New England Fishery Management Council
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John Pappalardo, *Chairman* | Paul J. Howard, *Executive Director*

MEMORANDUM

DATE: March 5, 2009

TO: Scientific and Statistical Committee (SSC)

FROM: Scallop Plan Development Team

SUBJECT: **Follow-up of issues to be reviewed related to Scallop Amendment 15**

The SSC reviewed several issues related to Scallop Amendment 15 at the February 6 SSC meeting. There was not sufficient time to review the methods for economic and social impacts, so a subset of SSC and Scallop PDT members met on February 19 to discuss the details and report back to the full SSC at the next meeting - March 17.

Overall the SSC members present at the sub-Committee meeting were supportive of the methods that will be used to assess economic and social impacts of this action. Specifically, Dr. Demet Haksever presented a bioeconomic model that will be used to estimate producer and consumer benefits and a price model that will be used to predict prices within a reasonable range given various assumptions. She also summarized the fixed and trip costs that are used in the analyses, and explained a production model that has been developed that will identify appropriate fishing power adjustment (FPA) alternatives for the leasing and stacking alternatives under consideration.

Amendment 15 is considering several alternatives to address excess capacity in the limited access scallop fishery and provide more flexibility for efficient utilization of the resource through various stacking and leasing alternatives. Amendment 15 includes several alternatives to prevent overall effort from increasing as a result of leasing and/or stacking. Concerns have been raised that if DAS and access area trips are sold or leased from vessels with lower fishing power to vessels with higher fishing power, overall effort will increase. Therefore, Amendment 15 includes several fishing power adjustment alternatives to address this concern; however identifying the appropriate way to define these adjustments and evaluate them is critical for preventing effort from increasing as a result of stacking and/or leasing.

Review of the production model and fishing power adjustment alternatives was the primary focus of the sub-Committee meeting on February 19, and will hopefully be the focus of discussions at the upcoming SSC meeting on March 17 as well. An addendum is being prepared that will summarize the major discussion points from the sub-Committee meeting on February 19 as well as additional analyses that have been prepared since that time (Document 3).

Additional documents that were available at the February SSC meeting are included again for reference. Staff presentations have been updated to help focus discussion and summarize what the sub-Committee discussed on February 19.

Lastly, the SSC also reviewed the general ACL framework being considered in Scallop Amendment 15 at the February 6 SSC meeting. At that meeting the SSC requested quantitative analyses from the Scallop PDT to demonstrate that the proposed ABC complies with NS1 Guidelines. The Scallop PDT is currently working on those analyses and will report back to the SSC at a later date, potentially the May SSC meeting.

Relevant Meeting Materials:

1. **Sections of Scallop Amendment 15 DEIS – Description of stacking and leasing alternatives only**
2. **Summary of methods used for economic analyses**
   (Same document provided at Feb 6 SSC meeting)
3. **Addendum to Methods used for Economic Analyses**
   (Including information discussed and analyses prepared since the February 16 sub-Committee meeting)
4. **Summary of issues that will be considered in the social impact assessment**
   (Same document provided at Feb 6 SSC meeting)

ECONOMIC METHODS FOR ANALYSIS OF AMENDMENT 15 ALTERNATIVES

NEFMC, Demet Haksever

TYPE OF AFFECTS CONSIDERED IN ECONOMIC ANALYSES

- Changes in net benefits including both consumer and producer benefits compared to status quo
- Changes in the distribution of benefits and costs
- Changes in income and employment
- Cumulative impact of the regulations

Cost-benefit Analysis of Annual catch limits and accountability measures

- Any change in landing streams with ACTs compared to status quo will change the net benefits.
- Changes in the monitoring and enforcement costs (information from NMFS)
- ACL under another FMP that may be set for the scallop fishery, such as yellowtail flounder ACL under the multispecies FMP.
- Risk and Uncertainty – Sensitivity Analyses

BIO-ECONOMIC MODEL

- Biological model projections for
  - Landings by market size category
  - LPUE
  - DAS-used

ECONOMIC MODEL

- Ex-vessel price model
- Estimation of revenues
- Operating expenses and fixed costs
- Crew lay system: Crew income
- Gross profits= (0.45)*Gross stock - Fixed costs
- Producer benefits (Producer Surplus)
- Consumer benefits (Consumer Surplus)
- Total economic benefits (total of producer and consumer benefits net of status quo

Annual Price Model by Market Category

- Annual average price by market category as an exponential function of
  - Meat Count (MCOUNT)
  - Average price of all scallop imports (PIMPORT)
  - Per capita personal disposable income (PCDPI)
  - Percent share of landings by market category in total landings (PCTLAND)
  - Total annual landings of scallop minus exports (SCLAND-SCEXP)
  - Dummy Variable as a proxy for price premium for Under 10 count scallops (D10)

