

# Methods for analyzing the capacity reduction alternatives

This document describes the methods used in analyzing the potential impacts of the three Capacity Reduction Alternatives contained in the Buyout Prospectus document. We'll break down the discussion into two sections: a description of the models used, and a description of the buyout simulation approach. Remember that these Alternatives only apply to permit holders with allocated Category A Days-at-Sea (DAS).

## 1.0 Description of the modeling approach and the models themselves

Our objective is to understand the implications of the buyout—what its benefits and costs may be, and how it may change both the groundfish fishery and the other fisheries that are intrinsically linked to the groundfish fishery. Our challenge is to set up a buyout model that reflects, as closely as possible, what may happen under the various alternatives.

The basic buyout model, as set up in the Prospectus document, goes like this:

- Step 1: Calculate the capacity of all permits
- Step 2: Receive bids, derive “Buyout Score” ratio as bid / capacity
- Step 3: Rank Buyout Scores from lowest to highest
- Step 4: Accept bids, starting at lowest Buyout Score and working up, while subtracting the bids from the total amount available to the buyout
- Step 5: Stop accepting bids when money is gone

Therefore, there are only four key pieces of information we need to know to model the buyout:

- (1) How do we determine capacity?
- (2) Who is likely to bid?
- (3) How much will they bid?
- (4) How much money is available to fund the buyout?

The first question we've already answered. We're using a stochastic production frontier formula that estimates the maximum possible output from a given combination of inputs (registered length, horsepower, allocated A and B DAS) using landings and revenue data from 2001 – 2005.

So, the next question is...who is likely to bid?

No one has a clue. We constructed several models based on the data from the two previous buybacks, including an exhaustive (and ultimately fruitless) attempt to adopt a very good bid-predictor model published by the NEFSC's Eric Thunberg and Drew Kitts, but none of the models predicted who would bid any better than, say, throwing darts blindfolded.

We simply can't predict with any degree of accuracy who will bid, and this is a bit of a hurdle when it comes to modeling a buyout. So instead of trying to predict who will bid, we took a different approach...we assumed that every permit holder has the same probability of placing a bid. This is another way of saying "we don't know and we won't try to guess."

Under this scenario, where any permit has an even shot at submitting a bid, the primary driver becomes *how many bids will be submitted?* If everyone submits a bid, then the entire pool of 1,008 Category A DAS permit holders is available for selection, and the pool of "cheap" effort is potentially large. If only half the permit holders submit bids, the pool of "cheap" effort becomes smaller, raising the marginal cost for each unit of capacity retired through the buyout.

So the end result of a buyout is heavily influenced by how many bids are placed...the more bids placed, the lower the marginal cost of buying capacity will be.

Having worked around the "who will bid?" dilemma, the third question is "how much will they bid?" To answer this, we experimented with four available data sources: (1) the 1996 vessel buyback, (2) the 2001 permit buyback, (3) the DAS leasing database and (4) the vessels for sale on the open market.

For Alternatives 2 and 3-ATT (Above the Threshold), I chose to use number four from the above list (vessels for sale on the open market). For Alternatives 1 and 3-BTT (Below the Threshold), I chose number two. Here's why.

(For details on the Alternatives and who is ATT and BTT, see the Buyout Prospectus, the Buyout Prospectus Executive Summary, or the three Alternatives Analysis documents, all available online).

### ***The Vessels for Sale bid estimation model***

Alternative 2 calls for retiring all federal (and potentially all state) permits. There are extra payouts associated with other permits held, but this Alternative comes pretty close to a complete divestiture of one's business...so the vessel-for-sale market is, perhaps, a decent approximation.

We could get our hands on data sufficient to match the listing sheet with a permit number for 36 vessels listed between March and July of 2006 that had groundfish permits with allocated 'A' Days-at-Sea. These vessels were listed primarily with Athearn Marine in New Bedford, MA, though two vessels were listed independently in Commercial Fisheries News. We recognize that these data sources omit the non-brokered sale market almost entirely—a market that may be more representative of vessel values—as well as any other vessel brokerage businesses in New England. However, we've got no way of accessing data on the non-brokerage market (other than the listings in Commercial Fisheries News and National Fisherman, which are rarely sufficient to confirm permit numbers), and Athearn Marine carries the vast majority of vessel listings in New England.

