + r_n.ping (8) + sst (8) + r_height.net (7) + r_soak (7) + r_length.net (6) + r_mesh (6) + lat (4) + depth.p (3) + length.net (2) + lon (2) + r_extnd (2) + height.net (1)		
Sperm whale (6)	**depth.p (98) + lon (86) + sst (70)** + r_drift.km (9) + r_depth.p (6) + r_lat (6) + r_days (5) + r_slope (5) + r_sst (5) + r_height.net (2) + r_lon (2) + r_soak (2) + r_extnd (1) + r_length.net (1) + r_mei.index (1) + r_mesh (1)	0.15	1.03
Common dolphin, short-beaked (324)	**days (100) + lat (100) + lon (100)**	0	0.965
Common dolphin, long-beaked (16)	**depth.p (100) + lat (99) + lon (37)** + r_slope (11) + r_sst (10) + drift.km (8) + r_drift.km (8) + r_days (5) + r_depth.p (5) + r_lat (5) + r_length.net (4) + days (3) + r_lon (2) + r_mei.index (2) + r_n.ping (1)	0.18	1.02
Risso's dolphin (27)	**lon (100) + slope (95) + lat (54)** + days (31) + r_drift.km (6) + r_days (3) + r_lon (3) + r_depth.p (2) + r_lat (2) + r_slope (2) + r_sst (2)	0.07	1.04
Pilot whale, short-finned (10)	**lon (82) + mei.index (67) + days (64)** + depth.p (25) + lat (13) + r_lon (8) + r_sst (8) + r_drift.km (6) + r_lat (6) + r_slope (6) + r_mei.index (4) + r_days (3) + r_depth.p (2) + r_height.net (2) + r_soak (2) + r_mesh (1) + r_n.ping (1) +	0.16	0.972
Pacific white-sided dolphin (27)	**depth.p (97) + lon (56) + sst (32)** + days (22) + r_slope (15) + r_depth.p (14) + r_lon (13) + r_days (11) + r_drift.km (11) + r_lat (11) + r_sst (10) + r_mei.index (3) + r_height.net (2) + slope (2) + r_n.ping (1)	0.30	1.04
Northern right whale dolphin (54)	**lat (100) + lon (100) + sst (99)** + r_drift.km (1)	0.003	1.00
Killer whale (1)	**r_days (24) + r_depth.p (23) + r_sst (23)**	0.67	1.21

	+ r_lon (22) + r_mei.index (22) + r_lat (20) + lat (18) + lon (14) + r_drift.km (13) + sst (12) + r_n.ping (11) + r_slope (11) + slope (10) + days (9) + drift.km (9) + r_mesh (9) + soak (9) + depth.p (8) + mei.index (8) + r_soak (8) + r_extnd (7) + r_height.net (6) + r_length.net (2) + height.net (1) + mesh (1)		
Striped dolphin (1)	**r_lat (24) + r_sst (24) + days (22)** + r_lon (22) + r_mei.index (18) + sst (18) + r_days (17) + r_depth.p (15) + lon (14) + mesh (13) + r_slope (13) + lat (12) + r_drift.km (12) + depth.p (11) + mei.index (11) + slope (10) + r_n.ping (9) + r_soak (8) + r_height.net (7) + r_mesh (6) + r_extnd (5) + drift.km (3) + r_length.net (3) + height.net (1) + length.net (1) + soak (1)	0.61	1.94
Bottlenose dolphin (2)	**r_days (32) + r_sst (29) + r_drift.km (26)** + slope (25) + r_lon (24) + r_slope (24) + r_lat (23) + r_depth.p (21) + r_height.net (15) + r_mei.index (15) + r_mesh (15) + r_soak (12) + r_n.ping (9) + soak (7) + r_extnd (6) + sst(6) + days (3) + r_length.net (3) + lat (2) + lon (2) + n.ping (1)	0.85	0.958
Dall's porpoise (21)	**lat (100) + lon (100) + n.ping (96)** + r_days (2) + r_lat (1) + r_sst (1)	0.01	1.05
All beaked whales (33)	**lon (100) + n.ping (100) + depth (91)** + mei.index (7) + sst (2)	0	0.99
Pygmy sperm whale (2)	**extnd (90) + depth.p (37) + lat (18)** + r_drift.km (15) + r_sst (15) + r_lon (14) + lon (13) + r_depth.p (11) + r_days (10) + r_lat (10) + r_mei.index (10) + r_slope (10) + days (9) + r_soak (8) + r_n.ping (7) + slope (6) + r_mesh (5) + r_length.net (3) + sst (3) + drift.km (2) + r_height.net (2) + mei.index (1) + r_extnd	0.40	1.08

	(1)		
Baird's beaked whale (1)	**r_days (24) + r_lon (24) + r_sst (23)** + r_depth.p (22) + r_slope (18) + r_lat (17) + sst (17) + drift.km (13) + lat (13) + r_mei.index (12) + days (11) + depth.p (11) + lon (11) + r_drift.km (10) + r_n.ping (9) + height.net (8) + r_extnd (8) + r_length.net (8) + soak (8) + r_height.net (6) + r_mesh (6) + slope (6) + mei.index (5) + r_soak (5) + extnd (4) + n.ping (1)	0.64	1.13
Hubb's beaked whale (5)	**drift.km (94) + lon (93) + lat (73)** + depth.p (32) + r_lon (4) + r_sst (2) + r_extnd (1) + r_slope (1)	0.03	0.93
Stejneger's beaked whale (1)	**r_days (34) + r_depth.p (21) + r_sst (21)** + r_drift.km (20) + r_lon (20) + extnd (18) + days (17) + lon (14) + r_mei.index (14) + r_slope (14) + drift.km (13) + r_n.ping (13) + sst (13) + r_lat (12) + depth.p (10) + slope (10) + lat (8) + r_height.net (5) + r_mesh (5) + r_soak (5) + mei.index (4) + soak (3) + height.net (2) + r_extnd (2) + mesh (1) + r_length.net (1)	0.62	0.99
Cuvier's beaked whale (21)	**lon (100) + n.ping (100) + sst (59)** + depth.p (38) + r_lat (2) + r_lon (1)	0.01	0.994
Unidentified ziphiid (3)	**lat (76) + lon (72) + days (34)** + r_lon (14) + r_slope (12) + r_sst (12) + depth.p (10) + drift.km (9) + r_days (9) + r_lat (9) + r_drift.km (8) + r_soak (8) + r_depth.p (7) + r_mei.index (7) + r_height.net (5) + mei.index (3) + r_length.net (2) + r_n.ping (2) + r_mesh (1)	0.32	1.02
Unidentified Mesoplodon (2)	**soak (76) + lon (42) + depth.p (21)** + r_sst (17) + r_days (14) + r_depth.p (14) + height.net (13) + r_lat (12) + r_drift.km (11) + r_lon (9) + sst (9) + lat (8) + r_slope (8) + r_length.net (7) + r_height.net (6) +	0.40	0.97

	r_mei.index (6) + r_soak (6) + slope (6) + r_extnd (5) + length.net (3) + mei.index (2) + r_mesh (2) + r_n.ping (2) + mesh (1)		
Unidentified whale (2)	**length.net (34) + r_sst (31) + r_depth (29)** + r_drift.km (29) + r_mei.index (24) + r_days (21) + r_lat (21) + r_lon (17) + r_height.net (11) + days (9) + slope (9) + r_extnd (8) + r_soak (8) + r_length.net (7) + sst (7) + r_n.ping (5) + r_mesh (4) + lat (3) + mei.index (1) + soak (1)	0.78	1.12
Unidentified cetacean (2)	**days (74) + drift.km (48) + slope (34)** + r_lat (21) + r_sst (18) + r_lon (17) + r_slope + (14) + r_days (11) + r_depth.p (11) + r_mei.index (11) r_soak (8) + r_extnd (6) + mesh (3) + r_n.ping (3) + sst (3) + lon (2) + r_height.net (2) + r_length.net (2) + r_mesh (2) + mei.index (1)	0.45	1.09
California sea lion (175)	**depth.p (100) + lon (97) + mesh (88)** + slope (13) + lat (2)	0	0.994
Steller's sea lion (2)	**extnd (80) + r_depth.p (24) + r_lat (23)** + soak (18) + r_slope (17) + r_lon (16) + r_sst (15) + r_drift.km (14) + r_mei.index (12) + r_height.net (11) + height.net (9) + r_days (7) + r_length.net (7) + mei.index (6) + r_extnd (6) + sst (6) + drift.km (5) + lon (5) +r_mesh (5) + r_n.ping (5) + r_soak (5) + lat (3) + days (1)	0.56	0.957
Northern elephant seal (111)	**lon (100) + n.ping (100) + sst (80)** + lat (20)	0	1.01
Unidentified pinniped (2)	**depth.p (78) + lon (53) + r_lat (19)** +r_lon (17) + lat (14) + r_slope(14) + r_days (13) +r_depth.p(13) + r_sst (13) + r_soak (12) +mei.index (10) +r_mei.index (8)+ r_n.ping (7) + r_drift.km (6) + r_mesh (6) + n.ping (4) + r_height.net (4) + r_length.net (4) + r_extnd(3) + days	0.46	0.971

	(1) + drift.km (1)		
Loggerhead sea turtle (14)	**lat (100) + lon (94) + days (93)** + sst (6) + r_slope (2) + r_days (1) + r_height.net (1) + r_lat (1) + r_lon (1) + r_sst (1)	0.02	1.04
Green sea turtle (1)	**r_sst (24) + sst (22) + r_depth.p (20) +** r_slope (20) + slope (17) + lat (16) + r_days(16) + r_lat (16) + r_lon (15) + r_drift.km (14) + r_n.ping (14) + r_mei.index (13) + days (12) + drift.km (12) + extnd (9) + depth.p (8) + lon (7) + mei.index (7) + n.ping (7) + soak (7) + r_soak (6) + height.net (4) + r_height.net (4) + mesh (3) + r_extnd (3) + r_mesh (3) + r_length.net (1)	0.56	0.968
Leatherback sea turtle (25)	**depth.p (100) + lat (100) + lon (100)**	0	0.95
Olive ridley sea turtle (1)	**r_lon (33) + r_sst (28) + r_days (23)** + r_lat (20) + r_drift.km (19) + sst (19) + r_depth.p (18) + r_slope (17) + r_mei.index (16) + days (13) + lon (11) + depth.p (10) + drift.km (10) + mesh (9) + r_n.ping (8) + lat (7) + r_soak (7) + slope (7) + r_height.net (6) + n.ping (4) + height.net (3) + mei.index (3) + r_mesh (3) + r_extnd (2) + r_length.net (2) +soak (2)	0.67	0.885
Unidentified sea turtle (3)	**days (101) + height.net (92) +extnd (83)** + lat (14) + r_lon (3) + r_slope (3) + r_lat (2) + r_extnd (1) + r_mei.index (1)	0.03	0.968
Unidentified bird (5)	**slope (100) + drift.km (79) + lat (30) +**height.net (15) + r_depth.p (10) + r_slope (9) + r_days (8) + r_lon (8) +lon (7) + r_drift.km + r_lat (6) + r_sst (5) + r_mei.index (4) +r_soak (4) +r_height.net (2) + r_mesh (2) + r_n.ping (2) + length.net (1) + mei.index (1)	0.22	1.04