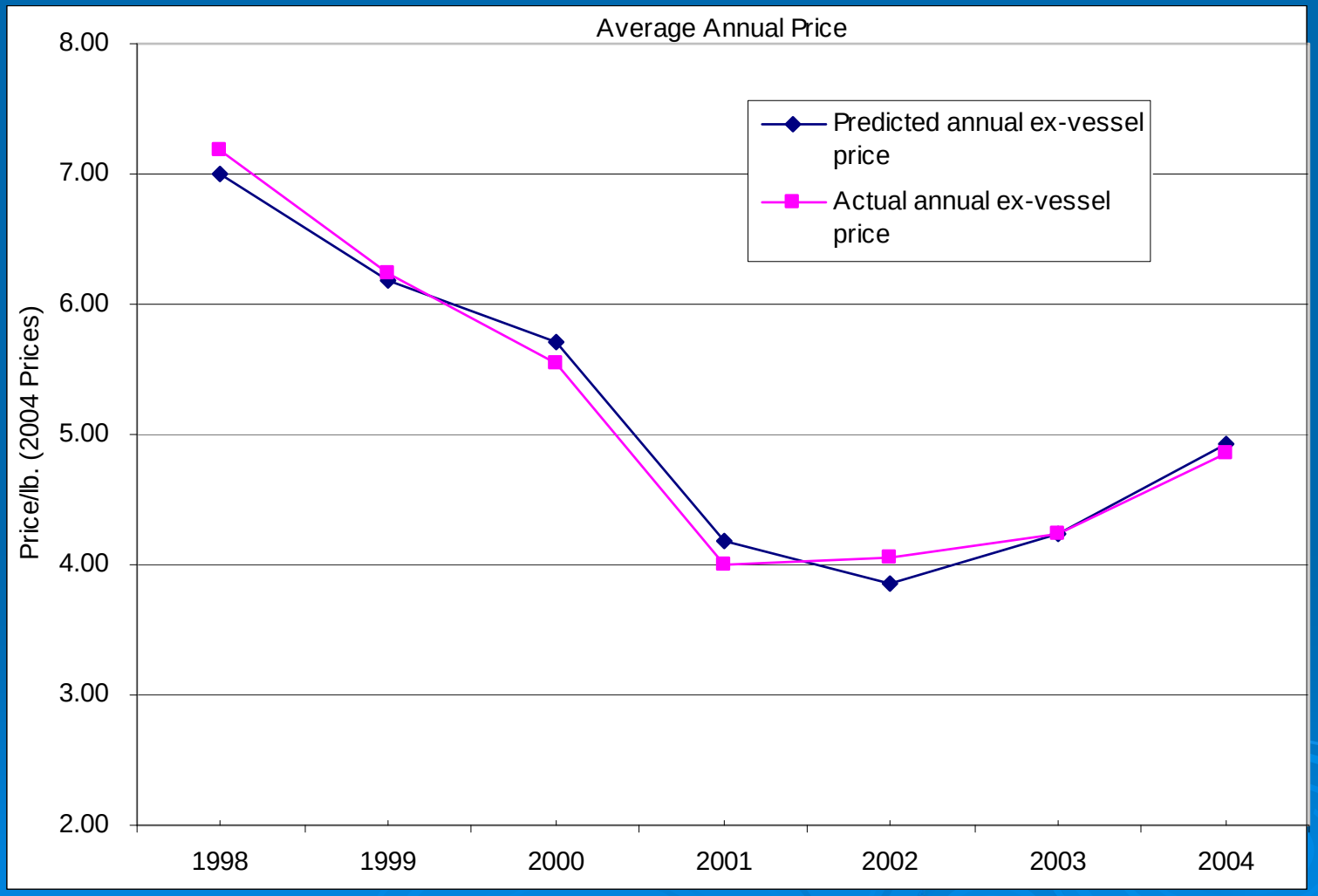
Market Category Model- Coefficients (adjusted R2=0.87)

Variables	Coefficients	Standard Error	t Stat
INTERCEPT	-2.2597	0.7736	-2.9210
MCOUNT	-0.0049	0.0014	-3.3897
PIMPORT	0.0247	0.0678	0.3639
PCDPI	0.0478	0.0090	5.2981
SCLAND-SCEXP	-0.0251	0.0052	-4.8596
DU10	0.0649	0.0525	1.2352
PCTLAND	-0.3084	0.0843	-3.6565

Predicted Prices by Market category: 1998-2004 average

Market Size Category	Actual Price	Predicted Price	Percent Difference
Under 10 count	6.47	6.37	-1.6%
11-20 count	5.40	5.55	2.9%
21-30 count	5.08	4.93	-3.0%
31-40 count	5.17	5.21	0.8%
41 plus count	5.05	5.04	-0.3%

Annual Average Prices – 1998-2004



Estimation of Trip Costs

- Trip costs include food, fuel, oil, ice, water and supplies.
- The trip costs per day-at-sea (TRPC06) is postulated to be a logarithmic function of
  - vessel crew size (CREW),
  - vessel size in gross tons (GRT),
  - fuel prices (FUELP),
  - trip length (DA),
  - average LPUE for the fleet (LPUEFLT).

Ordinary Least Squares Estimation

Model	lntrpc06
Dependent Variable	lntrpc06

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	87.24592	17.44918	127.47	<.0001
Error	419	57.35736	0.136891		
Corrected Total	424	144.6033			

Root MSE	0.36999	R-Square	0.60335
Dependent Mean	6.74380	Adj R-Sq	0.59861
Coeff Var	5.48634		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	4.675419	0.492682	9.49	<.0001
lngrt	1	0.305071	0.051137	5.97	<.0001
lncrew	1	0.862284	0.086305	9.99	<.0001
lnfuelp	1	0.995525	0.066177	15.04	<.0001
lnLPUEFLT	1	-0.23771	0.059468	-4.00	<.0001
lnda	1	0.167628	0.031358	5.35	<.0001

Durbin-Watson	1.721726
Number of Observations	425
First-Order Autocorrelation	0.139033

Estimation of Fixed Costs

- The fixed costs include insurance, maintenance, license, repairs, office expenses, professional fees, dues, utility, interest, and dock expenses.
- The expenses on insurance, maintenance, repairs and replacement of engine, electrical and processing equipment, gear and other equipment are obtained from the observer data
- Estimated as a function of vessel length, horsepower and crew.

The SYSLIN Procedure
Ordinary Least Squares Estimation

Model	lnfixedc
Dependent Variable	lnfixedc06n

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	47.63714	15.87905	42.76	<.0001
Error	283	105.0846	0.371324		
Corrected Total	286	152.7218			

Root MSE	0.60936	R-Square	0.31192
Dependent Mean	11.58883	Adj R-Sq	0.30463
Coeff Var	5.25820		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.248892	1.001379	3.24	0.0013
lnhp	1	0.515738	0.127651	4.04	<.0001
lnlen	1	1.032715	0.320903	3.22	0.0014
lncrew	1	0.253544	0.113418	2.24	0.0262

Durbin-Watson	1.842343
Number of Observations	287
First-Order Autocorrelation	0.074984

TOTAL ECONOMIC BENEFITS

- Consumer benefits: Landings and Price Model
- Producer benefits: Revenues and Costs
- TOTBEN=PS+CS
- Present value of the total benefits= PVTOTBEN= PVPS+PVCS

Measures to address excess capacity

- **Permit Stacking**
  - 2 permits only
  - 20/10/10/10 (HP/GT/NT/LOA) replacement criteria or
  - Fishing power adjustment
- **Open area DAS leasing:**
  - part or all days, to one or more vessels
  - 3 options – same as stacking
- **Access area trip leasing**
  - Entire trip – trips can't be combined.