Vessels sold through a broker, it may be assumed, may be more difficult to sell and, for one reason or another, their values may under-represent the values of the fleet as a whole. The flip side though is that owners typically list their vessels at some price above what they reasonably expect to collect for the sale and, therefore, in the

absence of firm sale-price data, the listing prices may inflate the value of these vessels. The two countervailing forces could, potentially, offset each other and yield a decent approximation of a vessel's value on the open market. Furthermore, because the market right now is relatively non-liquid (not many vessels for sale, and not a lot of quick turn-over for those that are), prices from listings may be biased upward relative to a reverse-bid auction environment, where there is a perceived pressure to bid relatively low for a permit or vessel. Additional upward bias may exist because of the additional payouts offered under an Alternative 2 scenario (other fishery permits, vessel scrapping/scrapping voucher, and category 'C' Days-at-Sea, to name three). These factors are presumably incorporated into the listing price of a vessel in a brokerage, but may not be incorporated into a bid placed in the buyout.

We settled on a model to describe the Vessels for Sale data that used the following characteristics to predict the listing price, which we are using as a proxy for a bid placed under an Alt2 or Alt3-ATT scenario:

- Upgraded baseline length
- Upgraded baseline horsepower
- Category A Days-at-Sea
- Documented age
- Groundfish landings history, best four years 1996-2001

These predictors give us the following equation to calculate an estimated bid:

$$\text{bid\_est\_alt2} = (0.44 * \text{up\_vhp}) + (3.406 * \text{up\_len}) + (.663 * \text{a\_das}) + (-4.712 * \text{age}) + (0.086 * \text{history})$$

Note that this equation yields an estimated bid in thousands of dollars—multiply the output by 1,000 to get the full value of the estimated bid.

Impressively, the model predicts 94% of the variability of the input data—it describes the listing price of the 36 vessels pretty well. When applied to all 1,008 permits with allocated A Days-at-Sea, the model yields a total fleet value of \$343,309,840.

We compared the moments (the statistical distribution) of the Vessels for Sale dataset to the fleet as a whole for both the variables in the model and the important variables that the model does not use, like active and latent DAS. They were all surprisingly similar. The only significant difference was in the history variable, where distribution of observations in the 75-95 percentiles of the Vessels for Sale dataset was a bit thinner—that is, the “top end” was present, but it dropped off more quickly for the Vessels for Sale dataset than it did in the fleet as a whole. All in all, both the predictive model and the moments of the important variables appeared solid. They'll serve as a more-than-suitable foundation for building our Alternative 2 and Alternative 3-ATT buyout analyses.

An important point emerges, however, when this model is coupled with the Buyout's provision for paying permit holders, under Alt 2 and Alt 3 Above-the-Threshold (ATT), a set premium for their non-groundfish moratorium permits. This premium would be paid by a Congressional allocation, not Buyout loan funds, and would be appended to the amount of a permit holder's bid—yielding a total payout substantially larger (in some cases) than the bid itself.

Table 1 – Breakdown of estimated mean payouts by vessel length class

Length Class	Mean estimated payout	Number permit holders	Total Congressional Allocation
1	\$0	25	\$0
2	\$52,670	130	\$6,847,100
3	\$99,580	122	\$12,148,760
4	\$147,050	53	\$7,793,650
	<i>Totals:</i>	330	\$26,789,510

Table 1 shows that the premium payment for other fishery permits may be substantial. Consequently, it can be assumed that if a large premium payment is being made, that permit holder will be likely to bid somewhat less than what the Vessels-for-sale model predicts.