Cormorant sp. (1)	**r_sst (21) + r_depth.p (20) + r_lon (20)** + r_drift.km (19) + r_days (18) + r_lat (17) + lat (15) + drift.km (14) + days (12) + mei.index (12) + depth.p (11) + r_slope (11) + slope (11) + sst (11) + lon (10) + n.ping (10) + r_mei.index (10) + length.net (9) + r_height.net (9) + r_length.net (8) + r_n.ping (8) + r_soak (8) + height.net (7) + r_mesh (5) + soak (3) + r_extnd (1)	0.58	0.944
Northern fulmar (20)	**days (100) + n.ping (100) + mei.index (97)** +r_drift.km (1) + r_lat (1) + r_sst (1)	0.01	0.999

Table 4. Sets observed, observer coverage, observed and estimated bycatch for MINKE WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.85	0.85	3.59	0	–
1991	470	0.0984	0	1.1	1.1	1.81	0	–
1992	596	0.136	0	0.64	0.64	2.18	0	–
1993	728	0.134	0	1.2	1.2	1.47	0	–
1994	759	0.179	1	2.8	3.8	0.42	6	0.99
1995	572	0.156	0	0.63	0.63	2.12	0	–
1996	421	0.124	1	3.5	4.5	0.65	8	1
1997	692	0.228	0	1.1	1.1	0.73	0	–
1998	587	0.175	0	0.13	0.13	0.36	0	–
1999	526	0.2	1	2.6	3.6	0.48	5	1
2000	444	0.229	0	0.99	0.99	1.36	0	–
2001	339	0.204	0	0.18	0.18	2.79	0	–
2002	360	0.221	0	0.05	0.05	3.28	0	–
2003	298	0.203	0	0.23	0.23	2.67	0	–
2004	223	0.206	0	0.33	0.33	3.18	0	–
2005	225	0.209	0	0.04	0.04	2.67	0	–
2006	266	0.186	0	0.03	0.03	0.58	0	–
2007	204	0.164	0	0.77	0.77	1.34	0	–
2008	149	0.135	0	0.31	0.31	0.81	0	–
2009	101	0.133	0	0.02	0.02	0.87	0	–
2010	59	0.12	0	1.5	1.5	1.76	0	–
2011	85	0.195	1	1.5	2.5	0.51	5	1.01
2012	83	0.187	0	0.38	0.38	2.77	0	–
2013	175	0.372	0	0.02	0.02	0.66	0	–
2014	97	0.237	0	0.07	0.07	4.61	0	–
1990–2000	5973	0.17	3	15.5	18.5	0.31	18	0.58
2001–2014	2664	0.24	1	5.4	6.4	0.44	4	0.99
2010–2014	499	0.28	1	3.5	4.5	0.58	4	1

Table 5. Sets observed, observer coverage, observed and estimated bycatch for FIN WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.02	0.02	4.92	0	–
1991	470	0.0984	0	0.56	0.56	3.33	0	–
1992	596	0.136	0	0.63	0.63	2.76	0	–
1993	728	0.134	0	0.98	0.98	1.45	0	–
1994	759	0.179	0	0.74	0.74	2.46	0	–
1995	572	0.156	0	0.31	0.31	3.39	0	–
1996	421	0.124	0	0.02	0.02	3.27	0	–
1997	692	0.228	0	0.13	0.13	3.1	0	–
1998	587	0.175	0	0.26	0.26	2.82	0	–
1999	526	0.2	1	0.27	1.27	0.61	5	1
2000	444	0.229	0	0.18	0.18	2.94	0	–
2001	339	0.204	0	0	0	–	0	–
2002	360	0.221	0	0.13	0.13	2.84	0	–
2003	298	0.203	0	0.17	0.17	3.68	0	–
2004	223	0.206	0	0.01	0.01	3.99	0	–
2005	225	0.209	0	0.17	0.17	2.28	0	–
2006	266	0.186	0	0.15	0.15	3.03	0	–
2007	204	0.164	0	0.09	0.09	6.05	0	–
2008	149	0.135	0	0.01	0.01	4.55	0	–
2009	101	0.133	0	0.01	0.01	4.02	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0	0	–	0	–
2013	175	0.372	0	0	0	–	0	–
2014	97	0.237	0	0.08	0.08	3.15	0	–
1990−2000	5973	0.17	1	4.1	5.1	0.69	6	1
2001−2014	2664	0.24	0	0.8	0.8	1.26	0	–
2010−2014	499	0.28	0	0.1	0.1	3	0	–

Table 6. Sets observed, observer coverage, observed and estimated bycatch for GRAY WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.04	0	0.01	0.01	7.04	0	–
1991	470	0.1	0	0.05	0.05	2.69	0	–
1992	596	0.14	0	0.01	0.01	4.71	0	–
1993	728	0.13	0	0.09	0.09	2.34	0	–
1994	759	0.18	0	0.06	0.06	1.98	0	–
1995	572	0.16	0	0.1	0.1	3.13	0	–
1996	421	0.12	0	0.36	0.36	1.78	0	–
1997	692	0.23	0	0.45	0.45	1.9	0	–
1998	587	0.18	1	3	4	0.46	6	1
1999	526	0.2	1	3.1	4.1	0.5	5	1
2000	444	0.23	0	0.32	0.32	1.01	0	–
2001	339	0.2	0	1.4	1.4	0.88	0	–
2002	360	0.22	0	0.18	0.18	1.39	0	–
2003	298	0.2	0	0.29	0.29	1.62	0	–
2004	223	0.21	0	0.19	0.19	1.74	0	–
2005	225	0.21	1	1.7	2.7	0.44	5	1.01
2006	266	0.19	0	0.37	0.37	2.13	0	–
2007	204	0.16	0	0.8	0.8	1.62	0	–
2008	149	0.14	0	0.1	0.1	1.31	0	–
2009	101	0.13	0	0.04	0.04	1.25	0	–
2010	59	0.12	0	0.59	0.59	2.65	0	–
2011	85	0.2	0	0.03	0.03	1.41	0	–
2012	83	0.19	0	0.05	0.05	2.43	0	–
2013	175	0.37	1	0.94	1.94	0.41	3	0.99
2014	97	0.24	0	0.16	0.16	2.65	0	–
1990–2000	5973	0.17	2	7.5	9.5	0.32	12	0.71
2001–2014	2664	0.24	2	6.8	8.8	0.26	8	0.7
2010–2014	499	0.28	1	1.8	2.8	0.46	4	0.99

Table 7. Sets observed, observer coverage, observed and estimated bycatch for HUMPBACK WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	1.3	1.3	2.27	0	–
1991	470	0.0984	0	0.45	0.45	2.12	0	–
1992	596	0.136	0	1.6	1.6	1.71	0	–
1993	728	0.134	0	1.8	1.8	1.56	0	–
1994	759	0.179	1	1.4	2.4	0.8	6	1
1995	572	0.156	0	0.77	0.77	1.81	0	–
1996	421	0.124	0	0.6	0.6	2.28	0	–
1997	692	0.228	0	0.54	0.54	1.63	0	–
1998	587	0.175	0	0.63	0.63	1.59	0	–
1999	526	0.2	1	0.61	1.61	0.78	5	0.98
2000	444	0.229	0	0.26	0.26	2.24	0	–
2001	339	0.204	0	0.28	0.28	2.05	0	–
2002	360	0.221	0	0.57	0.57	1.87	0	–
2003	298	0.203	0	0.24	0.24	2.53	0	–
2004	223	0.206	1	0.3	1.3	0.59	5	1.02
2005	225	0.209	0	0.14	0.14	4	0	–
2006	266	0.186	0	0.52	0.52	2.32	0	–
2007	204	0.164	0	0.29	0.29	3.02	0	–
2008	149	0.135	0	0.09	0.09	0.78	0	–
2009	101	0.133	0	0.57	0.57	2.98	0	–
2010	59	0.12	0	0.19	0.19	5.42	0	–
2011	85	0.195	0	0.04	0.04	0.99	0	–
2012	83	0.187	0	0.13	0.13	4.84	0	–
2013	175	0.372	0	0.09	0.09	2.51	0	–
2014	97	0.237	0	0.02	0.02	2.05	0	–
1990–2000	5973	0.17	2	10	12	0.43	12	0.7
2001–2014	2664	0.24	1	3.5	4.5	0.64	4	0.99
2010–2014	499	0.28	0	0.5	0.5	2.22	0	–

Table 8. Sets observed, observer coverage, observed and estimated bycatch for COMMON DOLPHIN, SHORT−BEAKED. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	8	192	200	0.28	183	0.46
1991	470	0.0984	44	325	369	0.14	447	0.2
1992	596	0.136	45	208	253	0.15	331	0.18
1993	728	0.134	28	204	232	0.16	209	0.28
1994	759	0.179	26	168	194	0.13	145	0.21
1995	572	0.156	38	189	227	0.14	244	0.23
1996	421	0.124	28	146	174	0.15	226	0.21
1997	692	0.228	22	103	125	0.15	96	0.24
1998	587	0.175	9	144	153	0.18	51	0.33
1999	526	0.2	36	100	136	0.16	180	0.23
2000	444	0.229	25	73	98	0.16	109	0.24
2001	339	0.204	7	41	48	0.25	34	0.43
2002	360	0.221	7	49	56	0.21	32	0.43
2003	298	0.203	17	59	76	0.2	84	0.31
2004	223	0.206	7	44	51	0.29	34	0.42
2005	225	0.209	12	34	46	0.21	57	0.28
2006	266	0.186	7	41	48	0.27	38	0.47
2007	204	0.164	9	49	58	0.22	55	0.36
2008	149	0.135	8	36	44	0.35	59	0.46
2009	101	0.133	1	28	29	0.37	8	1
2010	59	0.12	3	21	24	0.49	25	0.73
2011	85	0.195	2	16	18	0.43	10	0.7
2012	83	0.187	5	14	19	0.38	27	0.59
2013	175	0.372	6	10	16	0.2	16	0.41
2014	97	0.237	6	22	28	0.29	25	0.46
1990−2000	5973	0.17	309	1852	2161	0.05	1818	0.07
2001−2014	2664	0.24	97	464	561	0.07	404	0.12
2010−2014	499	0.28	22	83	105	0.14	79	0.25