Definitions of Capacity

- Technical: Capacity is the maximum amount of scallop harvest that can be produced with the existing vessels and gear (fixed inputs) if the levels of variable factors (DAS, Crew size) is not restricted.
- Maximum output is determined by ACL. There are more vessels than necessary to land the ACL if DAS is a variable.

- Economic:
  - The scallop harvest level that maximizes vessel profits at varying levels of effort or vessel size.
  - The harvest level that maximize total economic benefits – the sum of consumer and producer surplus.
- Socio-economic: The harvest level that satisfies the socio-economic goals and objectives of management including employment and minimum impacts on communities. This level is less than or equal to a specified biological limit (e.g., ACL).

- Capacity would vary with the level of sustainable harvest.

Excess capacity in the scallop fishery

- 2008 Report to Congress (NMFS): Sea Scallop Fishery is among the fisheries with an excess harvesting capacity (38 to 67%).
- Data envelopment analysis (DEA)
- Empirical analysis of the fishery indicates that there is excess capacity in the scallop fishery from a technical efficiency perspective.
- This implies that there is also excess capacity from an economic perspective.

Table 1. **Vessel size, DAS-used and LPUE by full-time limited access vessels**

Fishyear	Total Number of active vessels	Estimated DAS Allocation (1)	Average for 124 Vessels Fished Every Year since 1994			
			Average GRT	Average HP	Average DAS-used (all areas)	Average LPUE (2)
1994	210	204	168	899	180	519
1999	216	120	168	905	109	994
2003	279	120	167	905	117	1,867
2004	295	126	167	904	97	2,371
2005	312	100	166	907	83	2,004
2006	314	112	166	907	86	2,087
2007	315	111	166	907	93	1,884

Economic Impacts of Measures to address capacity

- A smaller number of vessels could harvest ACT if the vessels could increase their effort through permit stacking, DAS or access area leasing.
- This would increase the technical efficiency, reduce fishing costs, increase profits and producer surplus.
- Permit stacking and/or DAS leasing could have adverse economic impacts on vessels that are not involved with DAS transfers if no adjustments are made to DAS.
- Permit stacking and/or DAS leasing could have negative impacts on employment.
- Economic and Social impact analyses will include the impacts on employment, crew income, fishing communities, ports, and on vessels that are not involved in leasing or stacking.

Adjustment of DAS for the permit stacking and open area DAS leasing options (Fishing power adjustment)

- LPUE is higher and the trip length is longer for the group of vessels with a higher gross tonnage and horsepower compared to the smaller vessels.
- Therefore, DAS must be adjusted with relative landings per DAS (LPUE) of the vessels that are involved in permit-stacking or DAS-leasing.
- A technical production model is estimated in order to derive an adjustment factor.

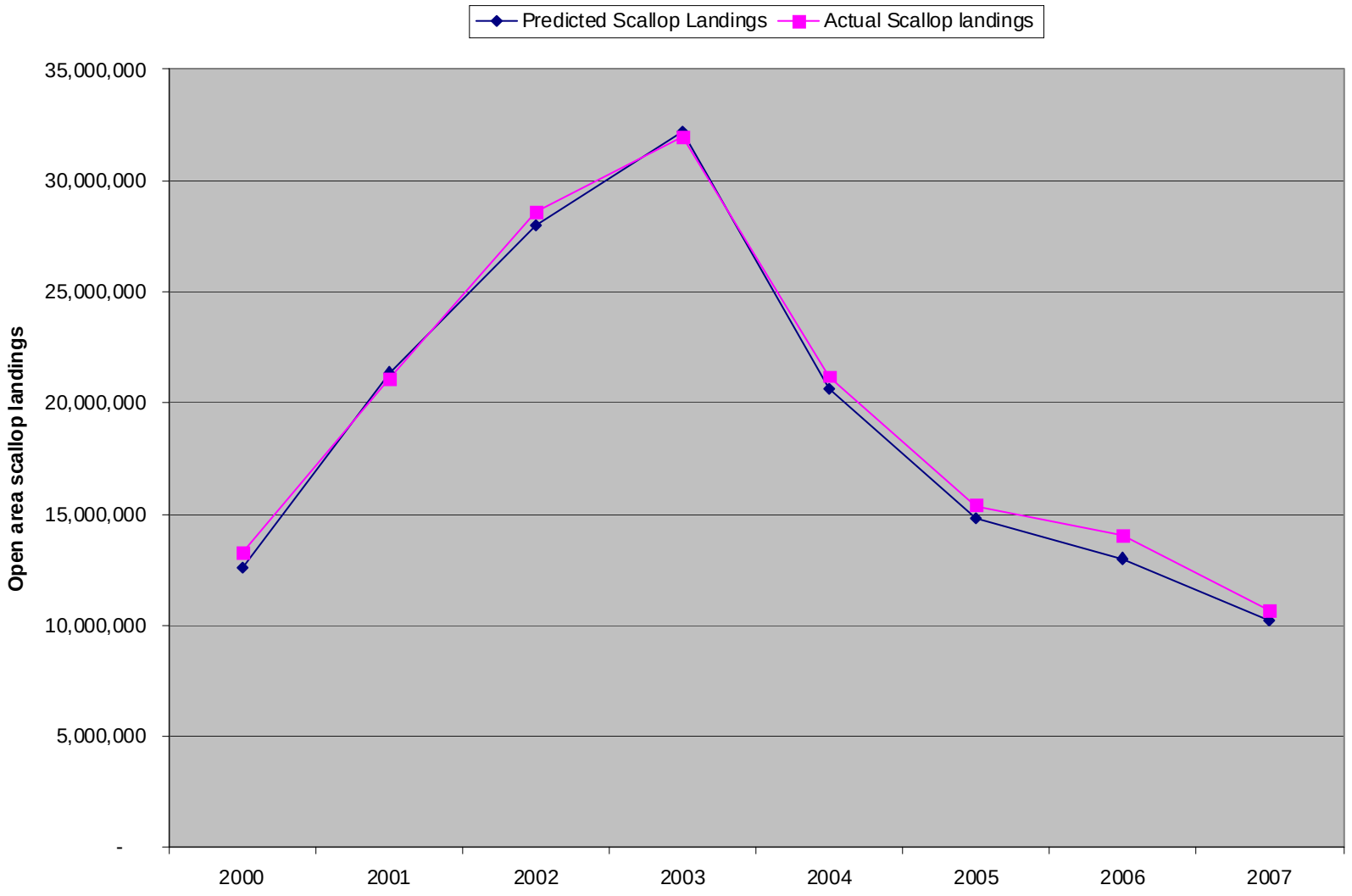
Cobb-Douglas Production Function with Increasing Returns to DAS
Period:2000-2007, Adj.R^2=0.92

