

A cooperative investigation towards an  
exempted trap to exclusively target  
*Cancer borealis* in Lobster Management  
Area 1.

Completion Report

Award number: 03-226

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## 1. Abstract:

This project development grant requested funds to facilitate and monitor the performance of an Experimental Fisheries Permit (EFP) to be issued to 100 lobster harvesters in Lobster Management Area 1. The EFP (first issuance on September 15, 2002) allows participants to develop a targeted Jonah crab trap designed to reduce or eliminate lobster bycatch. The Maine Department of Marine Resources (DMR) believes it is important to increase our understanding of Jonah crabs, *Cancer borealis*, and assess the potential for a targeted trap. Currently in the final year of a 3-year EFP renewal process the project has demonstrated the development of a Jonah crab specific trap, monitored EFP activity in Lobster Management Area 1, collected detailed biological information on Jonah Crabs and positioned the State of Maine, Atlantic States Marine Fisheries Commission and NMFS to make informed decisions on the utility of a directed crab trap and/or fishery. At the time of writing, the Maine DMR was proposing to implement biological limits on Jonah crabs. A new directed crab fishery faces many challenges including biological sustainability and gear conflicts with existing fisheries and whales.

## 2. Introduction:

The Jonah crab, *C. borealis*, has been a traditional bycatch for the Maine lobster industry for over 50 years. Recent increases in perceived abundance and value have led to an increased interest in and landings of crabs in Maine. In 2002, estimates indicate 9.5 million pounds of crab valued at \$4.1 million were landed in Maine (Figure 1). This is a 50% increase in pounds and value over the previous ten-year average (reporting standards do not require dealers to report or indicate specific species of crabs landed). The only management requirement in the State of Maine is possession of a Maine Lobster and Crab license. There are no regulations regarding Jonah crabs in Federal waters.

Recent management actions on lobsters and most recently groundfish have forced fishermen to redirect fishing effort on unregulated or emerging fisheries. In 2000, four fishermen cooperating with the Maine Department of Marine Resources (DMR) designed a modified side entry trap that greatly diminished lobster bycatch while catching sufficient quantities of Jonah crabs (Figure 2).

Building on the initial experiment, the DMR has received from the National Marine Fisheries Service (NMFS) an Experimental Fisheries Permit (EFP) that allows 100 fishermen to further develop a Jonah crab specific trap.

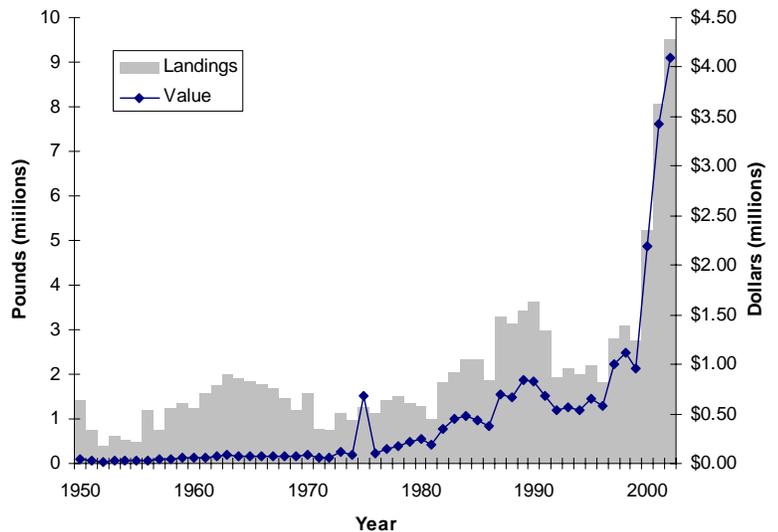


Figure 1. Annual landings and value of crabs landed in Maine 1950 to 2002. Current reporting is voluntary and is not reported by species.

If EFP participants are successful in designing a trap found to be incapable of catching lobsters, a permanent exemption may be granted by NMFS allowing targeted trapping above current levels of lobster traps. A supplemental allocation of traps or the creation of a new, targeted fishery for Jonah crabs could help to lessen the almost total reliance on the lobster fishery for coastal communities in Maine.

Trap design centers on work from the initial experiment by four fishermen in 2000, and has restricted the infinite number of variations participants could test. A minimum of 60% of the gear set must be of a modified side entry design with minimum entrance heads of 2.5" high, and 3.25" circular escape vents (Figure 2). The remaining 40% of traps must continue to follow the requirements for escape vents, but allow for exploration of a top entry style trap.

