ISC/12/SHARKWG-1/08

Estimation of total blue shark catches including releases and discards Japanese longline fisheries during 1975 and 2010 in the North Pacific

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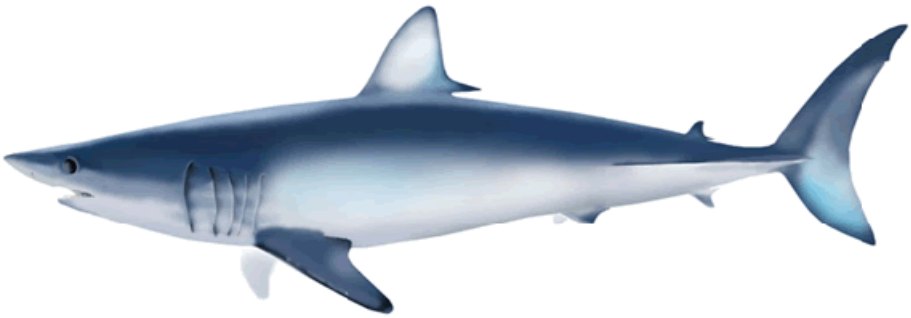

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Abstract

Total catch number including all live releases and dead discards is estimated in this study using fishery category specific standardized CPUE values as well as the results of comparison of catch rate of blue shark between commercial and non commercial operations. The targeting effects are investigated for each fishery category used for the CPUE standardization and based on the results of this, an additional variable are incorporated into the estimating models of shallow set of Hokkaido and Tohoku fleets both in 1975-1993, 1994-2010 to adjust the effect of blue shark target sets. The results of estimated total catch of blue shark caught by Japanese offshore and distant-water longliners peaked in 1980 at around 1,400,000 individuals, then it decreased to 800, 000 in 1990 and leveled off until 2006. Because we improved the method to estimate total catch by previous study for many points, the estimates in this study are considered more realistic than before and it is supposed to be the best available information as the input to the stock assessment.

Introduction

As blue shark is bycatch species for Japanese tuna longline, the estimation of the total removals of Japanese longliners from the sea is necessary for the input of stock analysis. The ISC shark working group agreed that this estimates should be conducted using unbiased information independent from fisherman, e.g., on-board observer data or research data (ISC, 2011). To meet with this agreement, Takahashi et. al., (2012) compared the log-book data of Japanese longliners to data collected by Japanese research and training longline vessels. In the present study, total landing of blue shark caught by Japanese longliners was estimated as the product of standardize CPUE obtained by "reliable log-book" data (Yokawa and Ando, 2011; Hiraoka et al. 2011) and total amount of effort, and the total blue shark catches including releases and discards was estimated as the quotient of the estimate total landing divided by the estimate ratio of retained blue shark (Takahashi et al., 2012).

Materials and Methods

Data set

Catch and effort data used in this analysis were compiled by the National Research Institute of Far Seas Fisheries for 1975-2010. The focused area is same as the area strata decided at last ISC shark meeting (Figure 1, ISC, 2011). Set by set data used in the analysis, and it has the information of catch number, amount of effort (number of hooks), the number of branch lines between floats (hooks par baskets: HPB) as the proxy of gear configuration and location of set by resolution of 1x1 degree, vessel category (Kinkai and Enyo), and prefecture of vessel register. Categories of Kinkai and Enyo mean offshore and distant-water and they are defined by the tonnage of vessel. Because the quality of blue shark catch data is rather variable (Hiraoka et al., 2011; Yokawa and Ando, 2011) than tunas and billfishes, gear configuration simply defined as two categories, deep (HPB>6) and shallow (HPB<7) to get the simpler model structure. The data which HPB is smaller than 3 and larger than 21 are removed from the analysis. Before 1994, there was no shark species separated data and estimated blue shark catches (Hiraoka et al. 2012) are used for below analysis.

Here, three categories, i.e. shallower or deeper gear setting (shallower HPB<7 and deeper HPB>6), Kinkai or Enyo water longliner and before 1993 or later, are necessity to consider whether analyses should be separated by each category because of the change of targeting

species, operation location, effective effort and/or the logbook system.

The total catch is estimated by following process;

1) Data are divided by the vessel type (Kinkai or Enyo), by gear configuration (Deep or Shallow), and by prefecture of vessel register (Hokkaido & Tohoku or others).
2) CPUE trends are estimated by using standardization method with generalized linear model for approval category described below. Total catch at log-book level (including catch by vessels of 0 blue shark catch) are estimated by applying variables such as hooks to the CPUE standardization model developed in the step 1).
3) Total catch (including discard/release by vessels with blue shark catch in their log-book) are estimated as the quotient of the total catch at log-book level divided by the coefficient (ratio of CPUE between research and commercial longline) estimated by Takahashi et al. (2012).

CPUE standardization

Target effect in the CPUE standardization

The Japanese longliners has been changed their target species historically in the north Pacific (Yokawa, 2005). Especially the Japanese surface longliners based on Kesennuma fishing port (corresponding to the fleet of Kinkai registered in Tohoku and Hokkaido in this study) have been more frequently targeting blue shark in recent years (Yokawa, 2009; Clarke et al., 2011). The historical change of target species is one of the fundamental factors to skew the trend of estimated abundance index. To remove this effect, the existences of annual change of target species are checked by using the directed CPUE method (Biseau, 1998). To examine the magnitude of the historical change of target species, the directed CPUE method by Biseau (1998) is applied on the each data set descried in the part of CPUE standardization. The method is to plot the cumulated catch (landing) of a particular species caught against to the proportion of the species in a trip. If the species were targeted by the fishery, most of the catches of the species were obtained by trips of whose catch occupying major portion of the total catch and the plot is concave downward on the part of high proportion of the species. For the data sets which supposed to receive apparent effect by the change of the target species by the results of this analysis, an additional factor is introduced into the model of CPUE standardization to adjust this effect. Though Yokawa (2009) used the ratio of catch of blue shark and tunas as the factor to adjust the effect, this method should be affected by the change of the stock trend of tunas (Anonumous, 1997). Instead of this, the percentile of the annual CPUE value of blue shark is introduced into the model (Chang, et al., 2009). Each data of the year was divided into 11 categories, 0 catch and every 10^{th} percentile, and these 11 categories.

If there is significant shift of targeting, the factor of target effect was imported to models by using blue shark catch ratio in total catch. However the ratio should be affected by the annual change of stock abundance for other species also (Anonymous, 1997) so the ratio of order of blue shark catch ratio in total catch in each year is used as the factor to indicate targeting (Chang et al., 2009). Each ratio was categorized to 11 categories by the order of blue shark catch ratio except zero-catch. The cruise of zero-catch was gathered to one category.

Series of models

Because of the differences such as blue shark catch ability, positive catch ratio as well as

the quality of data (Hiraoka et al., 2011; Yokawa and Ando, 2011), data was categorized by vessel type (Kinkai or Enyo), by gear configuration (shallow or deep), prefecture of vessel register (Hokkaido & Tohoku or others), as well as by the data quality (before 1994 or after 1993). Standardization of CPUE of data belonging to different category conducted separately. In consequence, there are 8 patterns of CPUE trend are needed to be standardized, i.e.

1-1-1: Kinkai with shallower setting between 1975 and 1993.
1-1-2: Kinkai with deeper setting between 1975 and 1993.
1-2-1: Enyo with shallower setting by between 1975 and 1993.
1-2-2: Enyo with deeper setting between 1975 and 1993.
2-1-1: Kinkai with shallower setting between 1994 and 2010.
2-1-2: Kinkai with deeper setting between 1994 and 2010.
2-2-1: Enyo with shallower setting between 1994 and 2010.
2-2-2: Enyo with deeper setting between 1994 and 2010.

Fleet categories produced similar trends of standardized CPUE are combined and re-standardized to simplify the process.

In consequence, seven models are constructed to standardize CPUE, i.e.

1-1-1a: Kinkai with shallower setting by Hokkaido & Tohoku prefectures between 1975 and 1993.
1-1-2a: Kinkai with deeper setting by Hokkaido & Tohoku prefectures between 1975 and 1993.
1-2-1: Enyo with shallower setting by between 1975 and 1993.
1-2-2: Enyo with deeper setting between 1975 and 1993.
2-1-1a:Kinkai and Enyo with shallower setting by Hokkaido & Tohoku prefectures between 1994 and 2010.
2-1-2a: Enyo with deeper setting by Hokkaido & Tohoku prefectures between 1994 and 2010.
2-2-1: Enyo with shallower setting between 1994 and 2010.

Generalized linear models with negative-binomial error distribution are constructed to obtain standardized CPUE for the each category of fishery defined above, respectively. In the CPUE standardization, effects of year, quarter, area (the one designated by the WG in the last meeting), target effect, prefecture and their two way interactions were tried to introduce into the models. Because of computing power, step-wise method with AIC cannot be applied to estimate optimal model so interaction terms are picked up from more important factors by preliminary analysis using Poisson model. All model settings are shown in Table 1.

Results and Discussions

Relationship between the cumulated landings of blue shark and the proportion of blue shark in the total catch of the trip indicates that only Kinkai fleets with shallower setting registered in Hokkaido & Tohoku prefectures showed targeting trends for blue shark during 1975 to 1993 (Figure 2). For Hokkaido & Tohoku fleets, only Kinkai fleets with shallower setting before 1990's were concave downward which were targeting trend judged by Biseau (1998). But operations in the 1990s are seemed not to target blue shark actively than those of before the 1990s following by the criterion described by Biseau (1998). In this period, all graphs of Hokkaido & Tohoku are drawn by smooth line while those of other prefectures are zigzag lines.

This indicates that lower numbers of blue shark were reported by the other prefecture fleets than Hokkaido & Tohoku fleets. Thus we assumed that the operations conducted by other prefectures fleets were not target this species in 1975-1993.

In the period between 1994 and 2010, both Kinkai and Enyo fleets with shallower setting showed smooth and concave line considered to target blue shark especially recent years (Figures. 3-a1, b1). These results that the changes of target trends from 1975 to 2010 are corresponded with previous studies (Yokawa, 2005; Yokawa, 2009; Clarke et al., 2011) and the primary author of this WP confirmed this shifts by the interviews to the fisherman (Kesennuma skipper and radio operator union, personal comm.). Thus, we decided that the models for the data sets (fleets) of 1-1-1a and 2-1-1a include target effects as variable explanation (Table 1).

Based on the results described above, the models to standardize CPUEs of blue sharks caught by Japanese Kinkai and Enyo during period between 1975 and 2010 are fixed. The results of the CPUE standardizations are shown in the Appendix.

The catch numbers of blue shark calculated by each data set is shown in Figure 4. This catch number is corresponding to the number when all longliners report their catch of blue shark at the same high level however it would not include all the catch of blue shark as its lower market values than tunas and billfishes. Takahashi et al. (2012) compare the CPUE of blue shark caught by commercial longliners and research and training longliners which is mandated to report their blue shark catch. Takahashi et al. (2012) indicated that it is necessary to adjust the catch data of Enyo fleet with deeper setting in order to correct under reporting. Therefore the mean values of the ratio of blue shark catch rate of the commercial fleets to non-commercial fleets reported by Takahashi et al. (2012) (0.0780) are used as coefficient values to obtain the total catch including dead discard and live release of blue shark (for all periods). For all operations of shallower setting conducted by Hokkaido & Tohoku vessles, there are some evidences which support that under reporting of these operations would be negligible (Takahashi et al., 2012; Yokawa and Kimoto, 2012). The rest category of Kinkai with deeper setting could not compare with un-commercial fleets because no comparable fishery independent data is available. We assumed that Hokkaido & Tohoku fleets belong to these category (Kinkai with deeper setting) also constantly report sharks because relatively high positive catch rate were reported during 1975 to 2010 (Yokawa and Ando, 2012; Hiraoka et al., 2011). In addition, the similar level of CPUE value are observed between research operations with deep setting in 1960's (Nakano, 1994) and commercial longline fishery of this category by Hokkaido & Tohoku in 1970's. Because of these reason, the catch of this category were not extrapolated. Finally, the result of total catch number including all live releases and dead discards are shown in Table 2 and Figures 5 and 6. The estimated total catch of blue shark caught by Japanese longliners peaked in 1980 at around 1,400,000 individuals, then it decreased to 800,000 in 1990 and leveled off until 2006. Until the end of the 1990s, catches by deep sets occupied more than half while shallow obtained more catch number than deep sets in the 2000s. The total estimated catch was more than double of the total nominal catch (total log-book catch) during the 1970s and the 1980s, and the difference between these two values started to decrease in the 1990s. During the 2000s, it becomes roughly 20 %.

In the present study, some hypotheses were posited to estimate the total catch number including releases and discards of blue shark, they are; 1) the reporting rate of blue shark of each category data sets or fleet has not changed throughout the period analyzed. 2) deep set by longliners registered in Kinkai Hokkaido & Tohoku report all of their blue sharks catch to their

log-book. Further exploration of the information should be necessary to confirm these hypotheses, but we improved the method to estimate total catch by Kleiber et al. (2009) for many points. Thus, the estimates obtained by this study are more realistic than the one of previous study and it is supposed to be the best available information as the input to the stock assessment. At the same time, the estimated values should only be used for the scientific purpose until the validity of the hypotheses posited for the estimation is confirmed.

Reference

Anonymous 1997. AJUSTING FOR THE TARGETING ON OTHER SPECIES IN GLM'S, APPENDIX 5 of REPORT OF THE TUNA METHODOLOGY SESSION, Int. Comm. Cons. Atl.Tunas, Coll. Vol. Sci. Pap. 46(1), p. 210

Biseau, A. 1998. Definition of directed fishing effort in a mixed-species trawl fishery, and its impact on stock assessments, Aquat. Living Resour., 11, 119-136

Chang, S. K, H. I. Liu, and S. T, Chang 2008. CPUE Standardizations for Yellowfin Tuna Caught by Taiwanese Deep Sea Longline Fishery in the Tropical Indian Ocean Using Generalized Liner Mixed Model. IOTC-2008-WPTT-31

Clarke, S., K. Yokawa, H. Matsunaga and H. Nakano 2011. Analysis of North Pacific Shark Data from Japanese Commercial Longline and Research/Training Vessel Records. WCPFC-SC7-2011/EB-WP-02.

Hiraoka, Y., M. Kanaiwa and K. Yokawa 2012. Estimation of total blue shark catches including releases and discards Japanese longline fisheries during 1975 and 2010 in the North Pacific. Document submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Hiraoka, Y,., M. Taguch, M. Kanaiwa and K. Yokawa 2011. The operation pattern of Japanese tuna Longline fishery with the information for belonging region of vessels and reporting rate in the North Pacific Ocean, 1994-2010. ISC/11/SHARKWG-2/09

Kleiber, P., S. Clarke, K. Bigelow, H. Nakano, M. McAllister and Y. Takeuchi 2009. North Pacific blue shark stock assessment. NOAA Technical Memorandum NMFS-PIFSC-17, 74p.

ISC (2011) Report of the shark working group, 28 Nov – 3 Dec 2011 La Jolla California USA, 36 p.

Takahashi, N., Y. Hiraoka, A. Kimoto, K. Yokawa and M. Kanaiwa 2012. Comparison of CPUEs of Blue Shark Reported by Logbook of Japanese Commercial Longliners with Japanese Research and Training Longline Data. Document submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Yokawa, K. 2005 Operation patterns of Japanese offshore and distant-water longliners in the north Pacific, with emphasis on the billfishes. ISC/05/MAR&SW-WGs/16, 19p.

Yokawa, K. 2009 The effect of change of target species on the CPUE of swordfish caught by Japanese offshore surface longliners operating in the north Pacific. ISC/09/BILWG-1-06, 16p.

Yokawa, K. and T. Ando 2011. Review of species aggregated sharks data caught by Japanese offshore and distant-water longliners in the north Pacific in 1975-1993. ISC/11/SHARKWG-2/10

Yokawa, K and A. Kimoto 2012. Blue shark catch of Japanese surface longliners registered in

Kesennuma fishing port. ocument submitted to the ISC Shark Working Group Workshop, 28 May-4 June, 2012. ISC/12/SHARKWG-1/xx(Document submitted to this meeting).