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin Watson
lnscdealb	6	1955	97.4654	0.0499	0.2233	0.9205	0.9203	1.8297

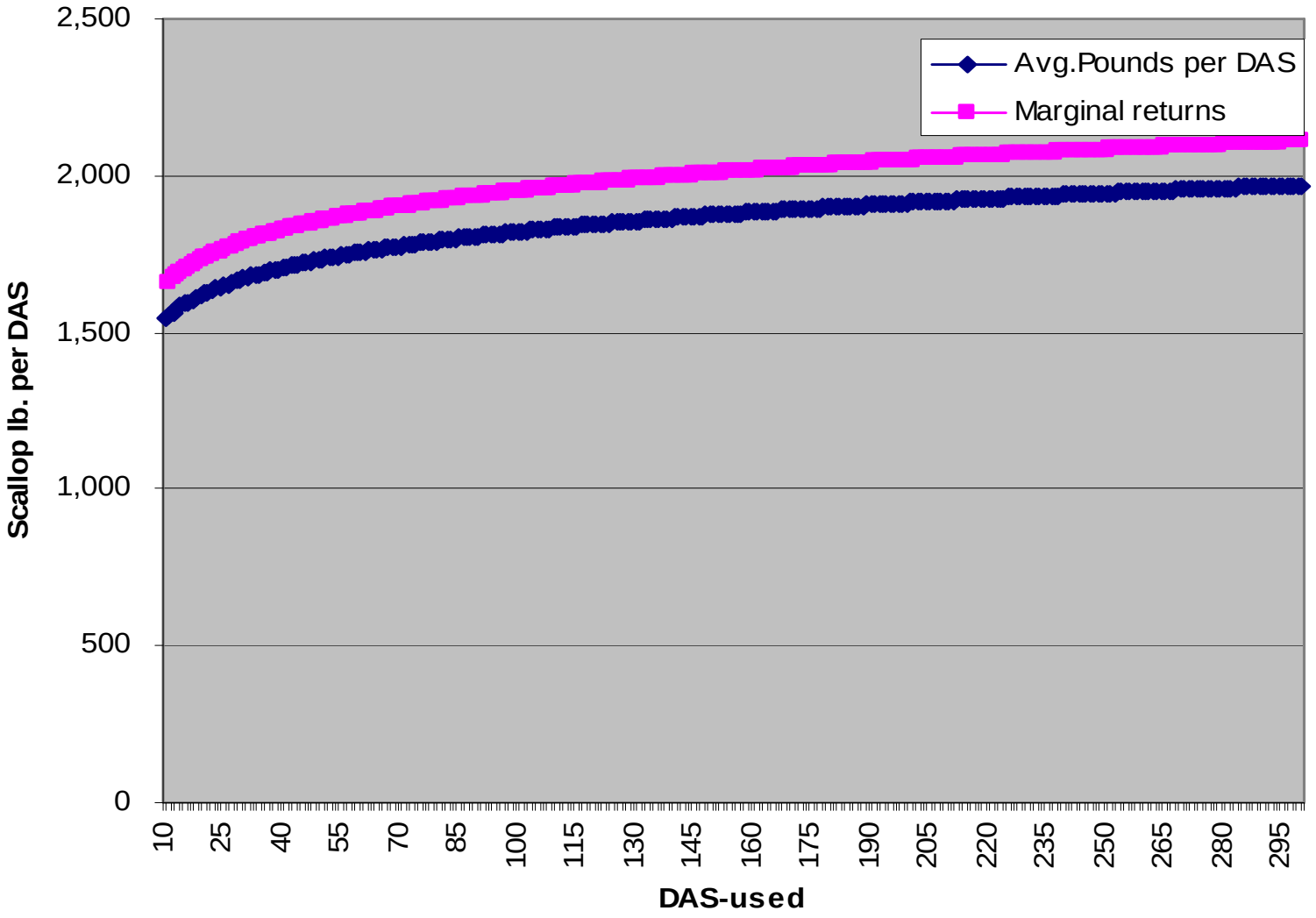
Nonlinear GMM Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
intc	-2.36244	0.2714	-8.70	<.0001
lnda	1.06354	0.00918	115.83	<.0001
lnhp	0.187749	0.0212	8.84	<.0001
lngrt	0.090467	0.0233	3.88	0.0001
dft	-0.34559	0.0215	-16.07	<.0001
lnlpue	1.047035	0.0313	33.43	<.0001

Cobb-Douglas Production Model Results



Average and Marginal Returns to DAS (Cobb-Douglas Production Function)



Open area translog production function estimates for full-time vessels)