Table 9. Sets observed, observer coverage, observed and estimated bycatch for COMMON DOLPHIN, LONG−BEAKED. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	5.7	5.7	2.22	0	−
1991	470	0.0984	0	18	18	1.09	0	−
1992	596	0.136	2	6.7	8.7	1.02	15	0.71
1993	728	0.134	0	5.3	5.3	1.1	0	−
1994	759	0.179	1	8.6	9.6	0.72	6	1.02
1995	572	0.156	4	5.8	9.8	0.54	26	1
1996	421	0.124	0	5	5	1.7	0	−
1997	692	0.228	4	7.9	11.9	0.39	18	0.61
1998	587	0.175	0	3.6	3.6	0.9	0	−
1999	526	0.2	1	4.6	5.6	0.83	5	0.99
2000	444	0.229	0	3.3	3.3	1.25	0	−
2001	339	0.204	0	5.9	5.9	0.93	0	−
2002	360	0.221	4	4.4	8.4	0.5	18	0.78
2003	298	0.203	0	4.6	4.6	1.09	0	−
2004	223	0.206	0	2.6	2.6	1.04	0	−
2005	225	0.209	3	2.8	5.8	0.48	14	0.56
2006	266	0.186	0	3.2	3.2	1.05	0	−
2007	204	0.164	0	1.5	1.5	1.53	0	−
2008	149	0.135	1	3.3	4.3	1.22	7	0.99
2009	101	0.133	0	0.88	0.88	1.83	0	−
2010	59	0.12	1	0.44	1.44	0.97	8	0.99
2011	85	0.195	1	2.7	3.7	1.51	5	0.97
2012	83	0.187	0	0.91	0.91	2.51	0	−
2013	175	0.372	0	0.27	0.27	3.18	0	−
2014	97	0.237	0	1.7	1.7	2.2	0	−
1990−2000	5973	0.17	12	74.5	86.5	0.29	71	0.43
2001−2014	2664	0.24	10	35.2	45.2	0.31	42	0.4
2010−2014	499	0.28	2	6	8	0.86	7	0.71

Table 10. Sets observed, observer coverage, observed and estimated bycatch for RISSO'S DOLPHIN.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	54	54	0.92	0	–
1991	470	0.0984	5	16	21	0.51	51	0.45
1992	596	0.136	5	16	21	0.53	37	0.44
1993	728	0.134	7	19	26	0.38	52	0.43
1994	759	0.179	1	9.3	10.3	0.54	6	1
1995	572	0.156	6	14	20	0.61	38	0.62
1996	421	0.124	0	4.7	4.7	1.24	0	–
1997	692	0.228	3	13	16	0.44	13	0.74
1998	587	0.175	0	13	13	0.68	0	–
1999	526	0.2	0	8.8	8.8	0.68	0	–
2000	444	0.229	2	8.2	10.2	0.57	9	0.7
2001	339	0.204	0	3.8	3.8	1.23	0	–
2002	360	0.221	0	4.3	4.3	0.86	0	–
2003	298	0.203	4	3	7	0.68	20	1
2004	223	0.206	0	0.56	0.56	2.07	0	–
2005	225	0.209	0	1	1	1.96	0	–
2006	266	0.186	0	1.4	1.4	1.62	0	–
2007	204	0.164	0	0.95	0.95	2.59	0	–
2008	149	0.135	1	6.2	7.2	1.08	7	1
2009	101	0.133	0	2.2	2.2	1.88	0	–
2010	59	0.12	0	1.1	1.1	3.13	0	–
2011	85	0.195	1	3	4	0.99	5	1.01
2012	83	0.187	0	1.3	1.3	1.62	0	–
2013	175	0.372	0	1.2	1.2	1.73	0	–
2014	97	0.237	0	1.4	1.4	1.34	0	–
1990–2000	5973	0.17	29	176	205	0.16	171	0.22
2001–2014	2664	0.24	6	31.4	37.4	0.37	25	0.7
2010–2014	499	0.28	1	8	9	0.7	4	1.01

Table 11. Sets observed, observer coverage, observed and estimated bycatch for PILOT WHALE, SHORT−FINNED. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.04	1	24	25	0.66	25	0.99
1991	470	0.1	0	4	4	1.29	0	–
1992	596	0.14	1	7.3	8.3	0.66	7	0.99
1993	728	0.13	8	40	48	0.43	62	0.59
1994	759	0.18	0	4.2	4.2	1.12	0	–
1995	572	0.16	0	1.5	1.5	1.9	0	–
1996	421	0.12	0	1.5	1.5	2.99	0	–
1997	692	0.23	1	2.2	3.2	0.61	4	1.01
1998	587	0.18	0	0.62	0.62	2	0	–
1999	526	0.2	0	0.44	0.44	2.09	0	–
2000	444	0.23	0	0.42	0.42	3.22	0	–
2001	339	0.2	0	0.66	0.66	2.34	0	–
2002	360	0.22	0	0.72	0.72	1.72	0	–
2003	298	0.2	1	2.9	3.9	0.68	5	1.02
2004	223	0.21	0	0.28	0.28	3.26	0	–
2005	225	0.21	0	0.01	0.01	5.11	0	–
2006	266	0.19	0	0.3	0.3	3.17	0	–
2007	204	0.16	0	0.28	0.28	3.74	0	–
2008	149	0.14	0	0.03	0.03	4.02	0	–
2009	101	0.13	0	1.2	1.2	1.97	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.2	0	0	0	–	0	–
2012	83	0.19	0	0.03	0.03	6.2	0	–
2013	175	0.37	0	0.02	0.02	5.45	0	–
2014	97	0.24	2	3.7	5.7	0.42	8	0.7
1990−2000	5973	0.17	11	86.2	97.2	0.3	65	0.45
2001−2014	2664	0.24	3	10.1	13.1	0.37	12	0.57
2010−2014	499	0.28	2	3.8	5.8	0.42	7	0.7

Table 12. Sets observed, observer coverage, observed and estimated bycatch for PACIFIC WHITE−SIDED DOLPHIN. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	3	30	33	0.72	69	0.57
1991	470	0.0984	5	24	29	0.5	51	0.66
1992	596	0.136	3	23	26	0.45	22	0.75
1993	728	0.134	2	11	13	0.69	15	0.7
1994	759	0.179	3	13	16	0.48	17	0.73
1995	572	0.156	1	7.9	8.9	0.75	6	0.99
1996	421	0.124	3	9.8	12.8	0.64	24	0.75
1997	692	0.228	3	8.6	11.6	0.44	13	0.57
1998	587	0.175	0	13	13	0.69	0	–
1999	526	0.2	0	9	9	0.66	0	–
2000	444	0.229	2	9.4	11.4	0.41	9	0.7
2001	339	0.204	2	9.8	11.8	0.58	10	0.7
2002	360	0.221	1	7.8	8.8	0.55	5	1.01
2003	298	0.203	0	2.9	2.9	1.2	0	–
2004	223	0.206	0	2.5	2.5	1.28	0	–
2005	225	0.209	0	0.47	0.47	2.35	0	–
2006	266	0.186	0	3.4	3.4	1.63	0	–
2007	204	0.164	1	1.8	2.8	0.81	6	1
2008	149	0.135	5	5	10	0.53	37	0.71
2009	101	0.133	2	1.6	3.6	0.76	15	1
2010	59	0.12	0	0.24	0.24	3.95	0	–
2011	85	0.195	0	2.4	2.4	1.2	0	–
2012	83	0.187	0	0.68	0.68	2.84	0	–
2013	175	0.372	0	0.49	0.49	1.75	0	–
2014	97	0.237	0	0.63	0.63	1.82	0	–
1990−2000	5973	0.17	25	158.7	183.7	0.2	147	0.24
2001−2014	2664	0.24	11	39.7	50.7	0.29	46	0.42
2010−2014	499	0.28	0	4.4	4.4	0.76	0	–

Table 13. Sets observed, observer coverage, observed and estimated bycatch for NORTHERN RIGHT WHALE DOLPHIN. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	55	55	0.82	0	–
1991	470	0.0984	7	42	49	0.47	71	0.43
1992	596	0.136	2	43	45	0.56	15	0.71
1993	728	0.134	7	34	41	0.38	52	0.43
1994	759	0.179	7	37	44	0.4	39	0.43
1995	572	0.156	9	37	46	0.34	58	0.66
1996	421	0.124	5	23	28	0.47	40	0.66
1997	692	0.228	5	25	30	0.39	22	0.44
1998	587	0.175	0	21	21	0.58	0	–
1999	526	0.2	3	19	22	0.35	15	0.57
2000	444	0.229	11	18	29	0.29	48	0.5
2001	339	0.204	5	8	13	0.42	25	0.53
2002	360	0.221	2	10	12	0.56	9	0.71
2003	298	0.203	1	4.9	5.9	0.59	5	1
2004	223	0.206	1	1.1	2.1	1.08	5	1
2005	225	0.209	0	1.8	1.8	2.13	0	–
2006	266	0.186	0	3.2	3.2	1.03	0	–
2007	204	0.164	1	8	9	0.51	6	1.01
2008	149	0.135	1	7.2	8.2	0.68	7	1
2009	101	0.133	0	3.8	3.8	1.13	0	–
2010	59	0.12	1	2.9	3.9	0.94	8	0.99
2011	85	0.195	1	3.7	4.7	0.78	5	0.99
2012	83	0.187	1	2.4	3.4	0.95	5	0.98
2013	175	0.372	2	1.2	3.2	0.39	5	0.99
2014	97	0.237	1	1.4	2.4	0.83	4	1
1990–2000	5973	0.17	56	354	410	0.13	329	0.19
2001–2014	2664	0.24	17	59.6	76.6	0.22	71	0.27
2010–2014	499	0.28	6	11.6	17.6	0.36	21	0.48

Table 14. Sets observed, observer coverage, observed and estimated bycatch for KILLER WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.41	0.41	2.96	0	–
1991	470	0.0984	0	0.17	0.17	5.29	0	–
1992	596	0.136	0	0.18	0.18	3.63	0	–
1993	728	0.134	0	0.21	0.21	3.35	0	–
1994	759	0.179	0	0.23	0.23	2.55	0	–
1995	572	0.156	1	0.39	1.39	0.9	6	1.01
1996	421	0.124	0	0.46	0.46	3.66	0	–
1997	692	0.228	0	0.14	0.14	2.7	0	–
1998	587	0.175	0	0.2	0.2	1.49	0	–
1999	526	0.2	0	0.13	0.13	1.3	0	–
2000	444	0.229	0	0.29	0.29	3.07	0	–
2001	339	0.204	0	0.07	0.07	2.67	0	–
2002	360	0.221	0	0.01	0.01	1.29	0	–
2003	298	0.203	0	0.01	0.01	1.46	0	–
2004	223	0.206	0	0.01	0.01	1.62	0	–
2005	225	0.209	0	0.09	0.09	5.71	0	–
2006	266	0.186	0	0.14	0.14	3.32	0	–
2007	204	0.164	0	0.13	0.13	2.66	0	–
2008	149	0.135	0	0.13	0.13	2.6	0	–
2009	101	0.133	0	0.21	0.21	5.39	0	–
2010	59	0.12	0	0.03	0.03	4.24	0	–
2011	85	0.195	0	0.69	0.69	2.1	0	–
2012	83	0.187	0	0.01	0.01	1.5	0	–
2013	175	0.372	0	0	0	–	0	–
2014	97	0.237	0	0.01	0.01	2.01	0	–
1990−2000	5973	0.17	1	2.8	3.8	0.77	6	1.01
2001−2014	2664	0.24	0	1.5	1.5	1.22	0	–
2010−2014	499	0.28	0	0.7	0.7	1.96	0	–