Table 1 Variable explanation of each model

Model	Variable explanation*
1975-1993	
1-1-1a: Kinkai_shallow_Hokkaido&Tohoku	year, area, season, target, year*target
1-1-2a: Kinkai_deep_Hokkaido&Tohoku	year, area, season, deep-HPB
1-2-1: Enyo_shallow	year, area, season, shallow-HPB, prefecture, year*area
1-2-2: Enyo_deep	year, area, season, deep-HPB, prefecture, year*area
1994-2010	
2-1-1a: Kinkai/Enyo_shallow_Hokkaido& Tohoku	vessel type, year, area, season, target, year*target, season*target
2-1-2a: Kinkai_deep_Hokkaido&Tohoku	year, area, season, deep-HPB*, area* deep-HPB, year* deep-HPB
2-2-1: Enyo_deep	year, area, season, deep-HPB , prefecture

*: year: effect of year, area: effect of area, season: effect of season, target: effect of targeting, deep-HPB: brunch line criteria of deeper setting (6-14, 14-20), shallow-HPB: brunch line criteria of shallower setting (3,4,5), vessel type: effect of vessel type (Kinkai or Enyo), prefecture: effect of prefecture (Hokkaido & Tohoku or other prefectures).

Table 2 Estimated total blue shark catches including releases and discards Japanese longline fisheries during 1975 and 2010 in the North Pacific

	Kinkai_shallow	Enyo_shallow	Kinkai_deep	Enyo_deep
1975	201155	29576	30905	213196
1976	301052	57122	79024	431017
1977	386204	44398	114616	529066
1978	308532	52456	89792	492000
1979	334091	27299	96023	753558
1980	328757	18838	201740	796155
1981	306617	16634	287738	808716
1982	273060	16848	350423	527772
1983	335472	22844	302686	574804
1984	304590	10605	340664	557491
1985	316125	14970	249170	591309
1986	382853	32932	312041	323442
1987	307360	18046	166849	352503
1988	279593	15562	96352	534510
1989	239685	9600	117856	615506
1990	222521	5767	133968	407448
1991	263905	8711	150573	377533
1992	296495	10399	159421	299781
1993	322306	14008	156411	400836
1994	268844	16701	96880	397931
1995	243888	27230	51330	511462
1996	277845	32356	80552	316025
1997	383533	45013	43583	354871
1998	376980	46239	40616	334110
1999	469133	63436	21885	228005
2000	609942	69289	84965	135473
2001	713655	101519	37657	147219
2002	627111	67178	30303	99943
2003	620553	77747	120826	113218
2004	530870	137913	67415	101667
2005	649988	98475	64686	131016
2006	554070	103020	107247	102965
2007	441925	83380	101306	116064
2008	389363	93391	30938	95180
2009	475573	104835	132172	80903
2010	398527	115996	0	260872

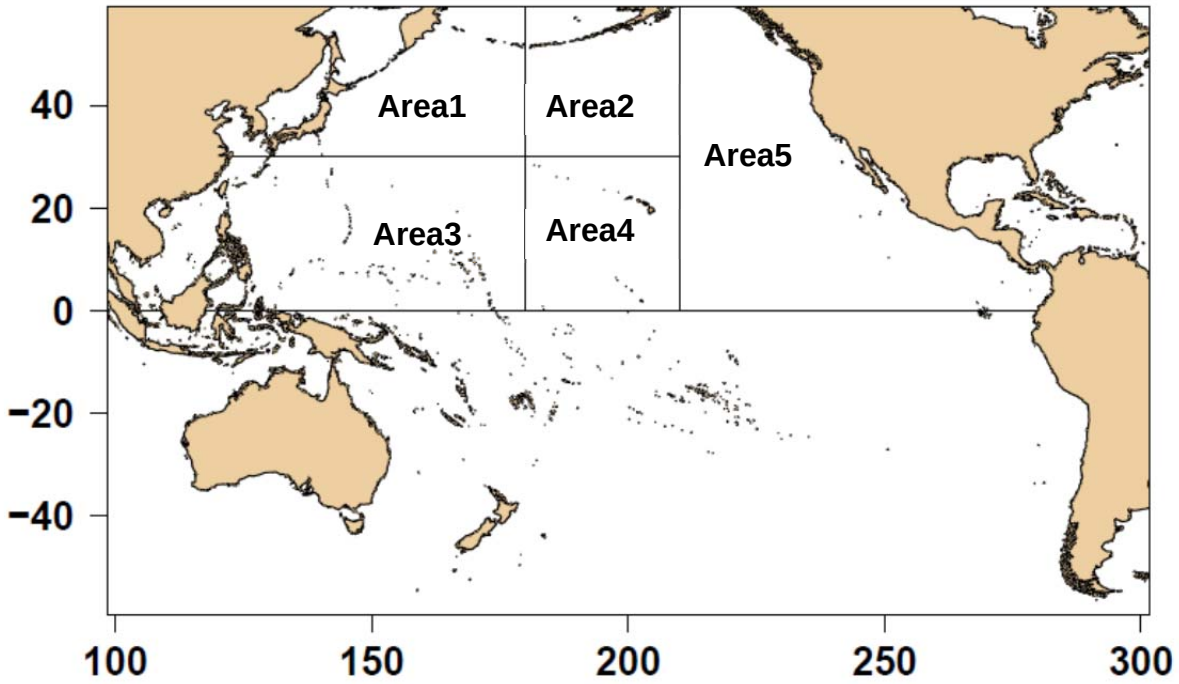

Figure 1 Area classification in this study.

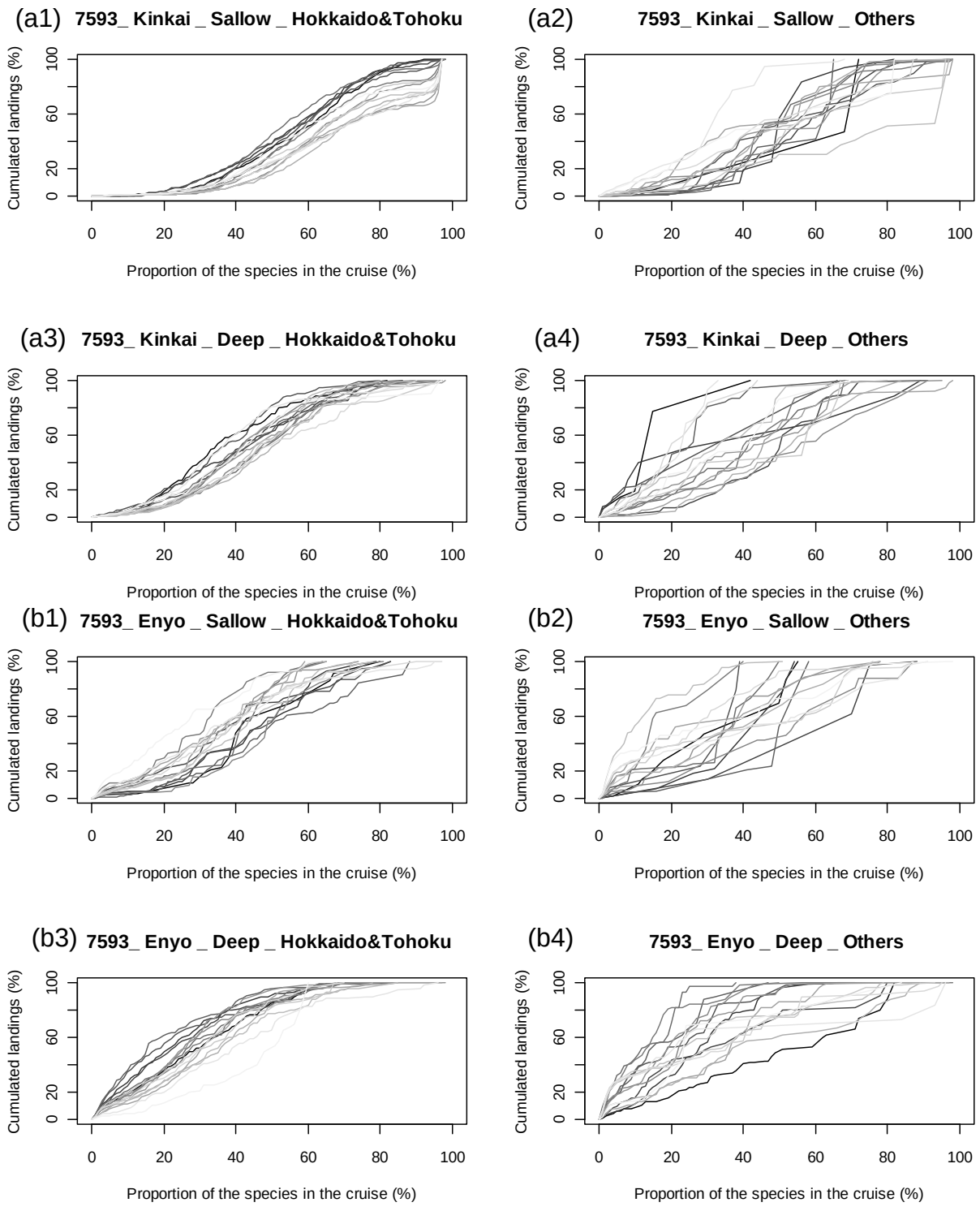

Figure 2 Cumulative blue shark landings caught by Japanese tuna longline fishery with shallower (HPB<7) or deeper (HPB<6) setting of *Kinkai* fleets (a1~a4) and *Enyo* fleets (b1~b4) during 1975 to 1993. Black line show the result in 1993 and line colors are paled out to 1975.

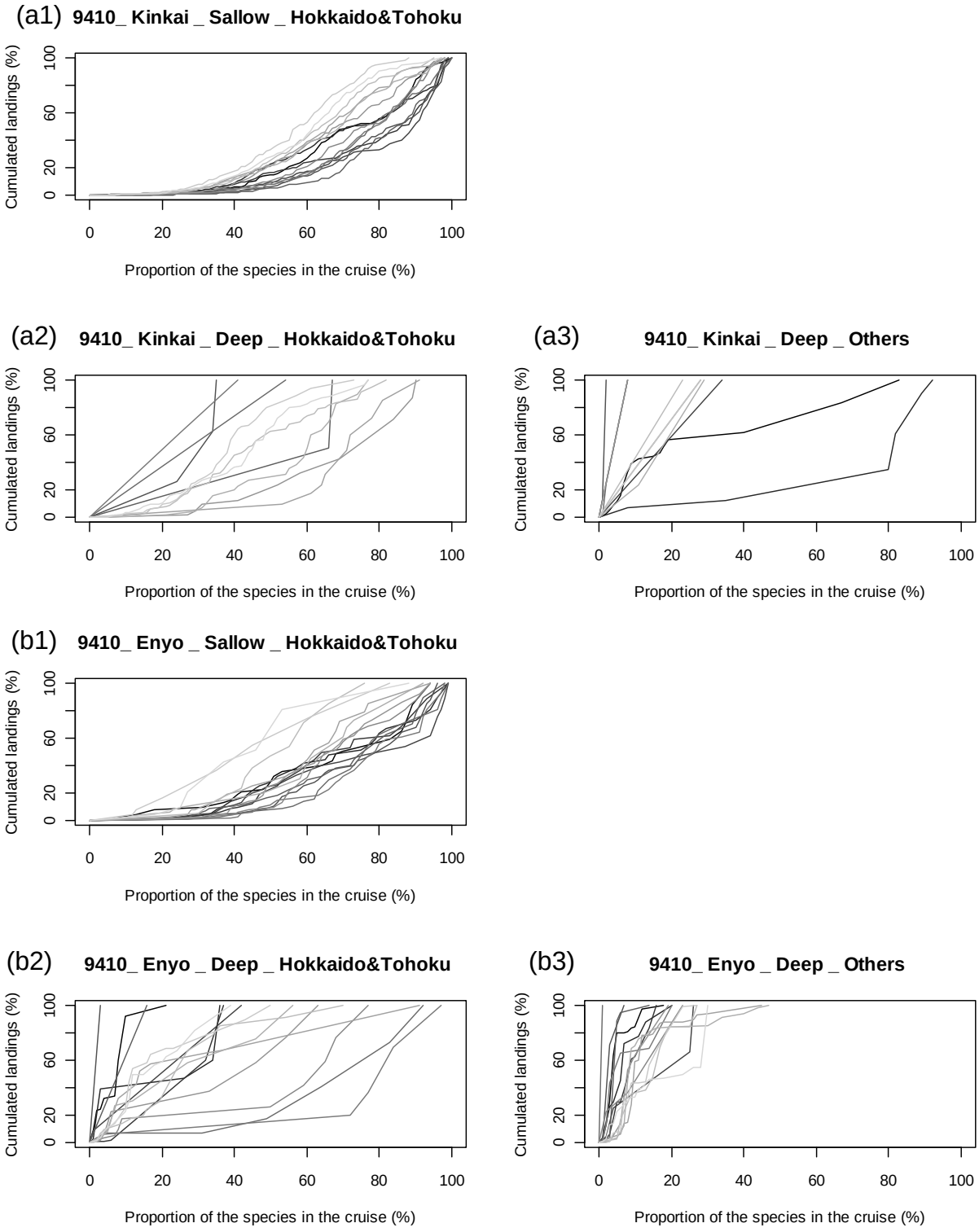

Figure 3 Cumulative blue shark landings caught by Japanese tuna longline fishery with shallower (HPB<7) or deeper (HPB<6) setting of *Kinkai* (a1~a3) and *Enyo* (b1~b3) during 1994 to 2010. Black line show the result in 2010 and line colors are paled out to 1994.

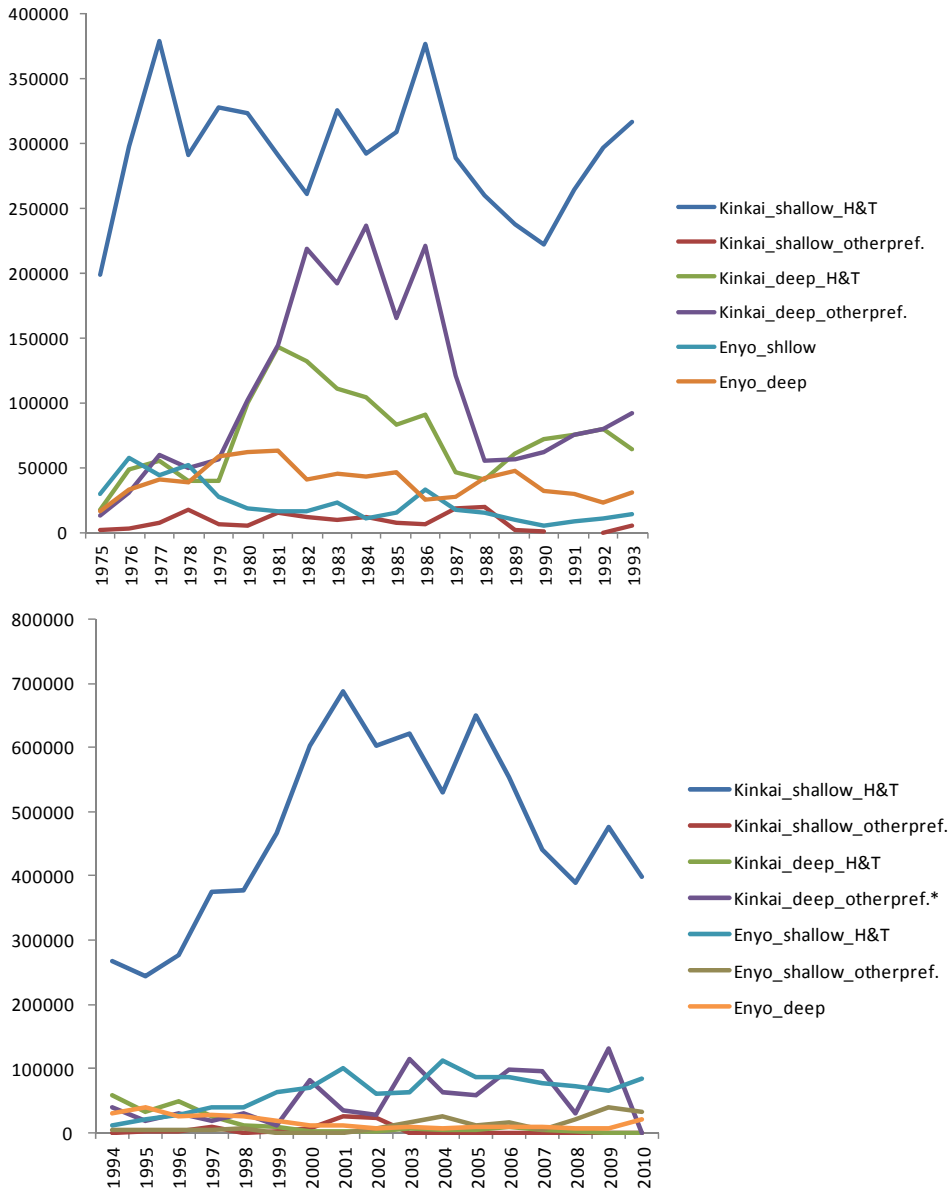

Figure 4 Predicted catches of blue shark calculated by each categories in 1997-1993 (upper) and in 1994-2010 (lower)

