NEW ENGLAND FISHERY MANAGEMENT COUNCIL

Framework 2 to the Herring FMP

and

2013-2015 Atlantic Herring Fishery Specifications

APPENDIX I:

September 2012 SSC Report: Herring ABC for FY 2013-2015

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New England Fishery Management Council
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C. M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

To: Paul J. Howard, Executive Director
From: Scientific and Statistical Committee
Date: 21 September 2012

Subject: Herring ABC for FY2013-2015

The Scientific and Statistical Committee (SSC) met on September 12, 2012 to address herring catch recommendations.

The SSC was asked to:

1. Review the available information provided by the Herring Plan Development Team (PDT) and develop recommendations regarding the specification of acceptable biological catch (ABC) for the 2013-2015 fishing years, as well as an ABC control rule.

In order to meet these terms of reference, the SSC considered the following:

1. 54th Northeast Regional Stock Assessment Workshop Assessment Summary Report
2. 54th Northeast Regional Stock Assessment Workshop Report
3. Panelist reports (Francis, Hall, Klaer, and summary by O'Boyle) from SARC 54
4. Presentation from lead analyst on Atlantic herring stock assessment
5. Presentation from Herring Plan Development Team

The SSC reviewed material provided by the herring PDT regarding two alternative ABC control rules for use in setting the ABC for FY2013-2015. The presentations by Jon Deroba and Lori Steele as well as the herring PDT report were clear and concise, facilitating the catch advice discussion. One control rule applied 75%Fmsy in all three projection years, while the other found the constant catch over the three projection years which had at most a 50% chance of overfishing in any of the three years. In this particular situation, these two control rules resulted in a total catch over the three years which is approximately the same (320 vs 342 thousand metric tons). There is a higher risk of overfishing in the first year associated with the 75%Fmsy control rule and a higher risk of overfishing in the second and third years associated with the constant catch control rule. The SSC could not find any scientific reason to prefer one of these control rules over the other and considered them to be comparable in terms of risk of overfishing, given the information available. The SSC notes that it is not appropriate to "mix and match" the ABC values from the two control rules, meaning that the FY2013-2015 ABC cannot be set as 130, 114, and 114 thousand metric tons, respectively. Instead, the Council should pick the control rule that they feel is most appropriate for the fishery and then use the three ABC values associated with that control rule as they set management regulations.

The SSC considered a number of characteristics of the fishery and stock assessment before arriving at this decision regarding the control rule for the next three years. The stock assessment made a major advance by considering the change in natural mortality needed to both reduce the retrospective pattern in the assessment and to more closely match the estimates of consumption by fish and marine mammals. The change in natural mortality rate combined with the estimation of a stock recruitment relationship in the assessment led to a fishing mortality reference point that is approximately half of the current natural mortality rate. The current estimated stock size is well above the biomass reference point and there are indications of a strong year class entering the fishery. All these factors lead the SSC to conclude that either control rule can be applied for the next three years with low probability of overfishing or causing the stock to become overfished.

While not an explicit term of reference, the SSC did discuss the role of herring in the ecosystem and options for setting ecosystem-based ABCs, as requested in the letter from Regional Administrator John Bullard to Council Chair Rip Cunningham. As a forage fish, concern was expressed that standard fishery reference points may not be appropriate. The SSC notes that both control rules for the next three years would result in fishing mortality rates well below the natural mortality rate and a stock size that is well above the standard biomass target, thereby likely meeting ecosystem-based biomass targets for a forage species by default if not by design.

However, the SSC requests guidance from the Council as to how it would like to see this stock managed, i.e., as a typical fishery with MSY-based reference points, or at a reduced fishing rate and higher stock size to account for its role in the ecosystem. This would ensure that the next time herring are assessed, a control rule could be created which meets the needs of the Council. A control rule which could be set for more than three years would need to consider a wide range of possible stock conditions and have a known objective. For example, the constant catch control rule for the next three years is acceptable because of the reduction in catch in the first year relative to the 75%Fmsy control rule. It is not clear whether a constant catch control rule which had larger initial catch than the 75%Fmsy control rule would be acceptable. Furthermore, the constant catch of 114 thousand metric tons for the next three years is not expected to be continued in perpetuity. Rather a new constant catch value would have to be estimated for the next set of forecast years, especially as the strong 2008 year class moves out of the population. One option that could be considered in a more complete control rule would be the use of indicators during the three years that could provide feedback regarding the performance of the control rule, and possibly indicate the need to re-evaluate the ABC for the second or third year.

The SSC recommends the use of either the 75%Fmsy or the Constant Catch control rule for herring for the next three years. The overfishing limit (OFL) and acceptable biological catch (ABC) in units of thousand metric tons for FY2013-2015 under the two separate control rules are:

Control Rule	Catch	2013	2014	2015
75%Fmsy	OFL	169	127	104
	ABC	130	102	88
Constant Catch	OFL	169	136	114
	ABC	114	114	114

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APPENDIX II:

December 2012 SSC Report: Herring ABC Control Rule Alternatives

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New England Fishery Management Council
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C. M. "Rip" Cunningham, Jr., *Chairman* | Paul J. Howard, *Executive Director*

To: Paul J. Howard, Executive Director
From: Scientific and Statistical Committee
Date: December 10, 2012

Subject: Herring ABC Control Rule Alternatives

The Scientific and Statistical Committee (SSC) met on November 19, 2012 to address herring acceptable biological catch (ABC) control rule alternatives for forage species.

The SSC was asked to:

2. Evaluate the ABC control rule alternatives suggested in the October 8, 2012 correspondence from Earth Justice (attachment) relative to the two alternatives previously endorsed by the SSC for the 2013-2015 herring fishery specifications (75% FMSY and Constant Catch). The two alternatives proposed by Earth Justice are: (1) the control rule based on the Lenfest Forage Fish Task Force Report and (2) a harvest control strategy for forage fish modeled after the Pacific Fishery Management Council's approach for Coastal Pelagic Species.

In order to meet these terms of reference, the SSC considered the following:

6. October 8, 2012 Correspondence from EarthJustice re. Atlantic Herring Fishery Specifications for FY 2013-2015
7. October 18, 2012 Herring PDT Report
8. Draft Discussion Document: 2013-2015 Atlantic Herring Fishery Specifications
9. September 2012 Scientific and Statistical Committee (SSC) Report (Herring)
10. November 7, 2012 Draft Herring Committee Meeting Summary
11. SAW 54 Assessment Summary Report (July 2012)
12. Presentation from Herring Plan Development Team

The SSC considered two different aspects relative to the terms of reference for this topic: 1) the short term catch advice, meaning the 2013-2015 specifications, and 2) development of long term control rules to address the issue of whether the increased natural mortality rate (M) in the assessment fully captured all the ecosystem needs (including humans) related to forage species. Regarding the short term catch advice, it is difficult to address the Pacific control rule because the specific values of the cutoff, buffer, and fraction have not been specified for Atlantic herring. The SSC considered that the previous catch advice we recommended is probably higher than the catch recommended by this control rule, but that the spawning stock biomass expected in 2015 under either of our previous recommendations is well above the targeted 40% unfished amount. Similarly, the two current ABC recommendations are broadly consistent with the biomass aspect of the LenFest control rule (75% unfished) at currently estimated stock sizes and associated reference points. Thus, **the SSC concluded that the previous ABC recommendations are broadly consistent with the intent of the two new control rules suggested by Earth Justice in terms of the 2013-2015 specifications.** Broad consistency between the SSC's recommendation and the control rule options suggested by Earth Justice should not necessarily be interpreted as an endorsement of Earth Justice's suggestions. As discussed below, more analysis is needed.

Regarding the development of long term control rules, the SSC could not address this issue at this meeting due to a lack of information to evaluate the performance such rules. A number of issues were discussed relative to this topic which would need to be considered when conducting the analyses. For example, multispecies predator-prey models could be used to directly evaluate the trade-offs between catch of a forage species and its ability to provide nutrition to predators targeted by other fisheries. Indicators could be determined for when herring are not meeting their role of forage in the ecosystem. The logical problems of basing catch advice on maximum sustainable yield from a single species model when the species is being modeled as having a changing natural mortality rate due to changes in consumption would need to be addressed. There are possible unintended consequences relative to treating forage species differently than other managed species, such as the potential for a large population of herring to compete directly with whales for food or to eat the eggs of groundfish. Given all these considerations, the SSC agrees with the Plan Development Team that more analysis is needed before long term control rules can be implemented for this species. **The SSC recommends that control rules for forage species should be part of a broader national workshop that involves the community that advises the Council system.**

While the control rules suggested by Earth Justice could not be evaluated at this meeting, it was noted that the Pacific control rule had a feature that should be avoided in any control rule: a step function where a small change in biomass made a large and sudden change in the acceptable catch. Instead, a ramped change in catch as biomass changes would be more appropriate from both a biological and management perspective.

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APPENDIX III:

Simulating Removals of the Inshore Component for the Herring Fishery for Years 2013-2015 Using the Herring PDT's Sub-ACL Analysis

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Sub-ACL Analysis: Simulating Removals from the Inshore and Offshore Components of the Atlantic Herring Stock Under the 2013-2015 Herring Specification Management Options for Fishing Years 2013-2015 (Herring PDT, January 2013)

Prepared for the Atlantic Herring PDT

by

Steven Correia

Massachusetts Division of Marine Fisheries

February 13, 2013

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Simulations were used to assess the potential removals from the inshore and offshore components of the Atlantic herring stock for six management options described in FW2 and the Proposed 2013-2015 Atlantic herring specifications and those same options combined with seasonal sub-ACLs by management area.

The NEFMC's SSC committee recommended two approaches for setting ABC for fishing years 2013-2015:

A constant catch approach for each year (Table 1) and ABC based on F=75% F_{MSY}. Note that the buffer between ABC and OFL declines from 2013 to 2015 and no buffer exists between OFL and ABC in 2015.

Table 1 Alternative 2 (*Preferred Alternative*) – Proposed OFL and ABC Specifications (mt) for 2013-2015 YEAR

	2013	**2014**	**2015**
OFL (mt)	169,000	136,000	114,000
ABC (mt)	114,000	114,000	114,000
Buffer (mt)	54,000	22,000	0

**Note that a small buffer exists between ACL and ABC.*

The distribution of sub-area ACL by options is shown in Table 2. Each option also has *seasonal Sub-ACL Splits (2014-2015):* If provisions to allow for sub-ACL splitting are adopted in Framework 2, then the following seasonal splits may apply to this option for 2014 and 2015:

- Area 1A: 0% January-May; 100% June-December (authorized under Framework 1);
- Area 1B: 0% January-April; 100% May-December
- Area 2: 67% January-February; 33% March-December

The AMs that apply to the sub-ACLs would also apply to the seasonal sub-ACLs (i.e., closure of directed fishery at 95% or other threshold). For Area 2, any un-utilized sub-ACL from the first season (January-February) would be carried over to the second season (March-December) to allow for full utilization during the fishing year.

Table 2 Distribution of Sub-Area ACL (mt) by Management Options.

	Area 1A	**Area 1B**	**Area 2**	**Area 3**
Option 1: (2013-2015)	26,546	4,362	22,146	38,146
Option 2: (2013-2015)	31,200	5,400	25,900	45,300
Option 3: (2013-2015)	32,100	9,900	27,800	38,000
Option 4 (2013-2015)	32,000	5,800	32,000	38,000
Option 5 (2013)	32,000	10,800	27,000	38,000
Option 5(2014-2015)	32,000	5,800	32,000	38,000
Option 6 (2013:2015)	40,000	5,800	32,000	30,000
Preferred alternative	31,200	4,600	30,000	42,000

The simulation methodology is similar to the approach used in previous herring sub-ACL analyses. However, several elements of the input data has been updated to reflect more recent information.

Population mixing rate

In the simulations conducted in previous years, the population mixing rate was drawn from a triangular distribution (0.10 (acoustic survey), 0.13 (morphometric study numbers) and 0.30 (distribution of survey biomass). The 2006 TRAC assessment recommended these values. An update of time series of spatial distribution of the fall NEFSC survey biomass suggested that mixing rates were more variable than used in previous analyses.

Updated survey information was provided by Jonathan Deroba (NEFSC). His methodology is described below:

Herring management Area 1 was approximated using NEFSC survey strata 26-28 and 33-40. Herring management Area 2 was approximated using NEFSC survey strata 1-12 and 61-76. Herring management Area 3 was approximated using NEFSC survey strata 13-25, 29, and 30-32.
Some of the survey strata in some areas are partially or entirely across the Hague Line and in Canadian waters. These survey strata were included in the approximations of the herring management areas because the goal of this analysis was to inform decisions about the relative contributions of various subcomponents to the total herring complex. The herring management areas, however, were partially determined using biologically meaningless political boundaries (e.g., the Hague Line), and so these boundaries were not strictly applied.

The proportion of biomass in survey strata sets corresponding to management areas is shown in **Table 3**. The PDT recommended using a draw from a uniform distribution (0.10 and 0.90). This results in an average proportion inshore stock of 0.5, close to the 2002-2011 observed average, and covers the range of proportions in Area 1 (0.18 to 0.86). The population mixing rate is used to split the total stock biomass into inshore and offshore components and also to allocate catches to offshore and inshore. The proportions are month and area specific.

Table 3 Proportion of Total Minimum Area Swept Survey Biomass by Management Area (2000-2011)

	Proportion Biomass in Survey Strata-Sets		
Year	**Area 1**	**Area 2**	**Area 3**
2000	0.64	0	0.36
2001	0.29	0	0.71
2002	0.71	0	0.29
2003	0.37	0	0.63
2004	0.18	0.01	0.81
2005	0.53	0	0.47
2006	0.69	0	0.31
2007	0.44	0	0.56
2008	0.40	0	0.6
2009	0.31	0.03	0.66
2010	0.47	0.02	0.51
2011	0.86	0	0.14
Avg. 1963-2011	0.48	0.04	0.48
Avg. 2002-2011	0.49	0.01	0.5
Avg. 2007-2011	0.49	0.01	0.5

**The proportion of total biomass in Area 1 strata-set is considered inshore biomass component. The proportion of biomass in Area 3 is considered offshore biomass component.*
Source: NEFSC

Summer mixing rate

The summer mixing rate remains a random draw from a uniform distribution over the interval 0.2 to 0.8. It is only used for allocating catch to inshore and offshore components. The summer mixing rate only applies to catches from area 1A during the months of April through July.

Proportion of Catch by Month for Management Areas

The PDT updated the proportion of catches by month by sub-area using VTR reports. Preliminary work indicated that proportions were over-dispersed when compared to expected values from a multinomial distribution. Resampling from a multinomial distribution did not adequately reproduce the variability seen in the data. The model simulated a proportion of catches by month by resampling years from the 2000-2011 period (see Tables 11-13, bottom panels). The monthly proportion of catches for all management areas in the year selected were applied to all management areas.

The proposed 2013-2015 herring specifications also consider seasonal sub-ACLs. This would alter the monthly distribution of catch by management area. A "synthetic proportion" of catch by area and month to reflect the seasonal sub-ACL, was constructed (see Tables 11-13, top panels). For example, January and February were set to contain 50% of Area 2 catch. Catches for January and February were distributed based on observed proportion of catches in individual months (January or February) compared with total January-February catches in Area 2. Proportions for catches for March-December were constructed by estimating the proportions of catches for each of those months compared to total March-December catches. The proportions were adjusted so that only 50% of the total catches occurred during the period and that the total proportions of monthly catches summed to 1 for the year. The model simulated a proportion of catches by month by resampling years from the 2000-2011 period from the synthetic proportions tables. The monthly proportions of catches for all areas for the year selected are applied to all areas.

The mixing rates are applied to monthly catch by area and catches are assigned to either the inshore or offshore components. The monthly catch by components are summed to get total removals by components (**Table 4**).

Table 4 Percentage of catch coming from the inshore stock component by month and management area

	Management Area			
Month	**Area 1A**	**Area 1B**	**Area 2**	**Area 3**
Jan	100%	pop mix	pop mix	0%
Feb	100%	pop mix	pop mix	0%
Mar	100%	pop mix	pop mix	0%
April	SM	pop mix	0%	0%
May	SM	pop mix	0%	0%
June	SM	pop mix	0%	0%
July	SM	pop mix	0%	0%
August	100%	pop mix	pop mix	0%
Sept	100%	pop mix	pop mix	0%
Oct	100%	pop mix	pop mix	0%
Nov	100%	pop mix	pop mix	0%
Dec	100%	pop mix	pop mix	0%

**Pop mix is the population mixing rate drawn from a uniform distribution over the interval 0.1 to 0.9, inclusive. SM is summer mixing rate drawn from a uniform distribution over the interval 0.2 to 0.8, inclusive.*

New Brunswick catches

The Herring PDT updated the New Brunswick catches. As in the previous analysis, the Herring PDT used a random draw from the New Brunswick catch series (2002-2011). The New Brunswick catch does not exhibit a statistically significant trend during the 1995-2011 period as tested with linear regression (P=0.12), Kendall non-parametric correlation (p= 0.29) or runs tests (0.18). The Herring PDT used a random draw of catches covering the 2002 to 2011 period. All New Brunswick catches are assigned as removals from the inshore catch component (**Table 5**).

Table 5 New Brunswick Catches (mt) from 2002 to 2011

Year	Catch (mt)
2002	20210
2003	11874
2004	9008
2005	20685
2006	13055
2007	12863
2008	30944
2009	6448
2010	4031
2011	10958

**Time series 2002-2011 mean is 14,008 mt with a CV of 57%.*

Target catch-biomass ratio

The Target catch: biomass ratio was determined using OFL: projected January 1 biomass. This ratio should approximate a target exploitation rate comparable to fishing at F_{MSY} (**Table 6**)

Table 6 OFL-Projected January 1 Biomass and Ratio of OFL to January 1 Biomass

Year	OFL mt	Jan 1 Biomass mt	Target Ratio OFL:Biomass
2013	169,000	1,224,000	0.138
2014	136,000	1,079,000	0.126
2015	114,000	954,377	0.119

OFL-projected January 1 biomass and ratio of OFL to January 1 biomass. Projected January 1 biomass under constant catch 114,000 mt.
Source: NEFSC

Catch: biomass ratio is calculated for simulated component catch over simulated component biomass. The proportion of total simulations with ratios above the target ratio is the probability of exceeding the target ratio for a sub-component.

Results

Summary statistics for the distribution of catch: biomass ratio for various options are provided in Tables 7-10. Two particular features are of importance:

1) The fraction of simulations with ratios greater than the target ratio (column labeled P> target). This is a measure of the probability of exceeding the target ratio exploitation for the inshore or offshore components. These values should be compared across options.

2) The ratio of maximum ratio to target ratio (column labeled max:target). This is a measure of distribution tail length and provides a measure of potential impacts of having a rare event. The larger this ratio becomes, the higher the likelihood of having a large impact (although the probability of the event may be low). These values should be compared across options.

Conclusions

Year effects appear to have more influence for determining risk than the options (with or without sub-ACL). This occurs because a substantial buffer exists between OFL and ABC in 2013 and 2014, but no buffer between OFL and ABC exists in 2015. The influence of year effects appear to be true whether P> target ratio or maximum:target ratio are used to compare options.

Table 7 Summary statistics for the distribution of ratio of simulated inshore catch to simulated inshore biomass for options without seasonal sub-ACLs

Inshore catch : Inshore Biomass without Seasonal ACL

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Target ratio	P> target	max: target ratio
Option 1, 2013	0.04	0.06	0.08	0.10	0.12	0.49	0.14	0.18	3.5
Option 1, 2014	0.05	0.07	0.09	0.11	0.13	0.53	0.13	0.28	4.2
Option 1, 2015	0.05	0.08	0.10	0.13	0.15	0.60	0.12	0.38	5.0
Option 2, 2013	0.04	0.07	0.09	0.11	0.13	0.51	0.14	0.24	3.7
Option 2, 2014	0.05	0.08	0.10	0.13	0.15	0.57	0.13	0.33	4.5
Option 2, 2015	0.06	0.09	0.11	0.14	0.17	0.63	0.12	0.36	5.2
Option 3, 2013	0.05	0.08	0.10	0.12	0.14	0.50	0.14	0.25	3.6
Option 3, 2014	0.06	0.09	0.11	0.14	0.16	0.56	0.13	0.38	4.5
Option 3, 2015	0.07	0.10	0.12	0.15	0.18	0.65	0.12	0.52	5.5
Option 4, 2013	0.05	0.08	0.09	0.12	0.14	0.53	0.14	0.25	3.8
Option 4, 2014	0.06	0.09	0.11	0.14	0.16	0.60	0.13	0.38	4.8
Option 4, 2015	0.07	0.10	0.12	0.15	0.18	0.66	0.12	0.52	5.5
Option 5, 2013	0.05	0.08	0.10	0.12	0.14	0.51	0.14	0.26	3.7
Option 5, 2014	0.06	0.09	0.11	0.13	0.15	0.59	0.13	0.37	4.7
Option 5, 2015	0.07	0.10	0.12	0.15	0.18	0.68	0.12	0.52	5.7
Option 6, 2013	0.06	0.08	0.11	0.13	0.15	0.56	0.14	0.31	4.1
Option 6, 2014	0.06	0.09	0.12	0.15	0.18	0.63	0.13	0.45	5.0
Option 6, 2015	0.07	0.11	0.14	0.17	0.20	0.75	0.12	0.63	6.3

P> target are the number of simulations with a ratio greater than target ratio. The max to target ratio the ratio of the maximum ratio to target ratio (a measure of tail length of the distribution). Highlighted cells are options where the fraction of simulations with observed ratios greater than target ratio exceeds 50%.

Table 8 Summary statistics for the distribution of ratio of simulated offshore catch to simulated offshore biomass for options without seasonal sub-ACLs

Offshore catch: Offshore biomass ratio without seasonal sub-ACLs

	Min	**1st Quartile**	**Median**	**Mean**	**3rd Quartile**	**Max.**	**target**	**P> target**	**max: target ratio**
Option 1, 2013	0.06	0.07	0.09	0.12	0.14	0.42	0.14	0.27	3.1
Option 1, 2014	0.06	0.08	0.11	0.14	0.16	0.47	0.13	0.37	3.7
Option 1, 2015	0.07	0.09	0.12	0.15	0.18	0.55	0.12	0.50	4.6
Option 2, 2013	0.07	0.08	0.11	0.14	0.17	0.49	0.14	0.34	3.6
Option 2, 2014	0.08	0.10	0.13	0.16	0.19	0.57	0.13	0.50	4.5
Option 2, 2015	0.09	0.11	0.14	0.18	0.22	0.64	0.12	0.52	5.3
Option 3, 2013	0.07	0.08	0.10	0.13	0.15	0.45	0.14	0.30	3.3
Option 3, 2014	0.07	0.09	0.12	0.15	0.17	0.52	0.13	0.44	4.1
Option 3, 2015	0.08	0.11	0.13	0.17	0.20	0.59	0.12	0.60	4.9
Option 4, 2013	0.07	0.08	0.10	0.13	0.15	0.46	0.14	0.31	3.3
Option 4, 2014	0.07	0.09	0.12	0.15	0.17	0.51	0.13	0.44	4.1
Option 4, 2015	0.09	0.11	0.13	0.17	0.20	0.59	0.12	0.61	4.9
Option 5, 2013	0.07	0.08	0.10	0.13	0.15	0.45	0.14	0.30	3.3
Option 5, 2014	0.08	0.09	0.12	0.15	0.18	0.51	0.13	0.45	4.0
Option 5, 2015	0.08	0.11	0.13	0.17	0.20	0.58	0.12	0.61	4.8
Option 6, 2013	0.06	0.08	0.09	0.12	0.14	0.40	0.14	0.25	2.9
Option 6, 2014	0.07	0.09	0.11	0.13	0.16	0.47	0.13	0.37	3.7
Option 6, 2015	0.08	0.10	0.12	0.15	0.17	0.53	0.12	0.50	4.4

P> target are the number of simulations with a ratio greater than target ratio. The max to target ratio the ratio of the maximum ratio to target ratio (a measure of tail length). Highlighted cells are options where the fraction of simulations with observed ratios greater than target ratio exceeds 50%.