Period: 2000-2007 Adj.R^2=0.92

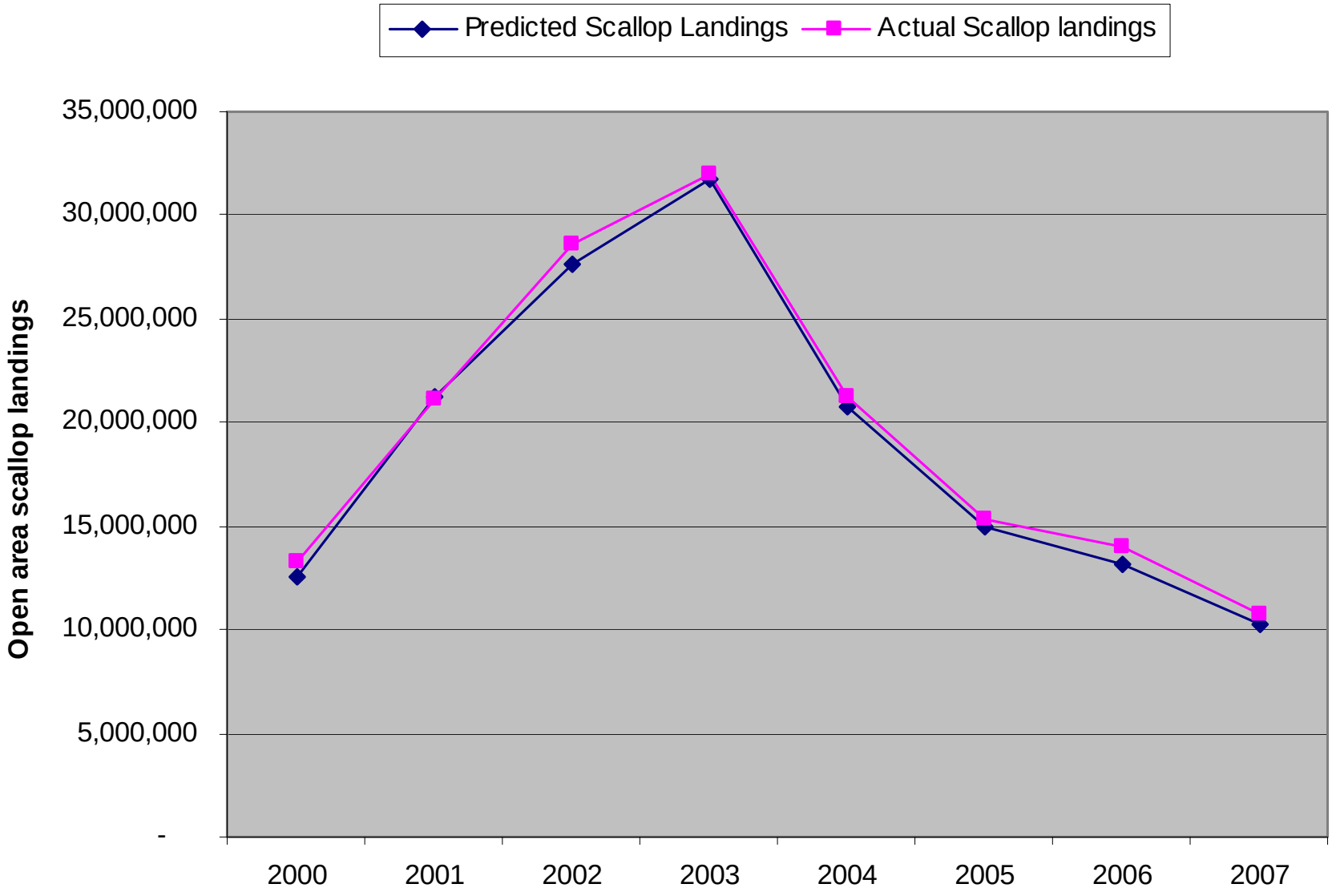
Nonlinear GMM Summary of Residual Errors

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin Watson
lnscdealb	7	1954	96.9636	0.0496	0.2228	0.9209	0.9206	1.8318