*Catch in 2009 were calculated by multiplying nominal catch in 2009 to median of estimated catch/nominal catch between 1993 and 2010 except 2009 because of no operation of Hokkaido & Tohoku fleets in 2009

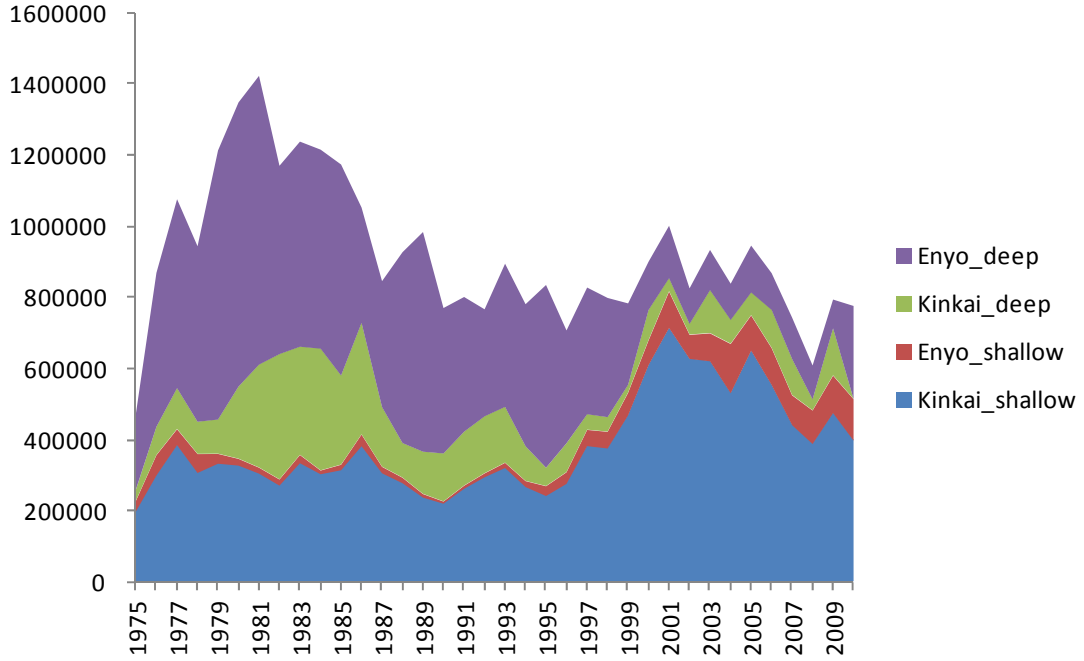

Figure 5 Estimated total blue shark catches including releases and discards Japanese longline fisheries during 1975 and 2010 in the North Pacific

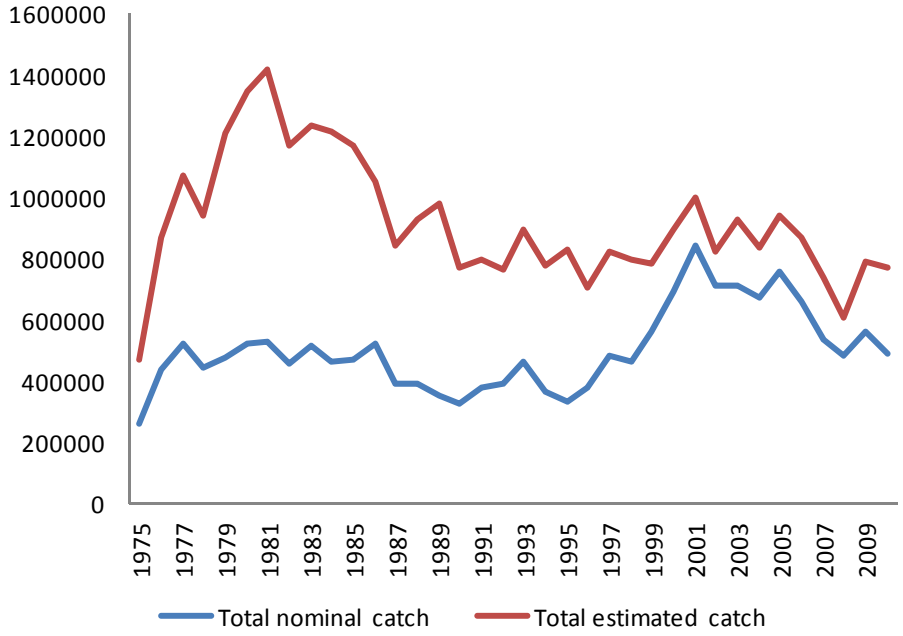

Figure 5 Comparison of total catch trends between nominal catches from log-book and estimated catches in this study.