To accommodate this, estimated bids were reduced for permit holders receiving premium payments for their other fishery permits. The amount of this reduction is proportional to the size of the premium payment, such that the new estimated bid is equal to the Vessels-for-sale modeled bid minus ½ of the premium payment. The new estimated bid has a variable floor, however, of ½ the Vessels-for-sale modeled bid for permit holders with more than 60% of their revenues coming from groundfish between 2003 and 2005. For vessels with less than 60% of their revenues coming from groundfish in those years, the minimum new estimated bid is equal to ¼ of that permit’s Vessels-for-sale modeled bid. Furthermore, permit holders who reach the \$500K threshold for the premium payment (see the Prospectus document for details on this) are assumed to be more likely to bid high than other vessels, since a portion of their recent revenues in other fisheries is not covered by the premium payment. These permit holders have a minimum bid of 1.5 times their Vessels-for-sale modeled bid.

***The 2000 Permit-only Buyback bid estimation model***

The 2000-2001 permit-only buyback is a good approximation of Alternative 1 and Alternative 3-BTT because, in each case, the permit holder is bidding exclusively on the value of his or her groundfish permit.

We recognize that a lot has changed since the bids were submitted for this buyback. For one, permits are likely to have a higher scarcity value now than they did then. However, regulatory conditions have tightened and the prospects for the future are more cloudy, and perhaps more dreary, than they were in 1999. Like in the Vessels for Sale model, these countervailing forces may balance each other out.

In any case, the only other approach we could think of--using the A\_DAS and HISTORY parameters from the Vessels for Sale bid estimate model--didn’t look nearly as promising. So we forged ahead with what we had and were delighted to find that we could fit a very reasonable model to these data.

After countless trials and errors, we settled on just three variables to predict the bids in the permit-only buyback:

- Registered gross tonnage
- Days at sea

- Groundfish landings history from 1996 – 1999

These predictors gave us the following equation to calculate an estimated bid:

$$\text{bid\_est\_alt1} = (947 * \text{gtons}) + (1061.9 * \text{das}) + (0.3435 * \text{history})$$

256 permits were used in the model, because that's how many permit holders submitted bids and had registered tonnage, das and history greater than zero. Amazingly, these three predictors alone account for 68% of the variability in the dataset. The gross tonnage variable, as used here, essentially wraps up the contribution of all of the permit's baseline characteristics to the value of the permit (that is, it serves as a proxy for the value of all the capital equipment characteristics associated with that permit). Including the allocated DAS in the model allows us to scale bids based on contemporary DAS allocations (note that we used A and B DAS in our bid predictor for Alt 1 and Alt 3-ATT). The history variable was the key piece of the puzzle—prior to incorporating this variable, we were able to explain no more than 25% of the variability in the dataset. Due to the amount of variability we can explain with it's inclusion, it appears that permit holders have been valuing permit history for a long time.

At the end of the day, all three variables were significant and the model was solid—rust-free chassis, tight suspension and all pistons were firing. It provided results that were, on average, lower than the Vessels for Sale model, but it had it's own quirky outliers. Importantly, it provided an independent model with which we could compare the Vessels for Sale results—a comparison that, as you'll see in the analyses, yielded surprisingly consistent results given that they were derived from entirely independent sets of data.

The last question is “how much is available for the buyout?” We ran all of the models using both \$80 and \$100 million. Because the Ctte has already allocated \$5.7 to the C-DAS program, and there will surely be some vessels scrapped at additional cost to the industry, allocating \$100 million to the purchase of capacity would probably require an industry loan in the \$110 million range...so \$100 million is probably slightly more than we should reasonably expect, and \$80 million is probably slightly less.

## 2.0 Analyzing the Capacity Reduction Alternatives

Using the four questions (stated above), we started to construct our analysis. Here's a quick recap of our foundation:

- (1) How do we determine capacity?

*Easy...like this:*

$$(-29 + (1.64 * \text{up\_vhp}) + (18.09 * \text{up\_len})) * (\text{a\_das} + \text{b1\_das} + \text{b2\_das})$$

- (2) Who is likely to bid?

*Everyone is equally likely to bid, but we don't know how many bids will be placed. So we'll run models at different bid-submission intervals.*

- (3) How much will they bid?