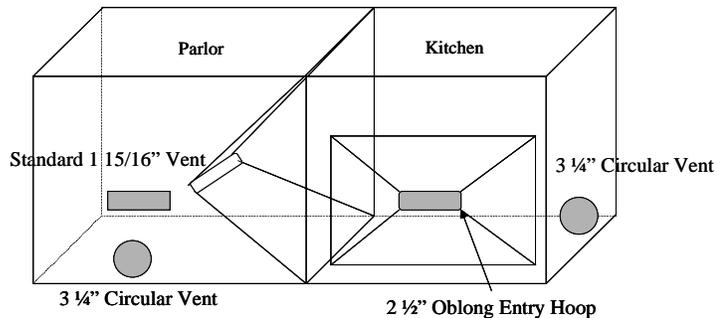


Figure 2. Experimental side entry trap tested during the EFP. This trap was first developed by Stonington Maine fishermen in 2000.

### 3. Project objectives and scientific hypotheses:

Project development funds provided the opportunity to support on-going EFP activity on Jonah crabs. The Maine DMR had been working with fishermen and NMFS since December 2000 to design and develop an EFP that would test the ability of gear to select for crab and be "incapable of catching lobsters." Initial field work was supported by existing DMR field capacity. With the issuance of the first year EFP in September 2002, the need to seek NEC funding to support the EFP activity was clear.

Specific objectives funded through the development grant were:

- To conduct two full-day observer trips per month through the duration of the EFP.
- To distribute, collect, enter and analyze logbook information.
- To facilitate discussion on gear performance and selectivity through quarterly meetings with EFP participants.

### 4. Participants:

The concept for this project was first introduced to the DMR by Brent Oliver, F/V Jarsulan III, of Stonington Maine in January 2000. During the spring and summer of 2000, Brent was joined by three additional Stonington Maine fishermen: Brad Billings, F/V Bumps and Bruises; Mike Grindle, F/V Sea Flea IV; and Gregg Eaton, F/V Atlantic Fever. These four fishermen formed the core of the experimental fishing activity, and remain so today. During the first two EFP permits 100 fishermen were qualified to participate, with over 30 fishermen actually setting experimental gear. Currently there are 84 fishermen assigned to the EFP (Table 1).

Scientific collaborations have been established with the University of Maine and the National Marine Fisheries Service (NMFS). Dr. Yong Chen has provided significant technical assistance while his graduate student, Kathleen Reardon, has been funded under this project and conducted the majority of the field work and initial analysis of logbook and at-sea observer data. Bonnie Van Pelt and Brian Hooker, NMFS, have provided guidance and reviewed EFP applications. Additional EFP justification was provided in the form of associated Environmental Assessments and a Biological Opinion both of which have been published in the Federal Register (NMFS 2001).

Table 1. Participants qualified for the 2004/2005 Experimental Fishing Permit.