Appendix: Summary outputs of GLM analyses from R

I. 1975 -1993

1-1-1a: 7593_Kinkai_Shallow_Hokkaido&Tohoku

Call:

```
glm.nb(formula = blshrk ~ as.factor(year) + as.factor(qt) + as.factor(area) +
    as.factor(target3) + as.factor(year):as.factor(target3) +
    offset(log(hook)), data = tdata, init.theta = 4.968318347,
    link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-5.0096  -0.5681   0.0000   0.2688   9.8048

Coefficients:
                                                  Estimate Std. Error  z value Pr(>|z|)
(Intercept)                                     -5.765e+00  2.361e-02 -244.153  < 2e-16 ***
as.factor(year)1976                             -6.025e-02  3.139e-02   -1.919 0.054959 .
as.factor(year)1977                              7.930e-02  2.985e-02    2.656 0.007900 **
as.factor(year)1978                             -1.236e-01  3.101e-02   -3.984 6.77e-05 ***
as.factor(year)1979                              1.318e-01  3.041e-02    4.333 1.47e-05 ***
as.factor(year)1980                              1.705e-01  3.065e-02    5.565 2.62e-08 ***
as.factor(year)1981                              2.952e-02  3.064e-02    0.963 0.335366
as.factor(year)1982                              1.296e-01  3.143e-02    4.124 3.73e-05 ***
as.factor(year)1983                             -1.099e-02  3.010e-02   -0.365 0.714999
as.factor(year)1984                             -8.485e-02  3.011e-02   -2.818 0.004826 **
as.factor(year)1985                             -7.180e-02  2.942e-02   -2.440 0.014685 *
as.factor(year)1986                             -1.491e-01  2.940e-02   -5.071 3.95e-07 ***
as.factor(year)1987                             -4.680e-01  3.016e-02  -15.515  < 2e-16 ***
as.factor(year)1988                             -4.363e-01  3.127e-02  -13.951  < 2e-16 ***
as.factor(year)1989                             -8.231e-01  3.252e-02  -25.311  < 2e-16 ***
as.factor(year)1990                             -5.519e-01  3.278e-02  -16.839  < 2e-16 ***
as.factor(year)1991                             -3.494e-01  3.258e-02  -10.722  < 2e-16 ***
as.factor(year)1992                             -3.339e-01  3.220e-02  -10.370  < 2e-16 ***
as.factor(year)1993                             -4.003e-01  3.276e-02  -12.221  < 2e-16 ***
as.factor(qt)2                                   7.776e-03  3.679e-03    2.114 0.034544 *
as.factor(qt)3                                  -5.981e-03  3.929e-03   -1.522 0.127989
as.factor(qt)4                                  -9.869e-03  4.280e-03   -2.306 0.021122 *
as.factor(area)2                                 6.996e-01  2.309e-01    3.030 0.002443 **
as.factor(area)3                                -3.144e-02  3.148e-03   -9.987  < 2e-16 ***
as.factor(area)4                                -5.715e-02  8.818e-02   -0.648 0.516890
as.factor(area)5                                -1.468e-01  1.283e-01   -1.144 0.252673
as.factor(target3)2                              6.081e-01  3.152e-02   19.295  < 2e-16 ***
as.factor(target3)3                              8.768e-01  3.113e-02   28.168  < 2e-16 ***
as.factor(target3)4                              1.045e+00  3.089e-02   33.842  < 2e-16 ***
as.factor(target3)5                              1.227e+00  3.055e-02   40.157  < 2e-16 ***
as.factor(target3)6                              1.408e+00  3.053e-02   46.105  < 2e-16 ***
as.factor(target3)7                              1.604e+00  3.031e-02   52.931  < 2e-16 ***
as.factor(target3)8                              1.855e+00  3.014e-02   61.541  < 2e-16 ***
as.factor(target3)9                              2.158e+00  2.995e-02   72.059  < 2e-16 ***
as.factor(target3)10                             2.777e+00  2.979e-02   93.205  < 2e-16 ***
as.factor(target3)11                            -2.701e+01  2.808e+03   -0.010 0.992327
as.factor(year)1976:as.factor(target3)2         -2.487e-03  4.224e-02   -0.059 0.953048
as.factor(year)1977:as.factor(target3)2         -9.371e-02  4.037e-02   -2.321 0.020286 *
as.factor(year)1978:as.factor(target3)2         -3.420e-02  4.175e-02   -0.819 0.412615
as.factor(year)1979:as.factor(target3)2         -1.290e-01  4.117e-02   -3.134 0.001727 **
as.factor(year)1980:as.factor(target3)2         -4.113e-02  4.146e-02   -0.992 0.321136
as.factor(year)1981:as.factor(target3)2         -1.037e-01  4.129e-02   -2.511 0.012028 *
as.factor(year)1982:as.factor(target3)2         -1.373e-01  4.251e-02   -3.230 0.001239 **
as.factor(year)1983:as.factor(target3)2         -3.421e-02  4.064e-02   -0.842 0.399934
as.factor(year)1984:as.factor(target3)2         -1.184e-01  4.073e-02   -2.908 0.003639 **
as.factor(year)1985:as.factor(target3)2         -1.681e-01  3.986e-02   -4.216 2.48e-05 ***
as.factor(year)1986:as.factor(target3)2         -2.436e-02  3.969e-02   -0.614 0.539355
as.factor(year)1987:as.factor(target3)2         -8.961e-02  4.061e-02   -2.207 0.027322 *
as.factor(year)1988:as.factor(target3)2         -9.293e-03  4.204e-02   -0.221 0.825068
as.factor(year)1989:as.factor(target3)2          3.310e-02  4.344e-02    0.762 0.446068
as.factor(year)1990:as.factor(target3)2         -9.329e-03  4.400e-02   -0.212 0.832091
as.factor(year)1991:as.factor(target3)2          8.843e-02  4.383e-02    2.018 0.043641 *
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as.factor(year)1992:as.factor(target3)2	3.045e-02	4.335e-02	0.702	0.482483
as.factor(year)1993:as.factor(target3)2	3.105e-02	4.411e-02	0.704	0.481487
as.factor(year)1976:as.factor(target3)3	3.194e-02	4.166e-02	0.767	0.443308
as.factor(year)1977:as.factor(target3)3	-8.127e-02	3.986e-02	-2.039	0.041492 *
as.factor(year)1978:as.factor(target3)3	-6.094e-03	4.121e-02	-0.148	0.882442
as.factor(year)1979:as.factor(target3)3	-1.010e-01	4.063e-02	-2.486	0.012908 *
as.factor(year)1980:as.factor(target3)3	-1.562e-02	4.094e-02	-0.382	0.702742
as.factor(year)1981:as.factor(target3)3	-8.294e-02	4.080e-02	-2.033	0.042043 *
as.factor(year)1982:as.factor(target3)3	-1.682e-01	4.199e-02	-4.005	6.21e-05 ***
as.factor(year)1983:as.factor(target3)3	-1.802e-02	4.007e-02	-0.450	0.652922
as.factor(year)1984:as.factor(target3)3	-1.438e-01	4.022e-02	-3.577	0.000348 ***
as.factor(year)1985:as.factor(target3)3	-2.180e-01	3.933e-02	-5.544	2.96e-08 ***
as.factor(year)1986:as.factor(target3)3	-4.003e-02	3.920e-02	-1.021	0.307119
as.factor(year)1987:as.factor(target3)3	-1.319e-01	4.008e-02	-3.290	0.001001 **
as.factor(year)1988:as.factor(target3)3	-4.277e-02	4.147e-02	-1.031	0.302330
as.factor(year)1989:as.factor(target3)3	1.018e-01	4.273e-02	2.382	0.017197 *
as.factor(year)1990:as.factor(target3)3	2.230e-02	4.333e-02	0.515	0.606751
as.factor(year)1991:as.factor(target3)3	1.381e-01	4.325e-02	3.193	0.001406 **
as.factor(year)1992:as.factor(target3)3	5.377e-02	4.275e-02	1.258	0.208517
as.factor(year)1993:as.factor(target3)3	1.218e-01	4.345e-02	2.803	0.005070 **
as.factor(year)1976:as.factor(target3)4	9.968e-02	4.117e-02	2.421	0.015464 *
as.factor(year)1977:as.factor(target3)4	-1.297e-02	3.950e-02	-0.328	0.742660
as.factor(year)1978:as.factor(target3)4	9.946e-03	4.086e-02	0.243	0.807657
as.factor(year)1979:as.factor(target3)4	-7.100e-02	4.031e-02	-1.761	0.078232 .
as.factor(year)1980:as.factor(target3)4	3.174e-02	4.062e-02	0.781	0.434601
as.factor(year)1981:as.factor(target3)4	-5.784e-02	4.043e-02	-1.430	0.152581
as.factor(year)1982:as.factor(target3)4	-1.194e-01	4.159e-02	-2.872	0.004085 **
as.factor(year)1983:as.factor(target3)4	3.685e-03	3.975e-02	0.093	0.926142
as.factor(year)1984:as.factor(target3)4	-9.575e-02	3.986e-02	-2.403	0.016283 *
as.factor(year)1985:as.factor(target3)4	-2.210e-01	3.904e-02	-5.660	1.51e-08 ***
as.factor(year)1986:as.factor(target3)4	-2.173e-03	3.887e-02	-0.056	0.955415
as.factor(year)1987:as.factor(target3)4	-8.045e-02	3.973e-02	-2.025	0.042859 *
as.factor(year)1988:as.factor(target3)4	8.415e-03	4.115e-02	0.204	0.837971
as.factor(year)1989:as.factor(target3)4	1.866e-01	4.229e-02	4.411	1.03e-05 ***
as.factor(year)1990:as.factor(target3)4	7.180e-02	4.297e-02	1.671	0.094743 .
as.factor(year)1991:as.factor(target3)4	2.039e-01	4.290e-02	4.752	2.02e-06 ***
as.factor(year)1992:as.factor(target3)4	1.020e-01	4.244e-02	2.403	0.016255 *
as.factor(year)1993:as.factor(target3)4	2.505e-01	4.305e-02	5.820	5.90e-09 ***
as.factor(year)1976:as.factor(target3)5	1.294e-01	4.095e-02	3.160	0.001580 **
as.factor(year)1977:as.factor(target3)5	3.139e-02	3.911e-02	0.803	0.422242
as.factor(year)1978:as.factor(target3)5	5.373e-02	4.044e-02	1.328	0.184041
as.factor(year)1979:as.factor(target3)5	-7.640e-02	3.992e-02	-1.914	0.055665 .
as.factor(year)1980:as.factor(target3)5	4.209e-02	4.027e-02	1.045	0.295884
as.factor(year)1981:as.factor(target3)5	-5.340e-02	4.005e-02	-1.333	0.182499
as.factor(year)1982:as.factor(target3)5	-1.096e-01	4.120e-02	-2.660	0.007810 **
as.factor(year)1983:as.factor(target3)5	6.492e-03	3.944e-02	0.165	0.869269
as.factor(year)1984:as.factor(target3)5	-9.317e-02	3.948e-02	-2.360	0.018279 *
as.factor(year)1985:as.factor(target3)5	-2.451e-01	3.866e-02	-6.338	2.32e-10 ***
as.factor(year)1986:as.factor(target3)5	-1.552e-03	3.852e-02	-0.040	0.967855
as.factor(year)1987:as.factor(target3)5	-1.137e-02	3.926e-02	-0.290	0.772188
as.factor(year)1988:as.factor(target3)5	1.460e-02	4.074e-02	0.358	0.720087
as.factor(year)1989:as.factor(target3)5	2.398e-01	4.185e-02	5.731	9.98e-09 ***
as.factor(year)1990:as.factor(target3)5	1.264e-01	4.254e-02	2.972	0.002959 **
as.factor(year)1991:as.factor(target3)5	1.963e-01	4.255e-02	4.612	3.98e-06 ***
as.factor(year)1992:as.factor(target3)5	1.107e-01	4.210e-02	2.629	0.008564 **
as.factor(year)1993:as.factor(target3)5	3.276e-01	4.269e-02	7.676	1.64e-14 ***
as.factor(year)1976:as.factor(target3)6	1.810e-01	4.075e-02	4.441	8.94e-06 ***
as.factor(year)1977:as.factor(target3)6	7.340e-02	3.902e-02	1.881	0.059937 .
as.factor(year)1978:as.factor(target3)6	9.173e-02	4.033e-02	2.274	0.022941 *
as.factor(year)1979:as.factor(target3)6	-6.467e-02	3.986e-02	-1.622	0.104731
as.factor(year)1980:as.factor(target3)6	2.255e-02	4.015e-02	0.562	0.574287
as.factor(year)1981:as.factor(target3)6	-4.333e-02	3.995e-02	-1.085	0.278031
as.factor(year)1982:as.factor(target3)6	-1.444e-01	4.128e-02	-3.498	0.000468 ***
as.factor(year)1983:as.factor(target3)6	-1.555e-02	3.932e-02	-0.396	0.692448
as.factor(year)1984:as.factor(target3)6	-1.024e-01	3.938e-02	-2.600	0.009335 **
as.factor(year)1985:as.factor(target3)6	-2.511e-01	3.856e-02	-6.512	7.41e-11 ***
as.factor(year)1986:as.factor(target3)6	-1.692e-02	3.843e-02	-0.440	0.659688
as.factor(year)1987:as.factor(target3)6	1.709e-03	3.919e-02	0.044	0.965224

as.factor(year)1988:as.factor(target3)6	1.486e-02	4.062e-02	0.366	0.714434
as.factor(year)1989:as.factor(target3)6	2.686e-01	4.170e-02	6.440	1.19e-10 ***
as.factor(year)1990:as.factor(target3)6	1.155e-01	4.246e-02	2.721	0.006508 **
as.factor(year)1991:as.factor(target3)6	1.998e-01	4.242e-02	4.710	2.48e-06 ***
as.factor(year)1992:as.factor(target3)6	1.188e-01	4.196e-02	2.832	0.004626 **
as.factor(year)1993:as.factor(target3)6	3.635e-01	4.257e-02	8.537	< 2e-16 ***
as.factor(year)1976:as.factor(target3)7	2.379e-01	4.041e-02	5.886	3.96e-09 ***
as.factor(year)1977:as.factor(target3)7	1.114e-01	3.875e-02	2.875	0.004037 **
as.factor(year)1978:as.factor(target3)7	1.068e-01	4.002e-02	2.669	0.007604 **
as.factor(year)1979:as.factor(target3)7	-8.032e-02	3.961e-02	-2.028	0.042562 *
as.factor(year)1980:as.factor(target3)7	-3.623e-03	3.997e-02	-0.091	0.927771
as.factor(year)1981:as.factor(target3)7	-4.839e-02	3.975e-02	-1.217	0.223439
as.factor(year)1982:as.factor(target3)7	-1.447e-01	4.091e-02	-3.536	0.000406 ***
as.factor(year)1983:as.factor(target3)7	-6.817e-02	3.909e-02	-1.744	0.081154 .
as.factor(year)1984:as.factor(target3)7	-1.435e-01	3.915e-02	-3.667	0.000246 ***
as.factor(year)1985:as.factor(target3)7	-2.774e-01	3.830e-02	-7.242	4.44e-13 ***
as.factor(year)1986:as.factor(target3)7	-3.171e-02	3.818e-02	-0.830	0.406291
as.factor(year)1987:as.factor(target3)7	-1.417e-02	3.890e-02	-0.364	0.715605
as.factor(year)1988:as.factor(target3)7	3.745e-02	4.033e-02	0.928	0.353155
as.factor(year)1989:as.factor(target3)7	2.808e-01	4.144e-02	6.777	1.23e-11 ***
as.factor(year)1990:as.factor(target3)7	9.473e-02	4.219e-02	2.245	0.024748 *
as.factor(year)1991:as.factor(target3)7	1.691e-01	4.215e-02	4.012	6.03e-05 ***
as.factor(year)1992:as.factor(target3)7	9.878e-02	4.164e-02	2.372	0.017689 *
as.factor(year)1993:as.factor(target3)7	3.910e-01	4.233e-02	9.237	< 2e-16 ***
as.factor(year)1976:as.factor(target3)8	2.245e-01	4.032e-02	5.568	2.58e-08 ***
as.factor(year)1977:as.factor(target3)8	8.008e-02	3.855e-02	2.077	0.037771 *
as.factor(year)1978:as.factor(target3)8	1.223e-01	3.988e-02	3.068	0.002158 **
as.factor(year)1979:as.factor(target3)8	-1.267e-01	3.942e-02	-3.214	0.001307 **
as.factor(year)1980:as.factor(target3)8	-6.155e-02	3.971e-02	-1.550	0.121188
as.factor(year)1981:as.factor(target3)8	-7.800e-02	3.951e-02	-1.974	0.048364 *
as.factor(year)1982:as.factor(target3)8	-1.838e-01	4.070e-02	-4.517	6.28e-06 ***
as.factor(year)1983:as.factor(target3)8	-1.141e-01	3.884e-02	-2.936	0.003322 **
as.factor(year)1984:as.factor(target3)8	-2.071e-01	3.892e-02	-5.320	1.04e-07 ***
as.factor(year)1985:as.factor(target3)8	-3.409e-01	3.810e-02	-8.948	< 2e-16 ***
as.factor(year)1986:as.factor(target3)8	-8.669e-02	3.796e-02	-2.284	0.022395 *
as.factor(year)1987:as.factor(target3)8	-4.259e-02	3.870e-02	-1.101	0.271069
as.factor(year)1988:as.factor(target3)8	-2.703e-02	4.011e-02	-0.674	0.500380
as.factor(year)1989:as.factor(target3)8	2.475e-01	4.122e-02	6.004	1.92e-09 ***
as.factor(year)1990:as.factor(target3)8	4.317e-02	4.197e-02	1.029	0.303617
as.factor(year)1991:as.factor(target3)8	9.985e-02	4.201e-02	2.377	0.017458 *
as.factor(year)1992:as.factor(target3)8	5.310e-02	4.155e-02	1.278	0.201247
as.factor(year)1993:as.factor(target3)8	3.313e-01	4.210e-02	7.869	3.56e-15 ***
as.factor(year)1976:as.factor(target3)9	2.410e-01	4.000e-02	6.025	1.70e-09 ***
as.factor(year)1977:as.factor(target3)9	9.524e-02	3.833e-02	2.485	0.012950 *
as.factor(year)1978:as.factor(target3)9	8.936e-02	3.962e-02	2.256	0.024101 *
as.factor(year)1979:as.factor(target3)9	-1.737e-01	3.923e-02	-4.427	9.55e-06 ***
as.factor(year)1980:as.factor(target3)9	-1.259e-01	3.957e-02	-3.182	0.001464 **
as.factor(year)1981:as.factor(target3)9	-9.421e-02	3.932e-02	-2.396	0.016591 *
as.factor(year)1982:as.factor(target3)9	-2.080e-01	4.047e-02	-5.140	2.74e-07 ***
as.factor(year)1983:as.factor(target3)9	-1.493e-01	3.873e-02	-3.854	0.000116 ***
as.factor(year)1984:as.factor(target3)9	-2.247e-01	3.870e-02	-5.807	6.36e-09 ***
as.factor(year)1985:as.factor(target3)9	-4.149e-01	3.789e-02	-10.951	< 2e-16 ***
as.factor(year)1986:as.factor(target3)9	-1.448e-01	3.780e-02	-3.831	0.000128 ***
as.factor(year)1987:as.factor(target3)9	-1.056e-01	3.848e-02	-2.744	0.006077 **
as.factor(year)1988:as.factor(target3)9	-1.026e-01	3.997e-02	-2.567	0.010249 *
as.factor(year)1989:as.factor(target3)9	2.156e-01	4.096e-02	5.264	1.41e-07 ***
as.factor(year)1990:as.factor(target3)9	-9.855e-03	4.174e-02	-0.236	0.813338
as.factor(year)1991:as.factor(target3)9	1.792e-02	4.176e-02	0.429	0.667855
as.factor(year)1992:as.factor(target3)9	2.454e-02	4.127e-02	0.594	0.552212
as.factor(year)1993:as.factor(target3)9	2.565e-01	4.198e-02	6.109	1.00e-09 ***
as.factor(year)1976:as.factor(target3)10	2.571e-01	3.981e-02	6.457	1.07e-10 ***
as.factor(year)1977:as.factor(target3)10	2.125e-01	3.809e-02	5.578	2.43e-08 ***
as.factor(year)1978:as.factor(target3)10	9.784e-02	3.940e-02	2.483	0.013010 *
as.factor(year)1979:as.factor(target3)10	-6.789e-02	3.893e-02	-1.744	0.081164 .
as.factor(year)1980:as.factor(target3)10	-2.265e-01	3.932e-02	-5.760	8.41e-09 ***
as.factor(year)1981:as.factor(target3)10	-1.595e-01	3.905e-02	-4.084	4.42e-05 ***
as.factor(year)1982:as.factor(target3)10	-3.494e-01	4.023e-02	-8.683	< 2e-16 ***
as.factor(year)1983:as.factor(target3)10	-2.965e-01	3.845e-02	-7.711	1.24e-14 ***

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as.factor(year)1984:as.factor(target3)10 -3.726e-01  3.846e-02   -9.688  < 2e-16 ***
as.factor(year)1985:as.factor(target3)10 -5.099e-01  3.763e-02  -13.549  < 2e-16 ***
as.factor(year)1986:as.factor(target3)10 -3.103e-01  3.756e-02   -8.262  < 2e-16 ***
as.factor(year)1987:as.factor(target3)10 -2.079e-01  3.824e-02   -5.436 5.45e-08 ***
as.factor(year)1988:as.factor(target3)10 -1.738e-01  3.967e-02   -4.382 1.18e-05 ***
as.factor(year)1989:as.factor(target3)10  1.450e-01  4.077e-02    3.557 0.000375 ***
as.factor(year)1990:as.factor(target3)10 -9.937e-02  4.147e-02   -2.396 0.016560 *
as.factor(year)1991:as.factor(target3)10 -1.952e-01  4.160e-02   -4.693 2.69e-06 ***
as.factor(year)1992:as.factor(target3)10  1.040e-01  4.103e-02    2.534 0.011268 *
as.factor(year)1993:as.factor(target3)10  2.864e-01  4.171e-02    6.867 6.57e-12 ***
as.factor(year)1976:as.factor(target3)11  3.531e-02  3.709e+03    0.000 0.999992
as.factor(year)1977:as.factor(target3)11 -1.320e-01  4.127e+03    0.000 0.999974
as.factor(year)1978:as.factor(target3)11  4.107e-02  4.545e+03    0.000 0.999993
as.factor(year)1979:as.factor(target3)11 -2.085e-01  4.623e+03    0.000 0.999964
as.factor(year)1980:as.factor(target3)11 -2.615e-01  4.534e+03    0.000 0.999954
as.factor(year)1981:as.factor(target3)11 -1.119e-01  4.316e+03    0.000 0.999979
as.factor(year)1982:as.factor(target3)11 -2.899e-01  5.974e+03    0.000 0.999961
as.factor(year)1983:as.factor(target3)11 -1.911e-01  5.997e+03    0.000 0.999975
as.factor(year)1984:as.factor(target3)11 -1.799e-01  5.762e+03    0.000 0.999975
as.factor(year)1985:as.factor(target3)11 -2.889e-01  6.593e+03    0.000 0.999965
as.factor(year)1986:as.factor(target3)11 -2.389e-01  7.140e+03    0.000 0.999973
as.factor(year)1987:as.factor(target3)11 -4.191e-02  8.125e+03    0.000 0.999996
as.factor(year)1988:as.factor(target3)11 -8.828e-02  7.800e+03    0.000 0.999991
as.factor(year)1989:as.factor(target3)11  1.956e-01  7.550e+03    0.000 0.999979
as.factor(year)1990:as.factor(target3)11 -4.738e-02  7.499e+03    0.000 0.999995
as.factor(year)1991:as.factor(target3)11 -2.580e-01  7.080e+03    0.000 0.999971
as.factor(year)1992:as.factor(target3)11 -3.283e-01  8.961e+03    0.000 0.999971
as.factor(year)1993:as.factor(target3)11 -2.777e-01  1.029e+04    0.000 0.999978
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(4.9683) family taken to be 1)

    Null deviance: 1196426  on 191744  degrees of freedom
Residual deviance:  161505  on 191529  degrees of freedom
AIC: 1232210

Number of Fisher Scoring iterations: 1


          Theta:  4.9683
      Std. Err.:  0.0212

 2 x log-likelihood:  -1231775.7470
Analysis of Deviance Table (Type II tests)

Response: blshrk
                              LR Chisq  Df Pr(>Chisq)
as.factor(year)                  32704  18  < 2.2e-16 ***
as.factor(qt)                     22   3  7.992e-05 ***
as.factor(area)                  108   4  < 2.2e-16 ***
as.factor(target3)               909843  10  < 2.2e-16 ***
as.factor(year):as.factor(target3)     3232 180  < 2.2e-16 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```
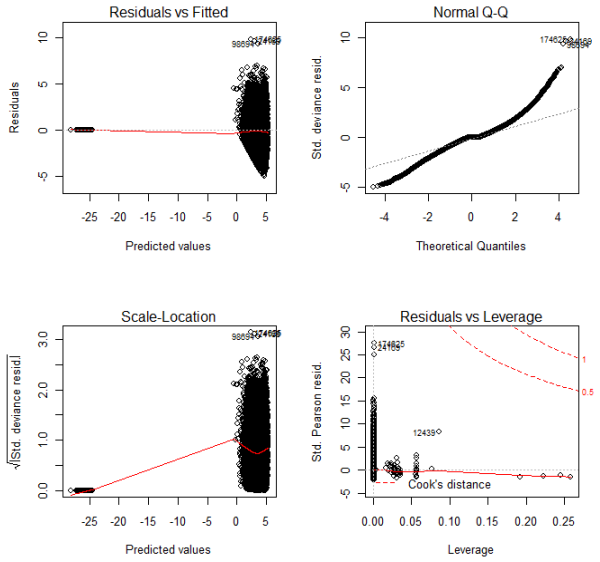



1-1-2a: 7593_Kinkai_deep

Call:

```
glm.nb(formula = blshrk ~ as.factor(year) + as.factor(qt) + as.factor(area) +
    as.factor(hpbc2) + offset(log(hook)), data = tdata, init.theta = 0.2443693461,
    link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.6623  -1.1948  -0.7041   0.0432   6.4966