Table 9 Summary statistics for the distribution of ratio of simulated inshore catch to simulated inshore biomass for options with seasonal sub-ACLs

inshore catch over inshore biomass ratio for options with seasonal sub ACL's

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	target exploitation	P>r1	max: target ratio
Option 1, 2013	0.04	0.06	0.08	0.10	0.12	0.48	0.14	0.19	3.4
Option 1, 2014	0.04	0.07	0.09	0.12	0.14	0.53	0.13	0.28	4.1
Option 1, 2015	0.05	0.08	0.10	0.13	0.15	0.61	0.12	0.38	5.1
Option 2, 2013	0.05	0.07	0.09	0.11	0.13	0.51	0.14	0.23	3.7
Option 2, 2014	0.05	0.08	0.10	0.13	0.15	0.58	0.13	0.35	4.4
Option 2, 2015	0.09	0.11	0.14	0.18	0.21	0.63	0.12	0.65	5.2
Option 3, 2013	0.05	0.08	0.10	0.12	0.14	0.53	0.14	0.27	3.8
Option 3, 2014	0.06	0.09	0.11	0.14	0.16	0.57	0.13	0.39	4.4
Option 3, 2015	0.07	0.10	0.12	0.16	0.18	0.65	0.12	0.53	5.4
Option 4, 2013	0.05	0.08	0.10	0.12	0.14	0.52	0.14	0.26	3.7
Option 4, 2014	0.06	0.09	0.11	0.14	0.16	0.61	0.13	0.38	4.7
Option 4, 2015	0.07	0.10	0.12	0.16	0.18	0.67	0.12	0.53	5.6
Option 5, 2013	0.05	0.08	0.10	0.12	0.14	0.53	0.14	0.26	3.9
Option 5, 2014	0.06	0.09	0.11	0.14	0.16	0.57	0.13	0.38	4.6
Option 5, 2015	0.07	0.10	0.12	0.15	0.18	0.66	0.12	0.52	5.5
Option 6, 2013	0.06	0.08	0.11	0.14	0.16	0.58	0.14	0.33	4.2
Option 6, 2014	0.06	0.10	0.12	0.15	0.18	0.63	0.13	0.47	5.0
Option 6, 2015	0.07	0.11	0.14	0.17	0.20	0.75	0.12	0.63	6.3
Preferred alt. 2013	0.05	0.07	0.09	0.12	0.14	0.52	0.14	0.24	3.8
Preferred alt. 2014	0.06	0.08	0.10	0.13	0.15	0.57	0.13	0.36	4.6
Preferred alt. 2015	0.06	0.09	0.12	0.15	0.17	0.63	0.12	0.49	5.3

P> target are the number of simulations with a ratio greater than target ratio. The max to target ratio the ratio of the maximum ratio to target ratio (a measure of tail length). Highlighted cells are options where the fraction of simulations with observed ratios greater than target ratio exceeds 50%.

Table 10 Summary statistics for the distribution of ratio of simulated offshore catch to simulated offshore biomass for options with seasonal sub-ACLs

offshore catch over offshore biomass ratio with seasonal sub-ACL's.

	Min.	1st Quartile	Median	Mean	3rd Quartile	Max.	target exploitation	P>r1	max: target ratio
Option 1, 2013	0.06	0.07	0.09	0.12	0.14	0.42	0.14	0.26	3.0
Option 1, 2014	0.06	0.08	0.11	0.14	0.16	0.48	0.13	0.37	3.7
Option 1, 2015	0.07	0.09	0.12	0.15	0.18	0.53	0.12	0.49	4.4
Option 2, 2013	0.07	0.09	0.11	0.14	0.17	0.48	0.14	0.34	3.5
Option 2, 2014	0.08	0.10	0.12	0.16	0.19	0.55	0.13	0.49	4.2
Option 2, 2015	0.09	0.11	0.14	0.18	0.21	0.63	0.12	0.65	5.2
Option 3, 2013	0.07	0.08	0.10	0.13	0.15	0.45	0.14	0.29	3.2
Option 3, 2014	0.07	0.09	0.12	0.15	0.17	0.50	0.13	0.44	3.9
Option 3, 2015	0.08	0.10	0.13	0.17	0.19	0.56	0.12	0.60	4.7
Option 4, 2013	0.07	0.08	0.10	0.13	0.15	0.45	0.14	0.30	3.2
Option 4, 2014	0.07	0.09	0.12	0.15	0.17	0.52	0.13	0.45	4.0
Option 4, 2015	0.08	0.10	0.13	0.17	0.20	0.60	0.12	0.59	5.0
Option 5, 2013	0.07	0.08	0.10	0.13	0.15	0.44	0.14	0.30	3.2
Option 5, 2014	0.07	0.09	0.12	0.15	0.17	0.53	0.13	0.43	4.2
Option 5, 2015	0.08	0.11	0.13	0.17	0.20	0.58	0.12	0.60	4.9
Option 6, 2013	0.06	0.07	0.09	0.12	0.14	0.40	0.14	0.25	2.9
Option 6, 2014	0.07	0.08	0.10	0.13	0.15	0.47	0.13	0.35	3.7
Option 6, 2015	0.08	0.10	0.12	0.15	0.17	0.50	0.12	0.49	4.2
Preferred alt. 2013	0.07	0.08	0.11	0.14	0.16	0.47	0.14	0.32	3.4
Preferred alt. 2014	0.08	0.10	0.12	0.16	0.18	0.53	0.13	0.47	4.2
Preferred alt. 2015	0.09	0.11	0.14	0.18	0.21	0.60	0.13	0.63	5.0

P> target are the number of simulations with a ratio greater than target ratio. The max to target ratio the ratio of the maximum ratio to target ratio (a measure of tail length). Highlighted cells are options where the fraction of simulations with observed ratios greater than target ratio exceeds 50%.

Table 11 Monthly proportion of VTR catches for Area 1A (Synthetic and Observed). Synthetic proportions are the proportions used to evaluate seasonal sub-ACL splits.

		Area 1A Synthetic Proportion of Catches by Month										
Month	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year 2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.19	0.21	0.18	0.18	0.19	0.13	0.15	0.08	0.09	0.11	0.04	0.06
7	0.29	0.2	0.25	0.11	0.19	0.16	0.27	0.17	0.22	0.22	0.03	0.14
8	0.24	0.18	0.14	0.23	0.16	0.12	0.29	0.24	0.29	0.13	0.08	0.19
9	0.09	0.12	0.15	0.23	0.14	0.2	0.12	0.22	0.02	0.04	0.1	0.12
10	0.18	0.22	0.11	0.13	0.16	0.2	0.15	0.28	0.19	0.14	0.38	0.49
11	0.01	0.07	0.17	0.13	0.15	0.19	0.01	0.00	0.18	0.35	0.35	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00

		Area 1A Observed Proportion Catches by Month										
Mont h	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year 2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
3	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
4	0.03	0.05	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.12	0.12	0.00	0.07	0.09	0.10	0.13	0.15	0.00	0.01	0.01	0.00
6	0.16	0.16	0.16	0.16	0.17	0.12	0.13	0.07	0.09	0.11	0.04	0.06
7	0.25	0.15	0.22	0.10	0.17	0.15	0.23	0.14	0.22	0.22	0.03	0.14
8	0.20	0.14	0.12	0.21	0.15	0.11	0.26	0.19	0.29	0.13	0.08	0.19
9	0.08	0.09	0.13	0.21	0.13	0.18	0.11	0.18	0.02	0.04	0.10	0.12
10	0.15	0.17	0.10	0.12	0.14	0.18	0.13	0.23	0.20	0.13	0.38	0.49
11	0.01	0.05	0.15	0.12	0.14	0.17	0.01	0.00	0.18	0.35	0.35	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00

Source: ME DNR

Table 12 Monthly proportion of VTR catches for Area 1B (Synthetic and Observed). Synthetic proportions are the proportions used to evaluate seasonal sub-ACL splits.

		Area 1B Synthetic Proportion of Catches by Month										
Month	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year 2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.02	0.01	0.30	0.00	0.00	0.08	0.16	0.05	0.41	0.77	0.28	0.24
6	0.04	0.02	0.07	0.06	0.00	0.01	0.01	0.18	0.22	0.00	0.00	0.06
7	0.09	0.00	0.20	0.09	0.02	0.08	0.10	0.08	0.08	0.00	0.07	0.00
8	0.01	0.02	0.03	0.09	0.00	0.00	0.00	0.06	0.07	0.02	0.22	0.00
9	0.03	0.17	0.05	0.00	0.04	0.00	0.11	0.02	0.00	0.15	0.33	0.70
10	0.00	0.05	0.01	0.00	0.08	0.36	0.23	0.05	0.00	0.03	0.11	0.00
11	0.81	0.32	0.00	0.42	0.62	0.39	0.28	0.07	0.03	0.03	0.00	0.00
12	0.00	0.41	0.33	0.35	0.23	0.08	0.12	0.48	0.20	0.00	0.00	0.00

		Area 1B Observed Proportions of Catches by Month										
Month	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year .2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.00	0.01	0.03	0.00	0.25	0.00	0.00	0.05	0.00	0.00	0.00	0.11
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
3	0.00	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.01	0.00	0.01	0.00	0.00	0.03	0.00	0.07	0.00	0.06	0.15
5	0.02	0.01	0.28	0.00	0.00	0.08	0.15	0.04	0.38	0.77	0.26	0.18
6	0.04	0.02	0.06	0.06	0.00	0.01	0.01	0.15	0.20	0.00	0.00	0.04
7	0.09	0.00	0.19	0.09	0.02	0.08	0.10	0.07	0.07	0.00	0.06	0.00
8	0.01	0.02	0.03	0.09	0.00	0.00	0.00	0.05	0.06	0.02	0.21	0.00
9	0.03	0.17	0.05	0.00	0.03	0.00	0.11	0.02	0.00	0.15	0.31	0.52
10	0.00	0.05	0.01	0.00	0.06	0.36	0.22	0.04	0.00	0.03	0.10	0.00
11	0.81	0.32	0.00	0.41	0.47	0.39	0.28	0.06	0.02	0.03	0.00	0.00
12	0.00	0.40	0.31	0.35	0.17	0.08	0.12	0.40	0.19	0.00	0.00	0.00

Source: ME DNR

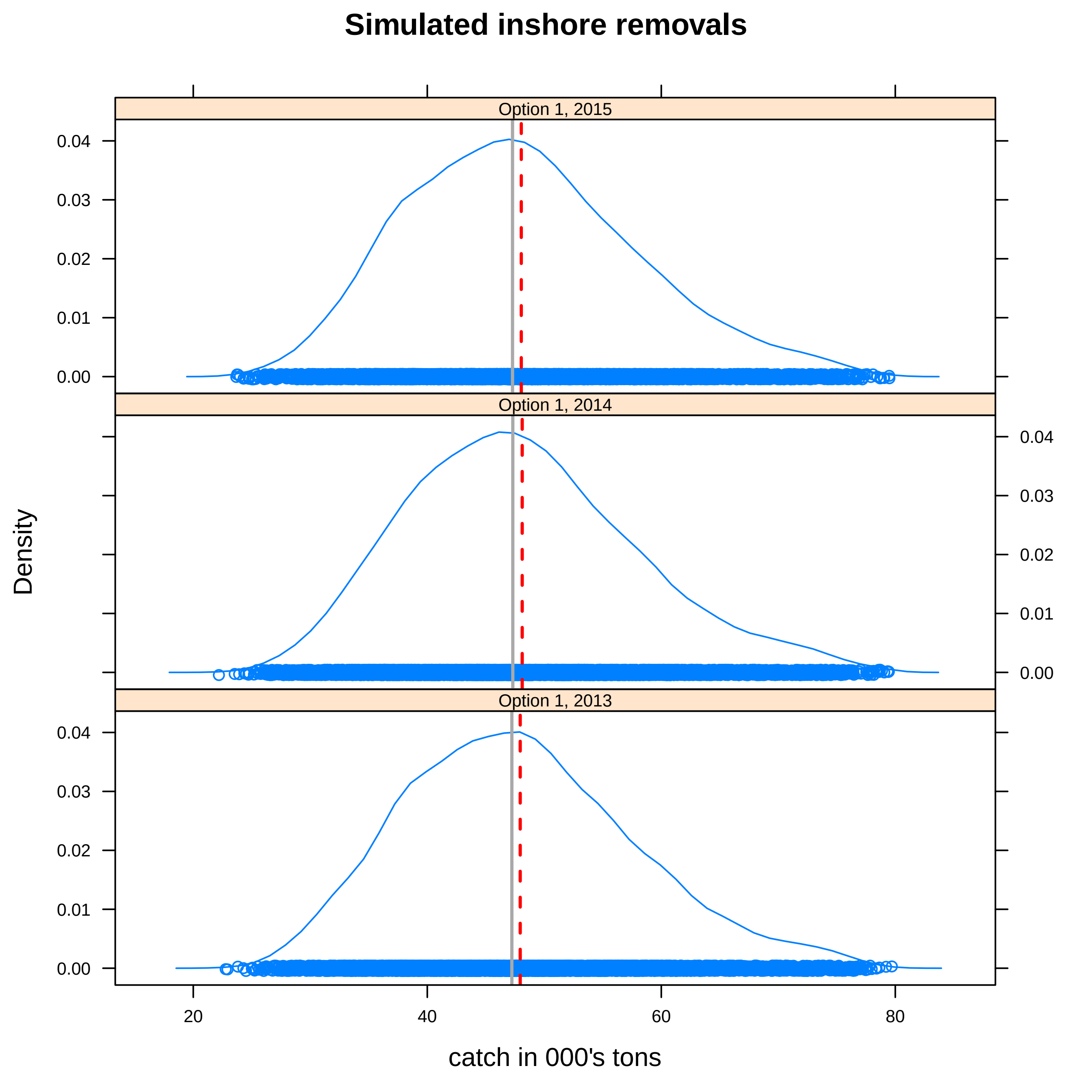
Table 13 Monthly proportion of VTR catches for Area 1A (Synthetic and Observed). Synthetic proportions are the proportions used to evaluate seasonal sub-ACL splits.

		Area 2 Synthetic Proportion of Catches by Month										
Month	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year 2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.32	0.45	0.38	0.39	0.19	0.35	0.34	0.48	0.33	0.50	0.50	0.46
2	0.35	0.22	0.29	0.28	0.48	0.32	0.33	0.19	0.34	0.17	0.17	0.21
3	0.10	0.09	0.11	0.09	0.08	0.17	0.17	0.09	0.12	0.19	0.07	0.16
4	0.01	0.16	0.01	0.02	0.09	0.03	0.06	0.09	0.03	0.05	0.02	0.05
5	0.00	0.01	0.03	0.02	0.01	0.02	0.00	0.07	0.00	0.00	0.00	0.00
6	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.03	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
11	0.04	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.05	0.00
12	0.19	0.04	0.14	0.20	0.15	0.11	0.05	0.08	0.10	0.09	0.18	0.12

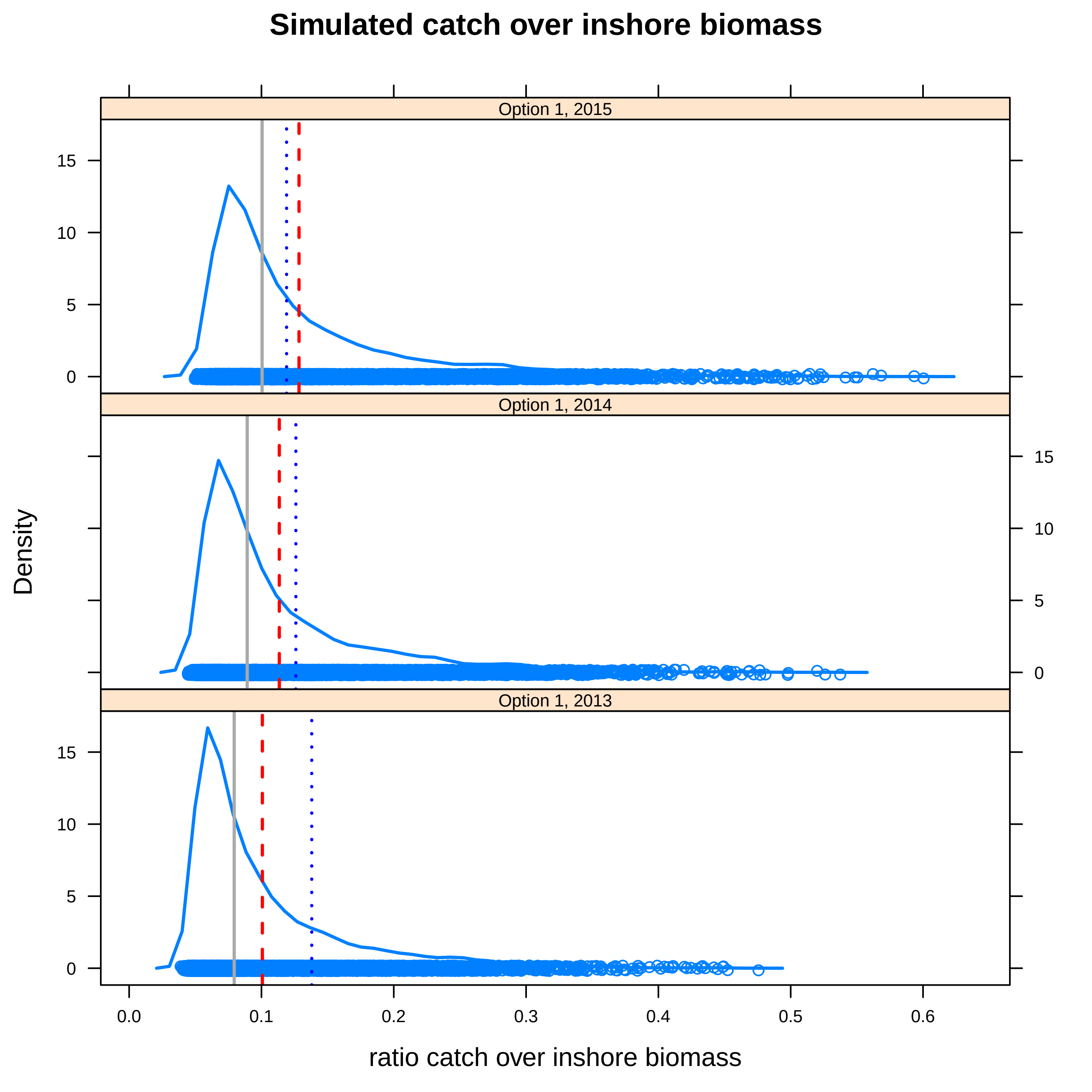
		Area 2 Observed Proportion of Catches by Month										
Month	**Year 2000**	**Year 2001**	**Year 2002**	**Year 2003**	**Year 2004**	**Year 2005**	**Year 2006**	**Year 2007**	**Year 2008**	**Year 2009**	**Year 2010**	**Year 2011**
1	0.34	0.60	0.48	0.30	0.14	0.30	0.27	0.44	0.34	0.52	0.38	0.35
2	0.37	0.29	0.37	0.21	0.37	0.28	0.27	0.17	0.35	0.18	0.13	0.17
3	0.09	0.03	0.05	0.13	0.13	0.21	0.24	0.11	0.11	0.17	0.11	0.23
4	0.01	0.06	0.01	0.02	0.14	0.04	0.09	0.11	0.03	0.05	0.03	0.07
5	0.00	0.00	0.02	0.02	0.01	0.03	0.01	0.08	0.00	0.00	0.00	0.00
6	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
11	0.03	0.00	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.08	0.00
12	0.17	0.01	0.06	0.30	0.22	0.14	0.07	0.09	0.10	0.08	0.28	0.18

Source: ME DNR

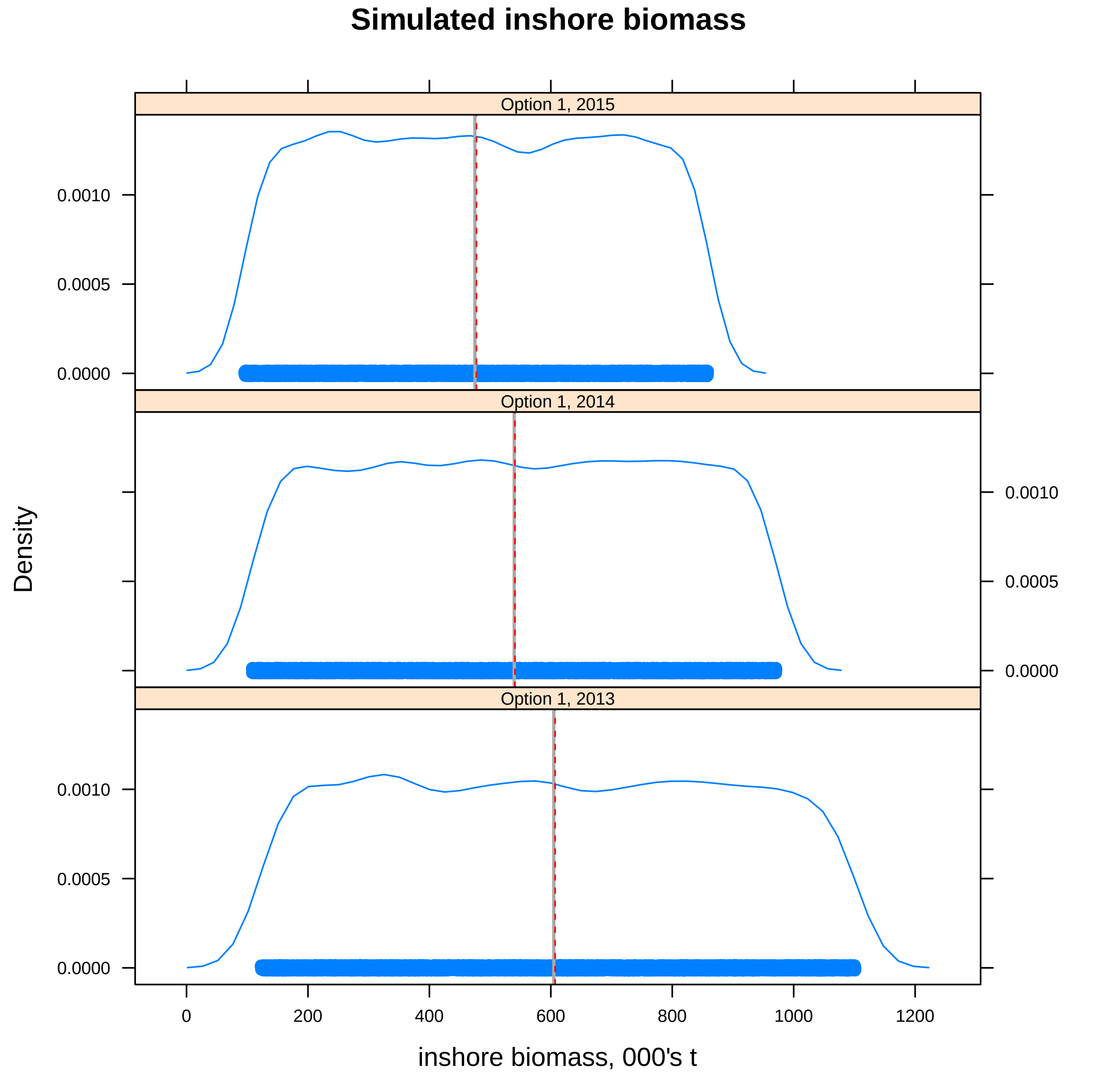
Intentionally Blank



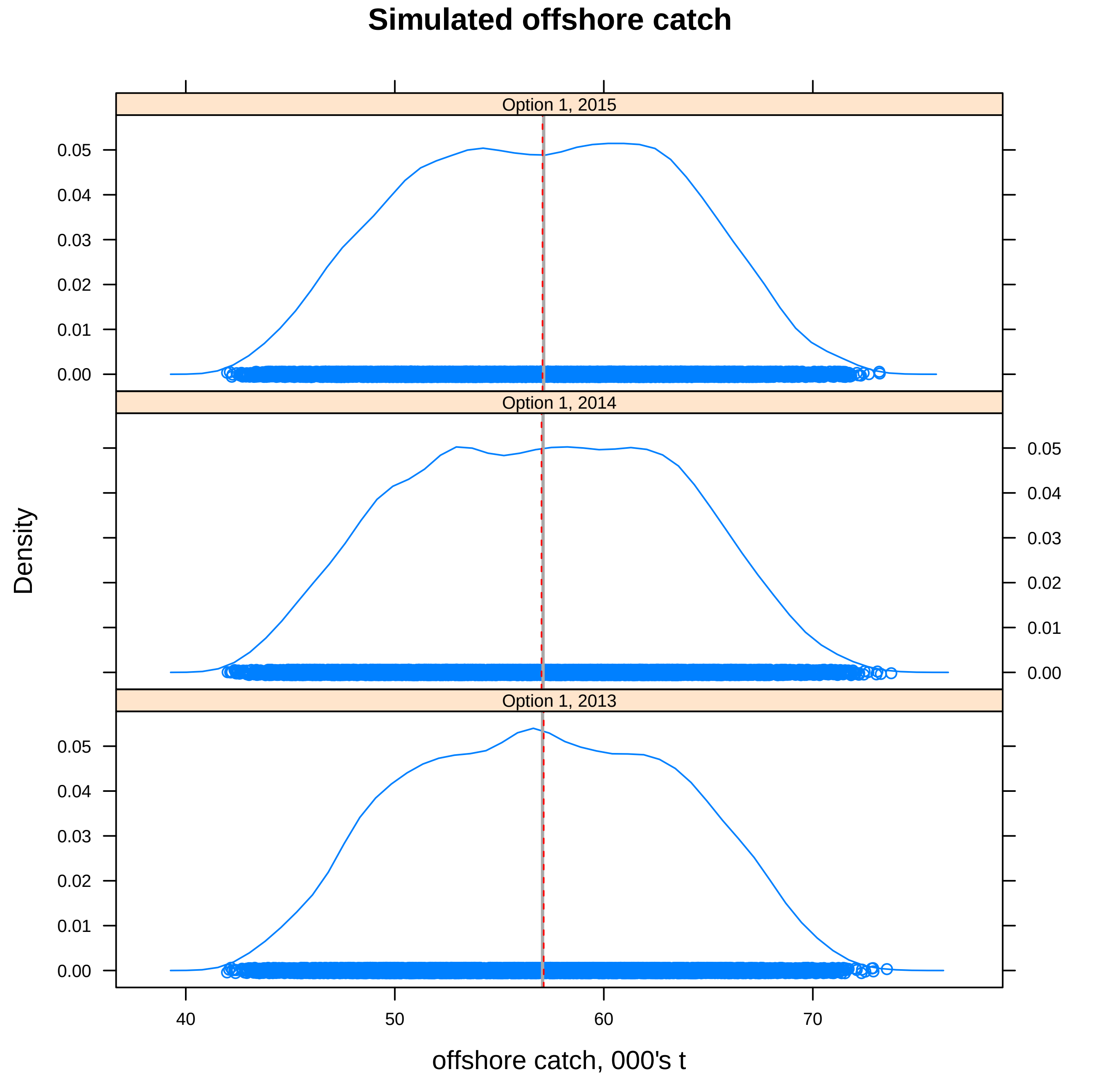
Simulated inshore removals
Option 1, 2015
Option 1, 2014
Option 1, 2013
Density
0.04
0.03
0.02
0.01
0.00
20
40
60
80
catch in 000's tons