*It depends on the Alternative. Alt1 and Alt3-BTT use the 2000 Permit-only bid estimation model, while Alt2 and Alt3-ATT use the Vessels-for-Sale bid estimation model.*

- (4) How much money is available to fund the buyout?  
*We ran simulations at both \$80 and \$100 million.*

One variable that is not covered in these four questions, but heavily influences the predicted results under the three Alternative scenarios, is the Catch History Multiplier (CHM). We ran all models both with the CHM and without it, so we can compare the costs and benefits of the CHM directly. The results of the modeling with regard to the CHM will be discussed shortly.

To simulate what might happen under each of the alternatives, we conducted a few mock-buyouts. Our simulations--mock-buyouts--included fixed bids (as predicted by the appropriate bid estimate model) but we varied the numbers of bids submitted. The instance of any one permit holder submitting a bid was completely random.

For example, in one mock-buyout, 100 permit holders out of the 1,008 available would be selected to submit a bid. Their bid amount is defined by the appropriate bid estimation model, and that bid is then compared to their permit's capacity estimate. This ratio (bid : capacity) then yields a "Buyout Score," and these are automatically ranked from lowest to highest. Starting with the first (lowest) Buyout Score, the value of the bids are added to one another until the sum reaches the value of the maximum funds available.

This is done 100 times, so that all permit holders submit bids roughly the same number of times. Sometimes a permit holder's bid is accepted, and sometimes, depending on the composition of the 100 Buyout Scores, it is rejected. Most permits were either accepted or rejected 90% of the time, but a few "bubble boats" emerged...permits that would have bids accepted only 20 or 30% of the time they were selected to bid.

After running 100 simulations with 100 permit holders selected to bid, we ran 100 simulations with 200 bids submitted...and then 100 simulations with 300 bids submitted...and on and on, at intervals of 100 bids, up to simulations where 1,000 bids were submitted. So, for each Alternative (with and without the CHM) we were running 1,000 simulations (ten intervals of 100 mock-buyouts). We experimented with running more, but between 100 and 200 simulations the results changed only slightly (about 0.1 percentage points) and between 200 and 1,000 simulations the results did not change. Because each set of 100 simulations takes about 12 minutes to run, we stuck with the 100-per-interval.

We were interested not only in which permits had accepted bids, but also in the attributes of those permits. We tracked the following eleven metrics throughout the simulations, and reported the average at each bid-submission interval:

- Number of groundfish permits and percent-of-total retired
- Number of capacity units and percent-of-total retired
- Number of allocated A-DAS and percent-of-total retired<sup>1</sup>
- Number of active A-DAS and percent-of-total retired<sup>1</sup>
- Number of latent A-DAS and percent-of-total retired<sup>1</sup>
- Number of leasee A-DAS and percent-of-total retired<sup>1</sup>
- Pounds of groundfish history and percent-of-total retired<sup>2</sup>

- Number of loligo moratorium permits retained (Alt1 and Alt3-BTT) or retired (Alt2 and Alt3-ATT)
- Number of illex moratorium permits retained (Alt1 and Alt3-BTT) or retired (Alt2 and Alt3-ATT)
- Number of monkfish category C moratorium permits retained (Alt1 and Alt3-BTT) or retired (Alt2 and Alt3-ATT)
- Number of monkfish category D moratorium permits retained (Alt1 and Alt3-BTT) or retired (Alt2 and Alt3-ATT)

<sup>1</sup>2005 DAS data

<sup>2</sup>Top four pounds landed between '96-'01

### ***The Catch History Multiplier***

Because we can simulate buyouts under conditions consistent with each of the three Alternatives, we can add the CHM to the capacity estimate and compare the costs and benefits. When simulations were run for all three Alternatives with and without the CHM, there was almost no difference in the overall amount of capacity retired, nor was there much of a difference in the numbers of permits, A-DAS or latent DAS retired.