Coefficients:
                      Estimate Std. Error  z value Pr(>|z|)
(Intercept)         -5.30681    0.03452 -153.740  < 2e-16 ***
as.factor(year)1976  0.47747    0.03992   11.961  < 2e-16 ***
as.factor(year)1977  0.85260    0.04073   20.932  < 2e-16 ***
as.factor(year)1978  0.69399    0.04071   17.048  < 2e-16 ***
as.factor(year)1979  0.52069    0.04108   12.674  < 2e-16 ***
as.factor(year)1980  1.10110    0.03863   28.505  < 2e-16 ***
as.factor(year)1981  0.94209    0.03605   26.134  < 2e-16 ***
as.factor(year)1982  1.09630    0.03670   29.870  < 2e-16 ***
as.factor(year)1983  0.99724    0.03749   26.597  < 2e-16 ***
as.factor(year)1984  0.91387    0.03717   24.588  < 2e-16 ***
as.factor(year)1985  0.68787    0.03794   18.128  < 2e-16 ***
as.factor(year)1986  0.98974    0.03865   25.605  < 2e-16 ***
as.factor(year)1987  0.55860    0.03988   14.006  < 2e-16 ***
as.factor(year)1988 -0.01911    0.03900   -0.490    0.624
as.factor(year)1989  0.31718    0.03924    8.083 6.32e-16 ***
as.factor(year)1990  0.52820    0.03932   13.434  < 2e-16 ***
as.factor(year)1991  0.51418    0.04005   12.839  < 2e-16 ***
as.factor(year)1992  0.89651    0.04314   20.782  < 2e-16 ***
as.factor(year)1993  0.87764    0.04294   20.441  < 2e-16 ***
as.factor(qt)2      -0.31593    0.01464  -21.579  < 2e-16 ***
as.factor(qt)3      -0.46348    0.01538  -30.126  < 2e-16 ***
as.factor(qt)4      -0.59978    0.01647  -36.417  < 2e-16 ***
as.factor(area)2    -1.87836    0.11357  -16.539  < 2e-16 ***
as.factor(area)3    -1.30607    0.01378  -94.762  < 2e-16 ***
as.factor(area)4    -3.49260    0.01981 -176.295  < 2e-16 ***
as.factor(area)5    -3.58804    0.22658  -15.836  < 2e-16 ***
as.factor(hpbc2)2   -0.55728    0.04102  -13.585  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

(Dispersion parameter for Negative Binomial(0.2444) family taken to be 1)

    Null deviance: 175255 on 159280 degrees of freedom
Residual deviance: 142189 on 159254 degrees of freedom
AIC: 792420

Number of Fisher Scoring iterations: 1

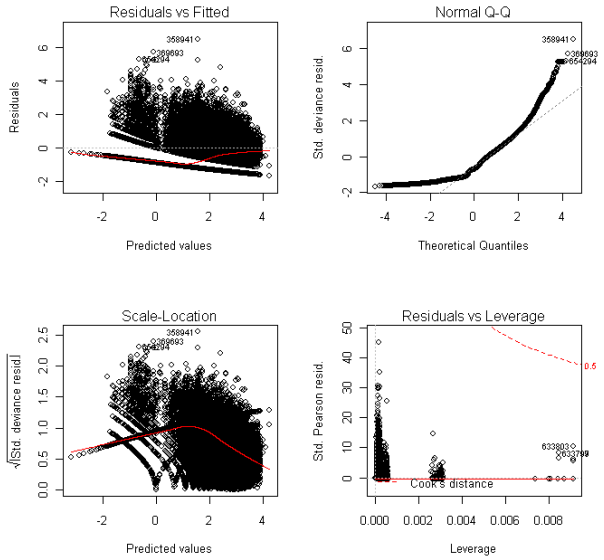
          Theta: 0.24437
      Std. Err.: 0.00116

 2 x log-likelihood: -792363.59700

Analysis of Deviance Table (Type II tests)

Response: blshrk
                LR Chisq Df Pr(>Chisq)
as.factor(year)   3344.2 18 < 2.2e-16 ***
as.factor(qt)   1455.7 3 < 2.2e-16 ***
as.factor(area)   25725.9 4 < 2.2e-16 ***
as.factor(hpbc2)   172.4 1 < 2.2e-16 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1



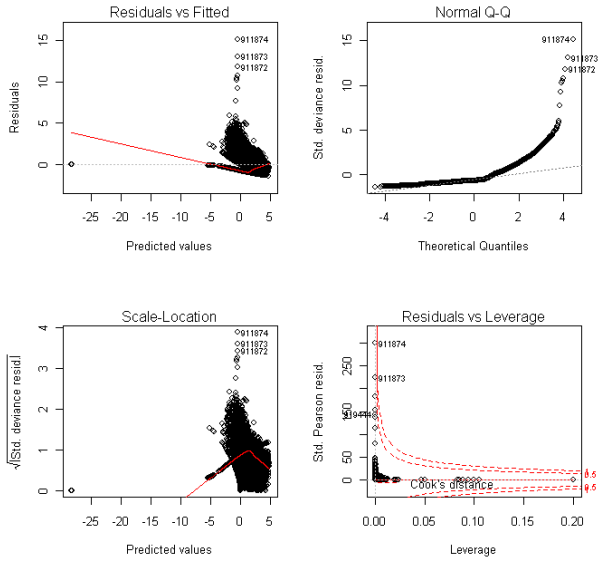
1-2-1: 7593_Enyo_shallow
Call:
glm.nb(formula = blshrk ~ as.factor(year) + as.factor(qt) + as.factor(area) +
    as.factor(hpb) + as.factor(fukenc2) + as.factor(year):as.factor(area) +
    offset(log(hook)), data = tdata, init.theta = 0.1497860511,
    link = log)

Deviance Residuals:
    Min   1Q   Median   3Q   Max
-1.3960 -0.8050 -0.6833 -0.3581 15.1417

Coefficients: (1 not defined because of singularities)
                                Estimate Std. Error z value Pr(>|z|)
(Intercept)   -3.347e+00 1.213e-01 -27.589 < 2e-16 ***
as.factor(year)1976   -6.781e-02 1.196e-01 -0.567 0.570650
as.factor(year)1977   1.794e-01 1.268e-01   1.414 0.157242
as.factor(year)1978   1.057e-01 1.291e-01   0.819 0.412863
as.factor(year)1979   -3.502e-01 1.443e-01 -2.427 0.015242 *

```
as.factor(year)1980                 1.050e-01  2.168e-01   0.485 0.628023
as.factor(year)1981                -4.947e-01  1.743e-01  -2.838 0.004536 **
as.factor(year)1982                -1.102e+00  1.931e-01  -5.706 1.16e-08 ***
as.factor(year)1983                -8.188e-01  1.572e-01  -5.209 1.90e-07 ***
as.factor(year)1984                -4.555e-01  2.039e-01  -2.234 0.025507 *
as.factor(year)1985                -1.041e+00  1.902e-01  -5.474 4.39e-08 ***
as.factor(year)1986                -1.028e+00  1.373e-01  -7.493 6.72e-14 ***
as.factor(year)1987                -1.087e+00  1.822e-01  -5.967 2.42e-09 ***
as.factor(year)1988                -1.339e+00  1.586e-01  -8.443  < 2e-16 ***
as.factor(year)1989                -1.539e+00  1.644e-01  -9.361  < 2e-16 ***
as.factor(year)1990                -1.898e+00  1.947e-01  -9.751  < 2e-16 ***
as.factor(year)1991                -1.197e+00  2.245e-01  -5.333 9.68e-08 ***
as.factor(year)1992                -5.777e-01  2.464e-01  -2.345 0.019050 *
as.factor(year)1993                -1.308e+00  1.940e-01  -6.741 1.57e-11 ***
as.factor(qt)2                    -7.338e-02  2.237e-02  -3.280 0.001037 **
as.factor(qt)3                    -3.769e-01  2.484e-02 -15.170  < 2e-16 ***
as.factor(qt)4                    -2.175e-01  2.655e-02  -8.192 2.58e-16 ***
as.factor(area)2                   -3.448e+00  1.650e-01 -20.894  < 2e-16 ***
as.factor(area)3                   -2.408e+00  1.094e-01 -22.012  < 2e-16 ***
as.factor(area)4                   -4.890e+00  1.107e-01 -44.158  < 2e-16 ***
as.factor(area)5                   -3.488e+00  9.880e-02 -35.304  < 2e-16 ***
as.factor(hpb)4                     4.648e-03  7.574e-02   0.061 0.951060
as.factor(hpb)5                    -1.163e+00  7.429e-02 -15.652  < 2e-16 ***
as.factor(hpb)6                    -1.091e+00  7.368e-02 -14.810  < 2e-16 ***
as.factor(fukenc2)2                 -2.944e-01  1.875e-02 -15.703  < 2e-16 ***
as.factor(year)1976:as.factor(area)2  9.162e-01  1.905e-01   4.809 1.52e-06 ***
as.factor(year)1977:as.factor(area)2 -1.644e-01  2.074e-01  -0.793 0.427901
as.factor(year)1978:as.factor(area)2  1.546e+00  2.145e-01   7.208 5.69e-13 ***
as.factor(year)1979:as.factor(area)2  5.299e-01  2.160e-01   2.454 0.014140 *
as.factor(year)1980:as.factor(area)2 -4.194e-02  2.634e-01  -0.159 0.873495
as.factor(year)1981:as.factor(area)2  3.016e-01  2.343e-01   1.287 0.197993
as.factor(year)1982:as.factor(area)2  7.155e-01  2.541e-01   2.815 0.004873 **
as.factor(year)1983:as.factor(area)2  1.288e+00  2.360e-01   5.456 4.88e-08 ***
as.factor(year)1984:as.factor(area)2  1.147e+00  2.599e-01   4.411 1.03e-05 ***
as.factor(year)1985:as.factor(area)2  1.285e+00  2.584e-01   4.974 6.55e-07 ***
as.factor(year)1986:as.factor(area)2  2.109e+00  2.785e-01   7.571 3.69e-14 ***
as.factor(year)1987:as.factor(area)2  4.623e-01  2.897e-01   1.596 0.110538
as.factor(year)1988:as.factor(area)2  2.659e-01  2.697e-01   0.986 0.324223
as.factor(year)1989:as.factor(area)2  6.303e-01  3.180e-01   1.982 0.047512 *
as.factor(year)1990:as.factor(area)2  2.206e+00  3.270e-01   6.746 1.52e-11 ***
as.factor(year)1991:as.factor(area)2  1.262e+00  3.505e-01   3.601 0.000317 ***
as.factor(year)1992:as.factor(area)2  2.192e+00  4.869e-01   4.502 6.74e-06 ***
as.factor(year)1993:as.factor(area)2  5.974e-01  1.231e+00   0.485 0.627474
as.factor(year)1976:as.factor(area)3  1.156e+00  1.426e-01   8.107 5.19e-16 ***
as.factor(year)1977:as.factor(area)3  5.215e-01  1.479e-01   3.526 0.000422 ***
as.factor(year)1978:as.factor(area)3  1.394e+00  1.515e-01   9.197  < 2e-16 ***
as.factor(year)1979:as.factor(area)3  1.221e+00  1.671e-01   7.307 2.74e-13 ***
as.factor(year)1980:as.factor(area)3  7.044e-01  2.370e-01   2.972 0.002957 **
as.factor(year)1981:as.factor(area)3  1.369e+00  1.998e-01   6.853 7.23e-12 ***
as.factor(year)1982:as.factor(area)3  2.132e+00  2.273e-01   9.379  < 2e-16 ***
as.factor(year)1983:as.factor(area)3  1.782e+00  2.029e-01   8.781  < 2e-16 ***
as.factor(year)1984:as.factor(area)3  9.124e-01  2.624e-01   3.478 0.000506 ***
as.factor(year)1985:as.factor(area)3  1.936e+00  2.393e-01   8.089 6.00e-16 ***
as.factor(year)1986:as.factor(area)3  1.591e+00  2.128e-01   7.475 7.74e-14 ***
as.factor(year)1987:as.factor(area)3  1.634e+00  2.217e-01   7.370 1.70e-13 ***
as.factor(year)1988:as.factor(area)3  1.878e+00  2.723e-01   6.898 5.27e-12 ***
as.factor(year)1989:as.factor(area)3  1.976e+00  3.019e-01   6.544 5.97e-11 ***
as.factor(year)1990:as.factor(area)3  2.812e+00  3.494e-01   8.046 8.54e-16 ***
as.factor(year)1991:as.factor(area)3  2.835e+00  3.465e-01   8.182 2.79e-16 ***
as.factor(year)1992:as.factor(area)3  1.919e+00  3.435e-01   5.587 2.31e-08 ***
as.factor(year)1993:as.factor(area)3  2.625e+00  2.662e-01   9.858  < 2e-16 ***
as.factor(year)1976:as.factor(area)4  1.619e+00  1.389e-01  11.652  < 2e-16 ***
as.factor(year)1977:as.factor(area)4  2.146e+00  1.477e-01  14.527  < 2e-16 ***
as.factor(year)1978:as.factor(area)4  2.135e+00  1.520e-01  14.042  < 2e-16 ***
as.factor(year)1979:as.factor(area)4  2.202e+00  1.659e-01  13.273  < 2e-16 ***
as.factor(year)1980:as.factor(area)4  1.489e+00  2.346e-01   6.348 2.18e-10 ***
as.factor(year)1981:as.factor(area)4  2.094e+00  1.957e-01  10.699  < 2e-16 ***
as.factor(year)1982:as.factor(area)4  1.636e+00  2.346e-01   6.973 3.11e-12 ***
```

```
as.factor(year)1983:as.factor(area)4  2.053e+00  2.110e-01   9.729  < 2e-16 ***
as.factor(year)1984:as.factor(area)4  2.372e+00  2.386e-01   9.942  < 2e-16 ***
as.factor(year)1985:as.factor(area)4  2.370e+00  2.272e-01  10.432  < 2e-16 ***
as.factor(year)1986:as.factor(area)4  2.368e+00  2.614e-01   9.060  < 2e-16 ***
as.factor(year)1987:as.factor(area)4 -4.303e-01  5.542e-01  -0.776 0.437549
as.factor(year)1988:as.factor(area)4  5.180e-02  3.680e-01   0.141 0.888054
as.factor(year)1989:as.factor(area)4  8.466e-01  2.944e-01   2.876 0.004033 **
as.factor(year)1990:as.factor(area)4  3.664e+00  2.956e-01  12.393  < 2e-16 ***
as.factor(year)1991:as.factor(area)4  3.474e+00  6.303e-01   5.511 3.56e-08 ***
as.factor(year)1992:as.factor(area)4  3.462e+00  4.510e-01   7.677 1.63e-14 ***
as.factor(year)1993:as.factor(area)4         NA         NA      NA       NA
as.factor(year)1976:as.factor(area)5  1.110e-01  1.246e-01   0.891 0.373123
as.factor(year)1977:as.factor(area)5 -8.351e-02  1.348e-01  -0.619 0.535604
as.factor(year)1978:as.factor(area)5  6.101e-02  1.393e-01   0.438 0.661521
as.factor(year)1979:as.factor(area)5  6.746e-02  1.540e-01   0.438 0.661420
as.factor(year)1980:as.factor(area)5  8.981e-01  2.242e-01   4.005 6.19e-05 ***
as.factor(year)1981:as.factor(area)5  1.103e-01  1.839e-01   0.600 0.548783
as.factor(year)1982:as.factor(area)5  2.129e+00  1.993e-01  10.683  < 2e-16 ***
as.factor(year)1983:as.factor(area)5  2.272e+00  1.689e-01  13.451  < 2e-16 ***
as.factor(year)1984:as.factor(area)5  9.097e-01  2.175e-01   4.182 2.89e-05 ***
as.factor(year)1985:as.factor(area)5  8.100e-01  2.415e-01   3.354 0.000796 ***
as.factor(year)1986:as.factor(area)5  2.370e+00  1.705e-01  13.901  < 2e-16 ***
as.factor(year)1987:as.factor(area)5 -8.362e-01  2.132e-01  -3.922 8.79e-05 ***
as.factor(year)1988:as.factor(area)5  1.640e+00  1.785e-01   9.185  < 2e-16 ***
as.factor(year)1989:as.factor(area)5  1.399e+00  1.953e-01   7.163 7.87e-13 ***
as.factor(year)1990:as.factor(area)5 -2.726e+00  6.265e-01  -4.352 1.35e-05 ***
as.factor(year)1991:as.factor(area)5  2.081e+00  2.643e-01   7.873 3.47e-15 ***
as.factor(year)1992:as.factor(area)5  7.003e-01  3.905e-01   1.793 0.072899 .
as.factor(year)1993:as.factor(area)5 -2.642e+01  2.536e+05   0.000 0.999917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(0.1498) family taken to be 1)

    Null deviance: 102066  on 121871  degrees of freedom
Residual deviance:  70969  on 121771  degrees of freedom
AIC: 325064

Number of Fisher Scoring iterations: 1


          Theta:  0.14979
      Std. Err.:  0.00114

 2 x log-likelihood:  -324860.34800

Analysis of Deviance Table (Type II tests)

Response: blshrk
                          LR Chisq Df Pr(>Chisq)
as.factor(year)             2137.7 18  < 2.2e-16 ***
as.factor(qt)               239.5  3  < 2.2e-16 ***
as.factor(area)            16917.3  4  < 2.2e-16 ***
as.factor(hpb)              1565.0  3  < 2.2e-16 ***
as.factor(fukenc2)             203.7  1  < 2.2e-16 ***
as.factor(year):as.factor(area)   3175.9 71  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```



1-2-1: 7593_Enyo_deep

Call:
glm.nb(formula = blshrk ~ as.factor(year) + as.factor(qt) + as.factor(area) +
    as.factor(hpbc2) + as.factor(fukenc2) + as.factor(year):as.factor(area) +
    offset(log(hook)), data = tdata, init.theta = 0.1124337443,
    link = log)

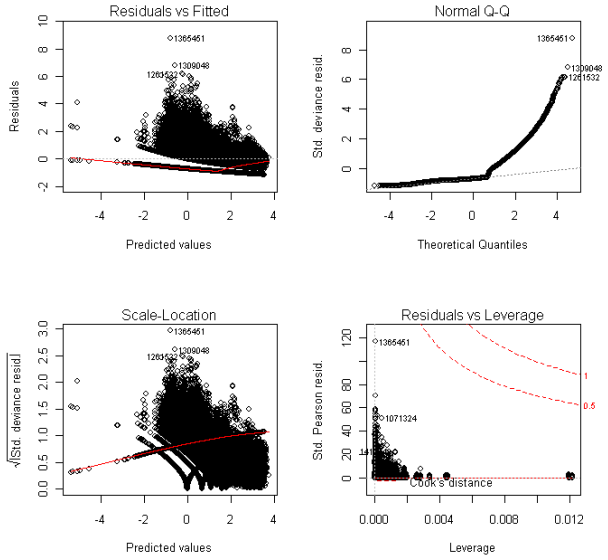
Deviance Residuals:
    Min   1Q   Median   3Q   Max
-1.1387 -0.7579 -0.6894 -0.5658   8.7644

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-4.66526	0.17468	-26.708	< 2e-16	***
as.factor(year)1976	-0.57603	0.19214	-2.998	0.002718	**
as.factor(year)1977	-0.41980	0.19795	-2.121	0.033943	*
as.factor(year)1978	-0.12833	0.20378	-0.630	0.528846	
as.factor(year)1979	-0.02815	0.19335	-0.146	0.884244	
as.factor(year)1980	0.32299	0.20254	1.595	0.110770	
as.factor(year)1981	-0.22232	0.20494	-1.085	0.278010	
as.factor(year)1982	-0.42718	0.21265	-2.009	0.044553	*
as.factor(year)1983	-0.47250	0.20919	-2.259	0.023902	*
as.factor(year)1984	-0.33506	0.20981	-1.597	0.110277	
as.factor(year)1985	-0.23799	0.20074	-1.186	0.235805	
as.factor(year)1986	-0.97817	0.23652	-4.136	3.54e-05	***
as.factor(year)1987	-0.78710	0.26579	-2.961	0.003063	**
as.factor(year)1988	-0.10538	0.23086	-0.456	0.648051	
as.factor(year)1989	-1.48965	0.21615	-6.892	5.51e-12	***
as.factor(year)1990	-1.26977	0.20965	-6.056	1.39e-09	***
as.factor(year)1991	-1.07616	0.19875	-5.415	6.14e-08	***
as.factor(year)1992	-1.74112	0.20747	-8.392	< 2e-16	***
as.factor(year)1993	-1.40183	0.20554	-6.820	9.10e-12	***
as.factor(qt)2	-0.08066	0.01333	-6.053	1.42e-09	***
as.factor(qt)3	0.09710	0.01470	6.604	4.00e-11	***
as.factor(qt)4	0.08245	0.01603	5.145	2.68e-07	***
as.factor(area)2	-1.10381	0.37479	-2.945	0.003228	**
as.factor(area)3	-1.37523	0.19962	-6.889	5.60e-12	***
as.factor(area)4	-2.16690	0.19216	-11.276	< 2e-16	***
as.factor(area)5	-2.36012	0.19789	-11.926	< 2e-16	***
as.factor(hpbc2)2	-0.36131	0.02945	-12.268	< 2e-16	***
as.factor(fukenc2)2	-0.73625	0.01049	-70.189	< 2e-16	***
as.factor(year)1976:as.factor(area)2	-0.77277	0.39997	-1.932	0.053351	.