Last Name	First Name	Address	Town	Last Name	First Name	Address	Town
Alley	Robert	PO Box 263	Beals Is	Lawrence	Durfee	63 Rider Trail Road	Boothbay
Alley	Jeffrey	PO Box 112	Winter Harbor	Lawson	Thomas	28 Mitchell Lane	Southwest Habor
Alley	Harley	PO BOX 162	Beals Island	Lawson	David	PO BOX 4	Bernard
Anderson	Herman (Randy)	PO Box 34 Rte 195	Corea	Limeaux	Nick	2644 Cutler Road	Cutler
ANDREWS	CHRISTOPHER	41 REED STREET	WESTBROOK	Lunt	Daniel	Sea Level	Frenchboro
Baum	Larry	33 Baum Road	Spruce Head	LUNT	ZACHARY	SEA LEVEL ST	Frenchboro
Beal	Mitchell	PO Box 50, 17 Mack Pt. Road	Beals	MACDONALD	ROBERT	1306 Sunshine Road	Deer isle
Billings	Brad	329 NORTH DEER ISLE RD	Deer Isle	McCole	Marc	PO Box 86	Bath
Billings	Joel	Box 580 A	Deer Isle	McLain	Brian	Bristol Rd, PO Box 61	New Harbor
Bridges	Bryan	PO BOX 66	BIRCH HARBOR	Merrill	John (Jack)	PO Box 994	Northeast Harbor
Carter	Shane	104 Blueberry Hill	Bar Harbor	Miller	Alan	PO Box 415	Spruce Head
Carver	Dwight	Box 131	Beals	Myers	Jason	HCR 61 Box 342	Tennants Harbor
Cates	Jeremy	PO Box 52	Cutler	Myreck	Mike	PO Box 36	Cushing
Chalmers	James	324 Seawall Road	Southwest Harbor	Oliver	Brent	PO Box 604	Deer Isle
CHIPMAN	JASON	233 WYMAN ROAD	MILBRIDGE	Opendisrott	Vincent II	20 Danielle Drive	Topsham
Christie	Ted	147 Log Cabin Road	West Port	Parkhurst	Matt	.221 Adams Pond Rd	Boothbay
CIOMEI	SETH	RR 1 BOX 28	STONINGTON	Philbrook	Steve	PO Box 269	Isleford
CROWLEY	RICKY	PO BOX 52	COREA	Polland	Peter, H.	PO box 138	Round Pond
Dyer	Justin	PO Box 739	Vinalhaven	PREBLE	CLARENCE	PO BOX 334 OAK ROAD	GEORGETOWN
Farnham	Jonathan	50 Murray Hill	East Boothbay	Robbins	Steve III	PO BOX 649	Stonington
Gilley	Glenn	68 Seawall Road	Southwest Harbor	RODGERS	DANIEL	PO BOX 108 WEST BAY RD	PROSPECT HARBOR
Graves	Ryan H.	PO Box #2	Northeast Harbor	Sargent	Stanley	Kansas Rd Box 269	Milbridge
Graybill	Warren	241 Cundy's Harbor Road	Harpswell	Simmons	Travis	PO Box 44	Port Clyde
Grindle	Michael	1434 COASTAL ROAD	Brooksville	Smith	Charles	PO Box 236	Beals Island
Heanssler	Chris	94 Pressey Village Rd.	Deer Isle	Smith	Aaron	PO Box 225	Beals
Heanssler	Scott	12 Billings Cove Lane	Deer Isle	Staples	Joe	407 Atlantic Road	Swans Island
Hillman	Jason	PO Box 265	Orr's Island	Staples	Carroll	PO Box 41	Swans Island
Hiltz Jr.	Dave	Coombs Mt. Rd. PO Box 117	Isle Au Haut	Stevens	Michael	PO BOX 353	GEORGETOWN
Hodgon	Jonathan	33 Stone Warf Road	Boothbay	Taylor	Jim	27 Summer Rd	Cushing
HOVERSON	RODNEY	6 STOVERS OCEAN AVE	HARPSWELL	Taylor	Steve	12 Island Ave.	Kittery
Johnson	Dan	122 Harbor Rd	Swans Island	Thompson	Frank	RR 1 BOX 757b	Vinalhaven
JOHNSON	KENNETH	5 LONG REACH LANE	HARPSWELL	Thompson	Jacob	RR 1 BOX 757b	Vinalhaven
Jones	Mark	PO Box 214	Boothbay	Thomsom	Mathew	PO Box 64	Nonhegan
Jones	Eric	83 Beach Hill Cross Road	Mount Desert	Treadwell	Joseph	7 Red Point	Swans Island
Joyce	Carlton	12 Grindle Hill Rd	Swans Island	Weber	Matt	PO Box 42	Nonhegan
Joyce	Jason	20 Grindle Hill Rd	Swans Island	Whidden	Clayton	18 WHIDDEN ROAD	Harpswell
Joyce	Spencer	PO 386	Swans Island	White	Jeffrey	PO Box 74 Birch Hill Rd.	York
Joyce	Joshua	PO 386	Swans Island	Whitmore	Greg	15 SHORE DR	WEST BATH
Knapp	Larry	PO Box 153	Boothbay	Whitmore	Ryan	16 SHORE DR	WEST BATH
Knapp	Caleb	Dover Rd.	Boothbay				

## 5. Methods:

Industry participants had several EFP requirements that limited the time, place and configuration of activity. Industry members were responsible for all purchasing of experimental gear but were able to keep any Jonah crab caught during EFP activity.

Participation was limited to 100 current Maine lobster/crab license-holders without prior fishery-related violations or convictions on their records. Fishermen were limited to a maximum of 200 exempted traps over and above their existing lobster trap limit, while participating in the Jonah crab experiment. Because Jonah crab is currently an unregulated species in Federal waters, if a gear exemption were developed, it would be available to vessels fishing in Federal waters without issuance of an EFP. The majority of the interested fishermen are currently Federal permit holders (lobster and multispecies). Less than 30% of EFP vessels are not federally permitted and the EFP exempts these vessels from Federal permit requirements.

Under current State of Maine regulations, an existing fishery (Jonah crab is covered under Maine lobster/crab licenses) cannot be limited in participation without first gaining legislative approval. However, the experimental status of this project allows the DMR to limit the number of special licenses issued to 100. The DMR arrived at this sample size by taking into consideration the number of traps needed to test adequately the experimental trap designs, and the number of lobstermen needed to ensure quality data, while minimizing bycatch rates and potential interactions with protected resources.

a. EFP Requirements

Participation

- 100 Maine lobster and crab license holders (first come first serve waiting list).
- Mandatory daily trip report.
- Mandatory social and economic survey.

Season and Area

- One year after the issuance of an EFP (anticipated renewal for total of three years).
- Federal Lobster Management Area 1 (FEDERAL WATERS ONLY).

Gear Requirements

- Maximum 200 traps per participant.
- At least 60% must be modified side entry.
- 2.5" oblong entry hoop(s).
- One 3.25" circular escape vent in parlor.
- One 3.25" circular escape vent in kitchen.
- One 1 15/16" standard lobster vent in parlor.
- A maximum 40% top-entry style trap.
- Minimum 3.6" diameter top entry (exempted by ME DMR in 1992 from escape vents and more recently for lobster trap tags).
- Two 3.25" circular escape vents.
- One 1 15/16" standard lobster vent in parlor.
- Maximum trap size (same as lobster).
- Biodegradable vent.
- A maximum soak time of two weeks.
- A minimum of 10 traps per vertical line.
- All vertical lines must be marked midway on buoy line.
- One 4" red mark.
- One 4" blue mark (state requirement).
- Only crab traps to a single line.
- All buoys clearly marked with the word "CRAB" appearing under the state lobster/crab license number.
- Traps must be marked with state lobster/crab license number and a consecutively numbered Crab Trap Tag to be issued by the DMR.