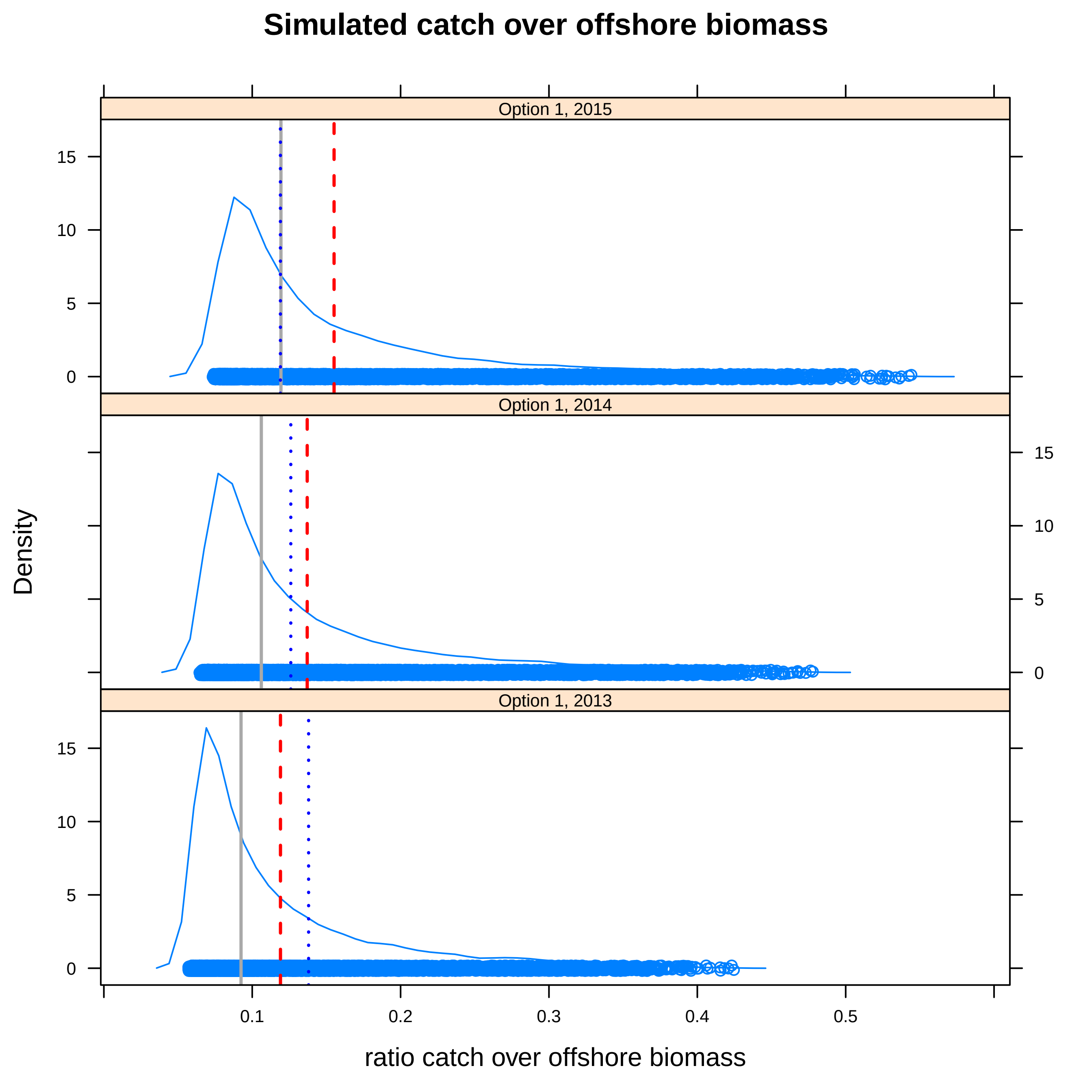


Simulated catch over inshore biomass
Option 1, 2015
Option 1, 2014
Option 1, 2013
Density
0
5
10
15
0.0
0.1
0.2
0.3
0.4
0.5
0.6
ratio catch over inshore biomass

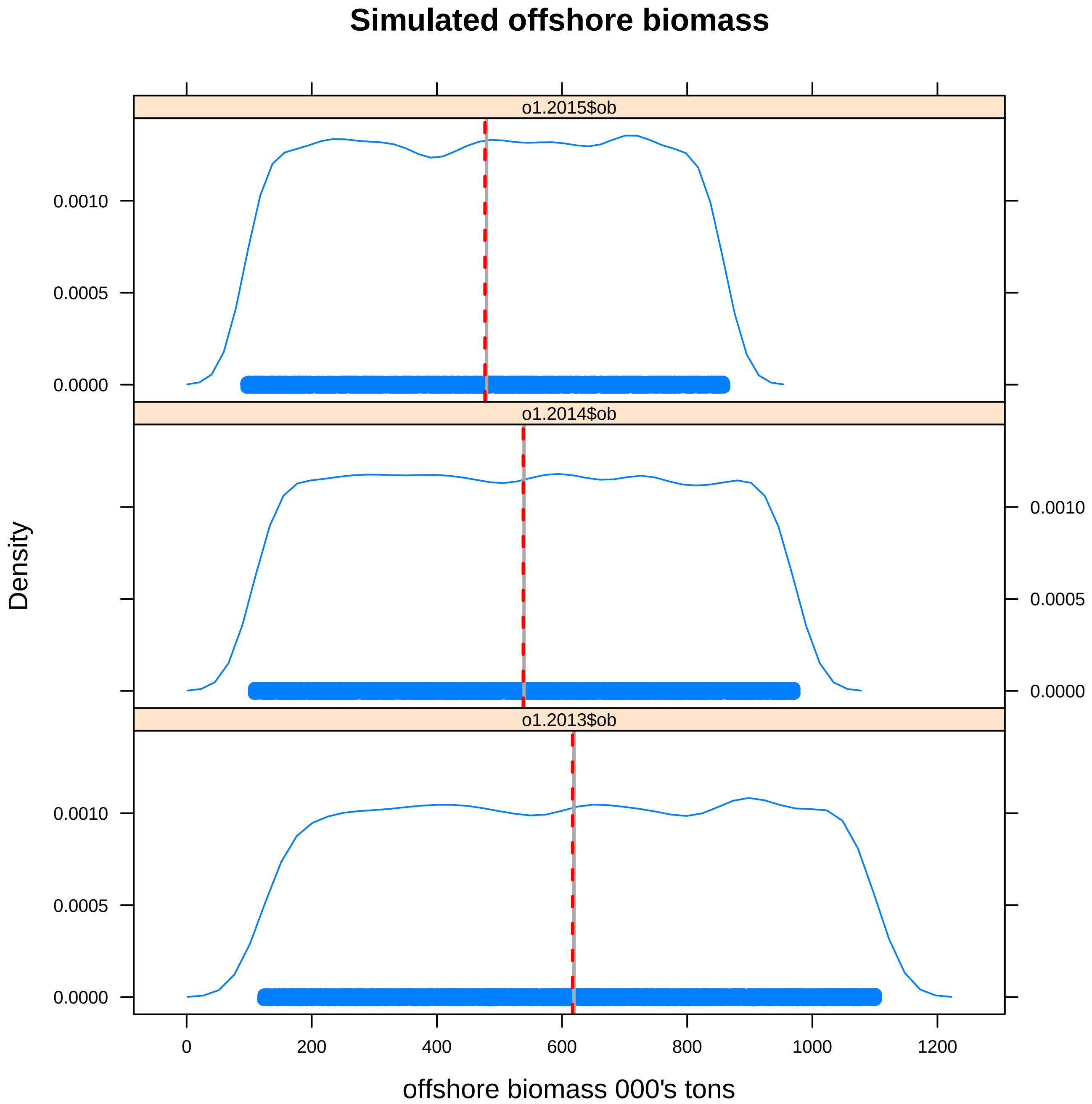


Simulated inshore biomass
Option 1, 2015
Option 1, 2014
Option 1, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
inshore biomass, 000's t

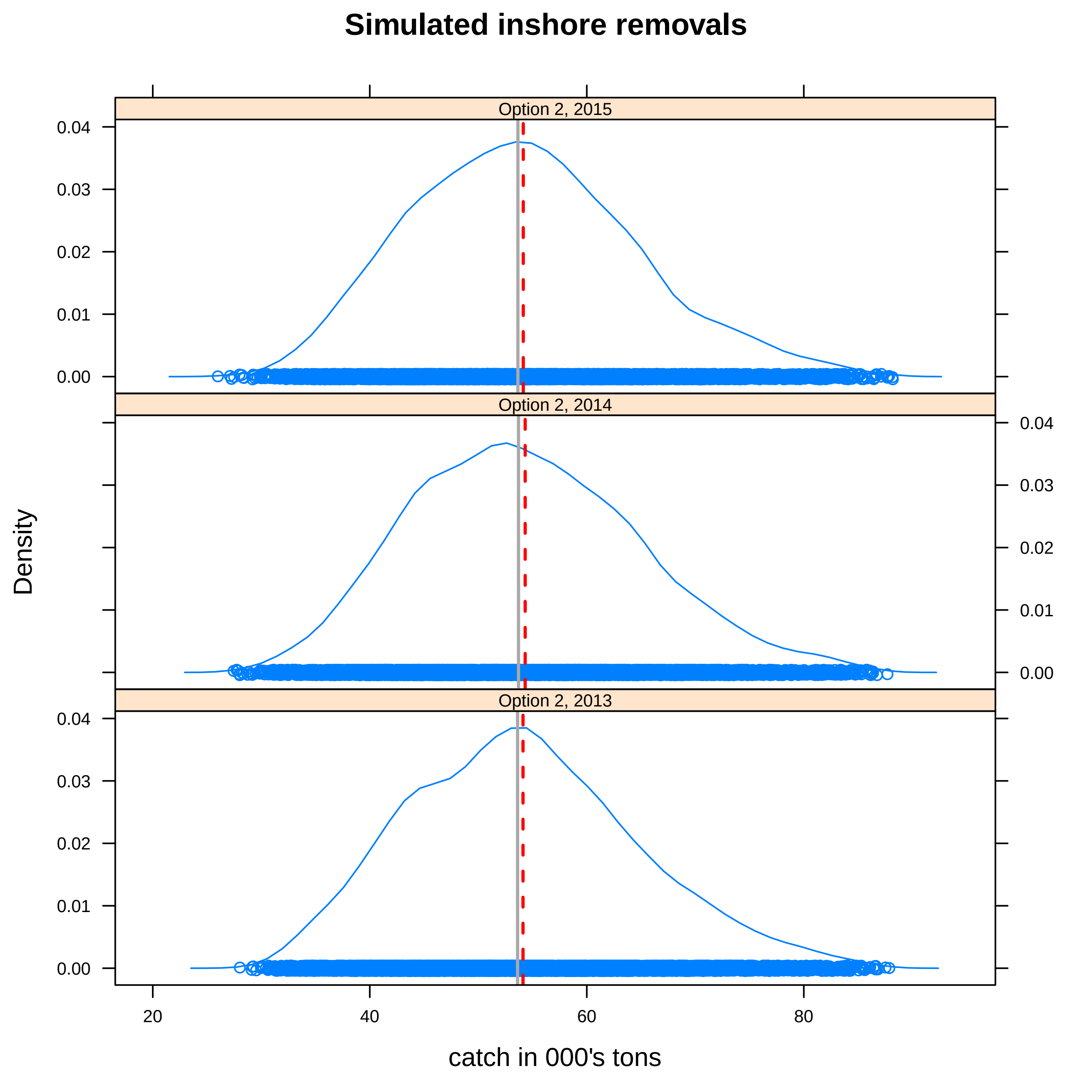

Simulated offshore catch
Option 1, 2015
Option 1, 2014
Option 1, 2013
0.00
0.01
0.02
0.03
0.04
0.05
Density
40
50
60
70
offshore catch, 000's t



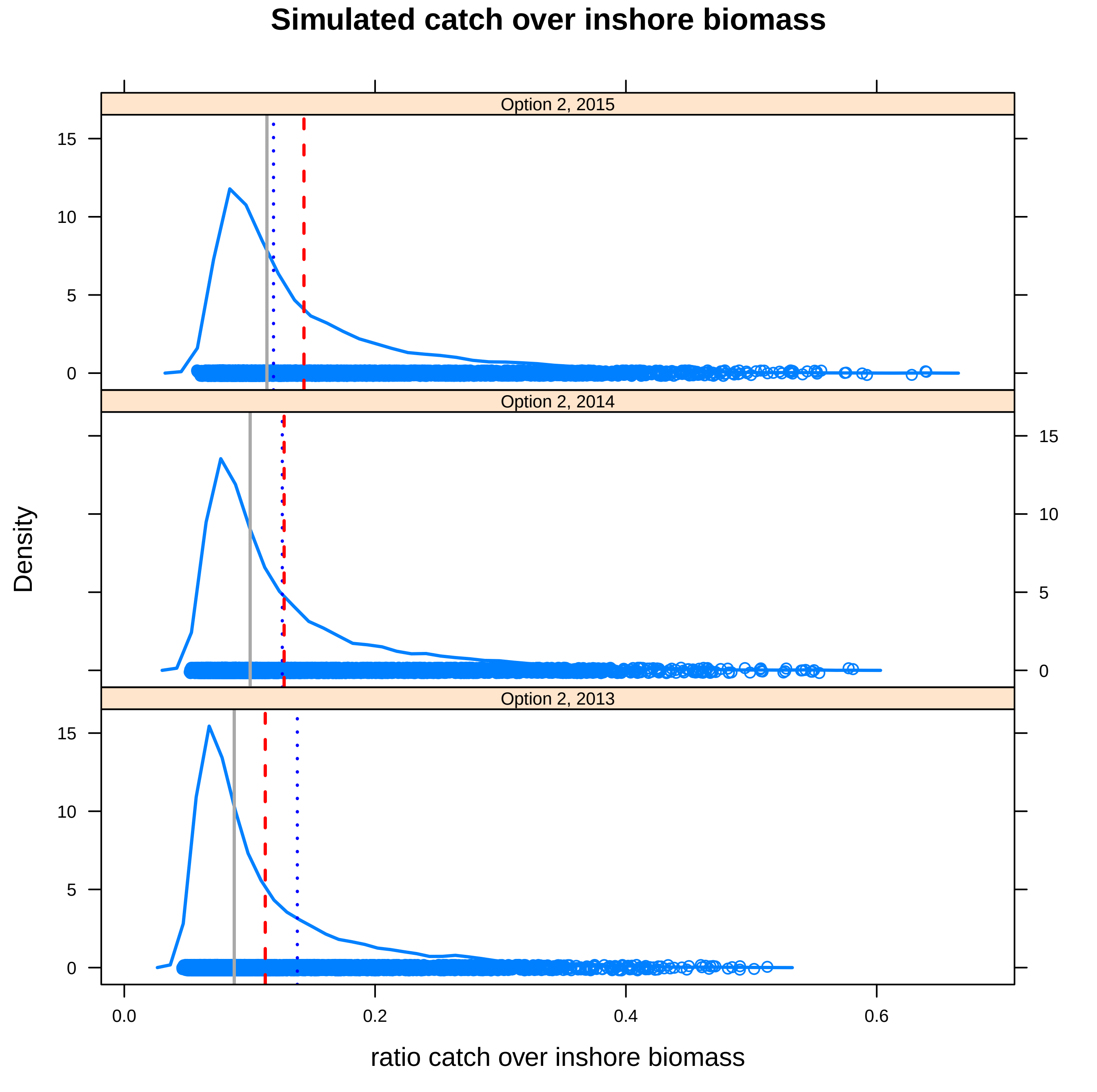
Simulated catch over offshore biomass
Option 1, 2015
Option 1, 2014
Option 1, 2013
Density
ratio catch over offshore biomass
0
5
10
15
0.1
0.2
0.3
0.4
0.5



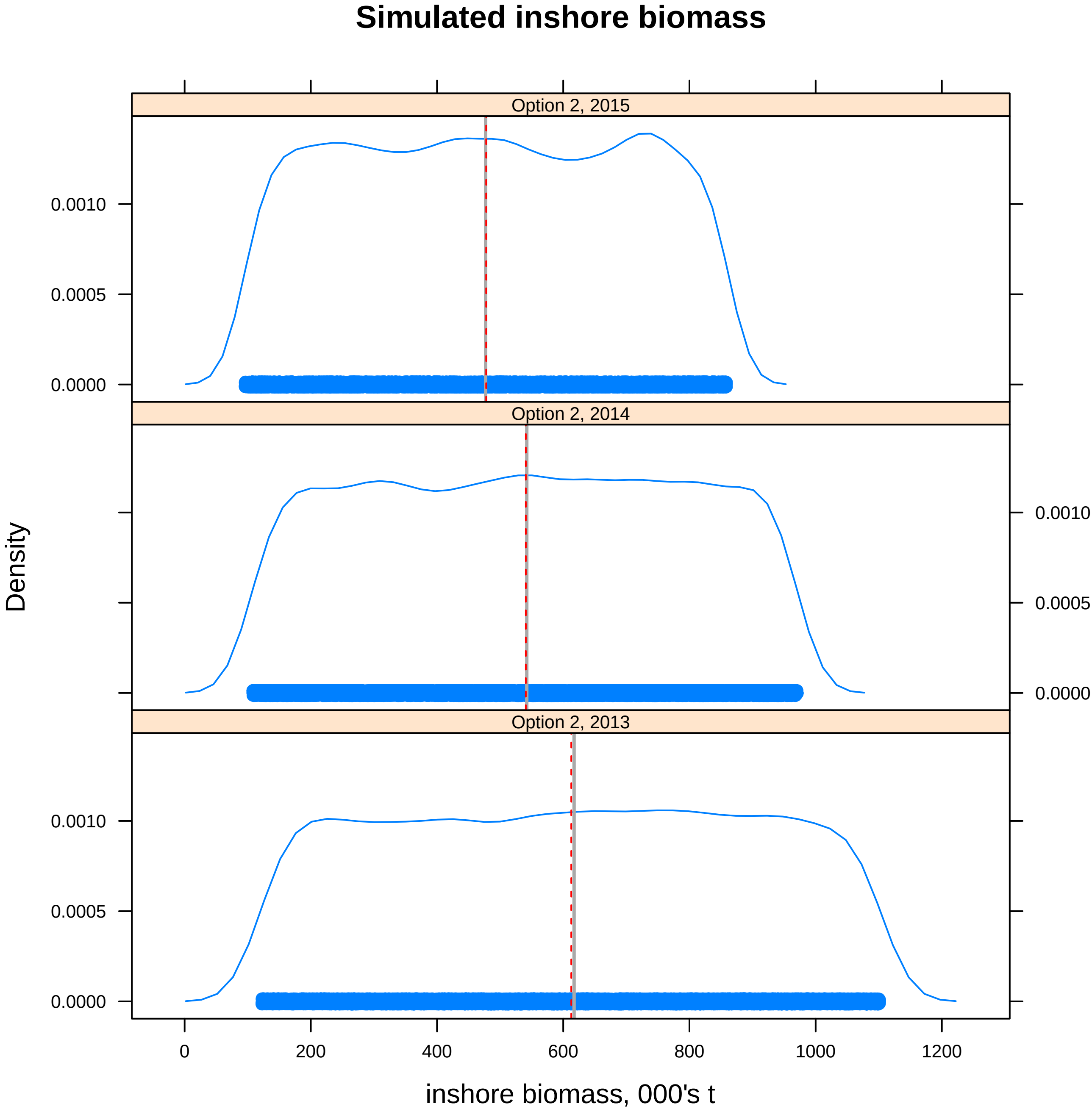
Simulated offshore biomass
o1.2015$ob
o1.2014$ob
o1.2013$ob
0.0000
0.0005
0.0010
Density
0
200
400
600
800
1000
1200
offshore biomass 000's tons

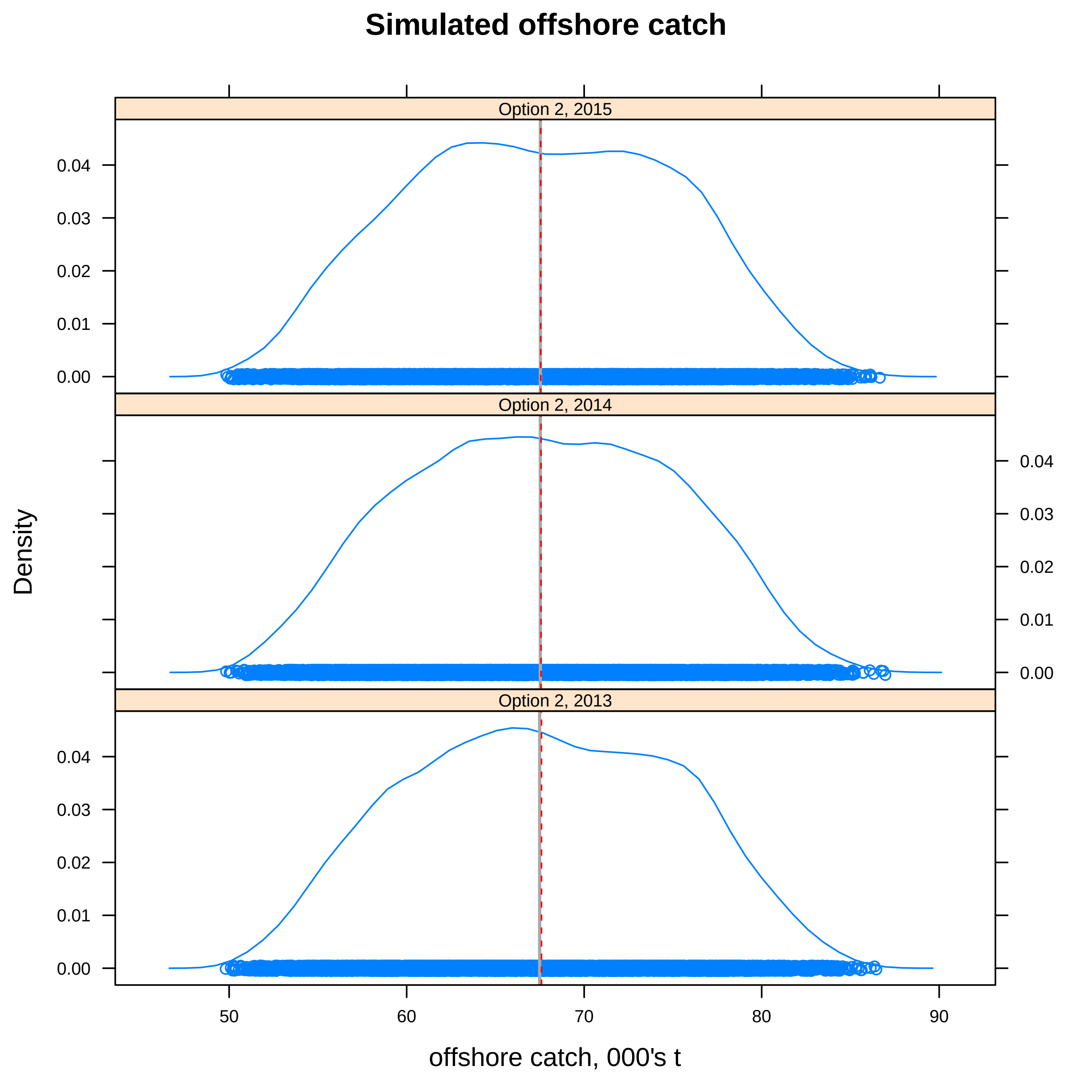


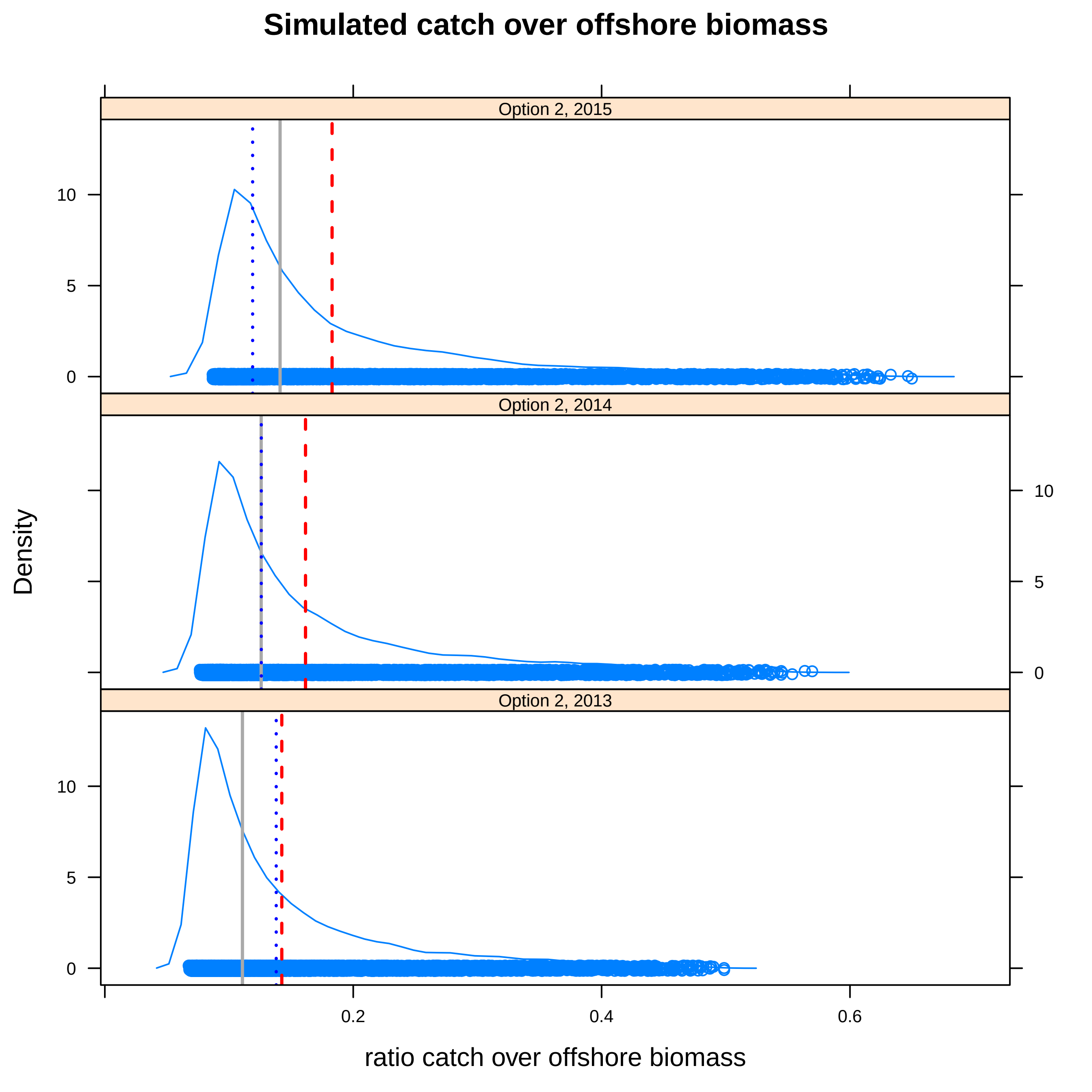
Simulated inshore removals
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
0.00
0.01
0.02
0.03
0.04
20
40
60
80
catch in 000's tons