Table 15. Sets observed, observer coverage, observed and estimated bycatch for DALL'S PORPOISE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	1	11	12	0.61	23	0.99
1991	470	0.0984	2	18	20	0.41	20	0.7
1992	596	0.136	1	23	24	0.29	7	1
1993	728	0.134	9	37	46	0.18	67	0.37
1994	759	0.179	2	17	19	0.25	11	0.71
1995	572	0.156	1	8.8	9.8	0.39	6	1.01
1996	421	0.124	2	6.3	8.3	0.41	16	0.71
1997	692	0.228	4	6	10	0.26	18	0.61
1998	587	0.175	0	1.3	1.3	1.11	0	–
1999	526	0.2	0	2.4	2.4	0.83	0	–
2000	444	0.229	0	0.66	0.66	2.06	0	–
2001	339	0.204	0	0.32	0.32	2.34	0	–
2002	360	0.221	0	0.38	0.38	2.62	0	–
2003	298	0.203	0	0.36	0.36	2.82	0	–
2004	223	0.206	0	0.27	0.27	2.85	0	–
2005	225	0.209	0	0.89	0.89	1.74	0	–
2006	266	0.186	0	0.18	0.18	3.85	0	–
2007	204	0.164	0	0.27	0.27	3.88	0	–
2008	149	0.135	0	0.12	0.12	5.59	0	–
2009	101	0.133	0	0.03	0.03	1.94	0	–
2010	59	0.12	0	0.01	0.01	2.82	0	–
2011	85	0.195	0	0.01	0.01	2.29	0	–
2012	83	0.187	0	0.03	0.03	3.17	0	–
2013	175	0.372	0	0.14	0.14	1.96	0	–
2014	97	0.237	1	0.16	1.16	0.4	4	0.98
1990−2000	5973	0.17	22	131.5	153.5	0.11	129	0.23
2001−2014	2664	0.24	1	3.2	4.2	0.63	4	1
2010−2014	499	0.28	1	0.4	1.3	0.46	4	1

Table 16. Sets observed, observer coverage, observed and estimated bycatch for STRIPED DOLPHIN.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0	0	–	0	–
1991	470	0.0984	0	0.65	0.65	3.36	0	–
1992	596	0.136	0	0.13	0.13	5.15	0	–
1993	728	0.134	0	0.93	0.93	2.43	0	–
1994	759	0.179	1	0.47	1.47	0.75	6	1
1995	572	0.156	0	0.05	0.05	10	0	–
1996	421	0.124	0	0	0	–	0	–
1997	692	0.228	0	0.1	0.1	5.71	0	–
1998	587	0.175	0	0.02	0.02	7.22	0	–
1999	526	0.2	0	0.03	0.03	7.67	0	–
2000	444	0.229	0	0.03	0.03	10	0	–
2001	339	0.204	0	0	0	–	0	–
2002	360	0.221	0	0	0	–	0	–
2003	298	0.203	0	0.24	0.24	3.98	0	–
2004	223	0.206	0	0	0	–	0	–
2005	225	0.209	0	0.04	0.04	10	0	–
2006	266	0.186	0	0	0	–	0	–
2007	204	0.164	0	0	0	–	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0	0	–	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0.13	0.13	5.71	0	–
2013	175	0.372	0	0.01	0.01	5.26	0	–
2014	97	0.237	0	0.03	0.03	10	0	–
1990−2000	5973	0.17	1	2.4	3.4	0.91	6	1
2001−2014	2664	0.24	0	0.4	0.4	2.7	0	–
2010−2014	499	0.28	0	0.2	0.2	4.3	0	–

Table 17. Sets observed, observer coverage, observed and estimated bycatch for BOTTLENOSE DOLPHIN. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.19	0.19	3.79	0	–
1991	470	0.0984	0	1.7	1.7	2.44	0	–
1992	596	0.136	3	3.5	6.5	1.09	22	1
1993	728	0.134	0	0.62	0.62	2.37	0	–
1994	759	0.179	0	0.53	0.53	2.15	0	–
1995	572	0.156	0	1.5	1.5	2.55	0	–
1996	421	0.124	0	0.85	0.85	3.74	0	–
1997	692	0.228	0	1.1	1.1	2.61	0	–
1998	587	0.175	0	0.18	0.18	3.58	0	–
1999	526	0.2	0	0.25	0.25	3.9	0	–
2000	444	0.229	0	2.1	2.1	1.99	0	–
2001	339	0.204	0	0.46	0.46	2.68	0	–
2002	360	0.221	0	0.47	0.47	3.46	0	–
2003	298	0.203	0	0.29	0.29	4.54	0	–
2004	223	0.206	0	3.5	3.5	1.69	0	–
2005	225	0.209	0	0.08	0.08	5.09	0	–
2006	266	0.186	0	0.58	0.58	3.99	0	–
2007	204	0.164	0	1.1	1.1	2.85	0	–
2008	149	0.135	0	0.03	0.03	0.76	0	–
2009	101	0.133	0	0.02	0.02	1.2	0	–
2010	59	0.12	1	0.01	1.01	0.01	8	0.99
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0.06	0.06	4.27	0	–
2013	175	0.372	0	0.21	0.21	3.59	0	–
2014	97	0.237	0	0	0	–	0	–
1990–2000	5973	0.17	3	12.5	15.5	0.67	18	0.99
2001–2014	2664	0.24	1	6.8	7.8	0.91	4	1.01
2010–2014	499	0.28	1	0.3	1.3	0.75	4	1

Table 18. Sets observed, observer coverage, observed and estimated bycatch for PYGMY SPERM WHALE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	5.9	5.9	1.34	0	–
1991	470	0.0984	0	2.5	2.5	1.25	0	–
1992	596	0.136	1	2.1	3.1	0.68	7	1
1993	728	0.134	1	1.8	2.8	0.74	7	1
1994	759	0.179	0	0.86	0.86	1.22	0	–
1995	572	0.156	0	1.2	1.2	1.37	0	–
1996	421	0.124	0	0.59	0.59	2.44	0	–
1997	692	0.228	0	0.26	0.26	2.07	0	–
1998	587	0.175	0	0.06	0.06	1.95	0	–
1999	526	0.2	0	0.03	0.03	0.56	0	–
2000	444	0.229	0	0.02	0.02	0.6	0	–
2001	339	0.204	0	0.03	0.03	4.46	0	–
2002	360	0.221	0	0.01	0.01	0.79	0	–
2003	298	0.203	0	0.02	0.02	5.8	0	–
2004	223	0.206	0	0	0	–	0	–
2005	225	0.209	0	0.05	0.05	3.2	0	–
2006	266	0.186	0	0.04	0.04	3.09	0	–
2007	204	0.164	0	0.24	0.24	4	0	–
2008	149	0.135	0	0.01	0.01	1.47	0	–
2009	101	0.133	0	0.01	0.01	1.43	0	–
2010	59	0.12	0	0.01	0.01	1.73	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0.01	0.01	1.51	0	–
2013	175	0.372	0	0.02	0.02	4.32	0	–
2014	97	0.237	0	0	0	–	0	–
1990−2000	5973	0.17	2	15.3	17.3	0.45	12	0.71
2001−2014	2664	0.24	0	0.4	0.4	2.18	0	–
2010−2014	499	0.28	0	0	0	–	0	–

Table 19. Sets observed, observer coverage, observed and estimated bycatch for BAIRD'S BEAKED WHALE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.08	0.08	1.57	0	–
1991	470	0.0984	0	0.69	0.69	3.14	0	–
1992	596	0.136	0	0.15	0.15	1.05	0	–
1993	728	0.134	0	0.61	0.61	2.3	0	–
1994	759	0.179	1	0.4	1.4	0.79	6	0.98
1995	572	0.156	0	0.1	0.1	1.22	0	–
1996	421	0.124	0	0.44	0.44	3.61	0	–
1997	692	0.228	0	0.17	0.17	2.84	0	–
1998	587	0.175	0	0.23	0.23	3.99	0	–
1999	526	0.2	0	0.18	0.18	3.83	0	–
2000	444	0.229	0	0.09	0.09	3.68	0	–
2001	339	0.204	0	0.07	0.07	5.28	0	–
2002	360	0.221	0	0.46	0.46	2.36	0	–
2003	298	0.203	0	0.09	0.09	1.35	0	–
2004	223	0.206	0	0.02	0.02	1.95	0	–
2005	225	0.209	0	0.08	0.08	4.78	0	–
2006	266	0.186	0	0.48	0.48	2.71	0	–
2007	204	0.164	0	0.02	0.02	1.49	0	–
2008	149	0.135	0	0.1	0.1	1.57	0	–
2009	101	0.133	0	0.01	0.01	1.92	0	–
2010	59	0.12	0	0.01	0.01	2.56	0	–
2011	85	0.195	0	0.01	0.01	2.65	0	–
2012	83	0.187	0	0	0	–	0	–
2013	175	0.372	0	0.02	0.02	1.51	0	–
2014	97	0.237	0	0.02	0.02	2.11	0	–
1990−2000	5973	0.17	1	3.1	4.1	0.78	6	0.99
2001−2014	2664	0.24	0	1.4	1.4	1.28	0	–
2010−2014	499	0.28	0	0.1	0.1	1.08	0	–

Table 20. Sets observed, observer coverage, observed and estimated bycatch for HUBB'S BEAKED WHALE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	9.8	9.8	1.23	0	–
1991	470	0.0984	0	2.8	2.8	1.46	0	–
1992	596	0.136	3	5	8	0.46	22	0.58
1993	728	0.134	0	3.9	3.9	0.9	0	–
1994	759	0.179	2	3.7	5.7	0.42	11	0.71
1995	572	0.156	0	0.36	0.36	1.54	0	–
1996	421	0.124	0	0.42	0.42	1.25	0	–
1997	692	0.228	0	0.45	0.45	2.06	0	–
1998	587	0.175	0	0.57	0.57	1.62	0	–
1999	526	0.2	0	2.5	2.5	1.11	0	–
2000	444	0.229	0	0.64	0.64	1.86	0	–
2001	339	0.204	0	0.24	0.24	3.64	0	–
2002	360	0.221	0	1.9	1.9	0.98	0	–
2003	298	0.203	0	0.05	0.05	4.44	0	–
2004	223	0.206	0	0.4	0.4	2.87	0	–
2005	225	0.209	0	0.05	0.05	1.78	0	–
2006	266	0.186	0	0.03	0.03	1.47	0	–
2007	204	0.164	0	0.02	0.02	1.73	0	–
2008	149	0.135	0	0.06	0.06	1.54	0	–
2009	101	0.133	0	0.02	0.02	1.93	0	–
2010	59	0.12	0	0.02	0.02	2.98	0	–
2011	85	0.195	0	0.02	0.02	2.19	0	–
2012	83	0.187	0	0.07	0.07	5.92	0	–
2013	175	0.372	0	0.72	0.72	1.21	0	–
2014	97	0.237	0	0.07	0.07	2.61	0	–
1990−2000	5973	0.17	5	30.1	35.1	0.33	29	0.45
2001−2014	2664	0.24	0	3.7	3.7	0.73	0	–
2010−2014	499	0.28	0	0.9	0.9	1.11	0	–