- All buoy lines must be attached with a knotless weak link at the buoy with a breaking strength of 600 lbs or less. Weak links may include swivels, plastic weak links, rope of appropriate breaking strength, hog rings, or rope stapled to a buoy stick. Buoy lines must break to produce a knotless end.
- Buoy lines and ground lines must be comprised entirely of sink or neutrally buoyant rope from June 1 to October 31.

#### Biological Limits

- Minimum legal carapace width of 5" (127 mm).
- No take of female crabs.
- No take of regulated species from experimental crab traps

#### *DMR EFP monitoring*

Monitoring of EFP activity by the DMR was accomplished through at-sea observers, daily logbooks, and periodic enforcement checks. Data elements collected during an at-sea observer trip included biological data on encountered species and catch-effort information. Observers were instructed to record data on each crab encountered in experimental gear. When catch volume was high a systematic sub-sampling routine was developed where the observer would sample at least one trap completely in each trawl for all data elements and in un-sampled traps record bycatch (lobsters, fin fish etc.). Biological data collected included size, sex, shell hardness, claws and egg stage if present. Catch-effort data collected included traps hauled (experimental and standard), bait used, set-over-days, depth, string type and location.

EFP participants were required to complete daily logbooks when experimental gear was hauled to document the amount of crabs harvested during EFP activity and to record the incidence of bycatch. Specific elements recorded on logbooks were date, location (10-minute grid), number of traps, pounds (by trap type), set-over-days, price, a description of gear and bycatch (species, number, length). Logbooks were periodically sent to the DMR for data entry. Documentation of fishing activity in 2002/2003 was used for participant eligibility for the 2003/2004 EFP.

#### **6. Data:**

The DMR has collected information on the catch and biological composition in experimental modified side entry crab traps from September 2002 to June 2004 through mandatory participant logbooks and at-sea observer trips. Data collected during commercial fishing operations fall under State of Maine confidentiality laws (<http://www.maine.gov/dmr/bmp/lawindex/6173.htm>) which prohibit the distribution and use of data that can be traced back to an individual. To overcome confidentiality concerns the DMR follows the "rule of three" where display and dissemination of results must be summarized with a minimum of three participants/trips/months/areas contributing to the information.

NEC project development funds provided the support to monitor EFP fishing activity, but did not directly contribute to the experimental fishing (participants were not compensated in any way beyond the ability to sell the catch) therefore the collected data is subject to

State of Maine confidentiality laws. Data will be provided to the NEC and the public at large in summarized form.

The DMR conducted fifteen observer trips from February 2003 to May 2004. A total of 327 trips were reported from participant logbooks. The number of observer trips was greatly hampered by low participation and severe weather. We have not recorded any data on top entry traps to date.

Table 2. The experimental trap hauls and participants by month since the beginning of the first EFP in September 2002 through March 2004.

Year	Month	Trap Hauls			Trips	Participants	
		Standard	Side	Top			
2002	SEPT	-	140	-	5	2	
	OCT	525	355	40	15	4	
	NOV	1470	330	110	18	5	
	DEC	1440	190	90	11	5	
2003	JAN	1080	165	200	11	5	
	FEB	1900	180	40	8	4	
	MAR	3585	820	60	19	8	
	APR	4560	1150	-	30	10	
	MAY	5303	1540	-	40	13	
	JUN	4075	1902	-	37	14	
	JUL	3100	1987	-	43	16	
	AUG	2840	1635	-	34	12	
	(EFP Year 1 ends)	SEPT	1340	490	-	13	12
		SEPT	592	280	-	10	
2004	OCT	790	460	-	19	7	
	NOV	640	160	-	8	3	
	DEC	450	70	-	3	2	
	JAN	-	-	-	-	-	
	FEB	260	10	-	1	1	
	MAR	520	80	-	2	1	
	Totals		34470	11944	540	327	32