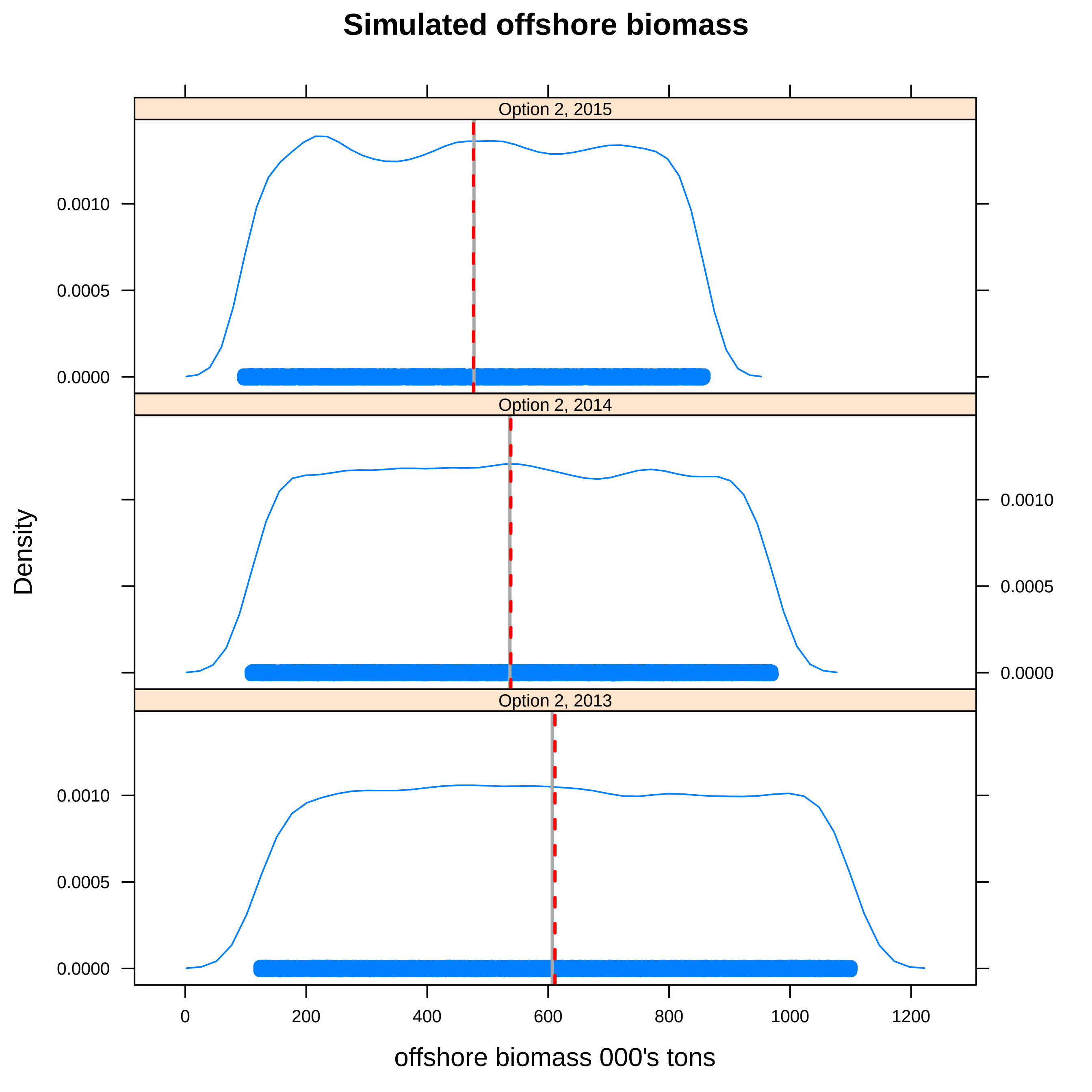
Simulated catch over inshore biomass
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
ratio catch over inshore biomass
0.0
0.2
0.4
0.6
0
5
10
15


Simulated inshore biomass
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
inshore biomass, 000's t

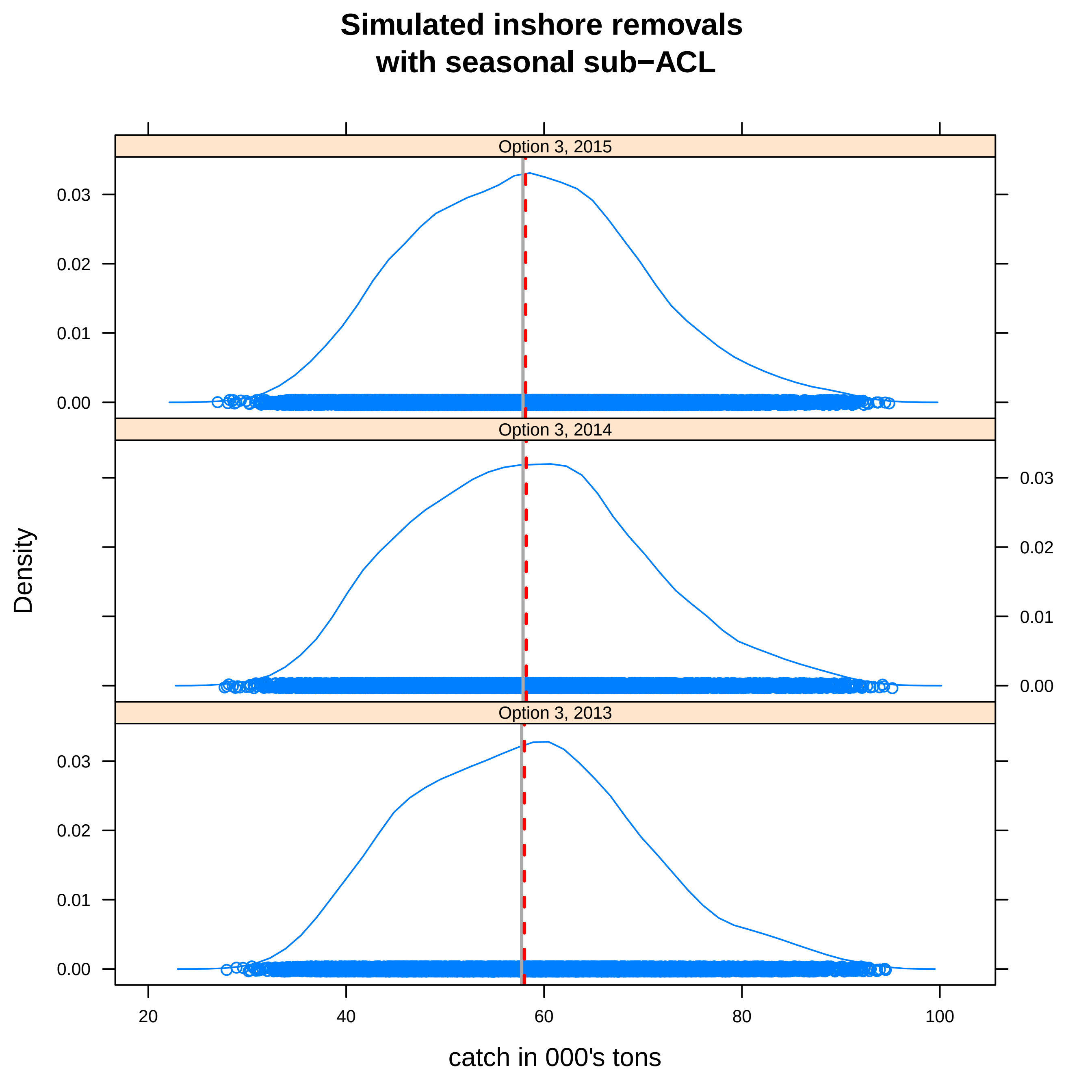

Simulated offshore catch
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
0.00
0.01
0.02
0.03
0.04
50
60
70
80
90
offshore catch, 000's t



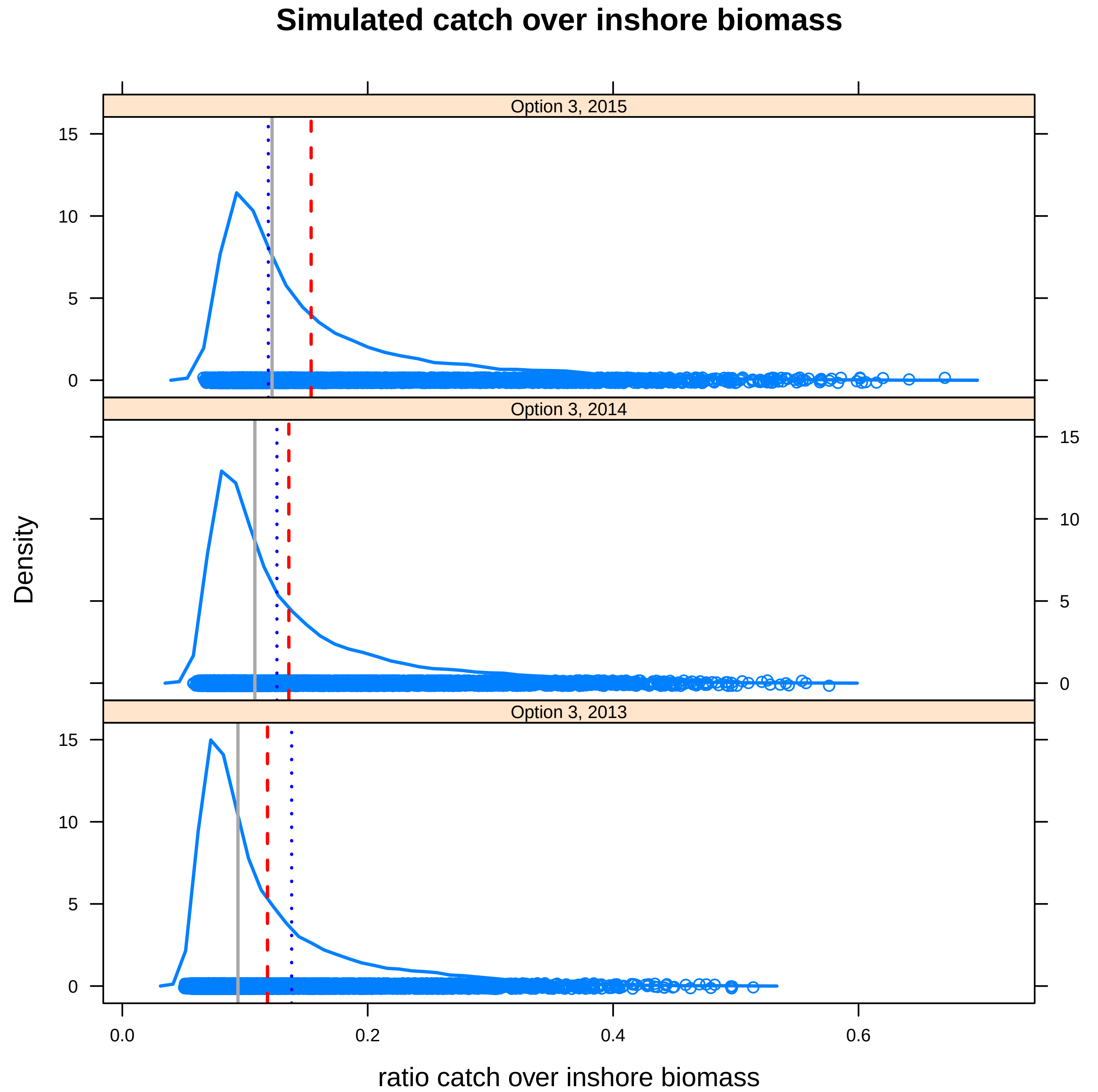
Simulated catch over offshore biomass
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
ratio catch over offshore biomass
0
5
10
0.2
0.4
0.6



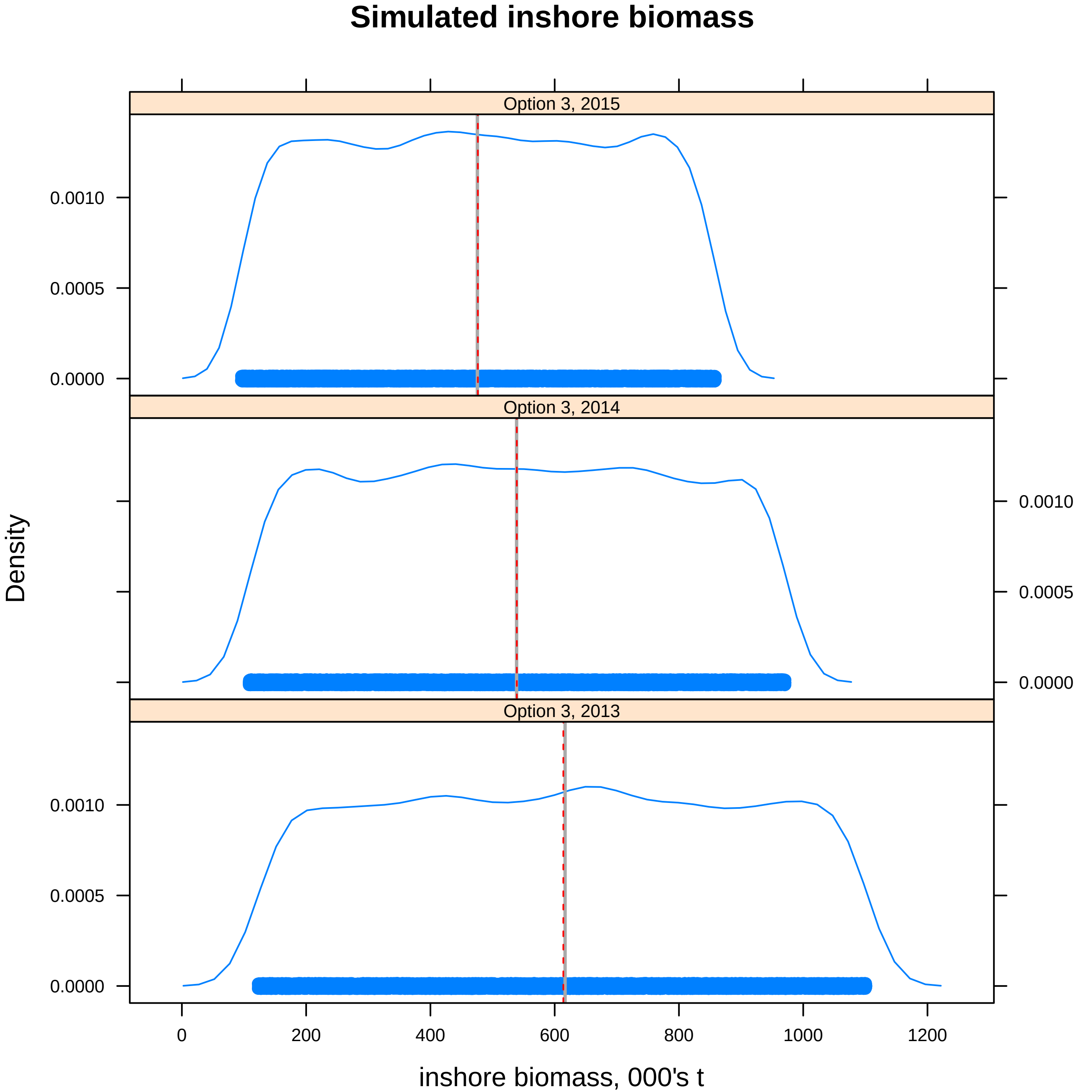
Simulated offshore biomass
Option 2, 2015
Option 2, 2014
Option 2, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
offshore biomass 000's tons



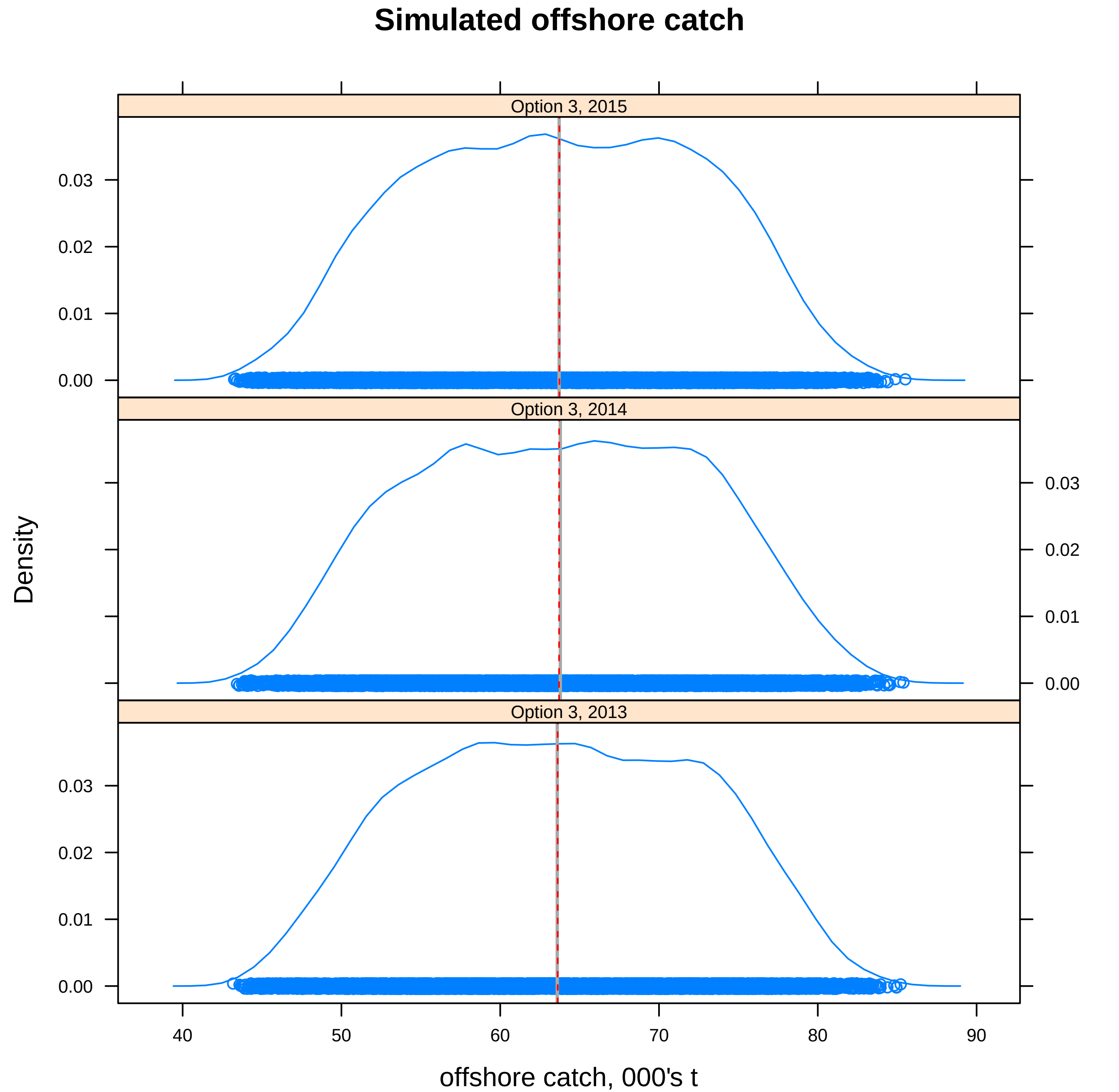
Simulated inshore removals
with seasonal sub−ACL
Option 3, 2015
Option 3, 2014
Option 3, 2013
Density
catch in 000's tons
0.00
0.01
0.02
0.03
20
40
60
80
100



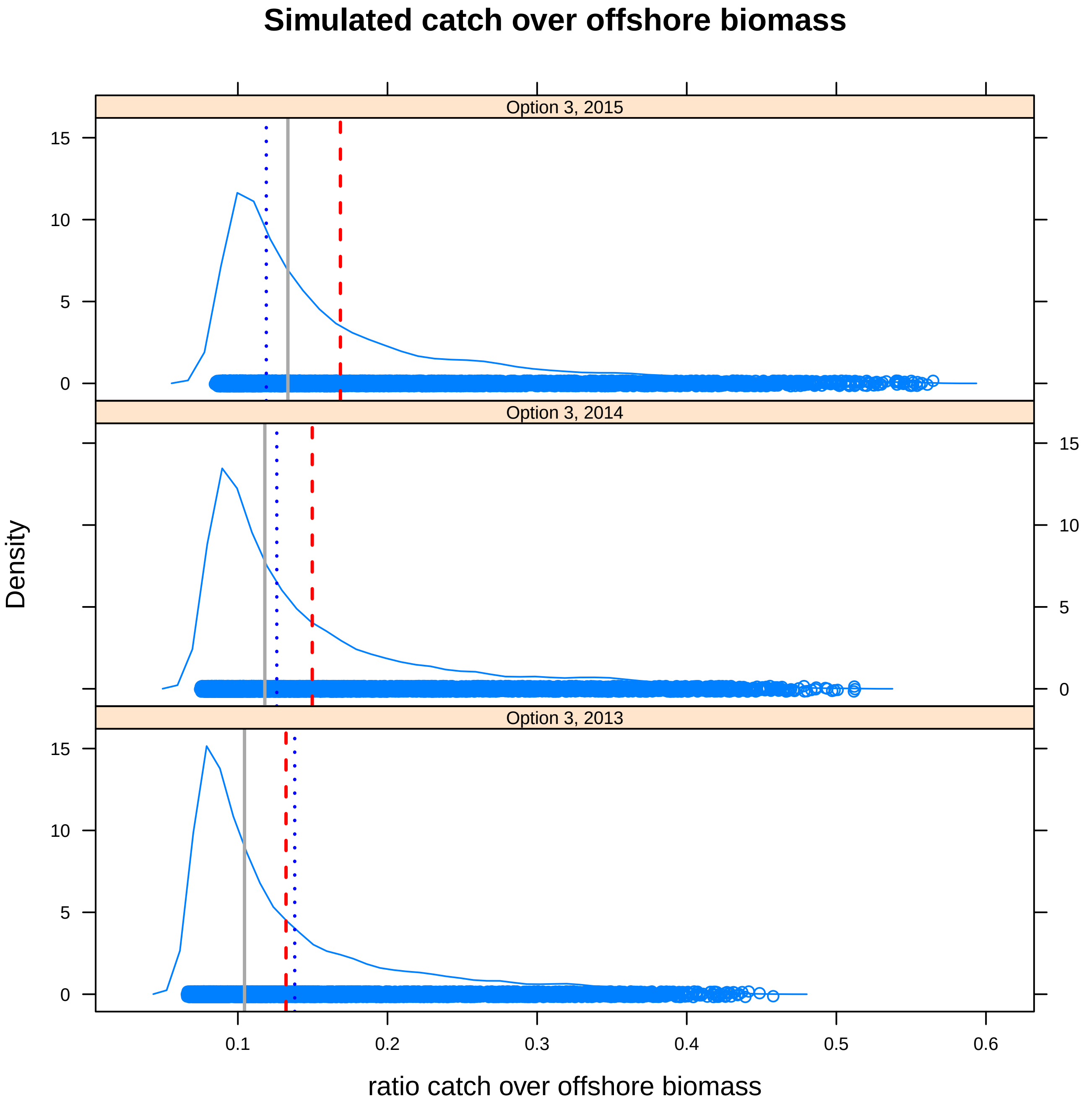
Simulated catch over inshore biomass
Option 3, 2015
Option 3, 2014
Option 3, 2013
Density
ratio catch over inshore biomass
0.0
0.2
0.4
0.6
0
5
10
15