Table 21. Sets observed, observer coverage, observed and estimated bycatch for STEJNEGER'S BEAKED WHALE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0	0	–	0	–
1991	470	0.0984	0	0.59	0.59	2.15	0	–
1992	596	0.136	0	0.77	0.77	2.32	0	–
1993	728	0.134	0	0.59	0.59	2.49	0	–
1994	759	0.179	1	0.48	1.48	0.62	6	1
1995	572	0.156	0	0.11	0.11	1.79	0	–
1996	421	0.124	0	0.6	0.6	2.03	0	–
1997	692	0.228	0	0.06	0.06	1.38	0	–
1998	587	0.175	0	0.1	0.1	2.31	0	–
1999	526	0.2	0	0.16	0.16	3.09	0	–
2000	444	0.229	0	0.35	0.35	2.61	0	–
2001	339	0.204	0	0.03	0.03	3.2	0	–
2002	360	0.221	0	0.22	0.22	2.32	0	–
2003	298	0.203	0	0.11	0.11	2.04	0	–
2004	223	0.206	0	0.01	0.01	3.46	0	–
2005	225	0.209	0	0.27	0.27	3.58	0	–
2006	266	0.186	0	0.11	0.11	4.59	0	–
2007	204	0.164	0	0.02	0.02	7.24	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0	0	–	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0.3	0.3	2.8	0	–
2012	83	0.187	0	0.07	0.07	3.36	0	–
2013	175	0.372	0	0.08	0.08	4.01	0	–
2014	97	0.237	0	0.03	0.03	10	0	–
1990−2000	5973	0.17	1	3.8	4.8	0.66	6	1
2001−2014	2664	0.24	0	1.2	1.2	1.31	0	–
2010−2014	499	0.28	0	0.5	0.5	2.02	0	–

Table 22. Sets observed, observer coverage, observed and estimated bycatch for SPERM WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.04	0	3.6	3.6	3.76	0	–
1991	470	0.1	0	3.7	3.7	1.69	0	–
1992	596	0.14	3	3.1	6.1	0.91	21	1.01
1993	728	0.13	3	8.8	11.8	0.89	23	0.76
1994	759	0.18	0	5.1	5.1	1.33	0	–
1995	572	0.16	0	5.3	5.3	1.24	0	–
1996	421	0.12	1	8.4	9.4	0.98	8	1
1997	692	0.23	0	0.86	0.86	1.84	0	–
1998	587	0.18	1	4.8	5.8	0.85	6	1
1999	526	0.2	0	1.7	1.7	1.7	0	–
2000	444	0.23	0	0.82	0.82	1.42	0	–
2001	339	0.2	0	1.4	1.4	1.4	0	–
2002	360	0.22	0	0.64	0.64	2.03	0	–
2003	298	0.2	0	0.26	0.26	4.42	0	–
2004	223	0.21	0	0.01	0.01	3.76	0	–
2005	225	0.21	0	0.04	0.04	4.38	0	–
2006	266	0.19	0	0.46	0.46	3.66	0	–
2007	204	0.16	0	0.35	0.35	4.26	0	–
2008	149	0.14	0	0.6	0.6	3.13	0	–
2009	101	0.13	0	0.15	0.15	8.53	0	–
2010	59	0.12	2	0.02	2.02	0.07	17	0.98
2011	85	0.2	0	0.13	0.13	6.91	0	–
2012	83	0.19	0	0.12	0.12	3.1	0	–
2013	175	0.37	0	0.25	0.25	1.81	0	–
2014	97	0.24	0	0.01	0.01	6.38	0	–
1990−2000	5973	0.17	8	46.2	54.2	0.36	47	0.5
2001−2014	2664	0.24	2	4.4	6.4	0.6	8	0.99
2010−2014	499	0.28	2	0.5	2.5	0.34	7	1.01

Table 23. Sets observed, observer coverage, observed and estimated bycatch for CUVIER'S BEAKED WHALE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	19	19	0.31	0	–
1991	470	0.0984	0	18	18	0.25	0	–
1992	596	0.136	6	26	32	0.19	44	0.4
1993	728	0.134	3	27	30	0.19	22	0.57
1994	759	0.179	6	18	24	0.14	34	0.4
1995	572	0.156	6	18	24	0.2	38	0.41
1996	421	0.124	0	8.1	8.1	0.36	0	–
1997	692	0.228	0	4.1	4.1	0.35	0	–
1998	587	0.175	0	0.24	0.24	2.37	0	–
1999	526	0.2	0	0.25	0.25	3.6	0	–
2000	444	0.229	0	0.16	0.16	3.92	0	–
2001	339	0.204	0	0.29	0.29	2.87	0	–
2002	360	0.221	0	0.04	0.04	10	0	–
2003	298	0.203	0	0	0	–	0	–
2004	223	0.206	0	0.04	0.04	10	0	–
2005	225	0.209	0	0	0	–	0	–
2006	266	0.186	0	0	0	–	0	–
2007	204	0.164	0	0.2	0.2	2.35	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0.06	0.06	7.74	0	–
2010	59	0.12	0	0.59	0.59	3.41	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0	0	–	0	–
2013	175	0.372	0	0.01	0.01	0.93	0	–
2014	97	0.237	0	0.02	0.02	1.02	0	–
1990−2000	5973	0.17	21	138.8	159.8	0.08	124	0.22
2001−2014	2664	0.24	0	1.2	1.2	1.89	0	–
2010−2014	499	0.28	0	0.6	0.6	3.06	0	–

Table 24. Sets observed, observer coverage, observed and estimated bycatch for UNID. ZIPHIID.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	1.3	1.3	1.6	0	–
1991	470	0.0984	0	2.3	2.3	1.41	0	–
1992	596	0.136	2	7.4	9.4	0.58	15	0.71
1993	728	0.134	0	1.3	1.3	0.91	0	–
1994	759	0.179	1	1.1	2.1	0.62	6	0.98
1995	572	0.156	0	0.62	0.62	2.27	0	–
1996	421	0.124	0	0.16	0.16	0.76	0	–
1997	692	0.228	0	0.25	0.25	0.47	0	–
1998	587	0.175	0	0.95	0.95	1.31	0	–
1999	526	0.2	0	0.65	0.65	0.89	0	–
2000	444	0.229	0	0.43	0.43	2.26	0	–
2001	339	0.204	0	0.06	0.06	1.49	0	–
2002	360	0.221	0	0.17	0.17	2.59	0	–
2003	298	0.203	0	0.13	0.13	5.06	0	–
2004	223	0.206	0	0.01	0.01	3.24	0	–
2005	225	0.209	0	0.02	0.02	1.91	0	–
2006	266	0.186	0	0.07	0.07	0.8	0	–
2007	204	0.164	0	0.06	0.06	1.42	0	–
2008	149	0.135	0	0.03	0.03	1.69	0	–
2009	101	0.133	0	0.12	0.12	1.29	0	–
2010	59	0.12	0	0.7	0.7	3.03	0	–
2011	85	0.195	0	0.05	0.05	1.51	0	–
2012	83	0.187	0	0.04	0.04	1.73	0	–
2013	175	0.372	0	0.03	0.03	1.09	0	–
2014	97	0.237	0	0.07	0.07	6.85	0	–
1990−2000	5973	0.17	3	16.5	19.5	0.36	18	0.57
2001−2014	2664	0.24	0	1.6	1.6	1.24	0	–
2010−2014	499	0.28	0	0.9	0.9	2.07	0	–

Table 25. Sets observed, observer coverage, observed and estimated bycatch for UNID. MESOPLODON. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	1	4.6	5.6	1.27	23	1.02
1991	470	0.0984	0	0.67	0.67	1.41	0	–
1992	596	0.136	1	1.4	2.4	0.84	7	0.99
1993	728	0.134	0	3	3	0.62	0	–
1994	759	0.179	0	1.3	1.3	1.1	0	–
1995	572	0.156	0	0.49	0.49	0.51	0	–
1996	421	0.124	0	0.83	0.83	1.19	0	–
1997	692	0.228	0	0.25	0.25	1.07	0	–
1998	587	0.175	0	0.43	0.43	2.14	0	–
1999	526	0.2	0	0.23	0.23	2.01	0	–
2000	444	0.229	0	0.74	0.74	1.79	0	–
2001	339	0.204	0	0.02	0.02	0.81	0	–
2002	360	0.221	0	0.11	0.11	4.65	0	–
2003	298	0.203	0	0.05	0.05	1.17	0	–
2004	223	0.206	0	0.02	0.02	1.04	0	–
2005	225	0.209	0	0.09	0.09	0.55	0	–
2006	266	0.186	0	0.05	0.05	1.2	0	–
2007	204	0.164	0	0.04	0.04	0.68	0	–
2008	149	0.135	0	0.05	0.05	1.67	0	–
2009	101	0.133	0	0.02	0.02	1.07	0	–
2010	59	0.12	0	0.02	0.02	2.49	0	–
2011	85	0.195	0	0.03	0.03	1.3	0	–
2012	83	0.187	0	0.05	0.05	0.76	0	–
2013	175	0.372	0	0.03	0.03	0.58	0	–
2014	97	0.237	0	0.02	0.02	1.77	0	–
1990−2000	5973	0.17	2	13.9	15.9	0.38	12	0.72
2001−2014	2664	0.24	0	0.6	0.6	0.99	0	–
2010−2014	499	0.28	0	0.2	0.2	0.51	0	–

Table 26. Sets observed, observer coverage, observed and estimated bycatch for CALIFORNIA SEA LION. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	2	55	57	0.48	46	0.99
1991	470	0.0984	4	93	97	0.32	41	0.5
1992	596	0.136	9	58	67	0.27	66	0.33
1993	728	0.134	12	74	86	0.26	90	0.33
1994	759	0.179	5	82	87	0.27	28	0.45
1995	572	0.156	5	52	57	0.26	32	0.45
1996	421	0.124	4	66	70	0.45	32	0.5
1997	692	0.228	39	61	100	0.13	171	0.3
1998	587	0.175	23	71	94	0.19	131	0.24
1999	526	0.2	6	48	54	0.26	30	0.41
2000	444	0.229	13	39	52	0.18	57	0.33
2001	339	0.204	2	48	50	0.4	10	0.71
2002	360	0.221	18	39	57	0.19	81	0.24
2003	298	0.203	4	30	34	0.23	20	0.5
2004	223	0.206	7	36	43	0.24	34	0.38
2005	225	0.209	1	24	25	0.28	5	0.98
2006	266	0.186	12	53	65	0.18	65	0.37
2007	204	0.164	8	24	32	0.34	49	0.39
2008	149	0.135	7	42	49	0.21	52	0.42
2009	101	0.133	5	18	23	0.29	38	0.44
2010	59	0.12	0	9.3	9.3	0.98	0	–
2011	85	0.195	18	17	35	0.28	92	0.52
2012	83	0.187	6	21	27	0.41	32	0.39
2013	175	0.372	3	9.5	12.5	0.27	8	0.57
2014	97	0.237	3	6.3	9.3	0.31	13	0.99
1990−2000	5973	0.17	122	699	821	0.07	718	0.12
2001−2014	2664	0.24	94	377.1	471.1	0.08	392	0.15
2010−2014	499	0.28	30	63.1	93.1	0.15	107	0.34