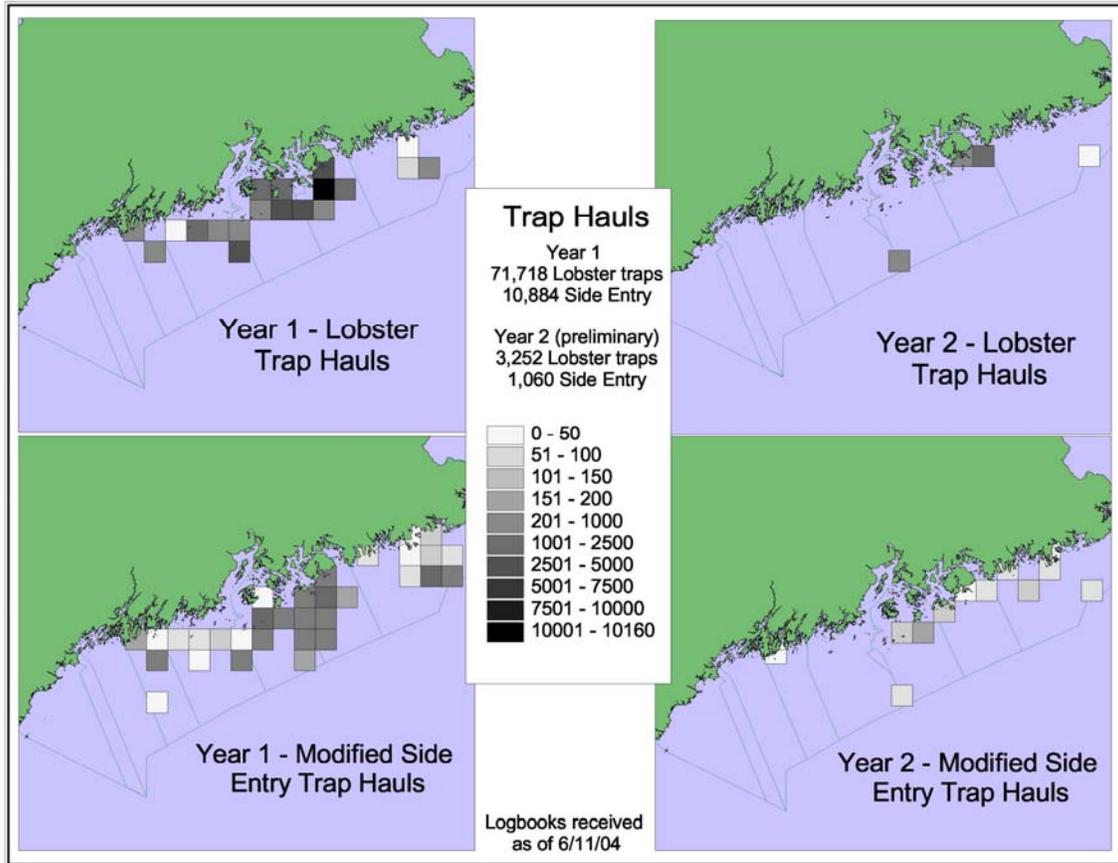


Figure 3. Distribution of EFP participant trap hauls for standard lobster and modified side entry in Federal Lobster Management Area 1 from September 2002 through June 2004. Data generated from participant logbooks.

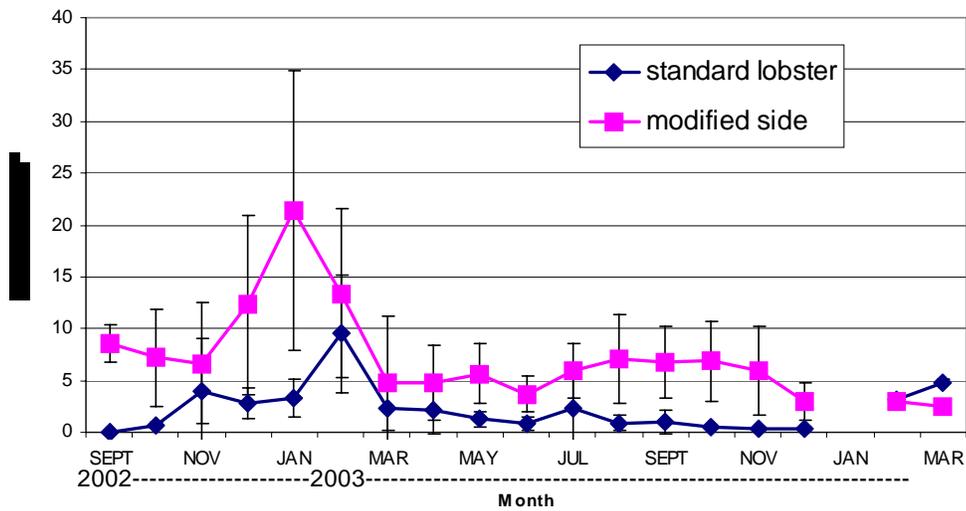


Figure 4. Daily trip reports of pounds of crabs caught per trap haul for standard lobster and modified side entry in ELMA1 from September 2002 through March 2004. Error bars indicate standard deviation of catch reported by trips.

Table 3. Number of trap hauls (th) and CPUE (pounds and number) of Jonah crab for three types of traps reported fished during the EFP. Number per trap haul based on an average weight of 1.03 lb. crab-1 for crabs >127 mm CW and with a hardshell.