```
as.factor(year)1977:as.factor(area)2 -2.42789    0.40057  -6.061 1.35e-09 ***
as.factor(year)1978:as.factor(area)2 -2.07597    0.40008  -5.189 2.12e-07 ***
as.factor(year)1979:as.factor(area)2 -1.22281    0.39354  -3.107 0.001889 **
as.factor(year)1980:as.factor(area)2 -2.37195    0.39557  -5.996 2.02e-09 ***
as.factor(year)1981:as.factor(area)2 -1.30114    0.39421  -3.301 0.000965 ***
as.factor(year)1982:as.factor(area)2 -1.47470    0.39965  -3.690 0.000224 ***
as.factor(year)1983:as.factor(area)2 -0.65546    0.39652  -1.653 0.098329 .
as.factor(year)1984:as.factor(area)2 -1.35166    0.39624  -3.411 0.000647 ***
as.factor(year)1985:as.factor(area)2 -2.29824    0.39161  -5.869 4.39e-09 ***
as.factor(year)1986:as.factor(area)2 -1.20461    0.41475  -2.904 0.003679 **
as.factor(year)1987:as.factor(area)2 -1.39606    0.42956  -3.250 0.001154 **
as.factor(year)1988:as.factor(area)2 -2.15550    0.40814  -5.281 1.28e-07 ***
as.factor(year)1989:as.factor(area)2 -0.52394    0.40082  -1.307 0.191155
as.factor(year)1990:as.factor(area)2 -1.14257    0.39858  -2.867 0.004149 **
as.factor(year)1991:as.factor(area)2 -1.40187    0.39280  -3.569 0.000359 ***
as.factor(year)1992:as.factor(area)2 -0.57661    0.40129  -1.437 0.150745
as.factor(year)1993:as.factor(area)2 -0.11586    0.39534  -0.293 0.769468
as.factor(year)1976:as.factor(area)3  0.46172    0.23371   1.976 0.048196 *
as.factor(year)1977:as.factor(area)3  0.19788    0.23050   0.858 0.390643
as.factor(year)1978:as.factor(area)3 -0.32062    0.23603  -1.358 0.174341
as.factor(year)1979:as.factor(area)3 -0.36098    0.22469  -1.607 0.108147
as.factor(year)1980:as.factor(area)3 -0.55087    0.23117  -2.383 0.017175 *
as.factor(year)1981:as.factor(area)3  0.33616    0.23402   1.436 0.150873
as.factor(year)1982:as.factor(area)3 -0.39531    0.24064  -1.643 0.100446
as.factor(year)1983:as.factor(area)3  0.22257    0.24537   0.907 0.364368
as.factor(year)1984:as.factor(area)3 -0.24482    0.24403  -1.003 0.315741
as.factor(year)1985:as.factor(area)3 -0.42345    0.24412  -1.735 0.082817 .
as.factor(year)1986:as.factor(area)3  0.51370    0.26398   1.946 0.051655 .
as.factor(year)1987:as.factor(area)3 -0.59452    0.29339  -2.026 0.042727 *
as.factor(year)1988:as.factor(area)3 -0.53402    0.28452  -1.877 0.060526 .
as.factor(year)1989:as.factor(area)3  0.06080    0.26250   0.232 0.816829
as.factor(year)1990:as.factor(area)3 -0.51570    0.25023  -2.061 0.039315 *
as.factor(year)1991:as.factor(area)3 -1.08361    0.26043  -4.161 3.17e-05 ***
as.factor(year)1992:as.factor(area)3 -1.32244    0.25062  -5.277 1.32e-07 ***
as.factor(year)1993:as.factor(area)3 -0.16037    0.24356  -0.658 0.510254
as.factor(year)1976:as.factor(area)4 -0.14810    0.21301  -0.695 0.486890
as.factor(year)1977:as.factor(area)4 -0.38184    0.21836  -1.749 0.080340 .
as.factor(year)1978:as.factor(area)4 -0.44264    0.22236  -1.991 0.046518 *
as.factor(year)1979:as.factor(area)4 -0.45544    0.21205  -2.148 0.031727 *
as.factor(year)1980:as.factor(area)4 -0.39510    0.22082  -1.789 0.073576 .
as.factor(year)1981:as.factor(area)4  0.43197    0.22312   1.936 0.052864 .
as.factor(year)1982:as.factor(area)4 -0.11454    0.23042  -0.497 0.619116
as.factor(year)1983:as.factor(area)4  0.21592    0.22757   0.949 0.342720
as.factor(year)1984:as.factor(area)4 -0.66610    0.22747  -2.928 0.003409 **
as.factor(year)1985:as.factor(area)4 -0.90384    0.21957  -4.116 3.85e-05 ***
as.factor(year)1986:as.factor(area)4 -0.25036    0.25392  -0.986 0.324141
as.factor(year)1987:as.factor(area)4 -0.14810    0.28186  -0.525 0.599266
as.factor(year)1988:as.factor(area)4 -0.39867    0.24727  -1.612 0.106898
as.factor(year)1989:as.factor(area)4  0.60579    0.23366   2.593 0.009523 **
as.factor(year)1990:as.factor(area)4  0.49070    0.22888   2.144 0.032038 *
as.factor(year)1991:as.factor(area)4  0.21710    0.22010   0.986 0.323936
as.factor(year)1992:as.factor(area)4  0.90500    0.22904   3.951 7.77e-05 ***
as.factor(year)1993:as.factor(area)4  0.48264    0.22489   2.146 0.031862 *
as.factor(year)1976:as.factor(area)5 -0.07474    0.21758  -0.343 0.731225
as.factor(year)1977:as.factor(area)5  0.04636    0.22049   0.210 0.833479
as.factor(year)1978:as.factor(area)5 -0.57405    0.22552  -2.545 0.010915 *
as.factor(year)1979:as.factor(area)5 -0.89385    0.21607  -4.137 3.52e-05 ***
as.factor(year)1980:as.factor(area)5 -0.69742    0.22494  -3.101 0.001932 **
as.factor(year)1981:as.factor(area)5 -0.04849    0.22709  -0.214 0.830917
as.factor(year)1982:as.factor(area)5  0.12485    0.23382   0.534 0.593367
as.factor(year)1983:as.factor(area)5  0.05750    0.23067   0.249 0.803135
as.factor(year)1984:as.factor(area)5  0.07358    0.23137   0.318 0.750483
as.factor(year)1985:as.factor(area)5 -0.06099    0.22303  -0.273 0.784514
as.factor(year)1986:as.factor(area)5  0.19895    0.25591   0.777 0.436905
as.factor(year)1987:as.factor(area)5  0.33465    0.28309   1.182 0.237166
as.factor(year)1988:as.factor(area)5 -0.21979    0.25061  -0.877 0.380488
as.factor(year)1989:as.factor(area)5  1.13464    0.23640   4.800 1.59e-06 ***
as.factor(year)1990:as.factor(area)5  0.55803    0.23073   2.418 0.015586 *
```

```
as.factor(year)1991:as.factor(area)5  0.24481    0.22102   1.108 0.268030
as.factor(year)1992:as.factor(area)5  0.92441    0.22899   4.037 5.42e-05 ***
as.factor(year)1993:as.factor(area)5  0.62394    0.22729   2.745 0.006047 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(0.1124) family taken to be 1)

    Null deviance: 283896  on 474751  degrees of freedom
Residual deviance: 247427  on 474652  degrees of freedom
AIC: 1066300

Number of Fisher Scoring iterations: 1


          Theta:  0.112434
      Std. Err.:  0.000445

 2 x log-likelihood:  -1066097.827000

Analysis of Deviance Table (Type II tests)

Response: blshrk
                          LR Chisq Df Pr(>Chisq)
as.factor(year)             2633.8 18  < 2.2e-16 ***
as.factor(qt)               242.0  3  < 2.2e-16 ***
as.factor(area)             16151.7  4  < 2.2e-16 ***
as.factor(hpbc2)              154.7  1  < 2.2e-16 ***
as.factor(fukenc2)            4450.0  1  < 2.2e-16 ***
as.factor(year):as.factor(area)   3145.6 72  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```