Table 27. Sets observed, observer coverage, observed and estimated bycatch for STELLER'S SEA LION.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	4.2	4.2	1.44	0	–
1991	470	0.0984	0	1.5	1.5	0.46	0	–
1992	596	0.136	1	2.2	3.2	0.46	7	1.01
1993	728	0.134	0	2.2	2.2	0.97	0	–
1994	759	0.179	1	1.1	2.1	0.65	6	1.01
1995	572	0.156	0	1.4	1.4	1.38	0	–
1996	421	0.124	0	1.2	1.2	1.79	0	–
1997	692	0.228	0	0.46	0.46	1.31	0	–
1998	587	0.175	0	0.13	0.13	0.5	0	–
1999	526	0.2	0	0.07	0.07	0.45	0	–
2000	444	0.229	0	0.05	0.05	0.44	0	–
2001	339	0.204	0	0.22	0.22	2.12	0	–
2002	360	0.221	0	0.04	0.04	0.66	0	–
2003	298	0.203	0	0.04	0.04	0.68	0	–
2004	223	0.206	0	0.03	0.03	0.65	0	–
2005	225	0.209	0	0.02	0.02	0.8	0	–
2006	266	0.186	0	0.04	0.04	0.7	0	–
2007	204	0.164	0	0.02	0.02	0.9	0	–
2008	149	0.135	0	0.04	0.04	0.95	0	–
2009	101	0.133	0	0.03	0.03	0.96	0	–
2010	59	0.12	0	0.02	0.02	1.19	0	–
2011	85	0.195	0	0.01	0.01	0.96	0	–
2012	83	0.187	0	0.18	0.18	4.1	0	–
2013	175	0.372	0	0	0	–	0	–
2014	97	0.237	0	0.01	0.01	1.35	0	–
1990−2000	5973	0.17	2	14.5	16.5	0.38	12	0.71
2001−2014	2664	0.24	0	0.7	0.7	1.21	0	–
2010−2014	499	0.28	0	0.2	0.2	3.22	0	–

Table 28. Sets observed, observer coverage, observed and estimated bycatch for UNID. PINNIPED.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.3	0.3	3.7	0	–
1991	470	0.0984	0	1.6	1.6	1.94	0	–
1992	596	0.136	0	0.13	0.13	3.16	0	–
1993	728	0.134	0	0.08	0.08	0.69	0	–
1994	759	0.179	0	0.78	0.78	2.01	0	–
1995	572	0.156	0	0.72	0.72	2.41	0	–
1996	421	0.124	0	0.51	0.51	2.68	0	–
1997	692	0.228	0	0.15	0.15	1.62	0	–
1998	587	0.175	2	1	3	0.58	11	0.71
1999	526	0.2	0	0.75	0.75	1.69	0	–
2000	444	0.229	0	0.42	0.42	2.33	0	–
2001	339	0.204	0	0.17	0.17	2.75	0	–
2002	360	0.221	0	0.79	0.79	1.68	0	–
2003	298	0.203	0	0.43	0.43	2.12	0	–
2004	223	0.206	0	0.19	0.19	2.79	0	–
2005	225	0.209	0	0.07	0.07	0.6	0	–
2006	266	0.186	0	1.7	1.7	1.26	0	–
2007	204	0.164	0	0.08	0.08	3.77	0	–
2008	149	0.135	0	0.04	0.04	0.98	0	–
2009	101	0.133	0	0.03	0.03	1.02	0	–
2010	59	0.12	0	0.03	0.03	1.36	0	–
2011	85	0.195	0	0.01	0.01	1.5	0	–
2012	83	0.187	0	0.01	0.01	1.4	0	–
2013	175	0.372	0	0.03	0.03	6.09	0	–
2014	97	0.237	0	0.01	0.01	2.16	0	–
1990−2000	5973	0.17	2	6.4	8.4	0.52	12	0.7
2001−2014	2664	0.24	0	3.6	3.6	0.81	0	–
2010−2014	499	0.28	0	0.1	0.1	4.04	0	–

Table 29. Sets observed, observer coverage, observed and estimated bycatch for N ELEPHANT SEAL.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	5	103	108	0.14	115	0.44
1991	470	0.0984	13	106	119	0.09	132	0.27
1992	596	0.136	15	96	111	0.07	110	0.26
1993	728	0.134	14	105	119	0.06	104	0.28
1994	759	0.179	22	84	106	0.09	123	0.24
1995	572	0.156	14	72	86	0.1	90	0.29
1996	421	0.124	5	55	60	0.15	40	0.45
1997	692	0.228	9	30	39	0.11	39	0.33
1998	587	0.175	4	14	18	0.35	23	0.5
1999	526	0.2	2	11	13	0.34	10	0.7
2000	444	0.229	6	10	16	0.25	26	0.4
2001	339	0.204	1	5.4	6.4	0.52	5	0.99
2002	360	0.221	1	5.6	6.6	0.47	5	0.99
2003	298	0.203	1	2.9	3.9	0.7	5	1.02
2004	223	0.206	0	3	3	0.79	0	–
2005	225	0.209	1	2.3	3.3	0.58	5	1
2006	266	0.186	0	1.6	1.6	1.15	0	–
2007	204	0.164	1	3.5	4.5	0.7	6	1
2008	149	0.135	0	2.8	2.8	1	0	–
2009	101	0.133	0	1.2	1.2	1.51	0	–
2010	59	0.12	0	3.1	3.1	0.99	0	–
2011	85	0.195	0	0.66	0.66	2.11	0	–
2012	83	0.187	0	0.24	0.24	2.62	0	–
2013	175	0.372	0	0.79	0.79	1	0	–
2014	97	0.237	1	3.3	4.3	0.37	4	1
1990–2000	5973	0.17	109	686	795	0.04	641	0.1
2001–2014	2664	0.24	6	36.4	42.4	0.19	25	0.41
2010–2014	499	0.28	1	8.1	9.1	0.4	4	1

Table 30. Sets observed, observer coverage, observed and estimated bycatch for LOGGERHEAD TURTLE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	13	13	0.89	0	–
1991	470	0.0984	0	16	16	0.65	0	–
1992	596	0.136	2	5.2	7.2	0.69	15	0.7
1993	728	0.134	5	14	19	0.36	37	0.45
1994	759	0.179	0	5.6	5.6	0.71	0	–
1995	572	0.156	0	3.9	3.9	1.06	0	–
1996	421	0.124	0	4.4	4.4	1.07	0	–
1997	692	0.228	3	5.2	8.2	0.55	13	0.58
1998	587	0.175	4	2.1	6.1	0.45	23	0.79
1999	526	0.2	0	2.7	2.7	1.09	0	–
2000	444	0.229	0	3.2	3.2	1.26	0	–
2001	339	0.204	1	2.8	3.8	0.84	5	1
2002	360	0.221	0	2.6	2.6	0.86	0	–
2003	298	0.203	0	1.6	1.6	1.5	0	–
2004	223	0.206	0	1.2	1.2	1.18	0	–
2005	225	0.209	0	0.59	0.59	1.76	0	–
2006	266	0.186	1	1.7	2.7	0.66	5	0.99
2007	204	0.164	0	4	4	1.18	0	–
2008	149	0.135	0	0.22	0.22	4.34	0	–
2009	101	0.133	0	1.3	1.3	1.98	0	–
2010	59	0.12	0	0.64	0.64	2.94	0	–
2011	85	0.195	0	0.18	0.18	3.76	0	–
2012	83	0.187	0	0.1	0.1	6.79	0	–
2013	175	0.372	0	0.03	0.03	5.46	0	–
2014	97	0.237	0	0.18	0.18	3.4	0	–
1990−2000	5973	0.17	14	75.3	89.3	0.22	82	0.32
2001−2014	2664	0.24	2	17.1	19.1	0.39	8	0.7
2010−2014	499	0.28	0	1.1	1.1	1.78	0	–

Table 31. Sets observed, observer coverage, observed and estimated bycatch for GREEN TURTLE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0	0	–	0	–
1991	470	0.0984	0	0.1	0.1	9.06	0	–
1992	596	0.136	0	0.25	0.25	3.92	0	–
1993	728	0.134	0	0.48	0.48	1.58	0	–
1994	759	0.179	0	0.19	0.19	4.2	0	–
1995	572	0.156	0	0.03	0.03	1.9	0	–
1996	421	0.124	0	0.51	0.51	1.69	0	–
1997	692	0.228	0	0.44	0.44	2.23	0	–
1998	587	0.175	0	0.4	0.4	2.22	0	–
1999	526	0.2	1	0.2	1.2	0.47	5	0.99
2000	444	0.229	0	0.49	0.49	2.41	0	–
2001	339	0.204	0	0.39	0.39	2.51	0	–
2002	360	0.221	0	0.18	0.18	2.62	0	–
2003	298	0.203	0	0.15	0.15	4.41	0	–
2004	223	0.206	0	0.01	0.01	2.58	0	–
2005	225	0.209	0	0.01	0.01	2.87	0	–
2006	266	0.186	0	0.37	0.37	2.67	0	–
2007	204	0.164	0	0.15	0.15	5.67	0	–
2008	149	0.135	0	0.01	0.01	3.42	0	–
2009	101	0.133	0	0.31	0.31	2.61	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0.01	0.01	3.99	0	–
2013	175	0.372	0	0.03	0.03	4.31	0	–
2014	97	0.237	0	0.01	0.01	3.05	0	–
1990−2000	5973	0.17	1	3.1	4.1	0.6	6	1.01
2001−2014	2664	0.24	0	1.6	1.6	1.11	0	–
2010−2014	499	0.28	0	0	0	–	0	–

Table 32. Sets observed, observer coverage, observed and estimated bycatch for LEATHERBACK TURTLE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	1	17	18	1	23	1
1991	470	0.0984	1	17	18	0.57	10	1.01
1992	596	0.136	4	16	20	0.4	29	0.5
1993	728	0.134	3	23	26	0.4	22	0.58
1994	759	0.179	1	8.5	9.5	0.52	6	0.98
1995	572	0.156	5	10	15	0.39	32	0.44
1996	421	0.124	2	24	26	0.37	16	0.71
1997	692	0.228	4	15	19	0.32	18	0.5
1998	587	0.175	0	6.1	6.1	0.72	0	–
1999	526	0.2	2	5.4	7.4	0.61	10	0.71
2000	444	0.229	0	2.6	2.6	0.95	0	–
2001	339	0.204	0	1.2	1.2	1.57	0	–
2002	360	0.221	0	0.61	0.61	1.5	0	–
2003	298	0.203	0	0.39	0.39	2.08	0	–
2004	223	0.206	0	0.27	0.27	2.77	0	–
2005	225	0.209	0	1.3	1.3	1.58	0	–
2006	266	0.186	0	1.7	1.7	1.29	0	–
2007	204	0.164	0	0.06	0.06	8.79	0	–
2008	149	0.135	0	1.4	1.4	1.48	0	–
2009	101	0.133	1	1.9	2.9	0.92	8	1
2010	59	0.12	0	0.03	0.03	6.17	0	–
2011	85	0.195	0	0.02	0.02	8.71	0	–
2012	83	0.187	1	0.37	1.37	0.66	5	1
2013	175	0.372	0	0.94	0.94	1.01	0	–
2014	97	0.237	0	0.32	0.32	2.79	0	–
1990–2000	5973	0.17	23	144.6	167.6	0.13	135	0.21
2001–2014	2664	0.24	2	10.5	12.5	0.42	8	0.72
2010–2014	499	0.28	1	1.7	2.7	0.53	4	1.01