Trap type	Year 1			Year 2		
	Trap hauls	Pounds	Avg lb/th	Trap hauls	Pounds	Avg lb/th
Modified Side Entry	10884	71718	6.59	1060	7140	6.74
Top Entry	540	3932	7.28	0	0	0
Standard lobster	31218	64799	2.08	3252	410	0.13

Table 4. The reported catch of regulated and non-regulated (shaded) species during September 2002 to May 2003 from participant logbooks.

Catch	Side Entry	Top Entry	Total	CPTH side*	CPTH top**	Length (cm)
Jonah crab***	63183	3818	67000	6.311	7.069	
Sub-legal Lobster	128	9	137	0.013	0.017	
Redfish	105		105	0.010		17.6
Hake	39		39	0.004		31.1
Legal Lobster	29		29	0.003		
Cod	21	2	23	0.002	0.004	33.0
Scallop	13		13	0.001		
Shrimp	7		7	0.001		
Dogfish	5		5	0.000		61.0
Flounder	2	1	3	0.000	0.002	31.2
Haddock		1	1	0.000	0.002	35.6
Mackerel	5		5	0.000		30.5
<i>Longhorn Sculpin</i>	431		431	0.043		21.2
<i>Cusk</i>	20	2	22	0.002	0.004	39.6
<i>Conger Eel</i>	2		2	0.000		30.5
<i>Skate</i>	3		3	0.000		43.2
<i>Wolfish</i>	1		1	0.000		71.1

\* Total 10011 side entry trap hauls, \*\* Total 540 top entry trap hauls

\*\*\* based on avg. Jonah crab weight of 1.03 lbs (>127 mm CW and hardshell)

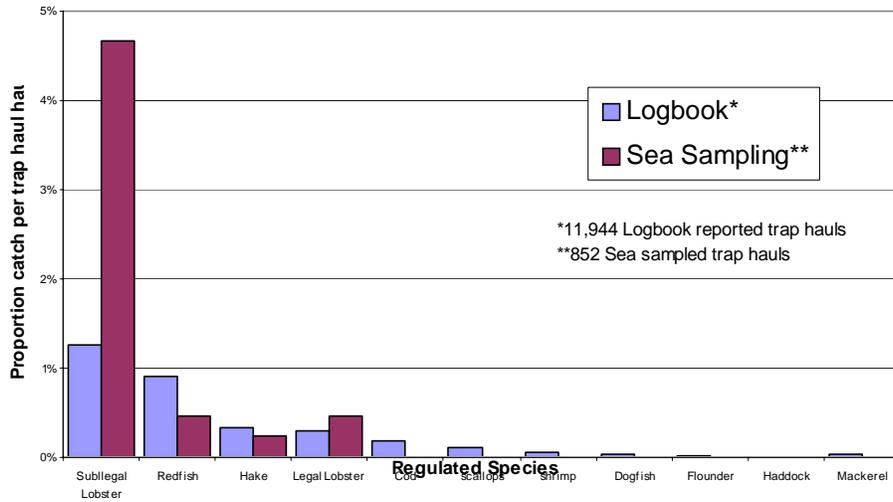


Figure 5. Bycatch of regulated species in experimental traps reported by logbooks and at-sea observing trips since the beginning of the EFP in September 2002.

Table 5. Summary statistics of observer data from modified side entry and standard lobster traps.

Sampling month	MODIFIED SIDE ENTRY TRAPS				
	Trap hauls	# measured traps	# crab measured	# crabs kept (>127 and hard)	# lobster bycatch
FEB (2003)	20	4	57	45	3
MAR	30	8	70	20	0
MAY	60	32	196	48	20
JUN	240	56	994	432	3
JUL	40	23	427	197	1
SEP	30	6	443	188	1
OCT	109	28	257	143	7
NOV	60	18	285	162	5
FEB (2004)	69	69	645	484	4
MAY	200	197	578	444	0
Totals	858	441	3952	2163	44

Table 5, Continued

Sampling month	STANDARD LOBSTER TRAPS					
	trap hauls	measured traps for crab	# crab measured	# crabs kept (>127 and hard)	measured traps for lobster	# lobster measured
FEB (2003)	340	32	661	335	320	428
MAR	217	46	691	346	217	364
MAY	100	34	59	12	100	177
JUN	635	170	456	228	635	2167
JUL	258				258	852
SEP	200	19	258	89	200	355
OCT	360	17	79	16	360	1447
NOV	571	7	98	23	531	3485
FEB (2004)	110	81	170	71	110	57
MAY	42	42	154	106	42	31
Totals	2833	448	2626	1226	2773	9363