II. 1994-2010

2-1-1a: 9410_Kinkai/Enyo_Shallow_Hokkaido&Tohoku

```
Call:
glm.nb(formula = blshrk ~ as.factor(year.x) + as.factor(qt) +
    as.factor(area) + as.factor(target3) + as.factor(vesseltype) +
    as.factor(year.x):as.factor(target3) + as.factor(qt):as.factor(target3) +
"    offset(log(hook)), data = tdata, init.theta = 2.831767455, "
    link = log)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-5.4690	-0.6311	-0.0197	0.3495	5.5101

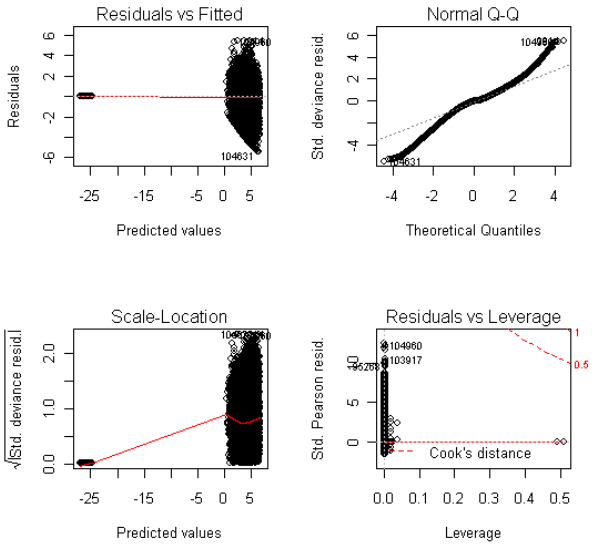
Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-6.18E+00	3.59E-02	-172.3	< 2e-16	***
as.factor(year.x)1995		3.66E-01	4.00E-02	9.166	< 2e-16 ***
as.factor(year.x)1996		4.22E-01	3.94E-02	10.719	< 2e-16 ***
as.factor(year.x)1997		3.18E-01	4.08E-02	7.791	6.63E-15***
as.factor(year.x)1998		4.15E-01	3.96E-02	10.473	< 2e-16 ***
as.factor(year.x)1999		5.14E-01	3.91E-02	13.161	< 2e-16 ***
as.factor(year.x)2000		7.67E-01	3.76E-02	20.384	< 2e-16 ***
as.factor(year.x)2001		3.15E-01	3.88E-02	8.122	4.59E-16***
as.factor(year.x)2002		3.48E-01	4.02E-02	8.659	< 2e-16 ***
as.factor(year.x)2003		7.76E-01	4.04E-02	19.224	< 2e-16 ***
as.factor(year.x)2004		8.49E-01	4.13E-02	20.548	< 2e-16 ***
as.factor(year.x)2005		8.46E-01	4.17E-02	20.313	< 2e-16 ***
as.factor(year.x)2006		5.87E-01	4.22E-02	13.923	< 2e-16 ***
as.factor(year.x)2007		3.11E-01	4.18E-02	7.442	9.91E-14***
as.factor(year.x)2008		-5.38E-01	4.55E-02	-11.829	< 2e-16 ***
as.factor(year.x)2009		4.47E-01	4.36E-02	10.241	< 2e-16 ***
as.factor(year.x)2010		-1.91E-02	4.62E-02	-0.413	0.67969
as.factor(qt)2	2.71E-01	2.49E-02	10.916	< 2e-16	***
as.factor(qt)3-	2.70E-01	2.79E-02	-9.681	< 2e-16	***
as.factor(qt)4-	2.15E-01	2.53E-02	-8.5	< 2e-16	***
as.factor(area)2		4.29E-02	1.25E-02	3.439	0.000583***
as.factor(area)3		-3.98E-01	7.07E-03	-56.213	< 2e-16 ***
as.factor(area)4		-5.86E-01	2.50E-02	-23.491	< 2e-16 ***
as.factor(area)5		-8.83E-01	1.23E-01	-7.21	5.60E-13***
as.factor(target3)2	7.01E-01	4.68E-02	14.978	< 2e-16	***
as.factor(target3)3	1.07E+00	4.57E-02	23.425	< 2e-16	***
as.factor(target3)4	1.32E+00	4.52E-02	29.254	< 2e-16	***
as.factor(target3)5	1.58E+00	4.49E-02	35.14	< 2e-16	***
as.factor(target3)6	1.80E+00	4.49E-02	40.177	< 2e-16	***
as.factor(target3)7	1.96E+00	4.48E-02	43.742	< 2e-16	***
as.factor(target3)8	2.14E+00	4.51E-02	47.508	< 2e-16	***
as.factor(target3)9	2.40E+00	4.62E-02	51.826	< 2e-16	***
as.factor(target3)10	2.86E+00	4.70E-02	60.744	< 2e-16	***
as.factor(target3)11	-2.71E+01		7.89E+03	-0.003	0.997259
as.factor(vesseltype)2	-3.26E-02		6.14E-03	-5.309	1.10E-07***
as.factor(year.x)1995:as.factor(target3)2	-1.32E-01	5.43E-02	-2.439	0.014724*	
as.factor(year.x)1996:as.factor(target3)2	-8.77E-02	5.36E-02	-1.638	0.101397	
as.factor(year.x)1997:as.factor(target3)2	4.37E-02	5.48E-02	0.799	0.424483	
as.factor(year.x)1998:as.factor(target3)2	-5.22E-04	5.38E-02	-0.01	0.99226	
as.factor(year.x)1999:as.factor(target3)2	-9.28E-02	5.32E-02	-1.744	0.081088 .	
as.factor(year.x)2000:as.factor(target3)2	-7.56E-02	5.13E-02	-1.474	0.140425	
as.factor(year.x)2001:as.factor(target3)2	1.55E-01	5.26E-02	2.948	0.003201**	
as.factor(year.x)2002:as.factor(target3)2	3.80E-02	5.46E-02	0.697	0.486014	
as.factor(year.x)2003:as.factor(target3)2	1.14E-01	5.49E-02	2.071	0.038368*	
as.factor(year.x)2004:as.factor(target3)2	9.67E-02	5.54E-02	1.745	0.080972 .	
as.factor(year.x)2005:as.factor(target3)2	-5.27E-02	5.69E-02	-0.927	0.353796	
as.factor(year.x)2006:as.factor(target3)2	-3.52E-02	5.78E-02	-0.609	0.542486	
as.factor(year.x)2007:as.factor(target3)2	5.21E-02	5.67E-02	0.919	0.358124	
as.factor(year.x)2008:as.factor(target3)2	5.03E-01	6.04E-02	8.337	< 2e-16 ***	
as.factor(year.x)2009:as.factor(target3)2	1.96E-01	5.92E-02	3.32	0.0009 ***	
as.factor(year.x)2010:as.factor(target3)2	5.12E-01	6.17E-02	8.295	< 2e-16 ***	
as.factor(year.x)1995:as.factor(target3)3	-1.66E-01	5.37E-02	-3.093	0.001982**	
as.factor(year.x)1996:as.factor(target3)3	-1.87E-01	5.30E-02	-3.533	0.00041***	
as.factor(year.x)1997:as.factor(target3)3	2.51E-02	5.42E-02	0.462	0.643735	
as.factor(year.x)1998:as.factor(target3)3	-3.10E-02	5.32E-02	-0.582	0.560298	
as.factor(year.x)1999:as.factor(target3)3	-1.62E-01	5.27E-02	-3.083	0.00205**	
as.factor(year.x)2000:as.factor(target3)3	-1.18E-01	5.08E-02	-2.326	0.020009*	
as.factor(year.x)2001:as.factor(target3)3	3.72E-01	5.20E-02	7.156	8.28E-13***	
as.factor(year.x)2002:as.factor(target3)3	2.15E-01	5.39E-02	3.988	6.66E-05***	
as.factor(year.x)2003:as.factor(target3)3	1.32E-01	5.43E-02	2.437	0.014812*	
as.factor(year.x)2004:as.factor(target3)3	3.73E-02	5.51E-02	0.676	0.499309	

as.factor(year.x)2005:as.factor(target3)3	-1.19E-01	5.63E-02	-2.109	0.034925*
as.factor(year.x)2006:as.factor(target3)3	7.45E-02	5.73E-02	1.3	0.193624
as.factor(year.x)2007:as.factor(target3)3	1.61E-01	5.61E-02	2.864	0.004184**
as.factor(year.x)2008:as.factor(target3)3	7.34E-01	5.93E-02	12.369	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)3	2.48E-01	5.87E-02	4.226	2.38E-05***
as.factor(year.x)2010:as.factor(target3)3	6.48E-01	6.11E-02	10.593	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)4	-1.82E-01	5.34E-02	-3.403	0.000666***
as.factor(year.x)1996:as.factor(target3)4	-2.03E-01	5.27E-02	-3.851	0.000118***
as.factor(year.x)1997:as.factor(target3)4	9.63E-02	5.39E-02	1.788	0.07381 .
as.factor(year.x)1998:as.factor(target3)4	-3.76E-02	5.28E-02	-0.712	0.476568
as.factor(year.x)1999:as.factor(target3)4	-1.33E-01	5.22E-02	-2.546	0.010893*
as.factor(year.x)2000:as.factor(target3)4	-1.03E-01	5.04E-02	-2.036	0.041711*
as.factor(year.x)2001:as.factor(target3)4	5.20E-01	5.16E-02	10.08	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)4	3.73E-01	5.35E-02	6.974	3.08E-12***
as.factor(year.x)2003:as.factor(target3)4	1.59E-01	5.40E-02	2.949	0.003188**
as.factor(year.x)2004:as.factor(target3)4	2.03E-02	5.49E-02	0.37	0.711022
as.factor(year.x)2005:as.factor(target3)4	-4.77E-02	5.59E-02	-0.853	0.393403
as.factor(year.x)2006:as.factor(target3)4	2.06E-01	5.69E-02	3.628	0.000285***
as.factor(year.x)2007:as.factor(target3)4	2.25E-01	5.57E-02	4.031	5.56E-05***
as.factor(year.x)2008:as.factor(target3)4	9.28E-01	5.89E-02	15.749	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)4	3.08E-01	5.83E-02	5.292	1.21E-07***
as.factor(year.x)2010:as.factor(target3)4	7.59E-01	6.08E-02	12.493	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)5	-2.18E-01	5.32E-02	-4.101	4.11E-05***
as.factor(year.x)1996:as.factor(target3)5	-2.47E-01	5.22E-02	-4.738	2.16E-06***
as.factor(year.x)1997:as.factor(target3)5	7.00E-02	5.37E-02	1.303	0.192481
as.factor(year.x)1998:as.factor(target3)5	-8.95E-02	5.27E-02	-1.697	0.089728 .
as.factor(year.x)1999:as.factor(target3)5	-1.60E-01	5.22E-02	-3.057	0.002233**
as.factor(year.x)2000:as.factor(target3)5	-1.23E-01	5.03E-02	-2.456	0.014054*
as.factor(year.x)2001:as.factor(target3)5	5.53E-01	5.15E-02	10.738	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)5	4.34E-01	5.33E-02	8.139	4.00E-16***
as.factor(year.x)2003:as.factor(target3)5	1.32E-01	5.39E-02	2.457	0.014019*
as.factor(year.x)2004:as.factor(target3)5	-3.03E-02	5.46E-02	-0.554	0.579439
as.factor(year.x)2005:as.factor(target3)5	-5.00E-02	5.57E-02	-0.898	0.369018
as.factor(year.x)2006:as.factor(target3)5	2.28E-01	5.66E-02	4.029	5.59E-05***
as.factor(year.x)2007:as.factor(target3)5	2.24E-01	5.55E-02	4.044	5.26E-05***
as.factor(year.x)2008:as.factor(target3)5	9.57E-01	5.85E-02	16.355	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)5	3.37E-01	5.81E-02	5.807	6.37E-09***
as.factor(year.x)2010:as.factor(target3)5	7.36E-01	6.06E-02	12.15	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)6	-2.52E-01	5.30E-02	-4.75	2.04E-06***
as.factor(year.x)1996:as.factor(target3)6	-3.10E-01	5.25E-02	-5.905	3.53E-09***
as.factor(year.x)1997:as.factor(target3)6	3.90E-02	5.36E-02	0.728	0.466905
as.factor(year.x)1998:as.factor(target3)6	-1.06E-01	5.26E-02	-2.013	0.044161*
as.factor(year.x)1999:as.factor(target3)6	-1.32E-01	5.19E-02	-2.544	0.010953*
as.factor(year.x)2000:as.factor(target3)6	-1.24E-01	5.03E-02	-2.457	0.013992*
as.factor(year.x)2001:as.factor(target3)6	5.51E-01	5.14E-02	10.711	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)6	4.44E-01	5.33E-02	8.324	< 2e-16 ***
as.factor(year.x)2003:as.factor(target3)6	1.36E-01	5.38E-02	2.529	0.011441*
as.factor(year.x)2004:as.factor(target3)6	-5.27E-02	5.46E-02	-0.966	0.334179
as.factor(year.x)2005:as.factor(target3)6	-2.81E-02	5.57E-02	-0.505	0.613673
as.factor(year.x)2006:as.factor(target3)6	2.60E-01	5.65E-02	4.595	4.33E-06***
as.factor(year.x)2007:as.factor(target3)6	2.41E-01	5.54E-02	4.352	1.35E-05***
as.factor(year.x)2008:as.factor(target3)6	9.77E-01	5.86E-02	16.688	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)6	3.27E-01	5.80E-02	5.645	1.65E-08***
as.factor(year.x)2010:as.factor(target3)6	7.90E-01	6.05E-02	13.068	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)7	-2.29E-01	5.28E-02	-4.338	1.44E-05***
as.factor(year.x)1996:as.factor(target3)7	-2.77E-01	5.21E-02	-5.32	1.04E-07***
as.factor(year.x)1997:as.factor(target3)7	5.33E-02	5.34E-02	0.997	0.318752
as.factor(year.x)1998:as.factor(target3)7	-7.71E-02	5.24E-02	-1.472	0.141084
as.factor(year.x)1999:as.factor(target3)7	-5.63E-02	5.19E-02	-1.085	0.278141
as.factor(year.x)2000:as.factor(target3)7	-7.55E-02	5.00E-02	-1.51	0.13101
as.factor(year.x)2001:as.factor(target3)7	5.82E-01	5.12E-02	11.364	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)7	5.00E-01	5.31E-02	9.418	< 2e-16 ***
as.factor(year.x)2003:as.factor(target3)7	1.59E-01	5.37E-02	2.962	0.003061**
as.factor(year.x)2004:as.factor(target3)7	-2.46E-02	5.43E-02	-0.452	0.650965
as.factor(year.x)2005:as.factor(target3)7	9.02E-02	5.54E-02	1.628	0.103566
as.factor(year.x)2006:as.factor(target3)7	3.37E-01	5.62E-02	5.997	2.01E-09***
as.factor(year.x)2007:as.factor(target3)7	2.97E-01	5.52E-02	5.385	7.24E-08***
as.factor(year.x)2008:as.factor(target3)7	1.08E+00	5.83E-02	18.574	< 2e-16 ***

as.factor(year.x)2009:as.factor(target3)7	4.10E-01	5.78E-02	7.094	1.30E-12***
as.factor(year.x)2010:as.factor(target3)7	9.18E-01	6.03E-02	15.233	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)8	-2.74E-01	5.26E-02	-5.214	1.85E-07***
as.factor(year.x)1996:as.factor(target3)8	-2.82E-01	5.19E-02	-5.447	5.13E-08***
as.factor(year.x)1997:as.factor(target3)8	1.03E-01	5.31E-02	1.944	0.051931 .
as.factor(year.x)1998:as.factor(target3)8	-6.56E-02	5.23E-02	-1.255	0.209537
as.factor(year.x)1999:as.factor(target3)8	4.00E-02	5.16E-02	0.775	0.43813
as.factor(year.x)2000:as.factor(target3)8	-3.87E-02	4.99E-02	-0.775	0.4382
as.factor(year.x)2001:as.factor(target3)8	6.30E-01	5.10E-02	12.359	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)8	5.28E-01	5.29E-02	9.989	< 2e-16 ***
as.factor(year.x)2003:as.factor(target3)8	1.91E-01	5.35E-02	3.563	0.000366***
as.factor(year.x)2004:as.factor(target3)8	1.56E-02	5.42E-02	0.288	0.773393
as.factor(year.x)2005:as.factor(target3)8	2.65E-01	5.53E-02	4.784	1.72E-06***
as.factor(year.x)2006:as.factor(target3)8	4.45E-01	5.61E-02	7.938	2.05E-15***
as.factor(year.x)2007:as.factor(target3)8	3.57E-01	5.51E-02	6.483	8.98E-11***
as.factor(year.x)2008:as.factor(target3)8	1.22E+00	5.82E-02	20.913	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)8	5.02E-01	5.75E-02	8.73	< 2e-16 ***
as.factor(year.x)2010:as.factor(target3)8	9.66E-01	6.01E-02	16.086	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)9	-2.93E-01	5.28E-02	-5.555	2.77E-08***
as.factor(year.x)1996:as.factor(target3)9	-2.66E-01	5.19E-02	-5.113	3.18E-07***
as.factor(year.x)1997:as.factor(target3)9	2.07E-01	5.33E-02	3.888	0.000101***
as.factor(year.x)1998:as.factor(target3)9	4.73E-02	5.23E-02	0.905	0.365542
as.factor(year.x)1999:as.factor(target3)9	1.82E-01	5.18E-02	3.507	0.000452***
as.factor(year.x)2000:as.factor(target3)9	1.81E-02	5.00E-02	0.361	0.717745
as.factor(year.x)2001:as.factor(target3)9	6.52E-01	5.11E-02	12.764	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)9	5.71E-01	5.30E-02	10.77	< 2e-16 ***
as.factor(year.x)2003:as.factor(target3)9	2.56E-01	5.37E-02	4.761	1.93E-06***
as.factor(year.x)2004:as.factor(target3)9	7.62E-02	5.44E-02	1.4	0.161548
as.factor(year.x)2005:as.factor(target3)9	4.63E-01	5.56E-02	8.331	< 2e-16 ***
as.factor(year.x)2006:as.factor(target3)9	6.06E-01	5.63E-02	10.771	< 2e-16 ***
as.factor(year.x)2007:as.factor(target3)9	5.05E-01	5.51E-02	9.156	< 2e-16 ***
as.factor(year.x)2008:as.factor(target3)9	1.34E+00	5.83E-02	23.029	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)9	6.85E-01	5.77E-02	11.876	< 2e-16 ***
as.factor(year.x)2010:as.factor(target3)9	1.08E+00	6.02E-02	17.912	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)10	-3.76E-01	5.24E-02	-7.167	7.66E-13***
as.factor(year.x)1996:as.factor(target3)10	-2.59E-01	5.16E-02	-5.016	5.27E-07***
as.factor(year.x)1997:as.factor(target3)10	3.38E-01	5.31E-02	6.364	1.97E-10***
as.factor(year.x)1998:as.factor(target3)10	2.44E-01	5.21E-02	4.673	2.97E-06***
as.factor(year.x)1999:as.factor(target3)10	3.44E-01	5.17E-02	6.645	3.04E-11***
as.factor(year.x)2000:as.factor(target3)10	-1.51E-02	4.98E-02	-0.302	0.762681
as.factor(year.x)2001:as.factor(target3)10	6.40E-01	5.10E-02	12.546	< 2e-16 ***
as.factor(year.x)2002:as.factor(target3)10	6.15E-01	5.28E-02	11.637	< 2e-16 ***
as.factor(year.x)2003:as.factor(target3)10	1.93E-01	5.36E-02	3.608	0.000309***
as.factor(year.x)2004:as.factor(target3)10	1.21E-01	5.44E-02	2.229	0.025835*
as.factor(year.x)2005:as.factor(target3)10	4.64E-01	5.54E-02	8.375	< 2e-16 ***
as.factor(year.x)2006:as.factor(target3)10	6.24E-01	5.62E-02	11.113	< 2e-16 ***
as.factor(year.x)2007:as.factor(target3)10	5.97E-01	5.49E-02	10.874	< 2e-16 ***
as.factor(year.x)2008:as.factor(target3)10	1.43E+00	5.81E-02	24.61	< 2e-16 ***
as.factor(year.x)2009:as.factor(target3)10	8.55E-01	5.76E-02	14.831	< 2e-16 ***
as.factor(year.x)2010:as.factor(target3)10	1.20E+00	6.00E-02	20.061	< 2e-16 ***
as.factor(year.x)1995:as.factor(target3)11	-2.72E-01	7.99E+03	0	0.999973
as.factor(year.x)1996:as.factor(target3)11	-2.97E-01	9.25E+03	0	0.999974
as.factor(year.x)1997:as.factor(target3)11	-1.65E-01	9.60E+03	0	0.999986
as.factor(year.x)1998:as.factor(target3)11	-1.19E-01	9.04E+03	0	0.99999
as.factor(year.x)1999:as.factor(target3)11	-5.23E-01	1.01E+04	0	0.999959
as.factor(year.x)2000:as.factor(target3)11	-7.60E-01	1.05E+04	0	0.999942
as.factor(year.x)2001:as.factor(target3)11	-3.56E-01	1.03E+04	0	0.999972
as.factor(year.x)2002:as.factor(target3)11	-3.34E-01	9.76E+03	0	0.999973
as.factor(year.x)2003:as.factor(target3)11	-8.05E-01	1.08E+04	0	0.999941
as.factor(year.x)2004:as.factor(target3)11	-8.34E-01	9.47E+03	0	0.99993
as.factor(year.x)2005:as.factor(target3)11	-9.61E-01	1.04E+04	0	0.999926
as.factor(year.x)2006:as.factor(target3)11	-7.20E-01	1.25E+04	0	0.999954
as.factor(year.x)2007:as.factor(target3)11	-4.67E-01	9.91E+03	0	0.999962
as.factor(year.x)2008:as.factor(target3)11	2.41E-01	1.47E+04	0	0.999987
as.factor(year.x)2009:as.factor(target3)11	-5.56E-01	2.75E+04	0	0.999984
as.factor(year.x)2010:as.factor(target3)11	-1.21E-01	1.34E+05	0	0.999999
as.factor(qt)2:as.factor(target3)2	-9.85E-02	3.07E-02	-3.213	0.001311**
as.factor(qt)3:as.factor(target3)2	1.71E-01	3.56E-02	4.791	1.66E-06***