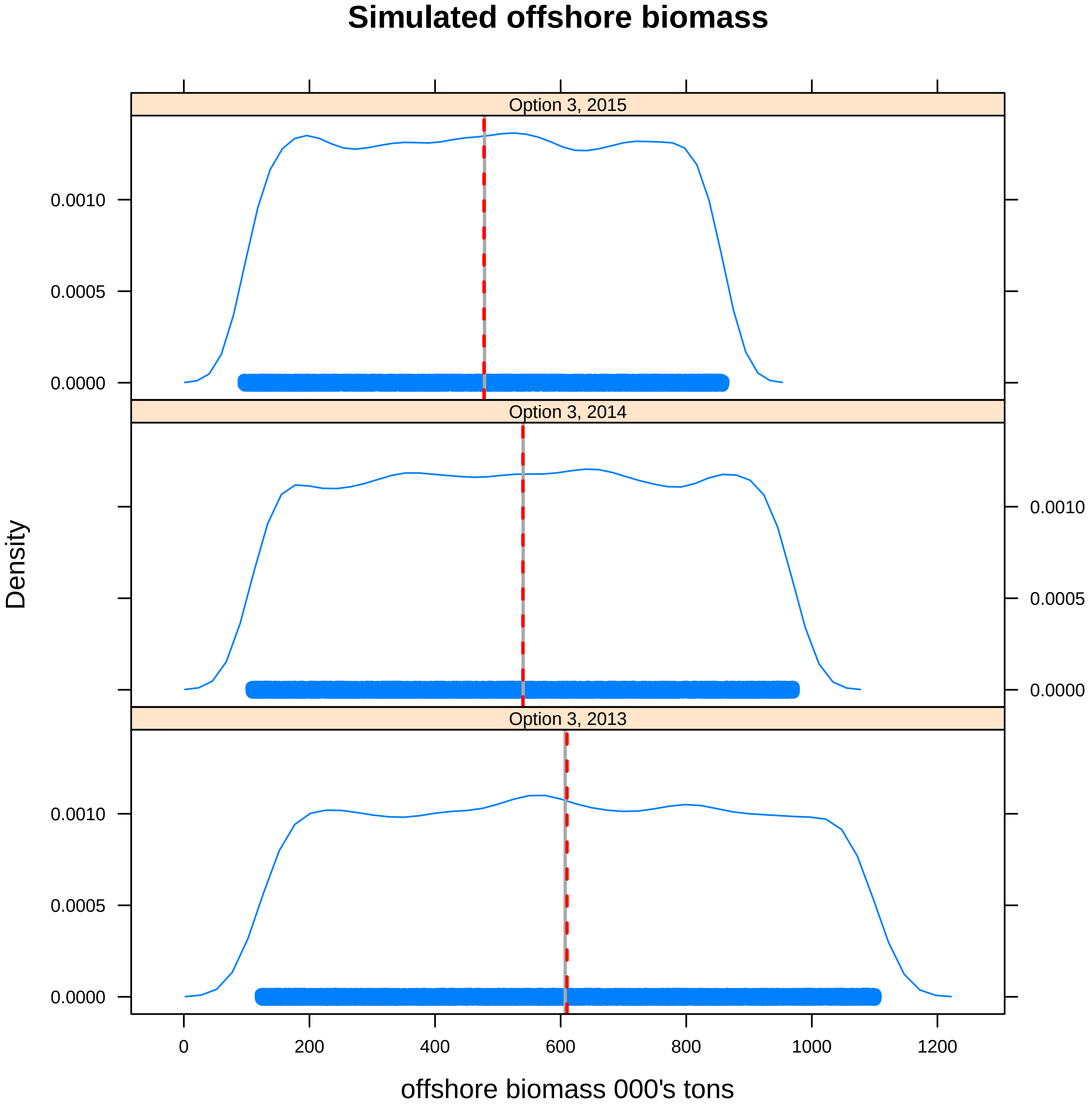
Simulated inshore biomass
Option 3, 2015
Option 3, 2014
Option 3, 2013
0.0000
0.0005
0.0010
Density
0
200
400
600
800
1000
1200
inshore biomass, 000's t

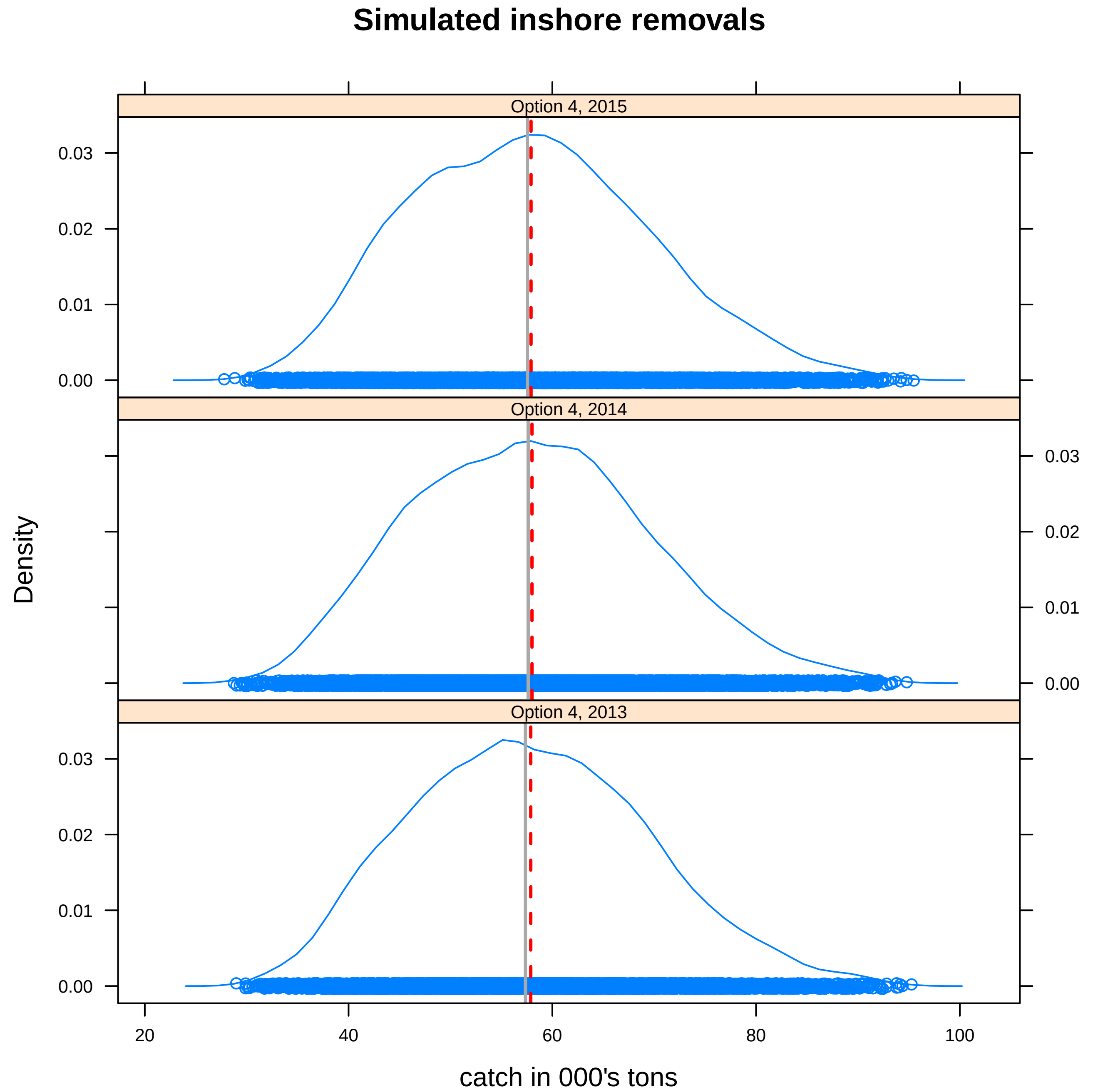


Simulated offshore catch
Option 3, 2015
Option 3, 2014
Option 3, 2013
Density
0.00
0.01
0.02
0.03
40
50
60
70
80
90
offshore catch, 000's t

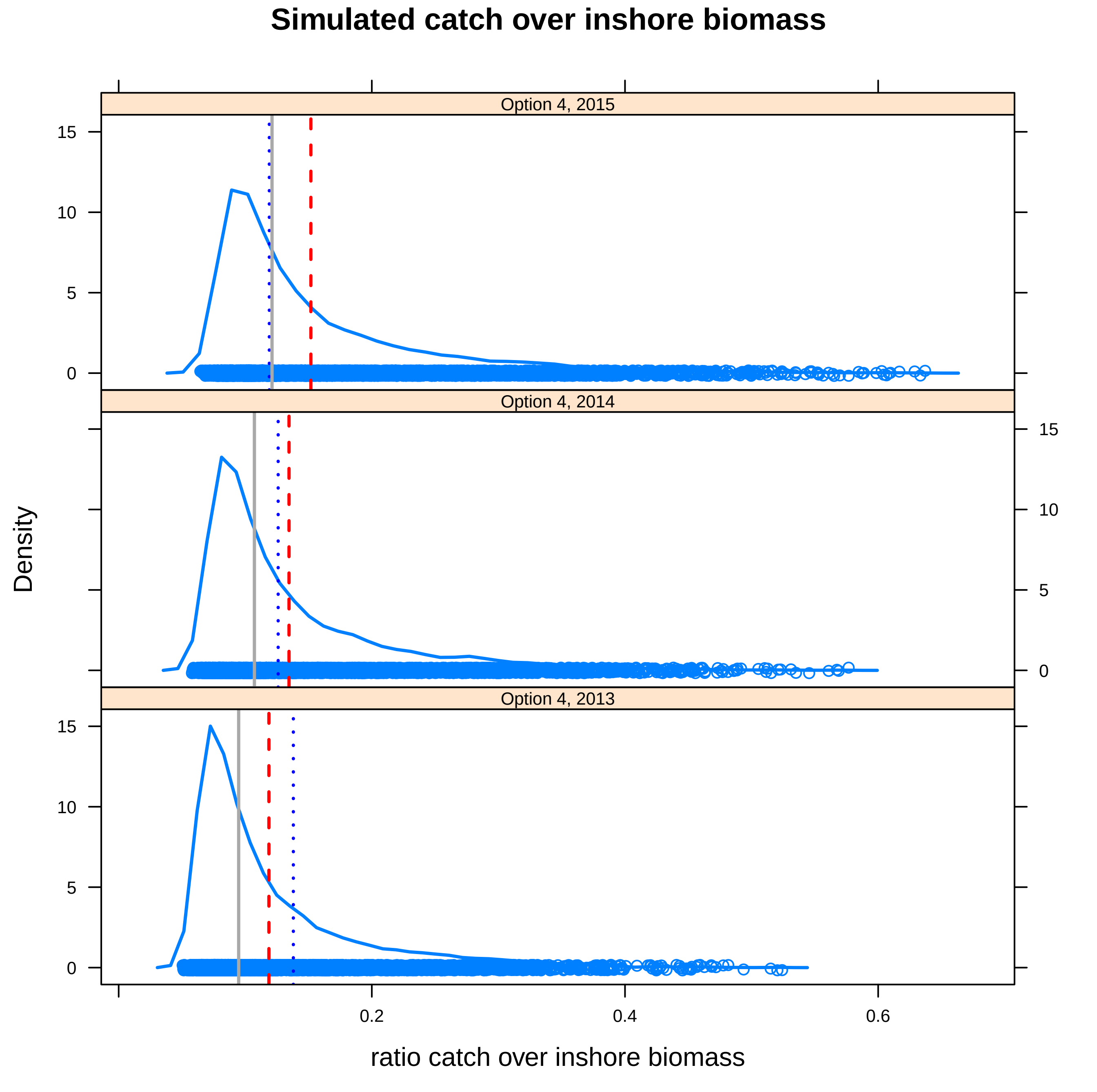


Simulated catch over offshore biomass
Option 3, 2015
Option 3, 2014
Option 3, 2013
Density
0
5
10
15
0.1
0.2
0.3
0.4
0.5
0.6
ratio catch over offshore biomass

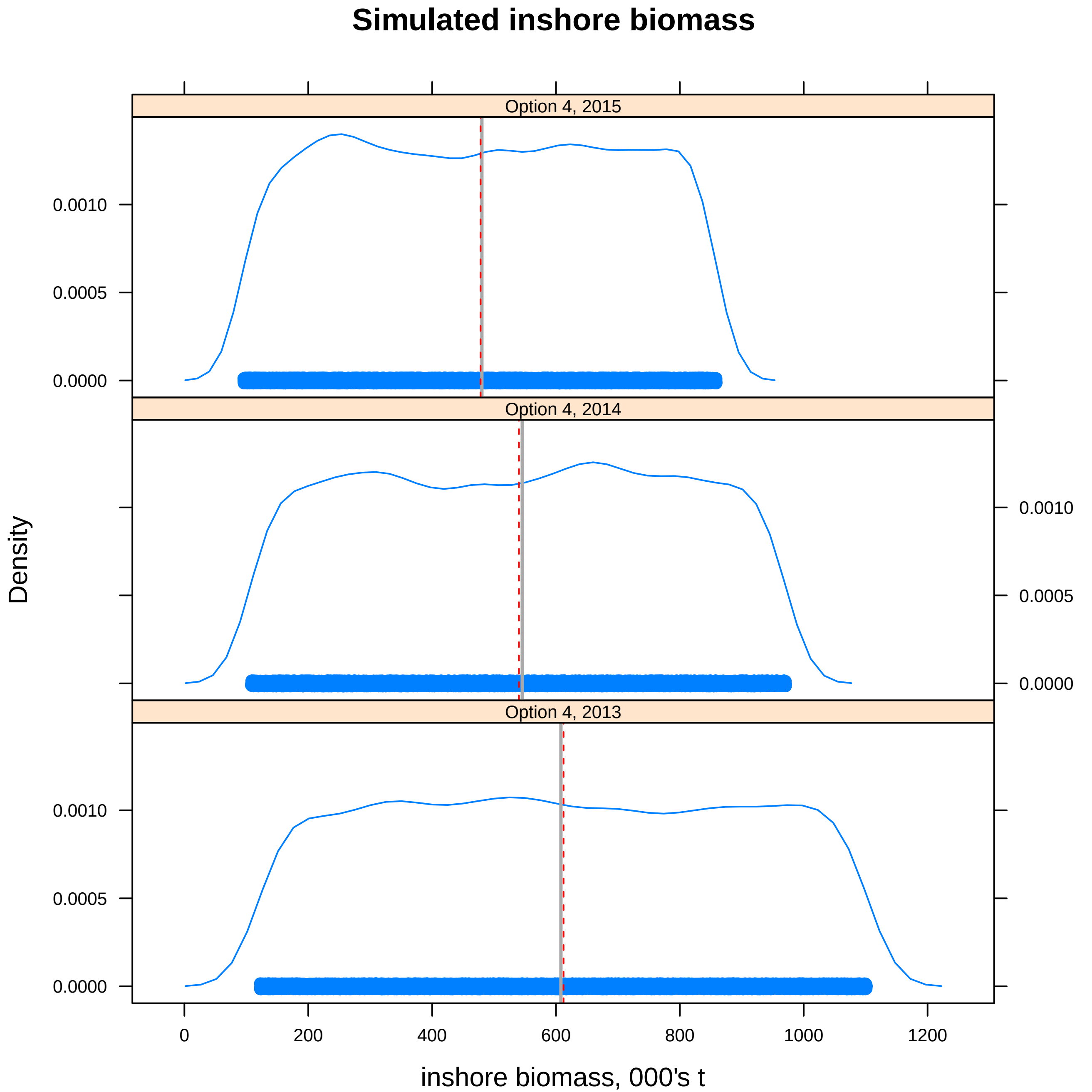

Simulated offshore biomass
Option 3, 2015
Option 3, 2014
Option 3, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
offshore biomass 000's tons

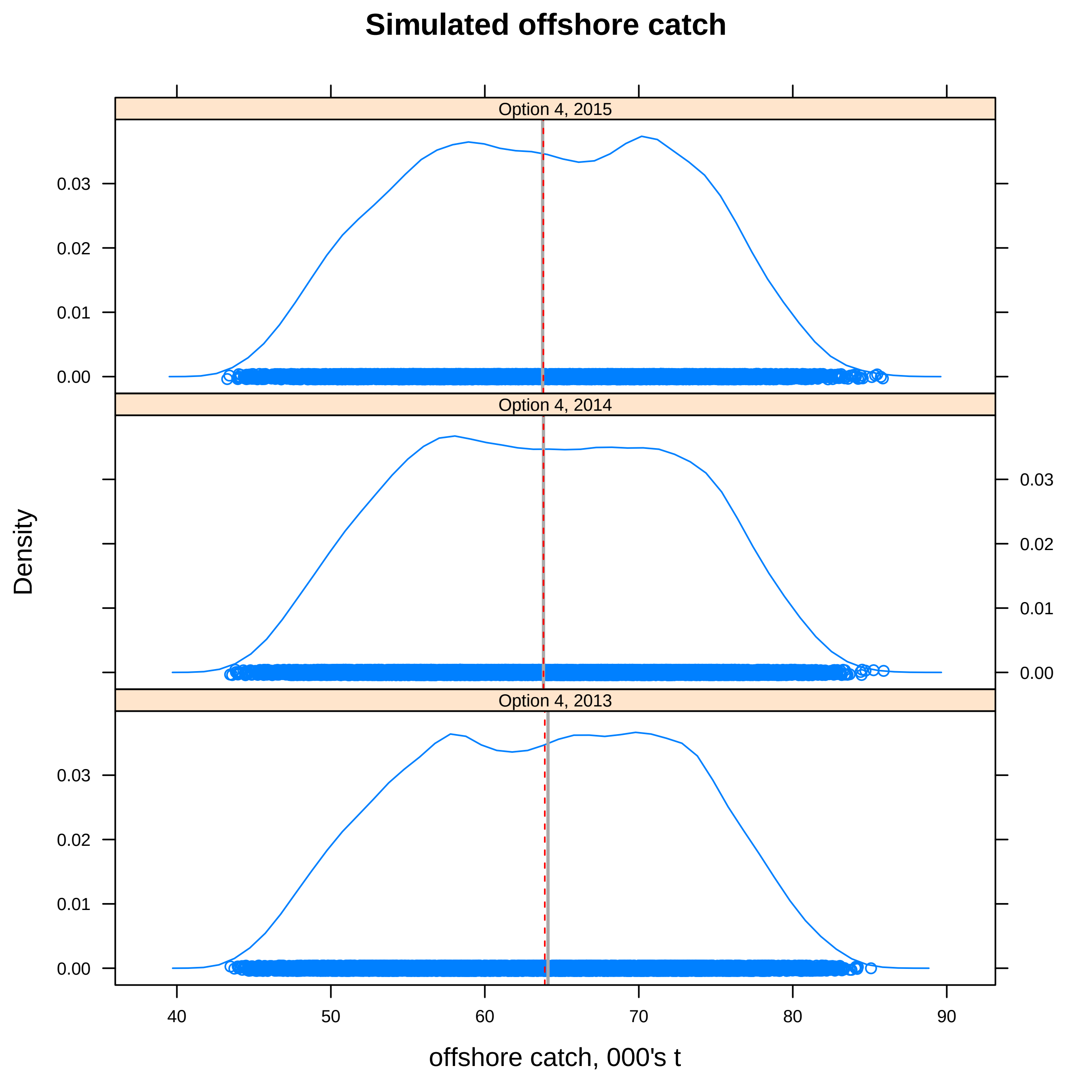


Simulated inshore removals
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
0.00
0.01
0.02
0.03
20
40
60
80
100
catch in 000's tons

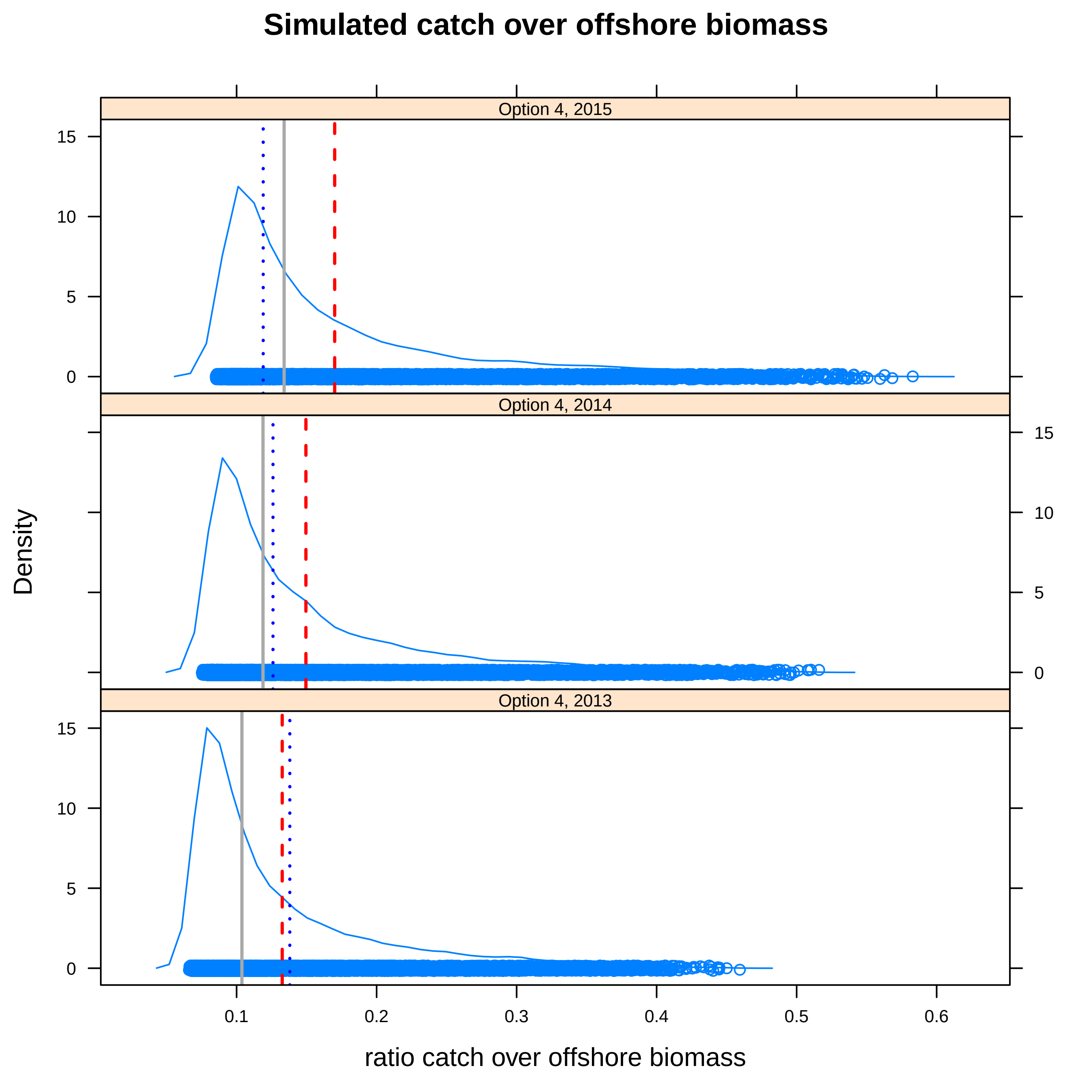


Simulated catch over inshore biomass
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
ratio catch over inshore biomass
0
5
10
15
0.2
0.4
0.6