Sampling month	TOTAL CRABS PER TRAP HAUL		CRABS KEPT PER TRAP HAUL (>127 and hard)		AVERAGE CARAPACE WIDTH OF KEPT CRABS (mm)	
	Side Entry	Standard Lobster	Side Entry	Standard Lobster	Side Entry	Standard Lobster
FEB (2003)	14.25	20.66	11.25	10.47	138.1	138.9
MAR	8.75	15.02	2.50	7.52	135.3	136.7
MAY	6.13	1.74	1.50	0.35	142.9	143.3
JUN	17.75	2.68	7.71	1.34	143.2	142.5
JUL	18.57		8.57		140.6	
SEP	73.83	13.58	31.33	4.68	139.1	146.6
OCT	9.18	4.65	5.11	0.94	151.8	145.1
NOV	15.83	14.00	9.00	3.29	138.7	141.4
FEB (2004)	9.35	2.10	7.01	0.88	136.1	143.8
MAY	2.93	3.67	2.25	2.52	135.1	134.8
Totals	8.96	5.86	4.90	2.74	140.09	141.46

Sampling month	TOTAL LOBSTER PER TRAP HAUL		AVERAGE CARAPACE LENGTH OF LOBSTERS (mm)	
	Side Entry	Standard Lobster	Side Entry	Standard Lobster
FEB (2003)	0.15	1.34	77.3	91.5
MAR	0.00	1.68	-	97.4
MAY	0.33	1.77	69.5	85.9
JUN	0.01	3.41	72.7	89.4
JUL	0.03	3.30	74.0	80.4
SEP	0.03	1.78	56.0	87.2
OCT	0.06	4.02	79.3	88.3
NOV	0.08	6.56	79.4	94.5
FEB (2004)	0.06	0.52	72.3	88.9
MAY	0.00	0.74	-	94.3
Totals	0.05	3.38	72.56	89.78

Table 6. Composition of Jonah crabs measured during at-sea observer trips.

	# of crabs	average carapace width (mm)
total crabs measured	6687	130.6
total male crabs	6049	132.9
soft	954 (16%)	139.8
hard	5095 (84%)	131.6
>127	1999 (65%)	139.9
>127mm and hard	1651 (54%)	139.1
total female crabs	637	108.7
eggers	42	116.2

Figure 6. Size frequency of male and female crabs observed in standard lobster and experimental side entry traps during the reporting period.

**7. Results and Conclusions:**

In September 2002 and September 2003, an EFP was issued to the Maine Department of Marine Resources (DMR) endorsing 100 Maine lobster harvesters to fish up to 200 additional modified crab traps in ENMA1. Since this time 32 harvesters have participated in the project recording nearly 11,950 trap hauls of experimental crab traps. Logbooks and observer trips have recorded very low non-targeted species catch rates and variable but high catch rates of *C. borealis*. Participation in the EFP has been low due to severe winters, high costs of investment in new gear to meet Protected Resources requirements and unknown catch rates of crab. As a condition of the EFP, neutrally buoyant or sink line was only applied during the months of June through October.

*EFP Participation and DMR Monitoring*

Participation was low in the first two years of the EFP. To date 32 harvesters have returned completed logbooks during the past 19 months (not all participants set experimental gear each month) (Table 2). Monthly participation peaked in the summer of 2003. There was incentive for participants to set gear as a condition of permit renewal by DMR. Harvesters who have been issued an EFP, but had not set experimental gear were removed from the program and replaced with harvesters on a first-come first-serve waiting list after the first year. There are presently 78 harvesters with permits.

The distribution of EFP permitted vessels covers the entire coast of Maine; however, participation has been limited to areas east of Boothbay Harbor (Figure 3). The highest concentration of experimental trap hauls has been in the Penobscot Bay region.

### *Characteristics of the EFP fishing activity*

To date nearly 47,000 trap hauls (standard lobster and experimental traps) have been recorded through participant DMR logbooks (Table 3). Participants generally are fishing 20-100 experimental traps each. The highest catch rates of Jonah crab were observed in modified side entry traps in the winter months. Over the 9-month reporting period modified side entry traps caught an average of 8.6 crabs per trap haul, as compared to 5.8 crab per trap haul for top entry and 2.9 crabs trap haul for standard lobster traps (Figure 4, Table 3). The reported landings from experimental traps were 82,790 lbs. with an average price per pound paid to fishermen of \$0.40. Based on DMR observer comments, participants were only retaining hard-shell male crabs.

### *Catch rates of targeted and non-targeted catch composition*

Reported non-targeted species catch was very low during the reporting period. Sublegal lobsters had the highest catch rate 0.013 trap haul-1 followed by Atlantic redfish and hake (Figure 5). In total, 35 legal sized lobsters were reported in 11,944 experimental trap hauls (Table 4). Lobsters were the only regulated species by-catch observed during DMR observer trips. Lobster bycatch recorded by observers was higher than that reported in logbooks. This difference was largely influenced by one sampling trip in May 2003 (Table 5). Overall the reported and observed level of bycatch is very low and consistent with previous levels reported for the lobster fishery (DMR unpublished). All non-targeted catch was immediately returned to the water alive. With the exception of 35 legal sized lobsters, the average size of non-targeted species was below minimum legal size. The largest regulated species bycatch was dogfish (72.4 cm). The entrance size for modified side entry traps of 2.5" (6.35 cm), may have limited the size and quantity of bycatch. In addition, the large 3.25" (8.26 cm) circular escape vents would allow most of the bycatch to escape while the trap is on the bottom. Top entry traps have larger entrance hoops, at a minimum of 3.66" (9.3 cm) and would likely be the primary entry and exist points for non-targeted species.