**Table 2 – Percentage difference in Cost-per-Capacity bought out with and without the CHM in the Buyout Score equation**

# bids submitted	Alternative 1	Alternative 2	Alternative 3
<b>300</b>	---	-0.41%	---
<b>400</b>	---	0.00%	0.55%
<b>500</b>	0.00%	-0.50%	0.00%
<b>600</b>	-0.74%	-0.52%	-0.66%
<b>700</b>	-0.79%	-1.07%	-0.69%
<b>800</b>	0.00%	-0.55%	-0.72%
<b>900</b>	0.00%	-1.12%	-0.75%
<b>1000</b>	0.00%	-1.69%	-0.78%

Table 2 shows that the CHM has an approximate cost of between 0 and 1.7 percent of the total per-unit cost of buying out capacity. We consider that to be pretty close to costless.

So if the CHM does not appear to raise the marginal cost of a buying out a unit of capacity, what does it do? Including the CHM appears to re-jigger the composition of the accepted bids to capture permits with significantly different attributes. Because there is little or no cost associated with the CHM, the decision to include or not include the CHM rests on determining if the re-distribution of the capacity retired with the CHM is a 'good' or 'bad' thing. To get a handle on exactly what the differences might be with or without the CHM, we calculated the percentage difference in capturing various attributes of permits that had bids accepted in our buyout simulations. Attributes used were:

- Capacity units
- Allocated A-DAS
- Actively used DAS (in 2005)
- Latent DAS (in 2005)
- Lessee DAS (in 2005)
- Landing history (lbs groundfish landed in best four years between 1996-2001)

This analysis shows that the primary contribution of including the CHM in the Buyout Score is the capture of significantly more permit history and active DAS and significantly less leasee DAS. This contribution remains consistent, more or less, through simulations under each of the three Alternatives (Figures 1 – 3, below).

Based on the results of the public information sessions, where permit holders clearly articulated a preference for capturing actively used DAS and permit history as a part of the buyout, and because the decision is virtually costless in terms of total capacity bought out, the Committee voted at their July 27 meeting to include the CHM in the Buyout Score Equation. All subsequent analyses of the Alternatives will incorporate the CHM.

Figure 1 – Alternative 1: Percent difference in capturing various attributes of permits bought out when using the CHM vs. not using the CHM in the Buyout Score equation