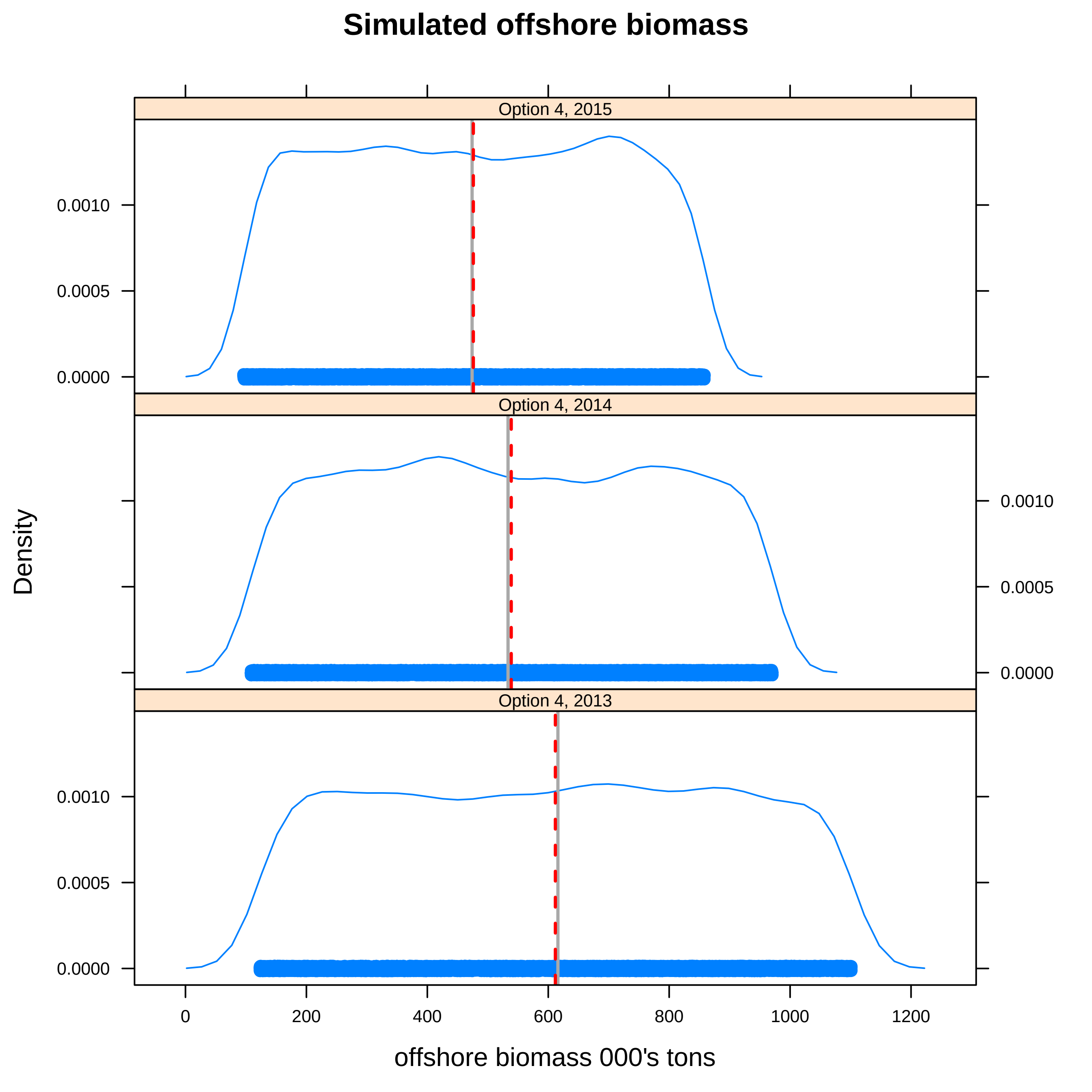

Simulated inshore biomass
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
inshore biomass, 000's t

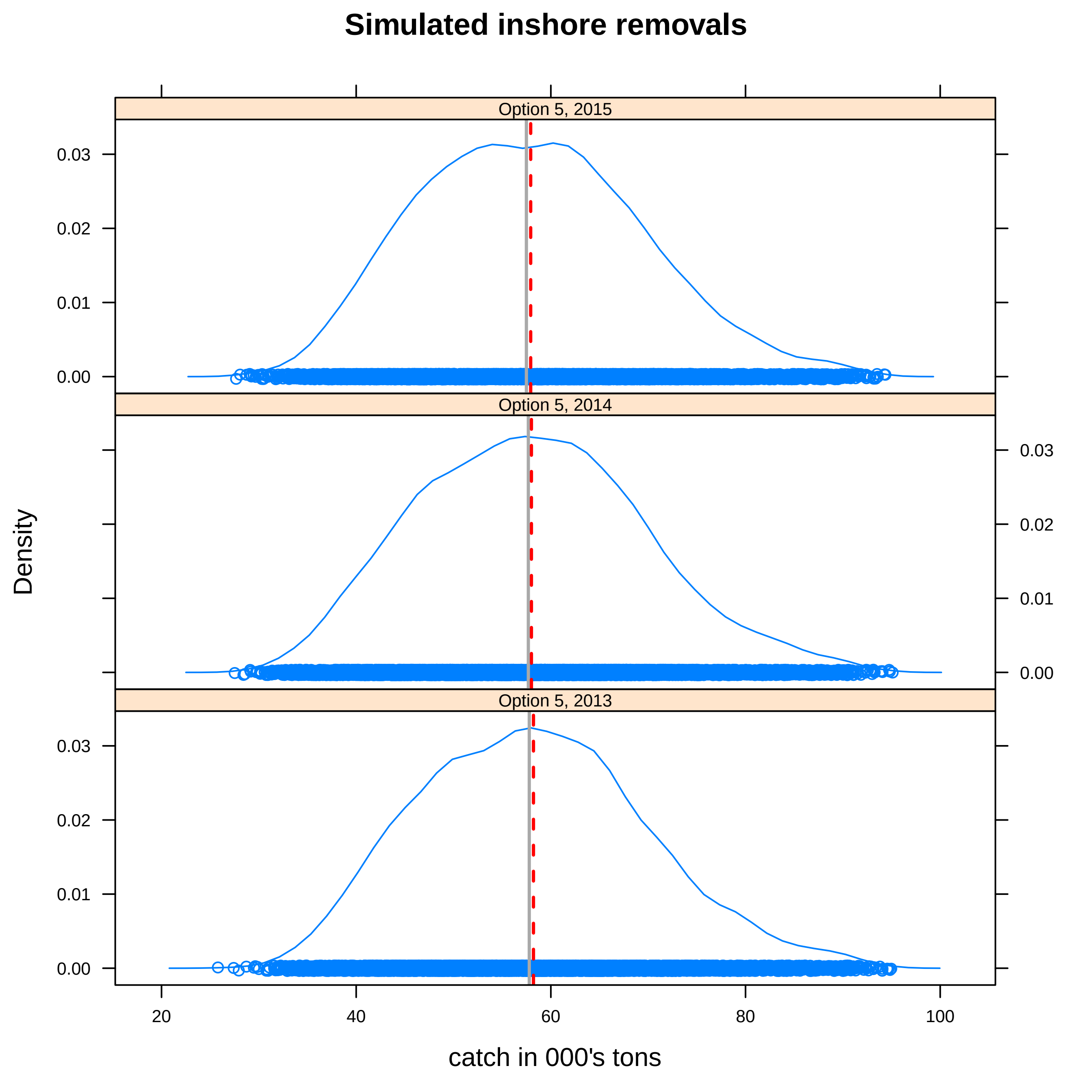


Simulated offshore catch
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
0.00
0.01
0.02
0.03
40
50
60
70
80
90
offshore catch, 000's t

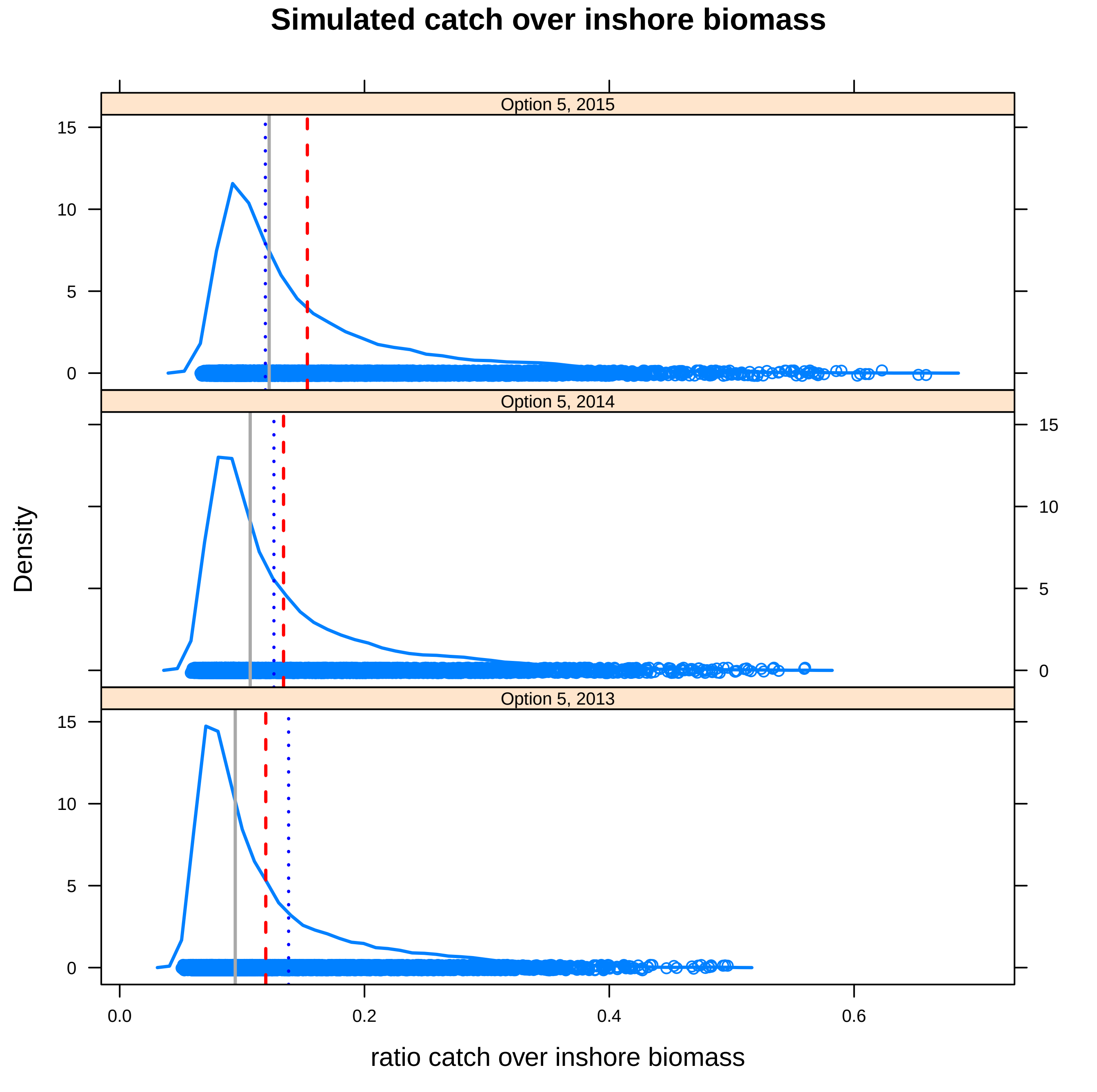


Simulated catch over offshore biomass
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
0
5
10
15
0.1
0.2
0.3
0.4
0.5
0.6
ratio catch over offshore biomass

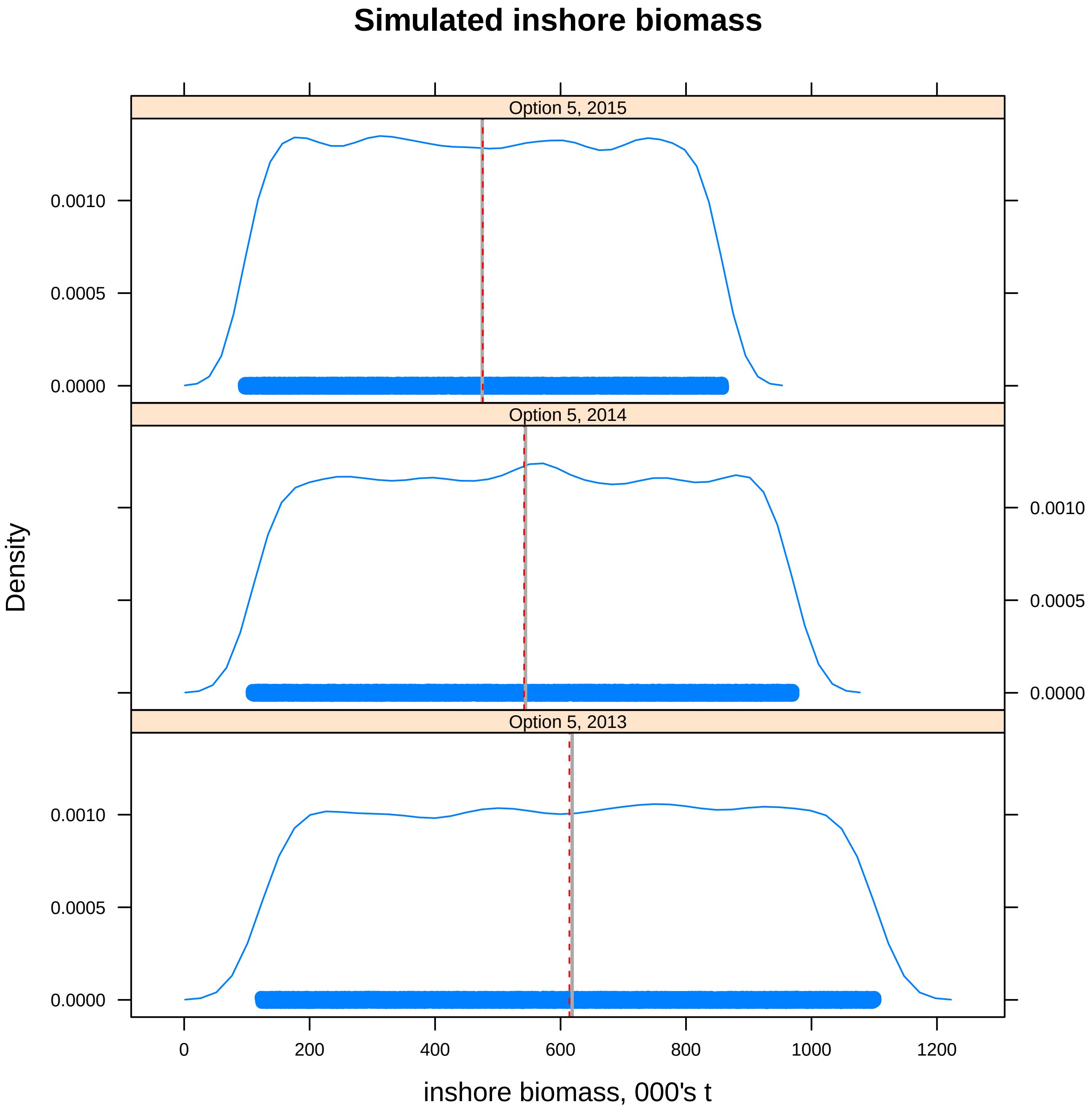

Simulated offshore biomass
Option 4, 2015
Option 4, 2014
Option 4, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
offshore biomass 000's tons

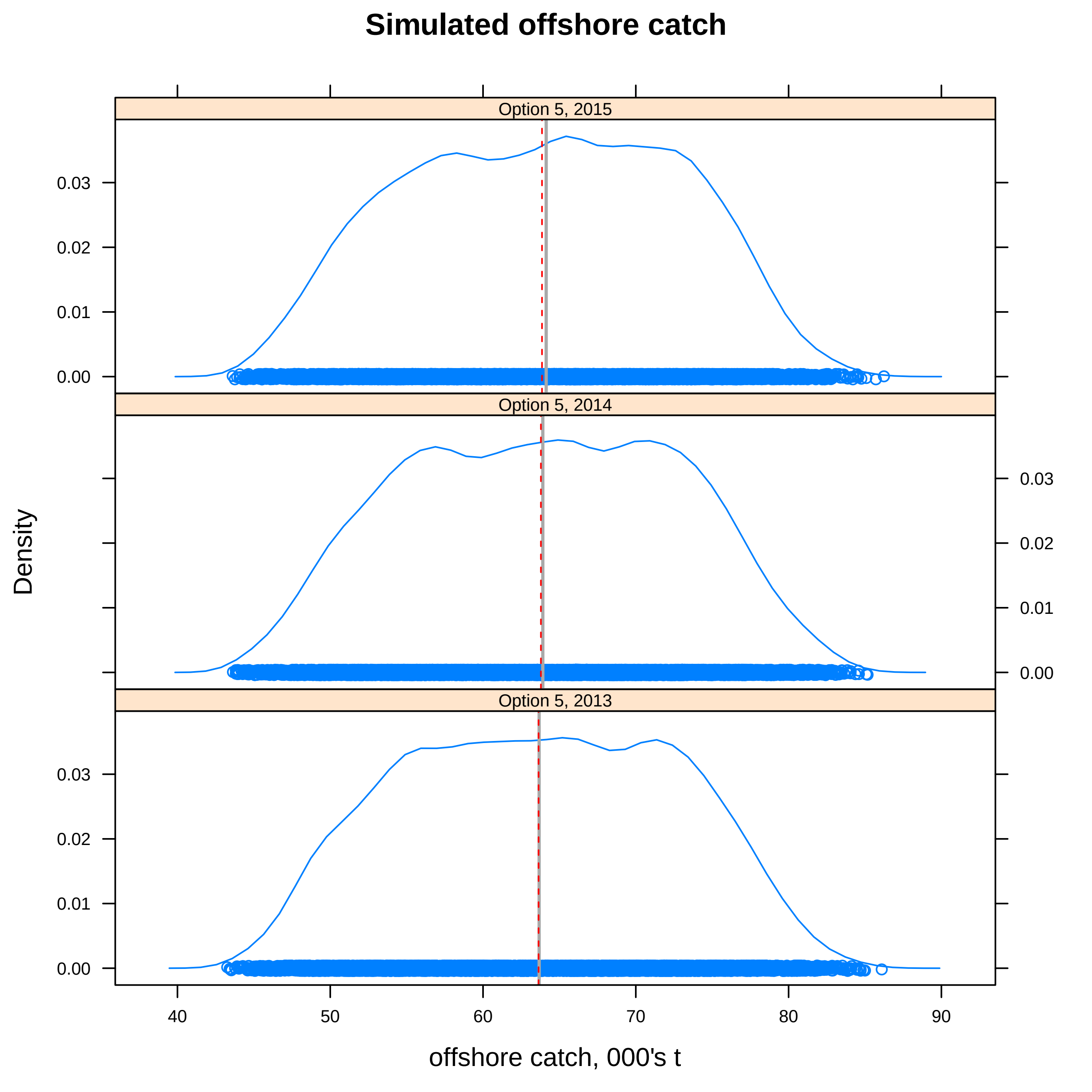


Simulated inshore removals
Option 5, 2015
Option 5, 2014
Option 5, 2013
Density
0.00
0.01
0.02
0.03
20
40
60
80
100
catch in 000's tons

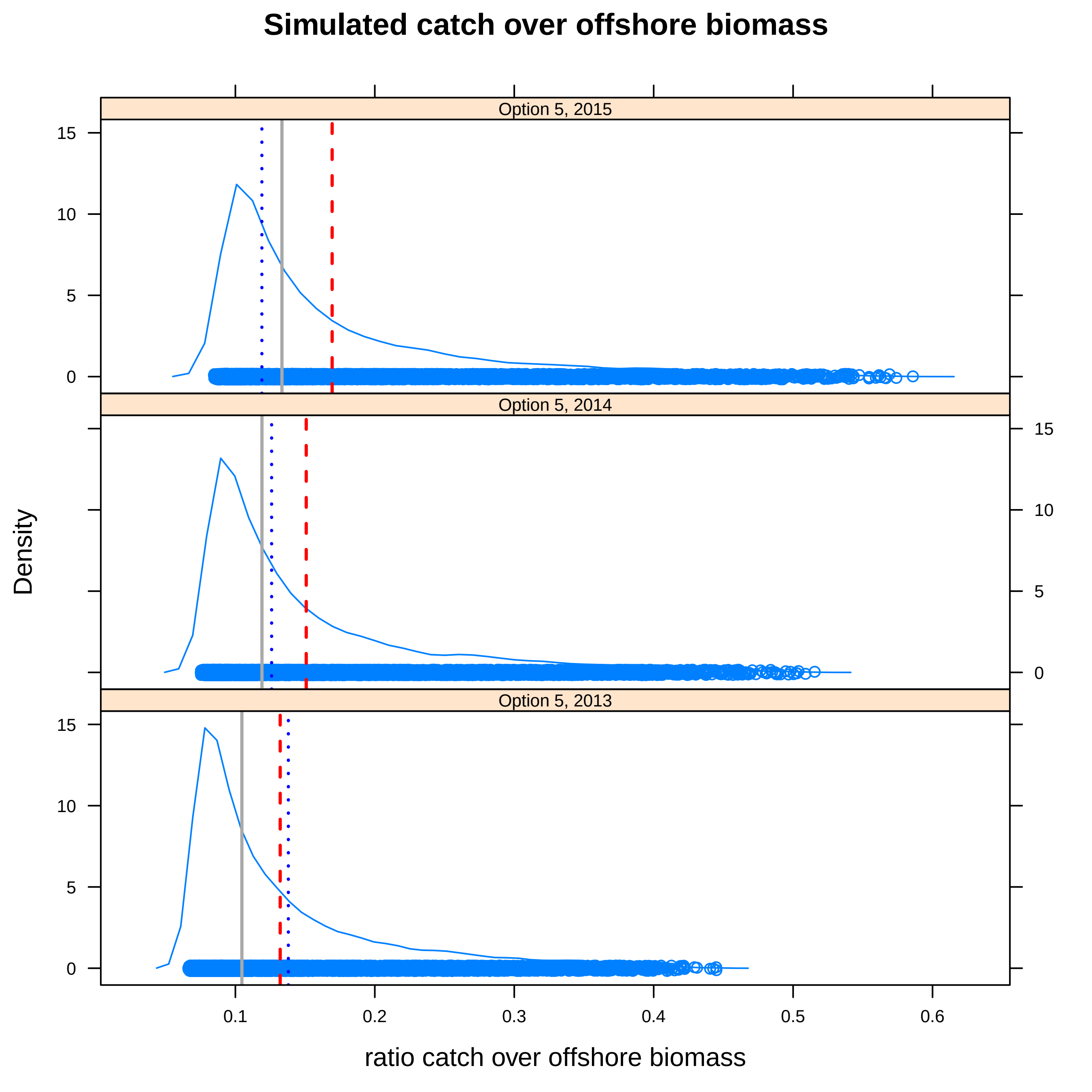


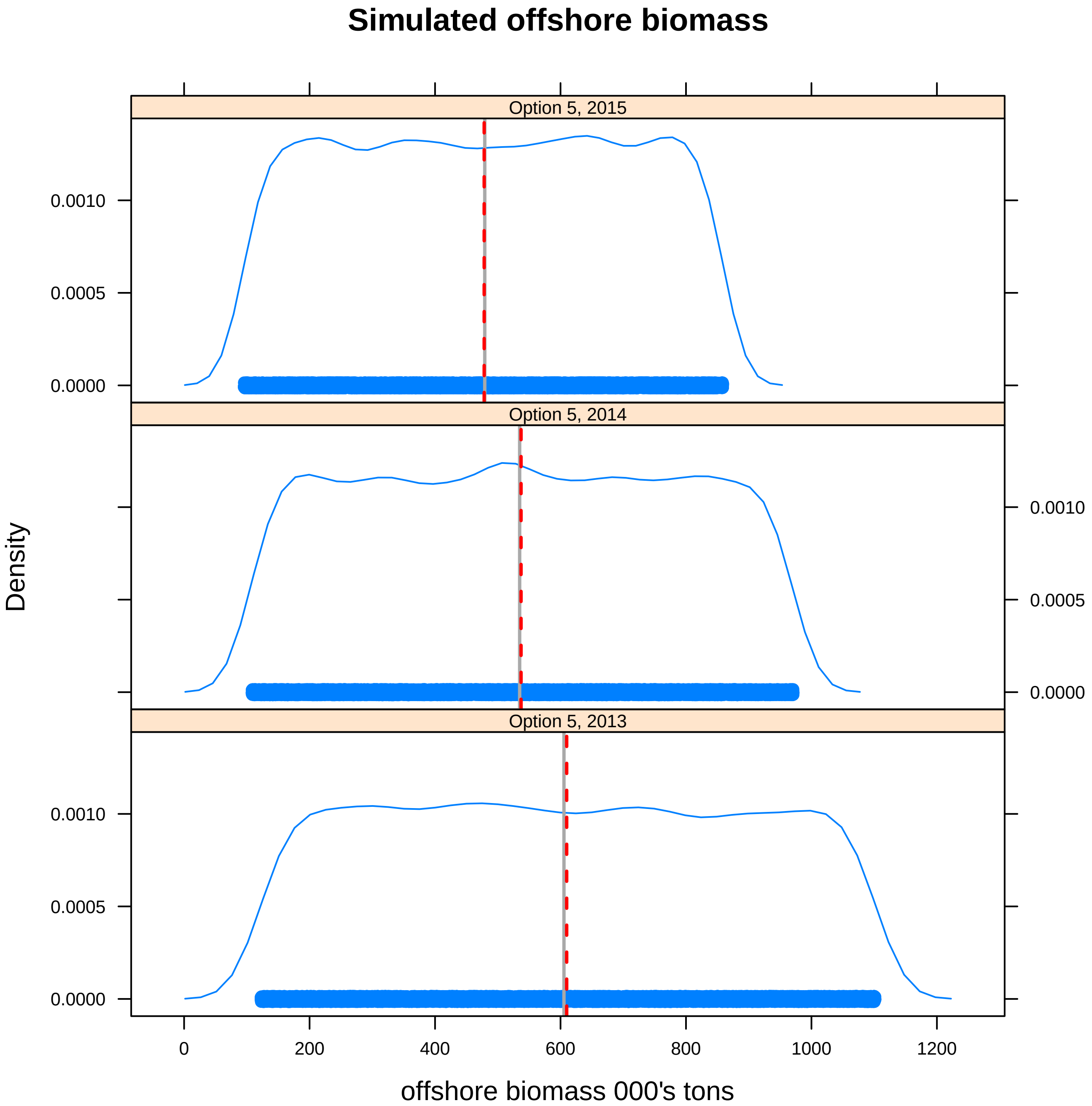
Simulated catch over inshore biomass
Option 5, 2015
Option 5, 2014
Option 5, 2013
Density
ratio catch over inshore biomass
0.0
0.2
0.4
0.6
0
5
10
15