Table 33. Sets observed, observer coverage, observed and estimated bycatch for OLIVE RIDLEY TURTLE. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.32	0.32	1.89	0	–
1991	470	0.0984	0	0.23	0.23	1.59	0	–
1992	596	0.136	0	0.21	0.21	1.16	0	–
1993	728	0.134	0	1.3	1.3	1.73	0	–
1994	759	0.179	0	0.3	0.3	0.82	0	–
1995	572	0.156	0	0.59	0.59	1.95	0	–
1996	421	0.124	0	0.51	0.51	1.06	0	–
1997	692	0.228	0	0.6	0.6	2.08	0	–
1998	587	0.175	0	0.33	0.33	0.97	0	–
1999	526	0.2	1	0.14	1.14	0.15	5	0.99
2000	444	0.229	0	0.13	0.13	2.74	0	–
2001	339	0.204	0	0.1	0.1	3.85	0	–
2002	360	0.221	0	0.24	0.24	1.05	0	–
2003	298	0.203	0	0.07	0.07	1.66	0	–
2004	223	0.206	0	0.07	0.07	1.34	0	–
2005	225	0.209	0	0.12	0.12	3.3	0	–
2006	266	0.186	0	0.1	0.1	1.81	0	–
2007	204	0.164	0	0.13	0.13	1.9	0	–
2008	149	0.135	0	0.13	0.13	2.13	0	–
2009	101	0.133	0	0.03	0.03	2.58	0	–
2010	59	0.12	0	0.02	0.02	1.21	0	–
2011	85	0.195	0	0.01	0.01	1.47	0	–
2012	83	0.187	0	0.01	0.01	1.64	0	–
2013	175	0.372	0	0.03	0.03	1.97	0	–
2014	97	0.237	0	0.08	0.08	1.67	0	–
1990−2000	5973	0.17	1	4.7	5.7	0.56	6	1
2001−2014	2664	0.24	0	1.1	1.1	0.69	0	–
2010−2014	499	0.28	0	0.2	0.2	1.07	0	–

Table 34. Sets observed, observer coverage, observed and estimated bycatch for UNID. TURTLE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.53	0.53	1.78	0	–
1991	470	0.0984	0	10	10	0.52	0	–
1992	596	0.136	0	2.4	2.4	0.7	0	–
1993	728	0.134	3	6.9	9.9	0.41	22	0.58
1994	759	0.179	0	0.97	0.97	1.51	0	–
1995	572	0.156	0	0.87	0.87	0.73	0	–
1996	421	0.124	0	0.25	0.25	1.11	0	–
1997	692	0.228	0	0.18	0.18	0.89	0	–
1998	587	0.175	0	0.04	0.04	0.79	0	–
1999	526	0.2	0	0.02	0.02	0.92	0	–
2000	444	0.229	0	0.11	0.11	4.81	0	–
2001	339	0.204	0	0	0	–	0	–
2002	360	0.221	0	0	0	–	0	–
2003	298	0.203	0	0.01	0.01	1.78	0	–
2004	223	0.206	0	0	0	–	0	–
2005	225	0.209	0	0.01	0.01	1.96	0	–
2006	266	0.186	0	0.01	0.01	1.45	0	–
2007	204	0.164	0	0	0	–	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0	0	–	0	–
2010	59	0.12	0	0.01	0.01	2.69	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0	0	–	0	–
2013	175	0.372	0	0	0	–	0	–
2014	97	0.237	0	0	0	–	0	–
1990−2000	5973	0.17	3	22.3	25.3	0.28	18	0.57
2001−2014	2664	0.24	0	0	0	–	0	–
2010−2014	499	0.28	0	0	0	–	0	–

Table 35. Sets observed, observer coverage, observed and estimated bycatch for UNID. BIRD.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	1	3.2	4.2	1.58	23	0.99
1991	470	0.0984	0	5.3	5.3	1.02	0	–
1992	596	0.136	1	4.5	5.5	0.7	7	1
1993	728	0.134	0	3.2	3.2	0.94	0	–
1994	759	0.179	1	2	3	0.66	6	1
1995	572	0.156	0	1.6	1.6	1.43	0	–
1996	421	0.124	0	1.5	1.5	1.33	0	–
1997	692	0.228	1	0.85	1.85	0.65	4	1.01
1998	587	0.175	0	0.53	0.53	1.2	0	–
1999	526	0.2	0	0.61	0.61	1.82	0	–
2000	444	0.229	0	0.32	0.32	1.88	0	–
2001	339	0.204	0	0.15	0.15	2.59	0	–
2002	360	0.221	1	1.8	2.8	0.55	5	1
2003	298	0.203	0	0.66	0.66	1.87	0	–
2004	223	0.206	0	0.49	0.49	2.53	0	–
2005	225	0.209	0	0.21	0.21	1.82	0	–
2006	266	0.186	0	0.2	0.2	3.12	0	–
2007	204	0.164	0	0.9	0.9	1.29	0	–
2008	149	0.135	0	0.35	0.35	3.43	0	–
2009	101	0.133	0	0.13	0.13	1.32	0	–
2010	59	0.12	0	0.29	0.29	2.39	0	–
2011	85	0.195	0	0.01	0.01	0.9	0	–
2012	83	0.187	0	0.13	0.13	4.85	0	–
2013	175	0.372	0	0.05	0.05	3.4	0	–
2014	97	0.237	0	0.06	0.06	5.05	0	–
1990−2000	5973	0.17	4	23.6	27.6	0.33	24	0.49
2001−2014	2664	0.24	1	5.4	6.4	0.48	4	0.98
2010−2014	499	0.28	0	0.5	0.5	1.76	0	–

Table 36. Sets observed, observer coverage, observed and estimated bycatch for UNID. CORMORANT. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0	0	–	0	–
1991	470	0.0984	0	0.35	0.35	2.96	0	–
1992	596	0.136	0	0.24	0.24	3.2	0	–
1993	728	0.134	0	0.06	0.06	10	0	–
1994	759	0.179	0	0.49	0.49	2.21	0	–
1995	572	0.156	0	0.23	0.23	3.07	0	–
1996	421	0.124	0	0	0	–	0	–
1997	692	0.228	0	0.17	0.17	2.98	0	–
1998	587	0.175	0	0.55	0.55	1.74	0	–
1999	526	0.2	0	0.44	0.44	1.81	0	–
2000	444	0.229	0	0.1	0.1	3.02	0	–
2001	339	0.204	0	0	0	–	0	–
2002	360	0.221	0	0.19	0.19	2.64	0	–
2003	298	0.203	1	0.01	1.01	0.1	5	1.01
2004	223	0.206	0	0.04	0.04	10	0	–
2005	225	0.209	0	0	0	–	0	–
2006	266	0.186	0	0.66	0.66	2.39	0	–
2007	204	0.164	0	0.07	0.07	4	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0	0	–	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0	0	–	0	–
2012	83	0.187	0	0.01	0.01	10	0	–
2013	175	0.372	0	0.35	0.35	1.84	0	–
2014	97	0.237	0	0.26	0.26	3.41	0	–
1990−2000	5973	0.17	0	2.6	2.6	0.98	0	–
2001−2014	2664	0.24	1	1.6	2.6	0.78	4	1
2010−2014	499	0.28	0	0.6	0.6	1.72	0	–

Table 37. Sets observed, observer coverage, observed and estimated bycatch for NORTHERN FULMAR.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.98	0.98	4.6	0	–
1991	470	0.0984	0	0.16	0.16	2.17	0	–
1992	596	0.136	0	0.17	0.17	1.76	0	–
1993	728	0.134	0	0.18	0.18	1.83	0	–
1994	759	0.179	0	0.08	0.08	2.51	0	–
1995	572	0.156	0	0.33	0.33	1.66	0	–
1996	421	0.124	0	2.1	2.1	0.75	0	–
1997	692	0.228	0	2.2	2.2	0.7	0	–
1998	587	0.175	0	5.1	5.1	0.74	0	–
1999	526	0.2	0	9.3	9.3	0.56	0	–
2000	444	0.229	16	39	55	0.13	70	0.36
2001	339	0.204	0	3.6	3.6	0.64	0	–
2002	360	0.221	1	4	5	0.51	5	1
2003	298	0.203	14	41	55	0.16	69	0.41
2004	223	0.206	0	1.3	1.3	1.62	0	–
2005	225	0.209	5	13	18	0.37	24	0.83
2006	266	0.186	0	2.3	2.3	0.97	0	–
2007	204	0.164	0	2.3	2.3	1.04	0	–
2008	149	0.135	0	2.2	2.2	1.04	0	–
2009	101	0.133	0	2.1	2.1	1.87	0	–
2010	59	0.12	0	1.8	1.8	1.67	0	–
2011	85	0.195	0	0.59	0.59	1.34	0	–
2012	83	0.187	0	3.5	3.5	1.38	0	–
2013	175	0.372	0	0.66	0.66	0.94	0	–
2014	97	0.237	0	1.2	1.2	1.1	0	–
1990−2000	5973	0.17	16	59.6	75.6	0.14	94	0.36
2001−2014	2664	0.24	20	79.5	99.5	0.14	83	0.36
2010−2014	499	0.28	0	7.8	7.8	0.67	0	–

Table 38. Sets observed, observer coverage, observed and estimated bycatch for UNID. WHALE.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.37	0.37	1.75	0	–
1991	470	0.0984	0	0.19	0.19	1.65	0	–
1992	596	0.136	0	0.48	0.48	1.91	0	–
1993	728	0.134	1	0.44	1.44	0.31	7	1
1994	759	0.179	0	0.4	0.4	1.58	0	–
1995	572	0.156	0	0.52	0.52	1.28	0	–
1996	421	0.124	0	0.43	0.43	1.53	0	–
1997	692	0.228	0	0.32	0.32	1.33	0	–
1998	587	0.175	0	0.62	0.62	1.25	0	–
1999	526	0.2	0	0.69	0.69	0.81	0	–
2000	444	0.229	0	0.4	0.4	1.18	0	–
2001	339	0.204	0	0.26	0.26	1.12	0	–
2002	360	0.221	0	0.46	0.46	0.81	0	–
2003	298	0.203	1	0.26	1.26	0.32	5	0.99
2004	223	0.206	0	0.22	0.22	1.77	0	–
2005	225	0.209	0	0.14	0.14	0.94	0	–
2006	266	0.186	0	0.37	0.37	0.89	0	–
2007	204	0.164	0	0.43	0.43	2.59	0	–
2008	149	0.135	0	0.14	0.14	0.44	0	–
2009	101	0.133	0	0.4	0.4	1.78	0	–
2010	59	0.12	0	0.05	0.05	1.46	0	–
2011	85	0.195	0	0.48	0.48	2.04	0	–
2012	83	0.187	0	0.1	0.1	0.72	0	–
2013	175	0.372	0	0.08	0.08	3.07	0	–
2014	97	0.237	0	0.11	0.11	3.8	0	–
1990−2000	5973	0.17	1	4.9	5.9	0.32	6	1.01
2001−2014	2664	0.24	1	3.5	4.5	0.38	4	1
2010−2014	499	0.28	0	0.8	0.8	1.3	0	–