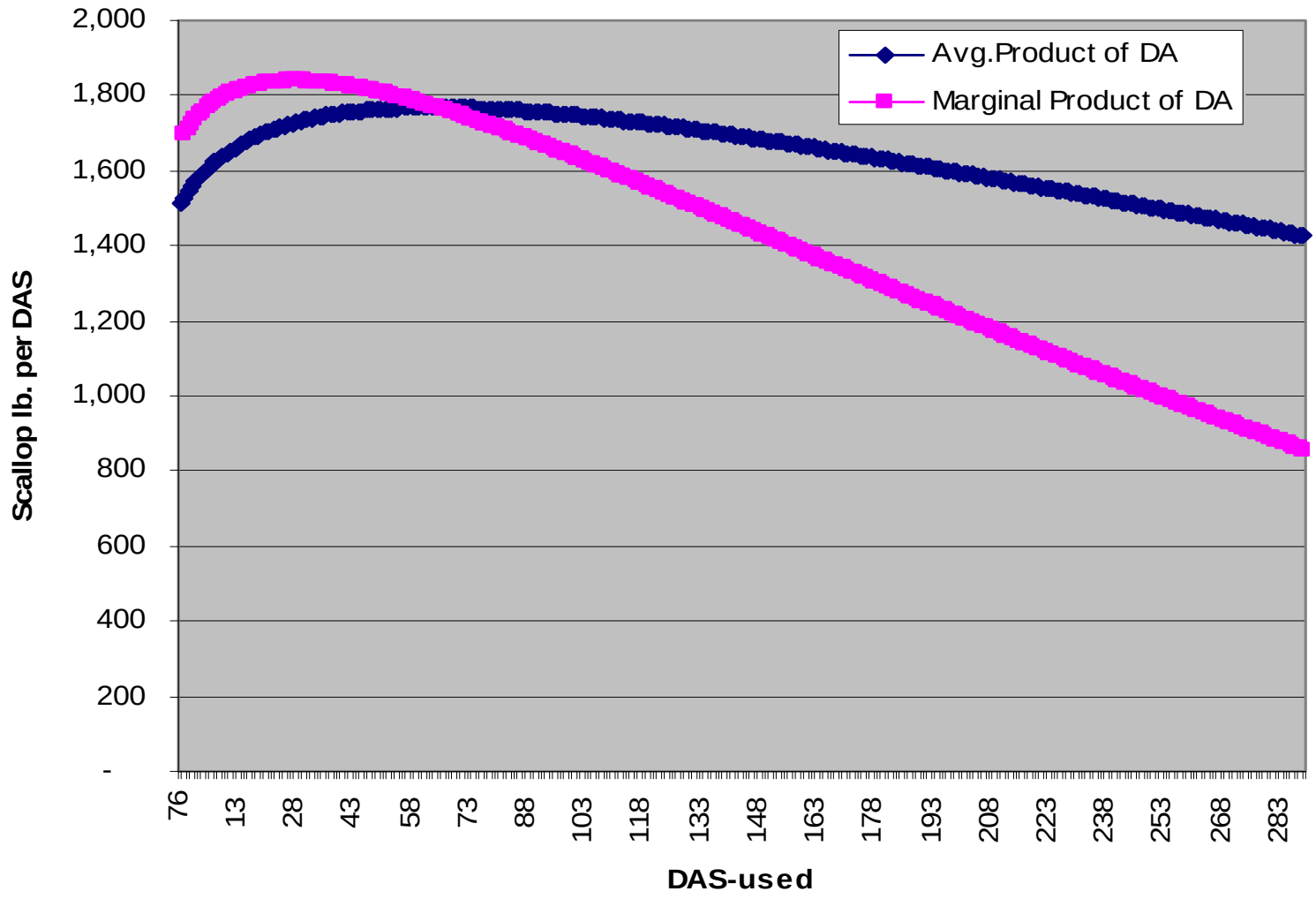
Nonlinear GMM Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
intc	-2.54183	0.2789	-9.12	<.0001
lnda	1.131731	0.0267	42.41	<.0001
lnhp	0.187173	0.0212	8.83	<.0001
lngrt	0.095646	0.0233	4.10	<.0001
dft	-0.34504	0.0213	-16.16	<.0001
lnlpue	1.04487	0.0313	33.40	<.0001
da	-0.00167	0.000611	-2.73	0.0063

Translog Production Model Results



Average and marginal returns to DAS (Translog function)



Adjustment Factor

- Landings per unit effort (LPUE) is estimated for each vessel. Adjustment factor for DAS transfer from vessel “i” to vessel “j” : $A_{ij} = LPUE_i / LPUE_j$
- Transferred DAS should be adjusted not only for relative HP and GRT’s of vessels, but also for increasing average returns to the DAS.

$$A_{ijHG} = \left((HP_i)^{0.18} (GRT_i)^{0.09} \right) / \left((HP_j)^{0.18} (GRT_j)^{0.09} \right)$$

$$Aij = A_{ijHG} * (D)$$

Adjustment Factor: Example

- Vessel A: HP=1400, GRT=185, DAS=40 DAS lease=30 from vessel B;
- Vessel B: HP=650, GRT=120, DAS=40;
- Fishing power adjustment when vessel A leases from vessel B:

  A vessel A= ((650)0.18 (120)0.09 / ((1400)0.18 (150)0.09 = 0.83
- An additional 10% adjustment should be applied to the leased DAS on top of the fishing power adjustment to account for increasing average returns to DAS.

Adjustment factors for HP and GRT (2007)

HP	GRT	HP-GRT Group	Number of vessels	11	12	13	14	22	23	24	33	34	43	44	53	54	64
<600	<50	11	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<600	50-99	12	7	0.96	1	1	1	1	1	1	1	1	1	1	1	1	1
<600	100-149	13	20	0.94	0.97	1	1	1	1	1	1	1	1	1	1	1	1
<600	>=150	14	6	0.94	0.97	1	1	1	1	1	1	1	1	1	1	1	1
600-719	50-99	22	3	0.93	0.96	0.99	0.99	1	1	1	1	1	1	1	1	1	1
600-719	100-149	23	19	0.91	0.95	0.97	0.97	0.99	1	1	1	1	1	1	1	1	1
600-719	>=150	24	13	0.90	0.94	0.96	0.96	0.97	0.9	1	1	1	1	1	1	1	1
720-863	100-149	33	22	0.89	0.92	0.95	0.95	0.96	0.9	0.9	1	1	1	1	1	1	1
720-863	>=150	34	50	0.87	0.91	0.93	0.93	0.94	0.9	0.9	0.9	1	1	1	1	1	1
864-1036	100-149	43	4	0.87	0.90	0.93	0.93	0.94	0.9	0.9	0.9	0.9	1	1	1	1	1
864-1036	>=150	44	23	0.86	0.89	0.92	0.92	0.93	0.9	0.9	0.9	0.9	0.9	1	1	1	1
1037-1243	100-149	53	5	0.85	0.88	0.91	0.91	0.92	0.9	0.9	0.9	0.9	0.9	0.9	1	1	1
1037-1243	>=150	54	25	0.84	0.87	0.89	0.89	0.90	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1	1
1244-1492	>=150	64	7	0.82	0.85	0.88	0.88	0.89	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1
>=1493	>=150	74	9	0.81	0.84	0.86	0.86	0.87	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9

8

Scenario Analysis with DAS leasing
(Table 5- Addendum)