Simulated inshore biomass
Option 5, 2015
Option 5, 2014
Option 5, 2013
0.0000
0.0005
0.0010
Density
0
200
400
600
800
1000
1200
inshore biomass, 000's t

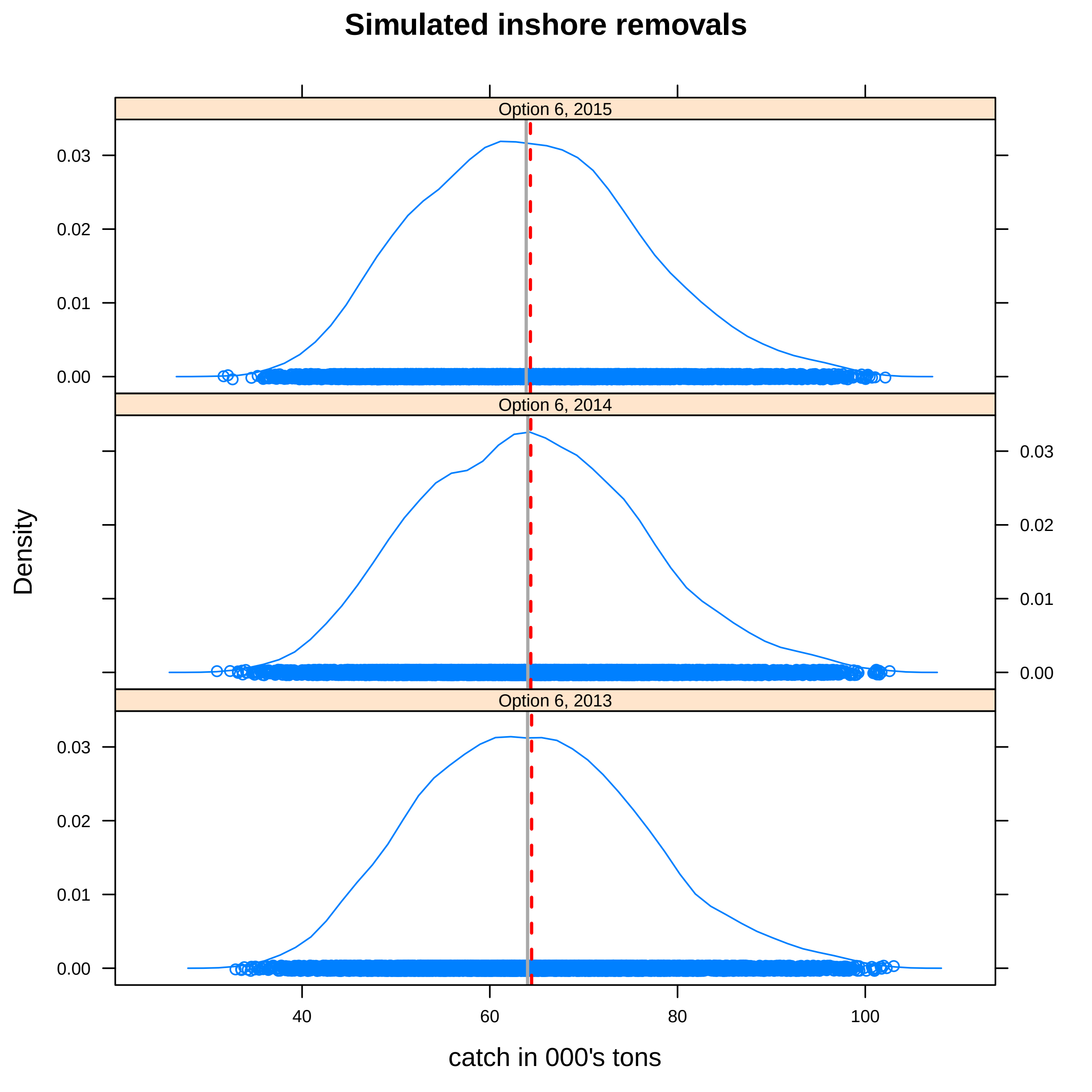


Simulated offshore catch
Option 5, 2015
Option 5, 2014
Option 5, 2013
0.00
0.01
0.02
0.03
Density
40
50
60
70
80
90
offshore catch, 000's t

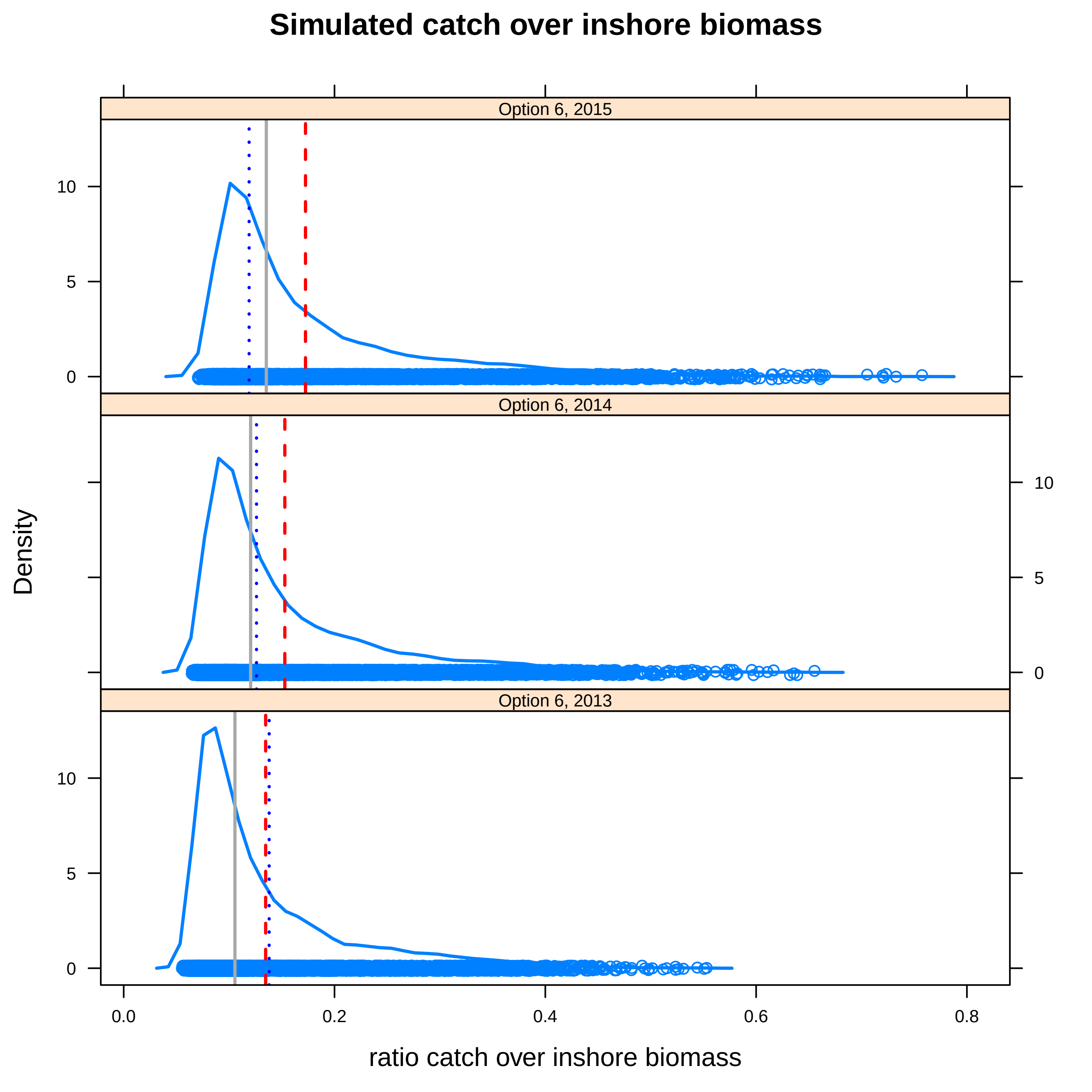

Simulated catch over offshore biomass
Option 5, 2015
Option 5, 2014
Option 5, 2013
Density
0
5
10
15
0.1
0.2
0.3
0.4
0.5
0.6
ratio catch over offshore biomass



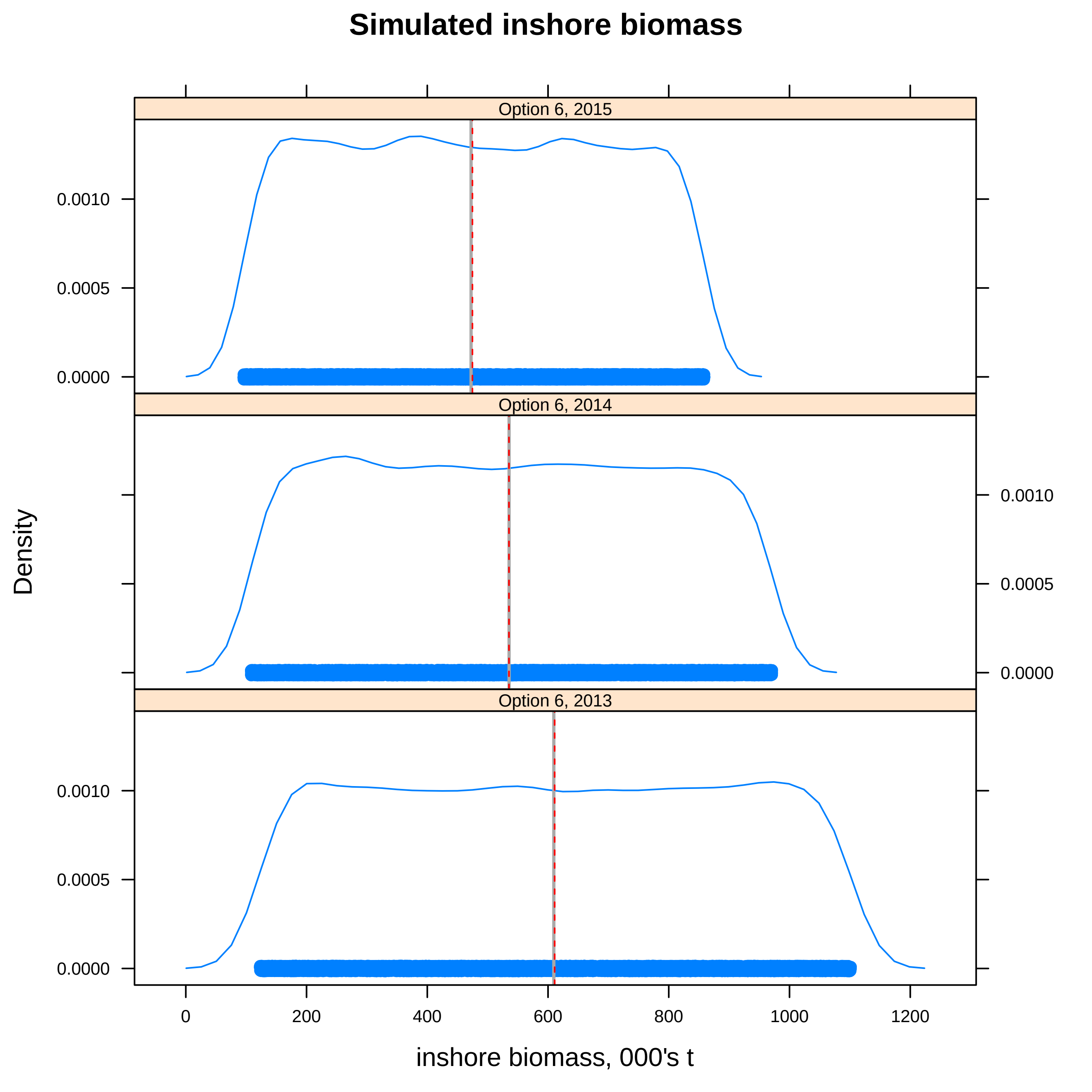
Simulated offshore biomass
Option 5, 2015
Option 5, 2014
Option 5, 2013
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
Density
offshore biomass 000's tons

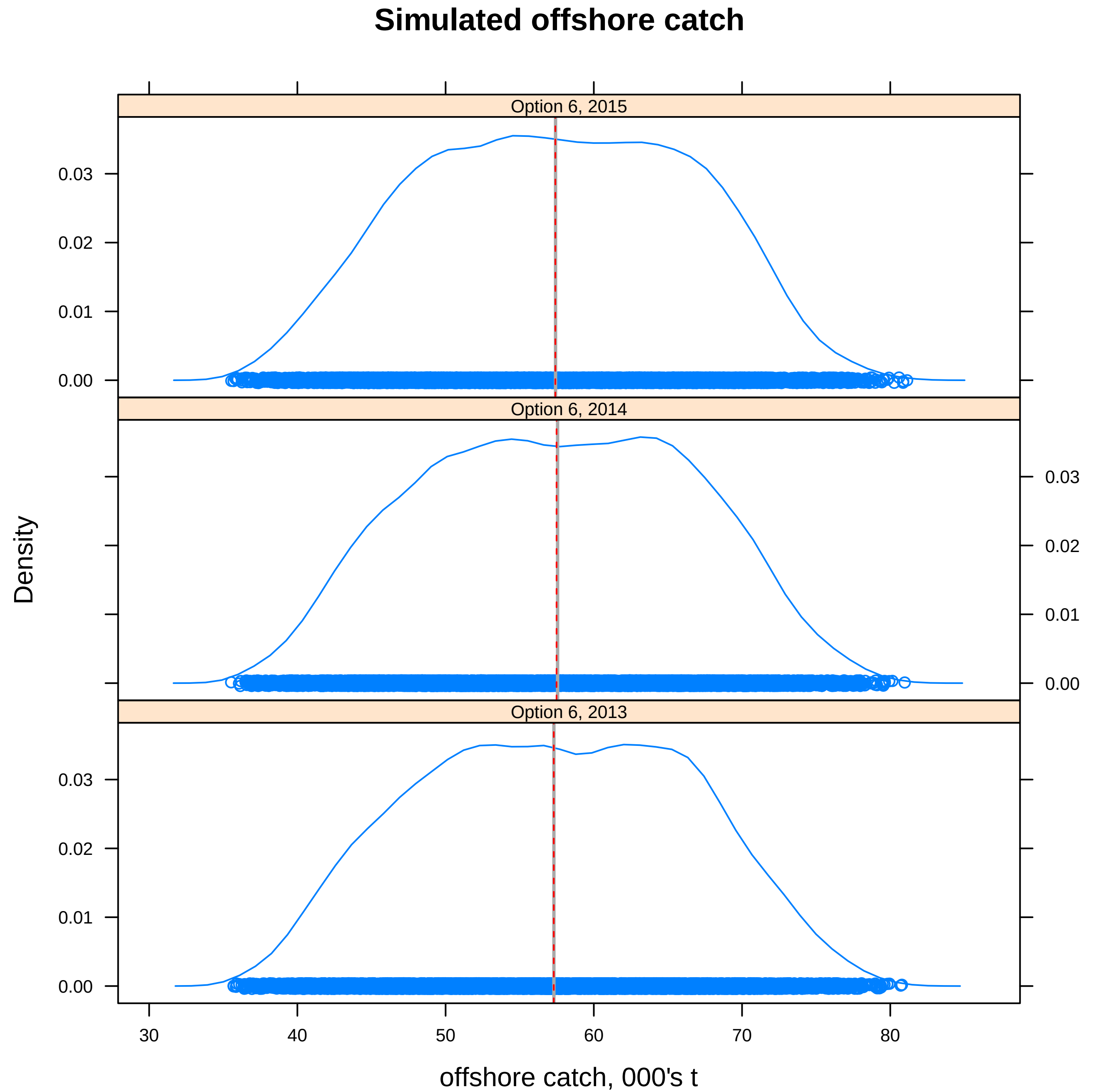


Simulated inshore removals
Option 6, 2015
Option 6, 2014
Option 6, 2013
0.00
0.01
0.02
0.03
Density
40
60
80
100
catch in 000's tons

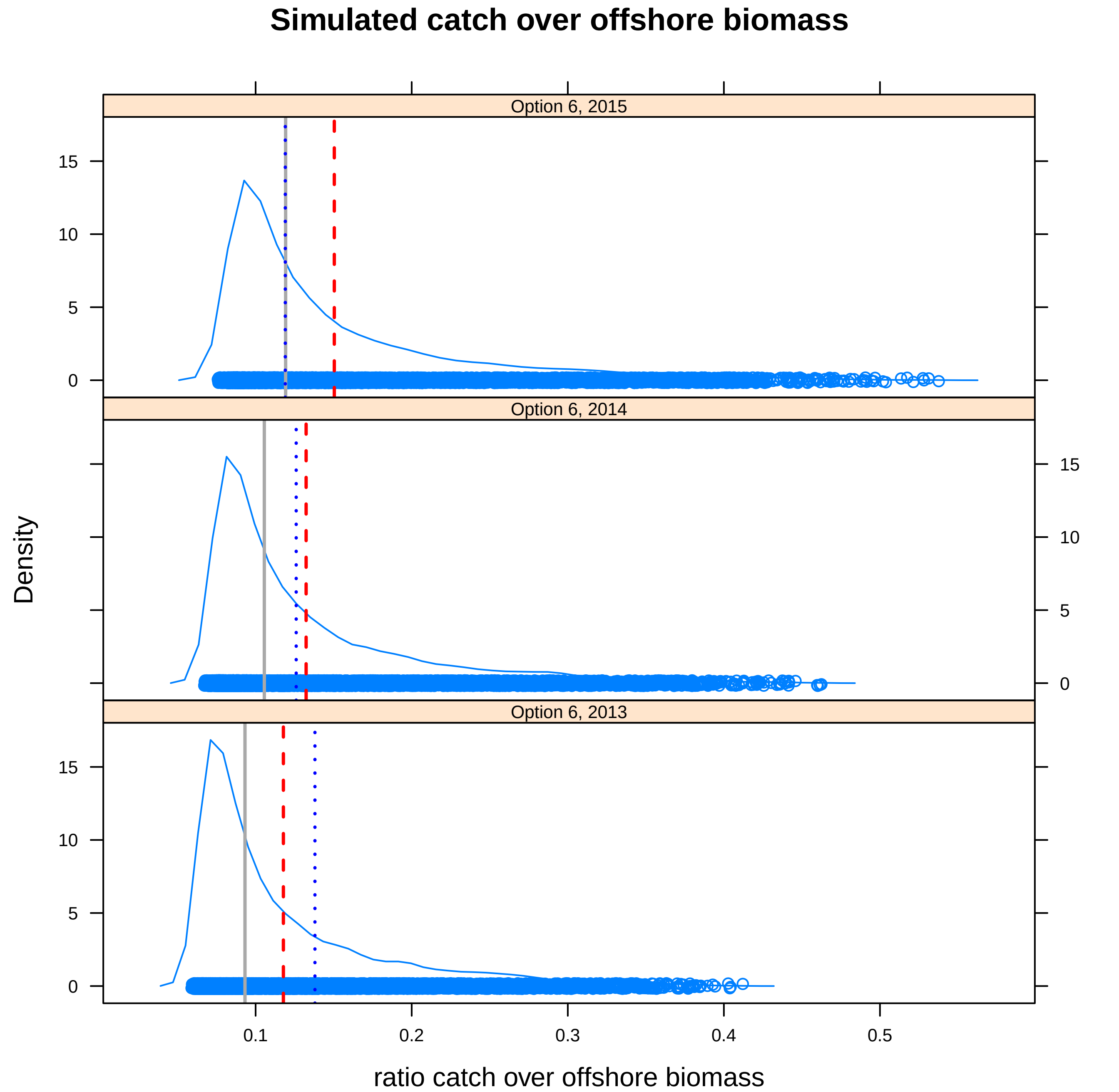


Simulated catch over inshore biomass
Option 6, 2015
Option 6, 2014
Option 6, 2013
Density
ratio catch over inshore biomass
0.0
0.2
0.4
0.6
0.8
0
5
10

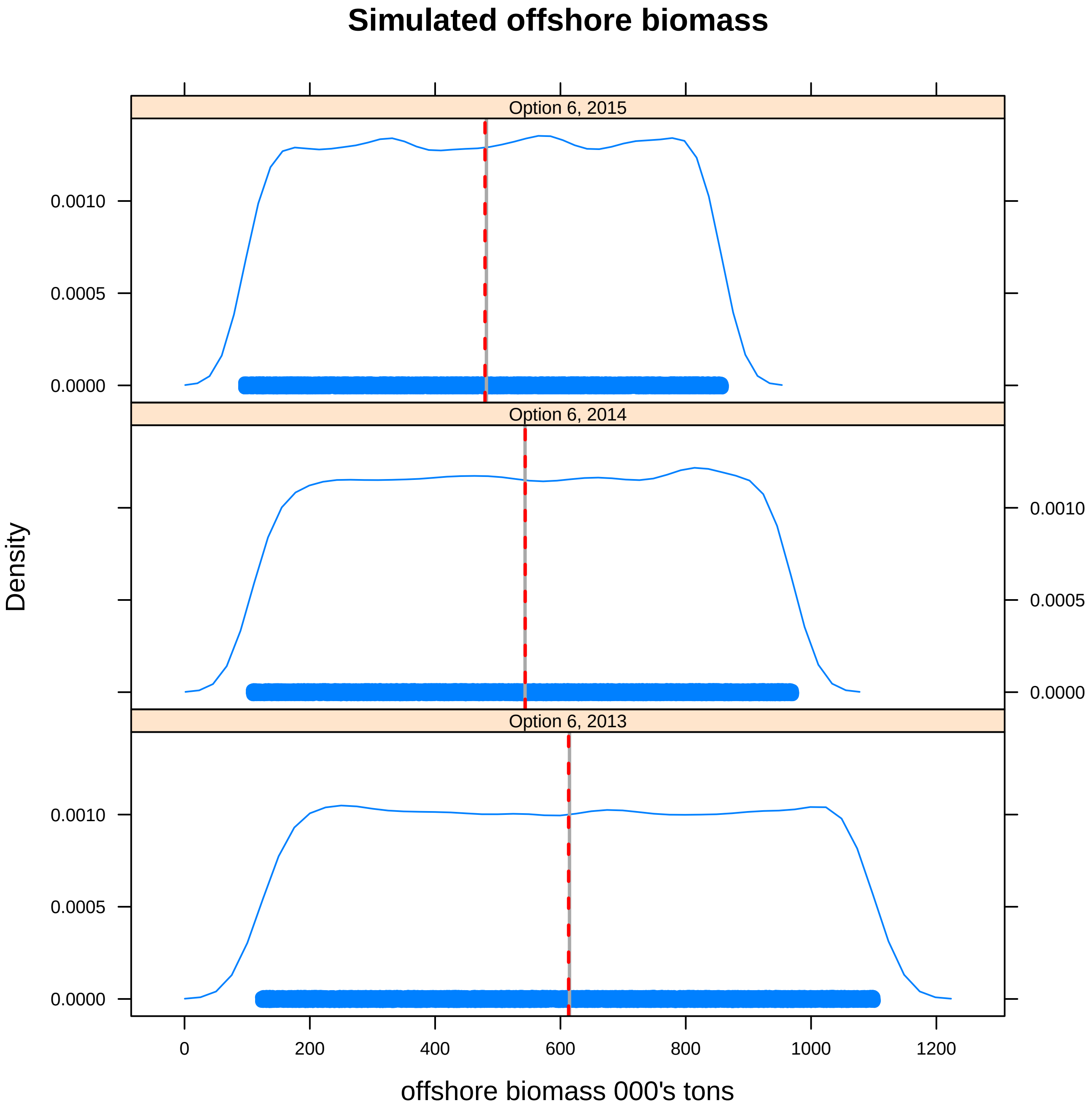

Simulated inshore biomass
Option 6, 2015
Option 6, 2014
Option 6, 2013
0.0010
0.0005
0.0000
Density
0
200
400
600
800
1000
1200
inshore biomass, 000's t