Table 39. Sets observed, observer coverage, observed and estimated bycatch for UNID. CETACEAN.
Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown.
Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	0.54	0.54	5.68	0	–
1991	470	0.0984	1	4.7	5.7	0.88	10	0.99
1992	596	0.136	1	1.3	2.3	0.79	7	1
1993	728	0.134	0	0.51	0.51	2	0	–
1994	759	0.179	0	0.68	0.68	2.11	0	–
1995	572	0.156	0	1.1	1.1	2	0	–
1996	421	0.124	0	0.2	0.2	3.8	0	–
1997	692	0.228	0	0.13	0.13	1.07	0	–
1998	587	0.175	0	0.34	0.34	3.06	0	–
1999	526	0.2	0	0.05	0.05	1.97	0	–
2000	444	0.229	0	0.06	0.06	5.47	0	–
2001	339	0.204	0	0.22	0.22	4.03	0	–
2002	360	0.221	0	0.05	0.05	2.45	0	–
2003	298	0.203	0	0.56	0.56	2.23	0	–
2004	223	0.206	0	0.38	0.38	2.78	0	–
2005	225	0.209	0	0.05	0.05	1.91	0	–
2006	266	0.186	0	0.24	0.24	4	0	–
2007	204	0.164	0	0.02	0.02	2.16	0	–
2008	149	0.135	0	0	0	–	0	–
2009	101	0.133	0	0.02	0.02	3.41	0	–
2010	59	0.12	0	0	0	–	0	–
2011	85	0.195	0	0.02	0.02	2.69	0	–
2012	83	0.187	0	0.01	0.01	4.82	0	–
2013	175	0.372	0	0.19	0.19	2.81	0	–
2014	97	0.237	0	0	0	–	0	–
1990−2000	5973	0.17	2	9.6	11.6	0.57	12	0.7
2001−2014	2664	0.24	0	1.8	1.8	1.11	0	–
2010−2014	499	0.28	0	0.2	0.2	2.61	0	–

Table 40. Sets observed, observer coverage, observed and estimated bycatch for ALL BEAKED WHALES. Tree estimates of bycatch represent UNOBSERVED bycatch. Total bycatch (observed + estimated) is also shown. Coefficients of variation are provided for each estimate, including annual ratio estimates.

Year	Obs.Sets	Obs.Cov	Obs.Bycatch	Tree.Est	Total.Bycatch	CV.Total.Bycatch	Ratio.Est	CV.Ratio.Est
1990	178	0.0436	0	32	32	0.23	0	–
1991	470	0.0984	0	32	32	0.19	0	–
1992	596	0.136	12	43	55	0.13	88	0.28
1993	728	0.134	4	45	49	0.13	30	0.5
1994	759	0.179	11	27	38	0.11	61	0.3
1995	572	0.156	6	23	29	0.16	38	0.4
1996	421	0.124	0	12	12	0.21	0	–
1997	692	0.228	0	6.5	6.5	0.26	0	–
1998	587	0.175	0	0.77	0.77	1.6	0	–
1999	526	0.2	0	0.43	0.43	2.6	0	–
2000	444	0.229	0	0.6	0.6	1.84	0	–
2001	339	0.204	0	0.06	0.06	3.71	0	–
2002	360	0.221	0	0.27	0.27	2.8	0	–
2003	298	0.203	0	0.14	0.14	4.82	0	–
2004	223	0.206	0	0.01	0.01	5.14	0	–
2005	225	0.209	0	0.01	0.01	7.41	0	–
2006	266	0.186	0	0.03	0.03	4.07	0	–
2007	204	0.164	0	0.17	0.17	3.89	0	–
2008	149	0.135	0	0.02	0.02	6.15	0	–
2009	101	0.133	0	0.14	0.14	5.87	0	–
2010	59	0.12	0	0.53	0.53	3.57	0	–
2011	85	0.195	0	0.05	0.05	8.12	0	–
2012	83	0.187	0	0	0	–	0	–
2013	175	0.372	0	0.22	0.22	2.35	0	–
2014	97	0.237	0	0.11	0.11	4.07	0	–
1990−2000	5973	0.17	33	222.3	255.3	0.06	194	0.18
2001−2014	2664	0.24	0	1.8	1.8	1.27	0	–
2010−2014	499	0.28	0	0.9	0.9	1.75	0	–

Figure 1. Locations of all 8,637 observed California drift gillnet fishery sets, 1990-2014. Left panel shows locations of 5,973 sets observed between 1990 and 2000, prior to the area closure implemented in 2001 to protect leatherback sea turtles. Right panel shows 2,664 sets observed from 2001-2014. Dashed line shows outline of leatherback closure area.

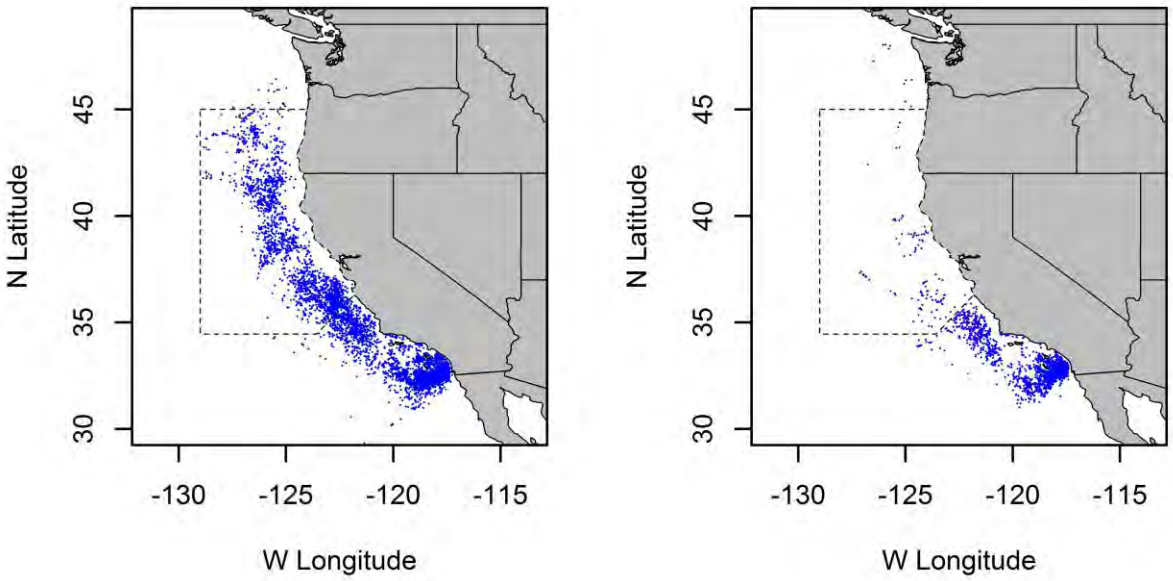
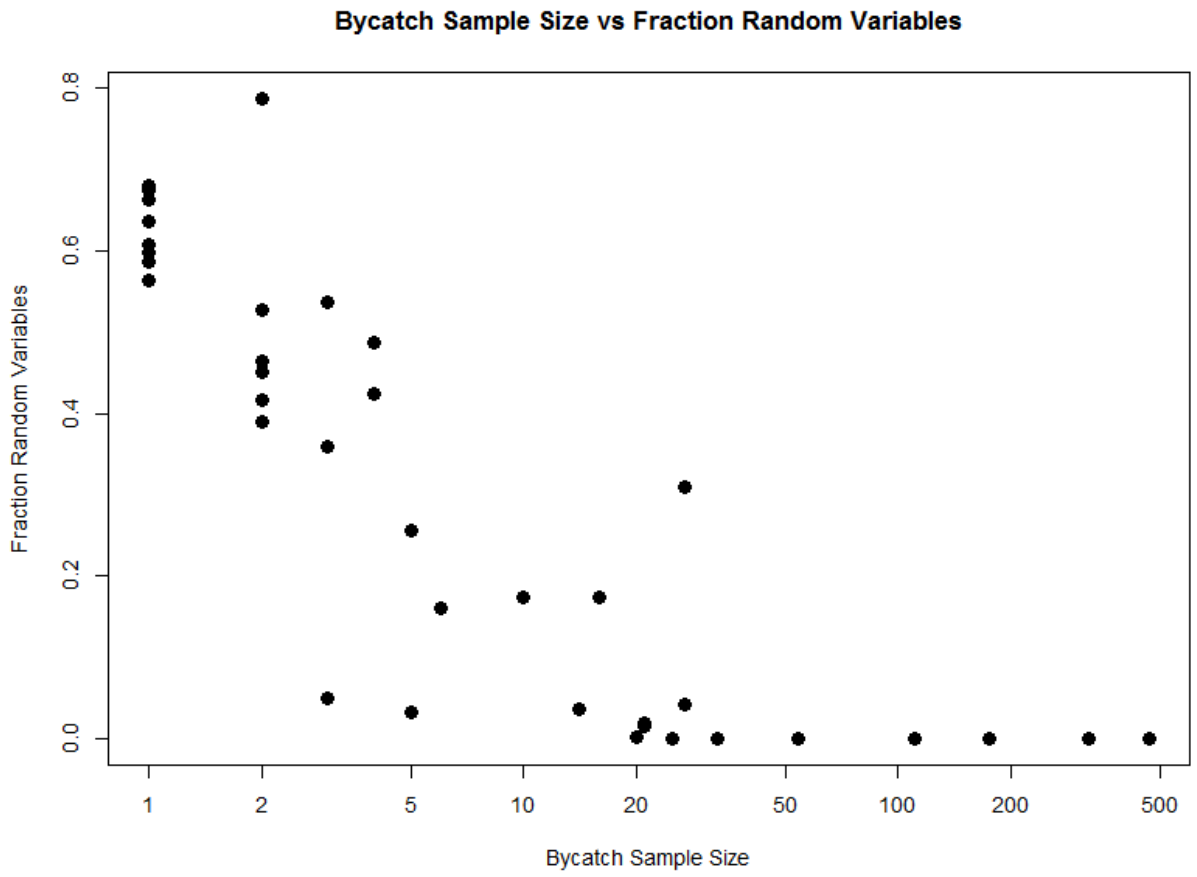
Figure 2. Relationship between bycatch sample sizes (≥ 1 animal entangled) and the fraction of random forests where permuted (random) variables were identified among the three-most important variables. Each point represents a different species or species group (i.e., all beaked whales).