HP-GRT Group	Number of vessels (Col.1)	DAS-used before leasing (Col.2)	After leasing				
			Unadjusted DAS (Col.3) (1+3)	Leased DA (unadjusted) (Col.4)	Leased DA (Adjusted for Fishing Power) (Col.5)	Leased DA (Adjusted for Fishing Power plus 10% DAS adjustment) (Col.6)	Adjusted DA (Adjusted for Fishing Power plus 10% DAS adjustment) (Col.7) (2+6)
11	3	27.4	0.0	0.0	0.0	0.0	0.0
12	7	26.6	0.0	0.0	0.0	0.0	0.0
13	20	29.4	0.0	0.0	0.0	0.0	0.0
14	6	28.3	0.0	0.0	0.0	0.0	0.0
22	3	31.7	0.0	0.0	0.0	0.0	0.0
23	19	32.3	0.0	0.0	0.0	0.0	0.0
24	13	26.2	0.0	0.0	0.0	0.0	0.0
33	22	29.4	0.0	0.0	0.0	0.0	0.0
34	50	29.7	49.4	19.8	19.3	17.4	47.0
43	4	19.5	19.5	0.0	0.0	0.0	19.5
44	23	30.8	57.4	26.7	25.1	22.6	53.4
53	5	25.9	45.0	19.0	17.5	15.7	41.6
54	25	31.6	55.1	23.5	21.0	18.9	50.5
64	7	30.0	54.2	24.2	21.2	19.1	49.1
74	9	30.4	60.2	29.9	24.7	22.2	52.6

Total open area DAS-used before and after leasing 2007 (Table 6- Addendum)

HP-GRT Group	Number of vessels (Col.1)	DAS-used before leasing (Col.2)	After leasing				
			Unadjusted DAS (Col.3) (1+3)	Leased DA (unadjusted) (Col.4)	Leased DA (Adjusted for Fishing Power) (Col.5)	Leased DA (Adjusted for Fishing Power plus 10% reduction) (Col.6)	Adjusted DA (Adjusted for Fishing Power plus 10% reduction) (Col.7) (2+6)
11	3	82.27	0.00	0.00	0.00	0.00	0.00
12	7	186.42	0.00	0.00	0.00	0.00	0.00
13	20	588.33	0.00	0.00	0.00	0.00	0.00
14	6	169.63	0.00	0.00	0.00	0.00	0.00
22	3	95.17	0.00	0.00	0.00	0.00	0.00
23	19	613.62	0.00	0.00	0.00	0.00	0.00
24	13	340.68	0.00	0.00	0.00	0.00	0.00
33	22	647.45	0.00	0.00	0.00	0.00	0.00
34	50	1482.87	2471.00	988.13	965.59	869.04	2351.91
43	4	78.12	78.12	0.00	0.00	0.00	78.12
44	23	707.65	1321.27	613.62	577.31	519.58	1227.22
53	5	129.61	224.77	95.17	87.36	78.62	208.23
54	25	789.93	1378.26	588.33	525.03	472.53	1262.46
64	7	209.88	379.51	169.63	148.72	133.85	343.73
74	9	273.53	542.22	268.69	222.12	199.91	473.44
	216	6395.16	6395.15	2723.56	2526.14	2273.52	5945.11

Constant average returns to DAS: Total open area scallop landings before and after leasing (2007, Table 7- Addendum)

HP-GRT Group	Scallop lb. before leasing (Col.2)	After leasing – Constant average returns to DAS					
		Scallop landings after leasing (No adjustment) (Col.3)	% Change in landings with no adjustment	Scallop landings after leasing (after fishing power adjustment)	% Change in landings after fishing power adjustment	Scallop landings after leasing (after fishing power and 10% DAS adjustment)	Adjusted DA (Adjusted for Fishing Power plus 10% reduction) (Col.7) (2+6)
11	70,299	-	-100.0%	-	-100.0%	-	-100.0%
12	215,114	-	-100.0%	-	-100.0%	-	-100.0%
13	802,213	-	-100.0%	-	-100.0%	-	-100.0%
14	241,824	-	-100.0%	-	-100.0%	-	-100.0%
22	170,265	-	-100.0%	-	-100.0%	-	-100.0%
23	949,048	-	-100.0%	-	-100.0%	-	-100.0%
24	528,486	-	-100.0%	-	-100.0%	-	-100.0%
33	988,181	-	-100.0%	-	-100.0%	-	-100.0%
34	2,194,110	3,701,405.17	68.7%	3,622,839	39.44%	3,519,741	37.66%
43	127,939	127,938.76	0.0%	127,939	0.00%	127,939	0.00%
44	1,100,966	2,071,250.57	88.1%	1,999,146	44.93%	1,922,541	42.73%
53	228,932	396,852.11	73.3%	383,235	40.26%	367,663	37.73%
54	1,338,680	2,358,005.34	76.1%	2,228,443	39.93%	2,157,375	37.95%
64	349,675	614,138.06	75.6%	597,458	41.47%	558,361	37.37%
74	431,617	851,087.83	97.2%	782,109	44.81%	743,708	41.96%
	9,737,348	10,120,677.84	3.9%	9,741,168	0.04%	9,397,328	-3.62%

Increasing average returns to DAS: Total open area scallop landings before and after leasing (2007, Table 8- Addendum)

HP-GRT Group	Scallop lb. before leasing (Col.2)	After leasing – Increasing average returns to DAS			
		Scallop landings after leasing (No adjustment) (Col.3)	% Change in landings with no adjustment	Scallop landings after leasing (after fishing power and 10% DAS adjustment)	Adjusted DA (Adjusted for Fishing Power plus 10% reduction) (Col.7) (2+6)
11	93,145	-	-100.0%	-	-100.0%
12	230,541	-	-100.0%	-	-100.0%
13	778,767	-	-100.0%	-	-100.0%
14	225,263	-	-100.0%	-	-100.0%
22	125,936	-	-100.0%	-	-100.0%
23	852,786	-	-100.0%	-	-100.0%
24	482,194	-	-100.0%	-	-100.0%
33	926,009	-	-100.0%	-	-100.0%
34	2,226,251	3,809,158	71%	3,617,658	62.50%
43	111,779	111,779	0%	111,779	0.00%
44	1,093,692	2,099,793	92%	1,945,570	77.89%
53	196,978	353,768	80%	326,375	65.69%
54	1,268,185	2,276,426	80%	2,077,806	63.84%
64	345,589	643,511	86%	580,611	68.01%
74	462,034	950,537	105.7%	825,916	78.76%
Total	9,419,150	10,244,973	8.8%	9,485,714	0.71%

Further need for analysis

- Impacts of unknown factors that influence LPUE that we cannot measure or model – e.g. reduction gear ratio, propeller size, use of Kort nozzle, skills of the crew and the captain etc.
- Adj.R^2 indicated that about 8% of the variance are due to other factors.
- Get expert information on other factors that influence LPUE.
- An additional ~5-10% to account for increases management uncertainty due to these factors.