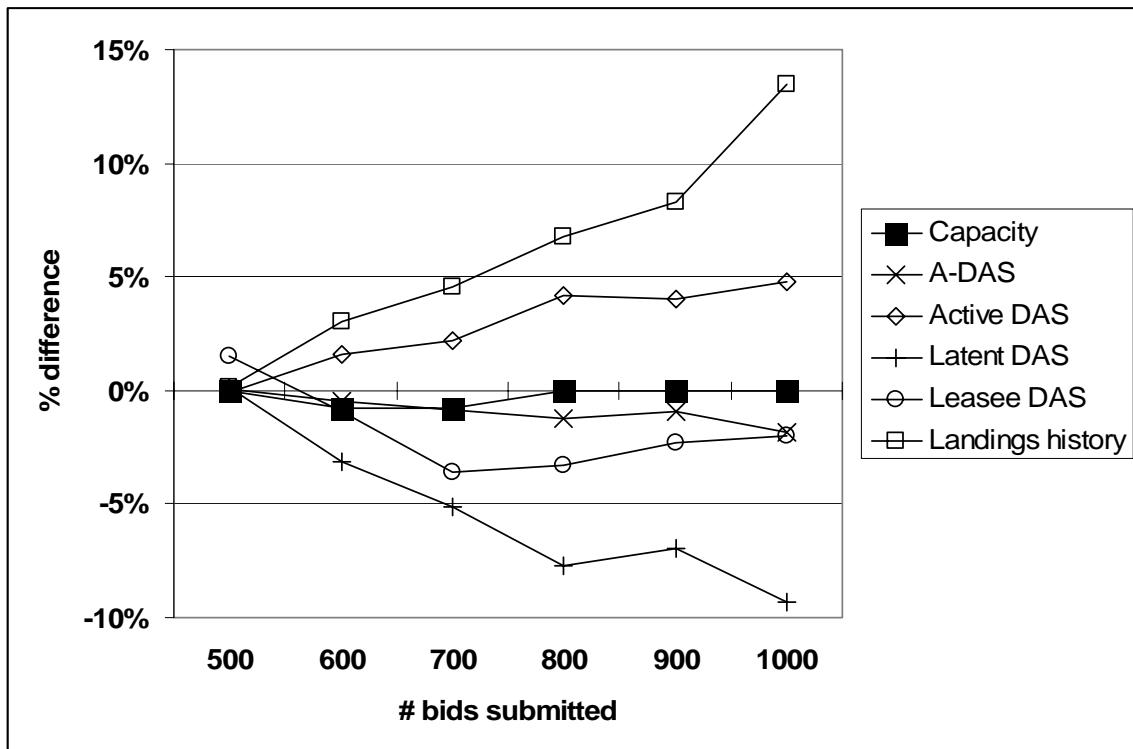


Figure 2 - Alternative 2: Percent difference in capturing various attributes of permits bought out when using the CHM vs. not using the CHM in the Buyout Score equation

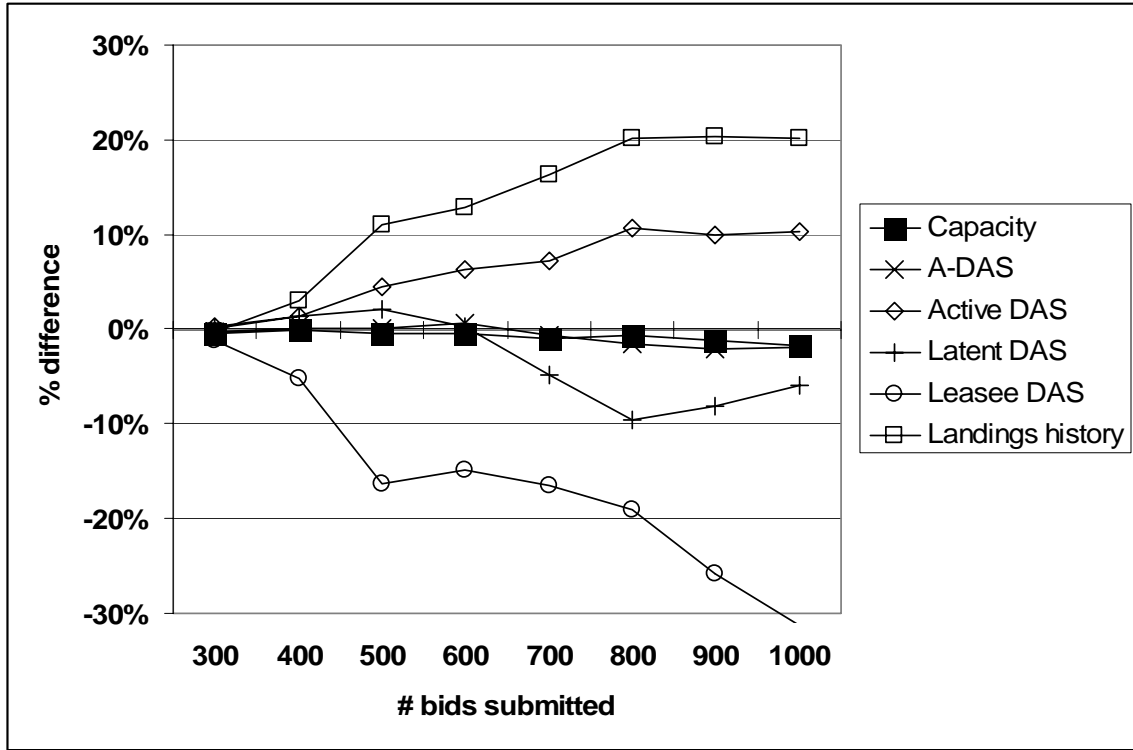


Figure 3 - Alternative 3: Percent difference in capturing various attributes of permits bought out when using the CHM vs. not using the CHM in the Buyout Score equation