```
as.factor(qt)4:as.factor(target3)2          1.31E-01  3.20E-02  4.109      3.97E-05***
as.factor(qt)2:as.factor(target3)3         -9.84E-02  2.99E-02  -3.285     0.001019**
as.factor(qt)3:as.factor(target3)3          2.17E-01  3.42E-02  6.346      2.20E-10***
as.factor(qt)4:as.factor(target3)3          1.90E-01  3.12E-02  6.068      1.29E-09***
as.factor(qt)2:as.factor(target3)4                    -1.35E-01 2.95E-02  -4.556     5.22E-06***
as.factor(qt)3:as.factor(target3)4                    2.55E-01  3.37E-02  7.556      4.15E-14***
as.factor(qt)4:as.factor(target3)4                    1.78E-01  3.15E-02  5.661      1.51E-08***
as.factor(qt)2:as.factor(target3)5                    -1.70E-01 2.94E-02  -5.795     6.82E-09***
as.factor(qt)3:as.factor(target3)5                    2.68E-01  3.34E-02  8.043      8.80E-16***
as.factor(qt)4:as.factor(target3)5                    1.72E-01  3.18E-02  5.409      6.34E-08***
as.factor(qt)2:as.factor(target3)6                    -1.88E-01 2.94E-02  -6.418     1.38E-10***
as.factor(qt)3:as.factor(target3)6                    2.77E-01  3.32E-02  8.36       < 2e-16    ***
as.factor(qt)4:as.factor(target3)6                    1.93E-01  3.28E-02  5.878      4.16E-09***
as.factor(qt)2:as.factor(target3)7                    -1.92E-01 2.96E-02  -6.479     9.26E-11***
as.factor(qt)3:as.factor(target3)7                    3.11E-01  3.33E-02  9.349      < 2e-16    ***
as.factor(qt)4:as.factor(target3)7                    2.12E-01  3.39E-02  6.265      3.73E-10***
as.factor(qt)2:as.factor(target3)8                    -1.96E-01 3.05E-02  -6.422     1.35E-10***
as.factor(qt)3:as.factor(target3)8                    3.34E-01  3.39E-02  9.852      < 2e-16    ***
as.factor(qt)4:as.factor(target3)8                    2.58E-01  3.58E-02  7.189      6.53E-13***
as.factor(qt)2:as.factor(target3)9                    -2.38E-01 3.23E-02  -7.354     1.93E-13***
as.factor(qt)3:as.factor(target3)9                    3.13E-01  3.54E-02  8.84       < 2e-16    ***
as.factor(qt)4:as.factor(target3)9                    2.60E-01  3.87E-02  6.719      1.83E-11***
as.factor(qt)2:as.factor(target3)10        -1.40E-01 3.57E-02  -3.913     9.10E-05***
as.factor(qt)3:as.factor(target3)10         4.65E-01  3.81E-02  12.206     < 2e-16    ***
as.factor(qt)4:as.factor(target3)10         3.66E-01  4.49E-02  8.163      3.28E-16***
as.factor(qt)2:as.factor(target3)11        -1.18E-01 6.15E+03  0          0.999985
as.factor(qt)3:as.factor(target3)11         1.73E-01  6.24E+03  0          0.999978
as.factor(qt)4:as.factor(target3)11         4.48E-02  6.21E+03  0          0.999994
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(2.8318) family taken to be 1)

    Null deviance: 543171  on 105070  degrees of freedom
Residual deviance: 104003  on 104846  degrees of freedom
AIC: 929064

Number of Fisher Scoring iterations: 1


          Theta:  2.8318
      Std. Err.:  0.0136

 2 x log-likelihood:  -928612.4490

Analysis of Deviance Table (Type II tests)

Response: blshrk
                                LR Chisq  Df Pr(>Chisq)
as.factor(year.x)                 15622  16  < 2.2e-16 ***
as.factor(qt)                      446   3  < 2.2e-16 ***
as.factor(area)                   3029   4  < 2.2e-16 ***
as.factor(target3)               321670  10  < 2.2e-16 ***
as.factor(vesseltype)                28   1  1.116e-07 ***
as.factor(year.x):as.factor(target3)     4235 160  < 2.2e-16 ***
as.factor(qt):as.factor(target3)          923  30  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
```

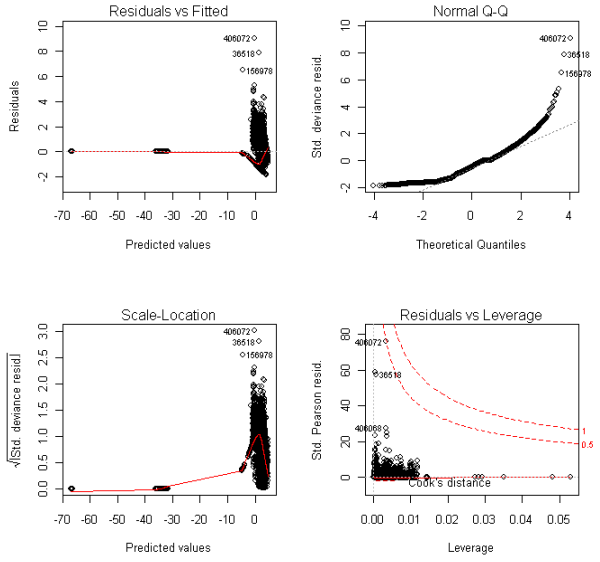


2-1-2a: 9410_Kinkai_deep_Hokkaido&Tohoku

Call:

```
glm.nb(formula = blshrk ~ as.factor(year) + as.factor(qt) + as.factor(area) +
    as.factor(hpbc2) + as.factor(area):as.factor(hpbc2) + as.factor(year):as.factor(hpbc2) +
    offset(log(hook)), data = tdata, init.theta = 0.3162632164,
    link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.8339  -1.0829  -0.4632   0.0000   9.0428

Coefficients: (3 not defined because of singularities)
                                              Estimate Std. Error  z value Pr(>|z|)
(Intercept)                                 -4.669e+00  3.991e-02 -116.968  < 2e-16 ***
as.factor(year)1995                         -3.139e-02  4.492e-02   -0.699  0.48462
as.factor(year)1996                          4.520e-01  4.517e-02   10.006  < 2e-16 ***
as.factor(year)1997                          4.860e-01  5.796e-02    8.385  < 2e-16 ***
as.factor(year)1998                          1.898e-01  7.275e-02    2.609  0.00907 **
as.factor(year)1999                         -9.382e-02  6.960e-02   -1.348  0.17771
as.factor(year)2000                         -1.181e+00  1.141e-01  -10.353  < 2e-16 ***
as.factor(year)2001                         -1.149e+00  1.161e-01   -9.895  < 2e-16 ***
as.factor(year)2002                         -6.800e-01  1.207e-01   -5.635 1.75e-08 ***
as.factor(year)2003                         -8.400e-01  1.312e-01   -6.404 1.52e-10 ***
as.factor(year)2004                          1.633e+00  1.085e-01   15.050  < 2e-16 ***
as.factor(year)2005                         -3.484e+01  1.762e+06    0.000  0.99998
as.factor(year)2006                         -3.560e+01  2.498e+06    0.000  0.99999
as.factor(year)2007                          2.260e+00  1.831e-01   12.342  < 2e-16 ***
as.factor(year)2008                          1.299e+00  2.269e-01    5.726 1.03e-08 ***
as.factor(year)2010                         -3.658e+01  6.247e+06    0.000  1.00000
as.factor(qt)2                              -7.209e-01  4.494e-02  -16.041  < 2e-16 ***
as.factor(qt)3                              -4.537e-01  3.920e-02  -11.572  < 2e-16 ***
as.factor(qt)4                              -7.684e-01  5.211e-02  -14.746  < 2e-16 ***
as.factor(area)2                            -1.212e+00  1.869e-01   -6.486 8.83e-11 ***
as.factor(area)3                            -8.969e-01  4.355e-02  -20.595  < 2e-16 ***
as.factor(area)4                            -3.006e+00  5.414e-02  -55.520  < 2e-16 ***
as.factor(hpbc2)2                           -1.225e+00  1.298e-01   -9.441  < 2e-16 ***
as.factor(area)2:as.factor(hpbc2)2          -3.559e+01  4.749e+06    0.000  0.99999
as.factor(area)3:as.factor(hpbc2)2          -2.484e+00  1.128e-01  -22.024  < 2e-16 ***
as.factor(area)4:as.factor(hpbc2)2          -3.179e+01  4.474e+05    0.000  0.99994
as.factor(year)1995:as.factor(hpbc2)2       -2.278e+00  2.253e-01  -10.110  < 2e-16 ***
as.factor(year)1996:as.factor(hpbc2)2       -3.648e-02  1.747e-01   -0.209  0.83462
as.factor(year)1997:as.factor(hpbc2)2       -3.384e+01  4.405e+05    0.000  0.99994
```

```
as.factor(year)1998:as.factor(hpbc2)2  7.348e-01  1.876e-01    3.917 8.98e-05 ***
as.factor(year)1999:as.factor(hpbc2)2 -3.097e-02  2.104e-01   -0.147  0.88297
as.factor(year)2000:as.factor(hpbc2)2  3.548e+00  2.628e-01   13.501  < 2e-16 ***
as.factor(year)2001:as.factor(hpbc2)2  3.033e+00  2.307e-01   13.149  < 2e-16 ***
as.factor(year)2002:as.factor(hpbc2)2  1.963e+00  2.500e-01    7.850 4.16e-15 ***
as.factor(year)2003:as.factor(hpbc2)2  3.284e+00  2.405e-01   13.654  < 2e-16 ***
as.factor(year)2004:as.factor(hpbc2)2  1.985e-01  2.289e-01    0.867  0.38592
as.factor(year)2005:as.factor(hpbc2)2  3.707e+01  1.762e+06    0.000  0.99998
as.factor(year)2006:as.factor(hpbc2)2  3.818e+01  2.498e+06    0.000  0.99999
as.factor(year)2007:as.factor(hpbc2)2         NA         NA       NA       NA
as.factor(year)2008:as.factor(hpbc2)2         NA         NA       NA       NA
as.factor(year)2010:as.factor(hpbc2)2         NA         NA       NA       NA
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(0.3163) family taken to be 1)

    Null deviance: 27670  on 19378  degrees of freedom
Residual deviance: 16722  on 19341  degrees of freedom
AIC: 97884

Number of Fisher Scoring iterations: 1


          Theta:  0.31626
      Std. Err.:  0.00435

 2 x log-likelihood:  -97806.34900

> Anova(res2)
Analysis of Deviance Table (Type II tests)

Response: blshrk
                              LR Chisq Df Pr(>Chisq)
as.factor(year)                795.6 15  < 2.2e-16 ***
as.factor(qt)                  366.4  3  < 2.2e-16 ***
as.factor(area)               3469.5  3  < 2.2e-16 ***
as.factor(hpbc2)              1045.1  1  < 2.2e-16 ***
as.factor(area):as.factor(hpbc2)   620.5  3  < 2.2e-16 ***
as.factor(year):as.factor(hpbc2)  2020.7 12  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```



2-2-1:9410Enyo_deep

```
Call:
glm.nb(formula = blshrk ~ as.factor(year.x) + as.factor(qt) +
    as.factor(area) + as.factor(hpbc2) + as.factor(fukenc2) +
    offset(log(hook)), data = tdata, link = log, init.theta = 0.06582913322)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-0.8922  -0.6049  -0.5238  -0.4352   5.3646

Coefficients:
                     Estimate Std. Error  z value Pr(>|z|)
(Intercept)          -5.61623    0.05120 -109.696  < 2e-16 ***
as.factor(year.x)1995  0.42805    0.03783   11.317  < 2e-16 ***
as.factor(year.x)1996  0.25964    0.04095    6.341 2.29e-10 ***
as.factor(year.x)1997  0.22924    0.04079    5.621 1.90e-08 ***
as.factor(year.x)1998  0.27427    0.04037    6.794 1.09e-11 ***
as.factor(year.x)1999 -0.11359    0.04006   -2.836  0.00457 **
as.factor(year.x)2000 -0.56129    0.04202  -13.359  < 2e-16 ***
as.factor(year.x)2001 -0.61791    0.04104  -15.056  < 2e-16 ***
as.factor(year.x)2002 -0.94935    0.04202  -22.592  < 2e-16 ***
as.factor(year.x)2003 -0.92844    0.04234  -21.926  < 2e-16 ***
as.factor(year.x)2004 -0.94550    0.04437  -21.309  < 2e-16 ***
as.factor(year.x)2005 -0.60608    0.04509  -13.443  < 2e-16 ***
as.factor(year.x)2006 -0.94081    0.04767  -19.735  < 2e-16 ***
as.factor(year.x)2007 -0.48023    0.05341   -8.992  < 2e-16 ***
as.factor(year.x)2008 -0.49953    0.05499   -9.085  < 2e-16 ***
as.factor(year.x)2009 -0.14740    0.05796   -2.543  0.01099 *
as.factor(year.x)2010  1.05227    0.05702   18.455  < 2e-16 ***
as.factor(qt)2        -0.03412    0.02251   -1.516  0.12952
as.factor(qt)3        -0.12273    0.02444   -5.021 5.13e-07 ***
as.factor(qt)4        -0.34125    0.02688  -12.696  < 2e-16 ***
as.factor(area)2      -1.53645    0.06017  -25.537  < 2e-16 ***
as.factor(area)3      -3.59752    0.04872  -73.847  < 2e-16 ***
as.factor(area)4      -2.13990    0.04544  -47.093  < 2e-16 ***
as.factor(area)5      -2.10372    0.04380  -48.034  < 2e-16 ***
as.factor(hpbc2)2     -0.15863    0.02188   -7.251 4.14e-13 ***
as.factor(fukenc2)2    0.11516    0.01808    6.368 1.92e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Negative Binomial(0.0658) family taken to be 1)

    Null deviance: 110045  on 285973  degrees of freedom
Residual deviance:  97384  on 285948  degrees of freedom
AIC: 435434

Number of Fisher Scoring iterations: 1


              Theta:  0.065829
          Std. Err.:  0.000423

 2 x log-likelihood:  -435380.385000

Analysis of Deviance Table (Type II tests)

Response: blshrk
                 LR Chisq Df Pr(>Chisq)
as.factor(year.x)    4395.9 16  < 2.2e-16 ***
as.factor(qt)         193.2  3  < 2.2e-16 ***
as.factor(area)      7475.4  4  < 2.2e-16 ***
as.factor(hpbc2)       46.8  1  7.962e-12 ***
as.factor(fukenc2)     41.7  1  1.065e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```