Risk analysis using the Simulation Model

- Conduct sensitivity analyses using the variance of HP and GRT coefficients.
- The confidence interval for the coefficient of HP variable: 0.15 to 0.23 and for the coefficient GRT variable: 0.05 to 0.15.
- The simulation model will be used to project fishing power adjustments and landings for the range of these coefficients. For example, setting the coefficient of HP at 0.23 would reduce the adjustment factor for the largest vessel to 0.77 from 0.81.
- Expand the model to include all full-time vessels (259 in the sample, 320 overall).
- Scenario analyses with DAS transfers from vessels with smaller LPUE's to larger LPUE's.

Economic Impacts of the Permit Stacking and DAS-leasing options

- If no change in *landings and prices,* no impacts on the consumer benefits and the total fleet revenue.
- Impacts on the total DAS-used, the fishing costs, producer surplus, vessel profits, prices, crew incomes, and employment
- These impacts will vary according to the number of vessels that will remain active in the fishery after permit stacking and/or DAS/access trip leasing.

Factors that will impact leasing/stacking and the scallop fleet size

- It is uncertain how many vessels will take advantage of permit stacking and various leasing options.
- The constraints on the number of stacked permits, on DAS leasing and on the ownership restrictions will affect the number of vessels that will remain active.
- Ownership structure of the scallop fishery will impact the number of vessels that will remain active in the fishery.

- Relative profitability of fishing with leased DAS taking into account fishing power adjustment.
  - Expected gain from leasing DAS to another vessel: The value of lease exceeds the revenue a vessel could obtain by fishing DAS itself net of trip, labor, and other operating costs.
  - Expected gain from leasing DAS from another vessel: The increase in revenue net of trip, labor, and other operating costs exceeds of value of the lease.
  - The income from other fisheries.

Ownership Structure of the Scallop Fishery

Permit Stacking, DAS and access area trip leasing: More likely for owners that already own more than one boat.
(Minimum number of boats after stacking/leasing: 173 to 232 boats)

Table 2. Ownership, number of boats and landed value (2008)

Ownership	Number of corporations	Number of boats	Landed value (2008)	% of Revenue
Own 1 vessel	117	117	101,652,320	30.2
Own 2-4 vessels	52	130	110,922,793	32.9
Own 5 or more vessels	13	99	88,098,814	26.2
Total	182	346	300,673,927	89.3

Scenario analyses: Simulation Model

- Estimating revenue per DAS net of trip and labor costs for each vessel
- Technical production model to estimate landings and trip and fixed cost functions to estimate costs for each group.
- Conduct various scenario analyses with effort transfers from vessels with a smaller revenue per day-at-sea to vessels with a higher daily net return.
- Scenario analyses by ownership

Example with Simulation Analysis

Status Quo

HP	Total landings	DAS-used	# FT boats	Estimated landings	Revenue per vessel	Trip costs per vessel	Fixed costs per vessel	Crew income+ Profits
<600	5,181,831	84	44	117,769	765,498	197,784	61,891	505,823
600 -825	8,993,583	87	67	134,233	872,512	221,500	72,788	578,223
850-970	8,609,564	82	63	136,660	888,288	228,105	95,380	564,804
>=1000	9,657,473	80	66	146,325	951,115	228,653	154,138	568,324
Total	32,442,452	19971	240		210,875,938	53,004,724	23,782,063	134,089,151

Permit Stacking/DAS leasing

HP	Total landings	DAS-used	# FT boats	Estimated landings	Revenue per vessel	Trip costs per vessel	Fixed costs per vessel	Crew Income+ profits
<600	-		0	117,769	-	-	-	-
600 -825	-		0	134,233	-	-	-	-
850-970	8,609,564	82	63	136,660	888,288	228,105	95,380	564,804
>=1000	23,561,188	200	66	356,988	2,320,420	572,187	154,138	1,594,095
Total	32,170,753	18379	129		209,109,892	52,134,955	16,182,020	140,792,918

Optimization Models and Lease Price

- A combination of linear programming and econometrics to estimate a price for DAS or access area trip lease.
- LP model to select an effort level that would maximize short-run profits for each scallop vessel.
- The shadow price of effort (unique to each vessel) from the model represents profitability of an additional DAS (or access area trip).
- NLP model to simulate a leasing market by using different (randomly generated) lease price values.

NLP Model

- Maximize industry profits subject to constraints on maximum DAS-use, on DAS transfers (or permit stacking).
- Show the optimum level of leasing activity that could occur (with or without restrictions).
- Estimate the direction of the effort transfers
- Determine economic impacts: Changes in fishing costs, producer surplus, profits, crew shares, employment and ports.

Limitations of the NLP Model

- Vessels may not actually pay for lease but pay a share of the catch
- NLP model maximizes industry profits, an actual lease market may not result in same level of profits.
- The geographic regions where vessels operate are not taken into account.

Impacts on Employment (Social and Economic Analyses)

- The employment in the scallop harvest sector could decline if the same number of crew is employed on the boat that leases or stacks permits.
- Data on crew size (permit and VTR) could be used to conduct different scenarios assuming that no crew currently fish on more than one permit or that there is complete crew cross over.
- Logbook data may help indicate whether fleet owned vessels are already using the same captains on multiple vessels.
- IMPLAN model could be used to estimate employment multipliers and regional impacts on employment.

Changes in the Distribution of benefits and Costs (Social and Economic Analyses)

- Qualitative discussion of distributional impacts based on empirical, economic and social analyses and literature review.
- The Impacts on single versus multi-boat owners
- Potential changes to the lay system – who would pay for the price of lease?
- Potential impacts of reduction in fishing costs on the ex-vessel price, on boats that were (not) involved in leasing/stacking.
- Qualitative discussion of impacts on vessel values