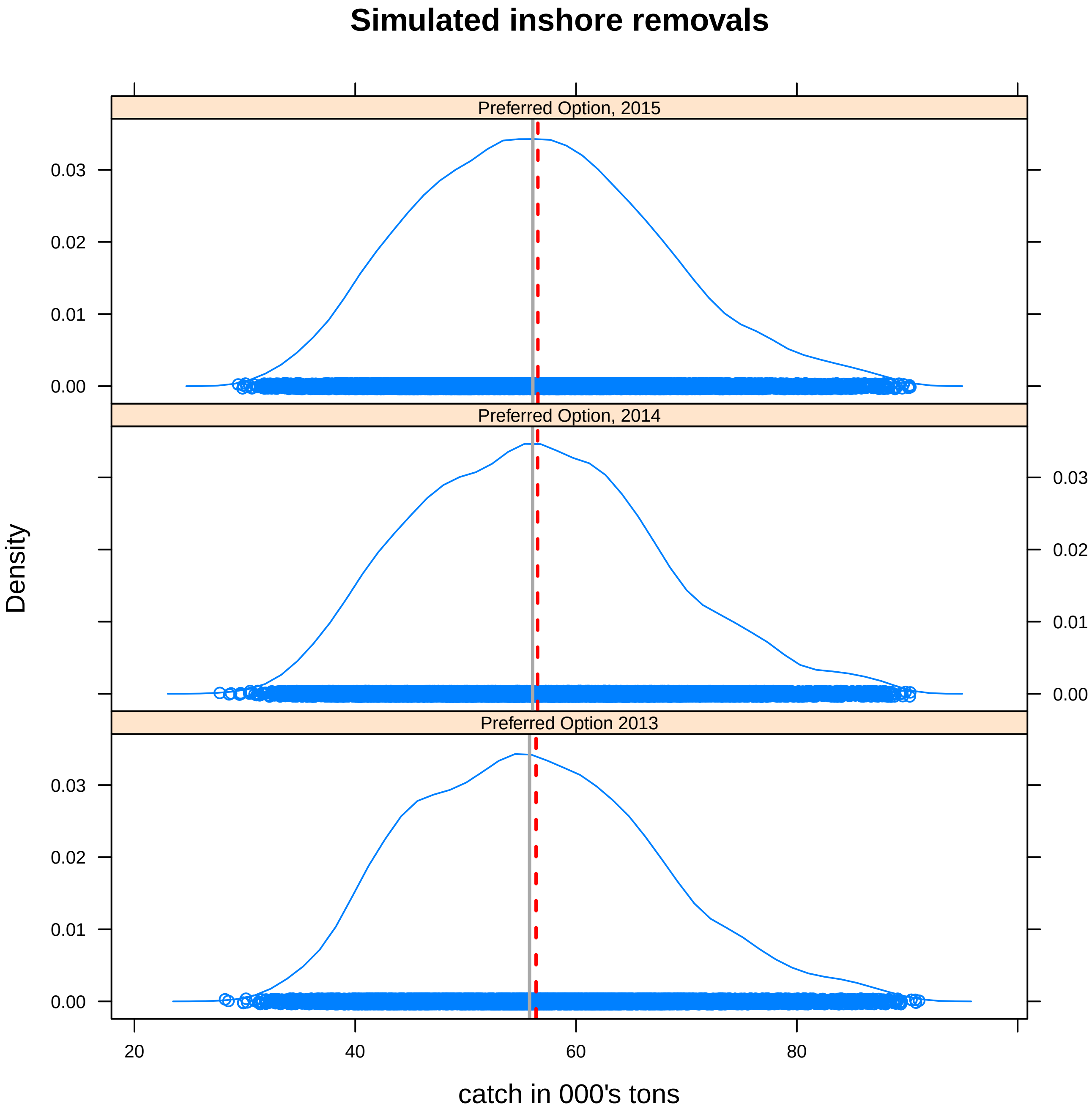


Simulated offshore catch
Option 6, 2015
Option 6, 2014
Option 6, 2013
0.00
0.01
0.02
0.03
30
40
50
60
70
80
Density
offshore catch, 000's t



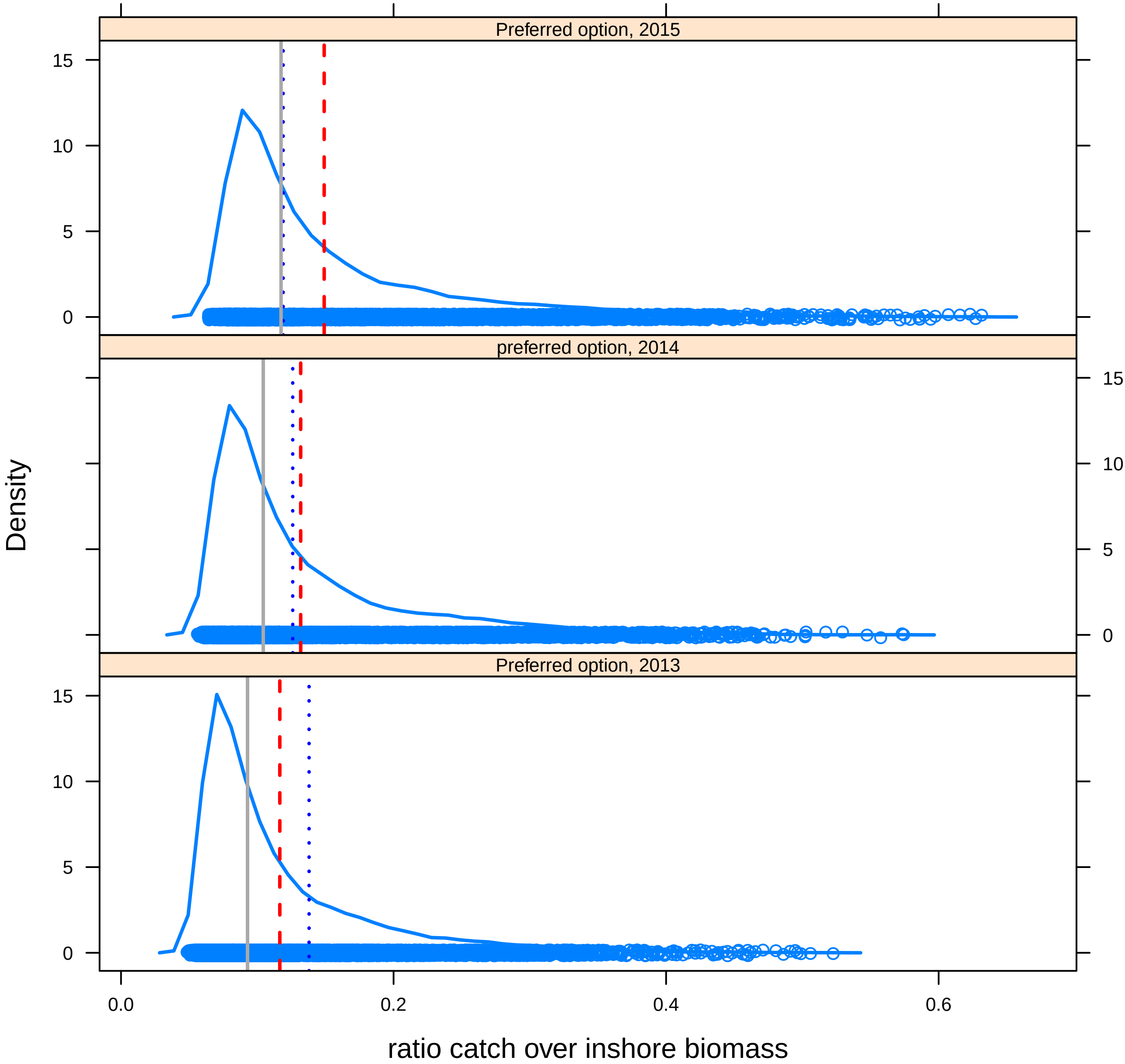
Simulated catch over offshore biomass
Option 6, 2015
Option 6, 2014
Option 6, 2013
Density
0
5
10
15
0.1
0.2
0.3
0.4
0.5
ratio catch over offshore biomass

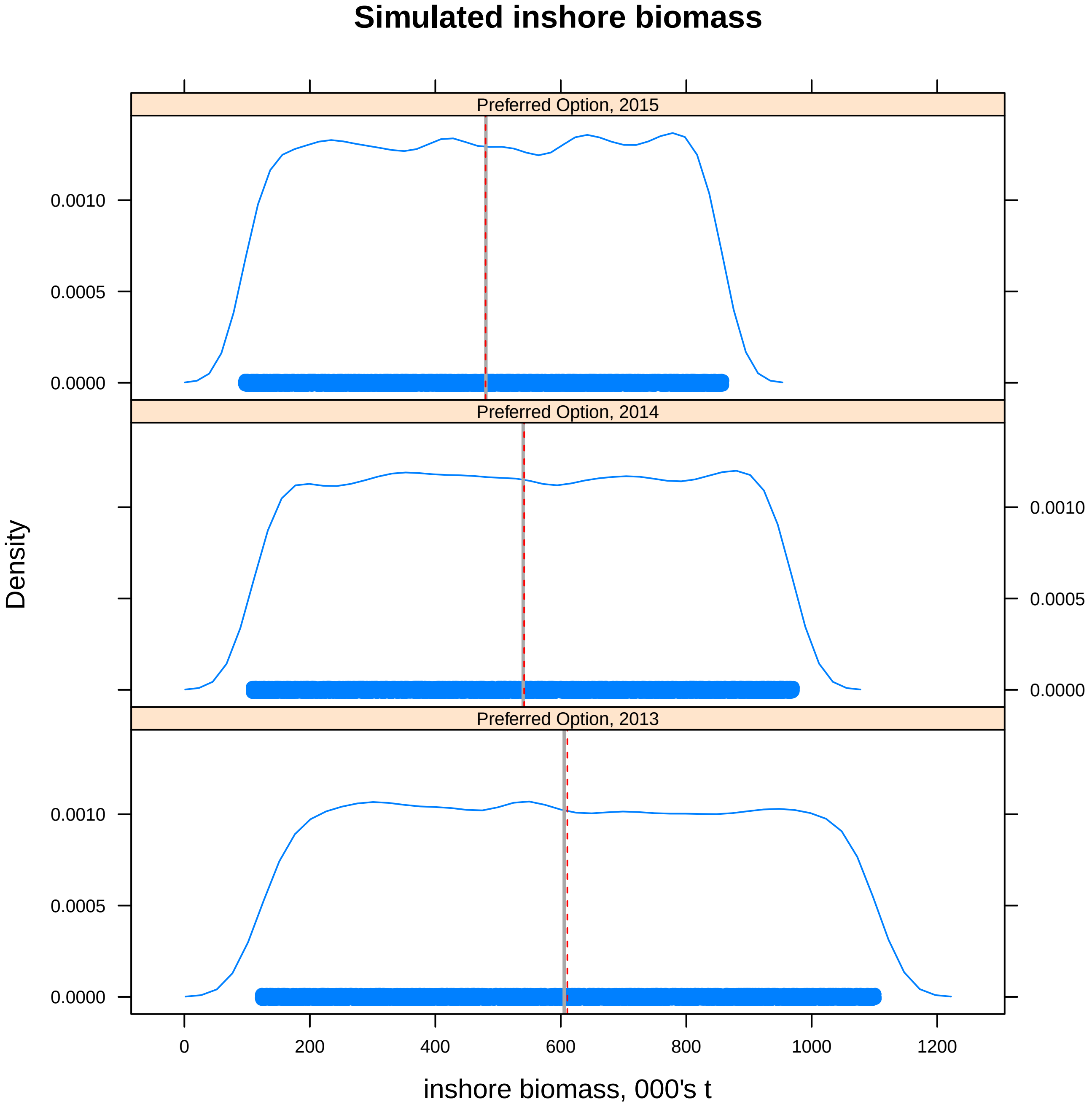

Simulated offshore biomass
Option 6, 2015
Option 6, 2014
Option 6, 2013
0.0000
0.0005
0.0010
Density
0
200
400
600
800
1000
1200
offshore biomass 000's tons



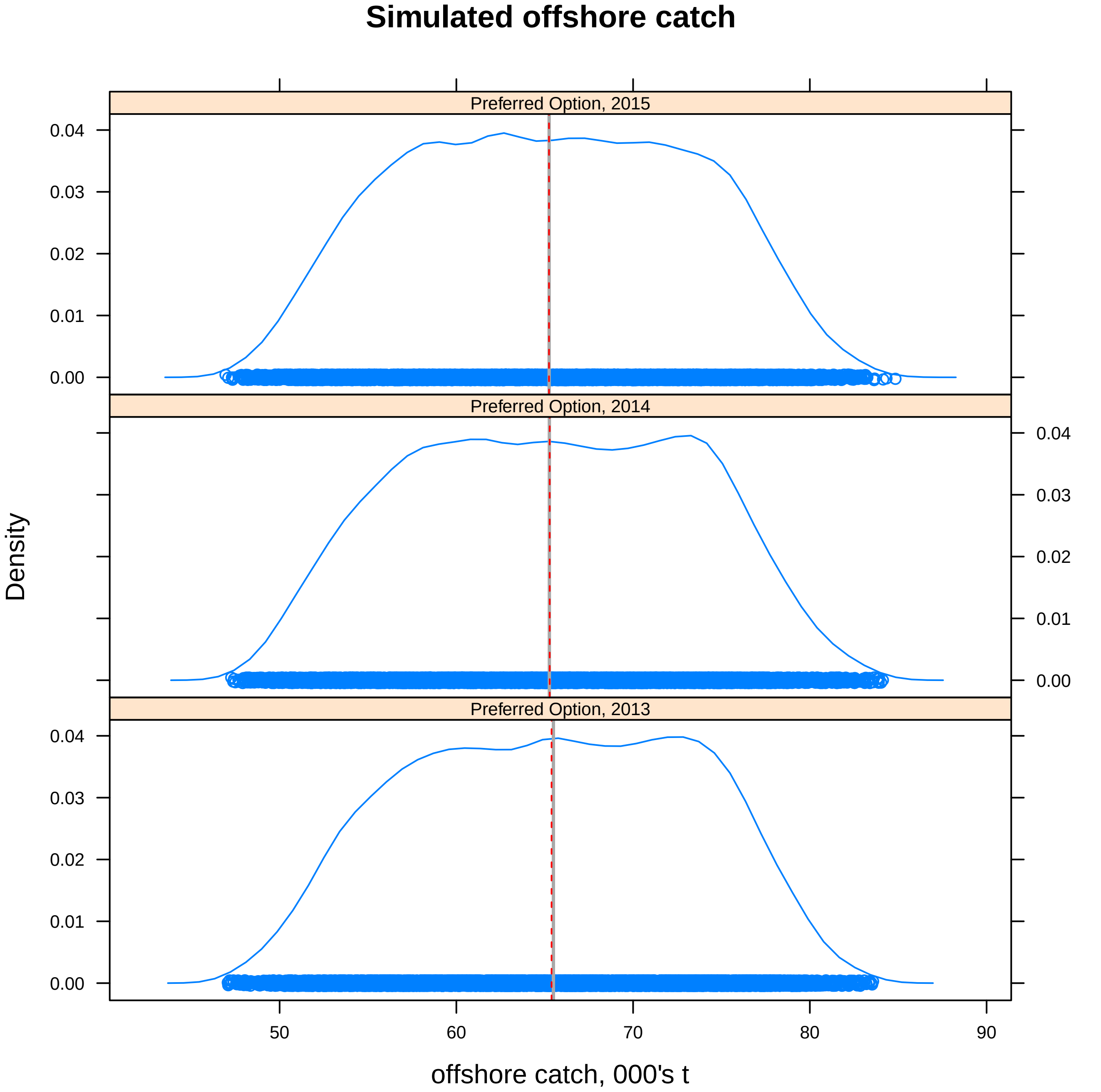
Simulated inshore removals
Preferred Option, 2015
Preferred Option, 2014
Preferred Option 2013
Density
catch in 000's tons
0.00
0.01
0.02
0.03
20
40
60
80

Simulated catch over inshore biomass

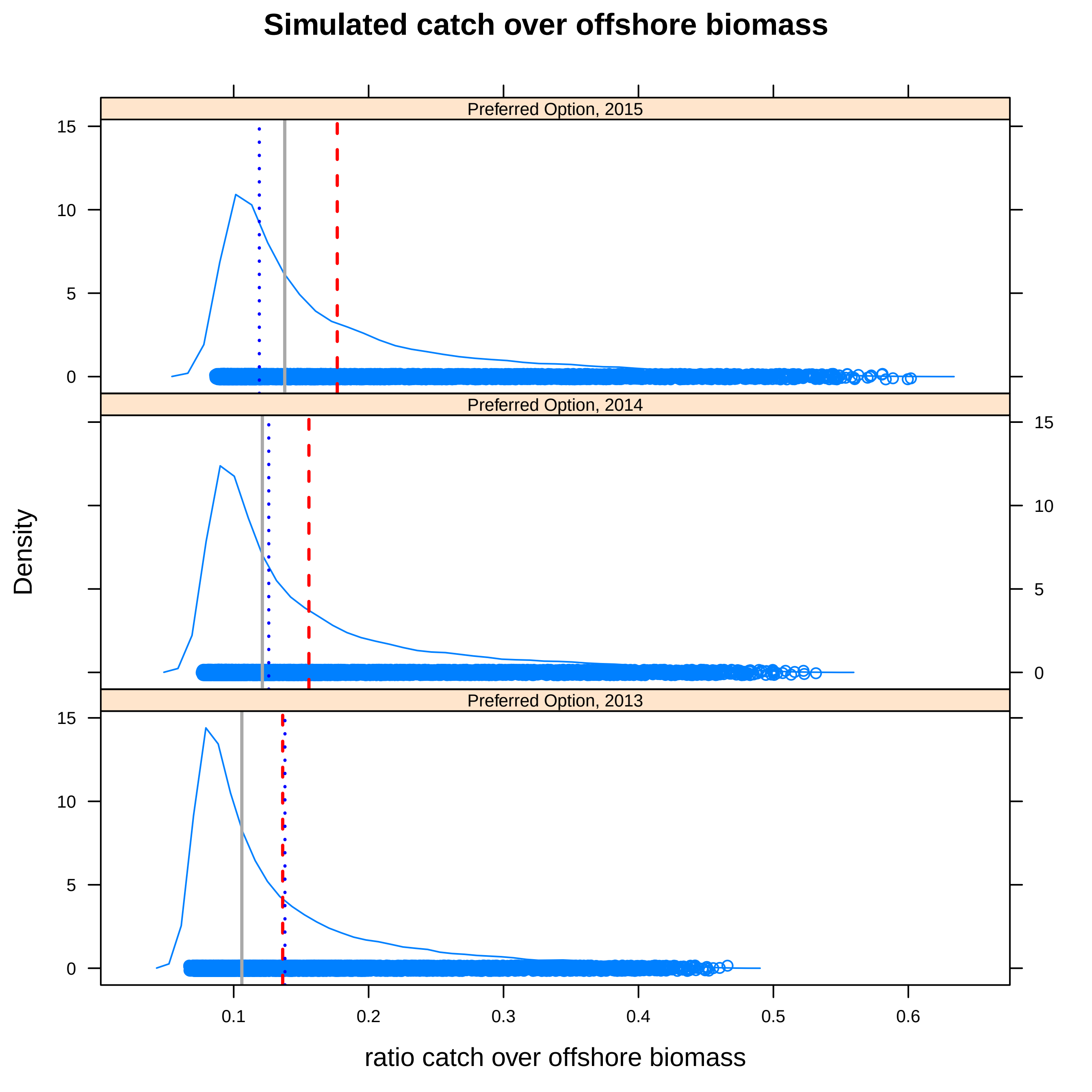


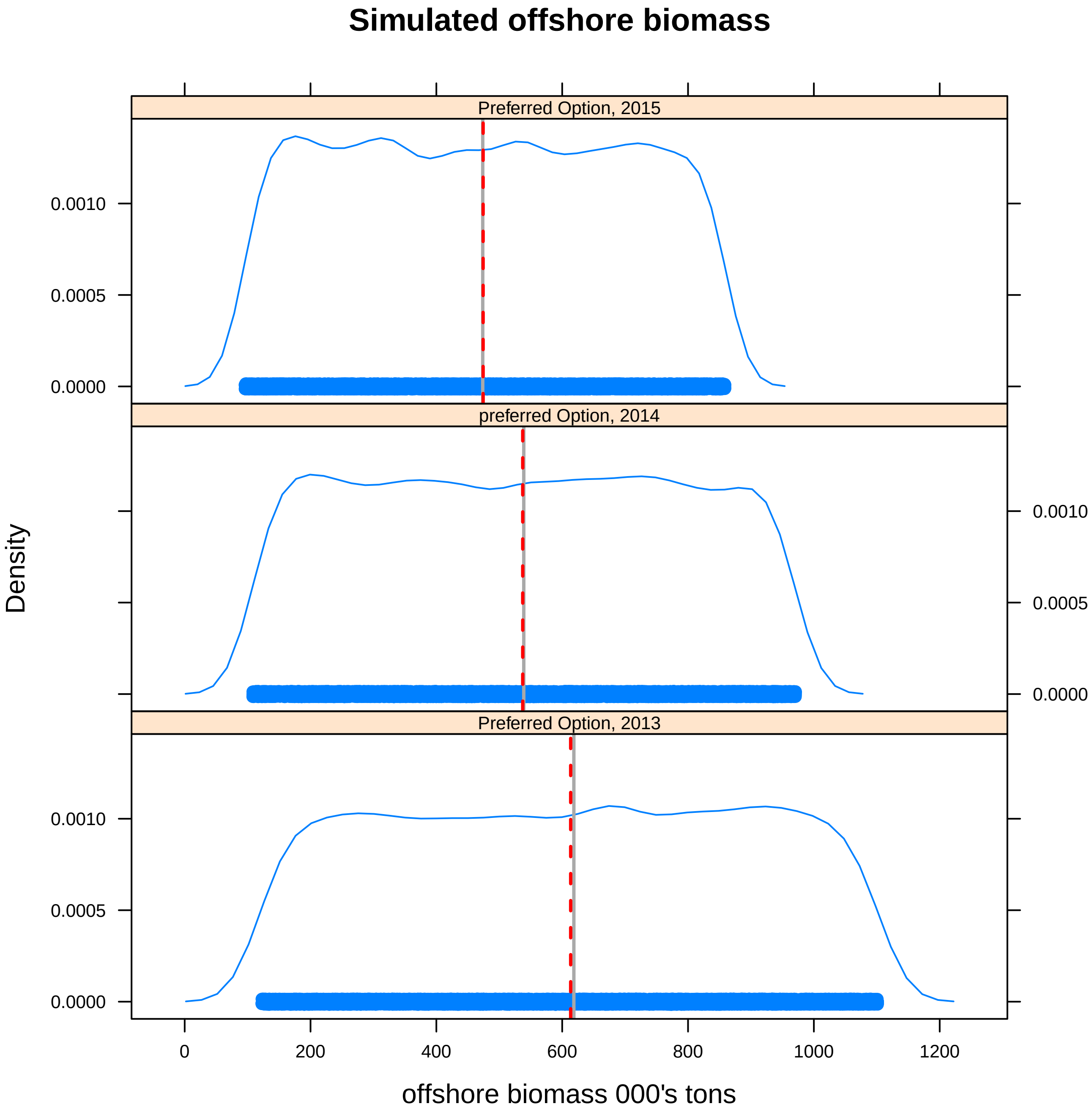


Simulated inshore biomass
Preferred Option, 2015
Preferred Option, 2014
Preferred Option, 2013
Density
0.0000
0.0005
0.0010
0
200
400
600
800
1000
1200
inshore biomass, 000's t



Simulated offshore catch
Preferred Option, 2015
Preferred Option, 2014
Preferred Option, 2013
0.00
0.01
0.02
0.03
0.04
Density
50
60
70
80
90
offshore catch, 000's t


Simulated catch over offshore biomass
Preferred Option, 2015
Preferred Option, 2014
Preferred Option, 2013
Density
ratio catch over offshore biomass
0
5
10
15
0.1
0.2
0.3
0.4
0.5
0.6



Simulated offshore biomass
Preferred Option, 2015
preferred Option, 2014
Preferred Option, 2013
0.0000
0.0005
0.0010
Density
0
200
400
600
800
1000
1200
offshore biomass 000's tons