### *Biological characteristics of targeted and non-targeted species caught in experimental gear.*

Jonah crabs caught in experimental and standard lobster traps were culled for size, shell-hardness and sex. Only hard-shell males greater than 127 mm carapace width (CW) were kept. Currently buyers are only accepting large hard-shell male crabs. Hard-shell crabs constituted approximately 50% of the total crabs caught (Table 5). Discarded crabs were immediately returned to the water directly from the trap.

Based on observer data, modified side entry crab traps caught very few and predominately small lobsters when compared with standard lobster traps. The average size of lobsters caught in experimental gear was 73 mm carapace length (CL), while the average size of lobsters in standard lobster traps was 90 mm (minimum legal size of lobsters is 82.6 mm CL).

The size composition of male *C. borealis* was similar between standard lobster and experimental lobster traps. Approximately 65% of the crabs counted were above the EFP proposed minimum size of 127 mm carapace width (Figure 4, Table 5).

#### *EFP Interactions with Protected Resources*

The DMR did not observe or receive any reports of interactions with protected resources by EFP participants. EFP participation was low (32 out of 100 participants) and the majority of the fishing activity was in winter months, a time period when the likelihood of encountering protected resources is lowest in the Gulf of Maine.

#### *Management Implications*

Participating fishermen have been successful in designing a trap specific for Jonah crab. Participation throughout the two EFP periods have been low in relation to the 100 permits that could have been issued. This level reflects the economic costs on individual fishermen of conducting gear research with out direct funding.

Best fishing practices are an arrangement of precautionary management in combination with selective gear that has low interactions with untargeted species. The existing lobster fishery and potential interactions with protected resources present barriers for successful exemption of Jonah crab traps or a development of a new directed crab fishery.

Jonah crab is a bycatch in the existing lobster fishery and directed trapping of crab is seasonal in nature. However, if conditions were to change (resource status or economic) making crab more profitable than lobster, the existing lobster fishery could re-direct a nearly unchecked amount of effort on the crab resource. Under these conditions it would not be advisable to have a newly developed but competing crab trap or fishery. Additionally, current market requirements direct fishermen to select for larger hard-shell male Jonah crab. If the market were to change where smaller crab (male and female) were harvested the crab resource could be threatened biologically. To mitigate unknown future market demands the DMR is taking a precautionary approach and proposing to enact rules making authority of the Commissioner of Marine Resources in 2005 to implement biological limits on crabs. Biological limits will include a prohibition of harvest of female crabs and a minimum size for male crabs that is matched with functional maturity (Moraysu et al. 2002). Until the potential effort by the existing lobster fishery could be accurately quantified, exemption of Jonah crab traps or the development of a new fishery will be investigated in a manner where participation would be strictly limited and the fishery would be considered supplemental in nature.

Interactions between Jonah crab gear and protected resources present an unknown but increased risk over the existing lobster fishery. Many large whale populations are at risk for entanglement with fixed gear. In the EFP steps were taken to decrease the risk of interactions with protected resources by limiting participation, requiring no more than one end-line per 10 trap trawl and requiring neutrally buoyant or sink line to be used on all groundlines between traps. However the location of the experimental fishing in the near-offshore (Figure 3) places crab traps in high risk areas (Perry 1999). Any increased risk to many protected resources may be unacceptable to NMFS under the Endangered

Species Act, and therefore establishment of any new fixed gear fisheries will need extensive risk analysis.

Project objectives were achieved in collaboration with industry participants for the development of new selective gear for Jonah crabs. These objectives matched well with NEC's goals of developing partnerships for gear development. Implications for management are mixed. New information collected during on-board observer trips and with participant logbooks has led to the DMR seeking to initiate basic biological limits on Jonah crabs. The development of an exempted gear for Jonah crab or a new targeted fishery faces several hurdles with the existing lobster fishery and protected resources.

## **8. Partnerships:**

This NEC funded project was conducted in strong partnership between industry and scientists. The proposed experimental crab traps were originally developed by industry. The DMR has taken the approach to allow follow industry's lead and work to help facilitate the process. The DMR feels this collaboration is a proactive approach to the development of selective gear and management of unregulated fisheries.

The development of the proposed modified side entry trap project by industry was accomplished within the first few months of the initial experiment in 2000, as the incentives stood to directly benefit industry participants. The response by the DMR and NMFS to follow through on the initial experiment with an expanded EFP in federal waters took two years. The delay in the EFP issuance reflects the institutional obstacles of proactive development projects. Since the issuance of the first EFP in September 2002, subsequent renewals have been accomplished at a much faster rate and have not resulted in a break in EFP activity. Industry enthusiasm and participation may have suffered from the delay in the issuance of the first EFP. From December 2000 to September 2002 industry saw a financial opportunity that declined considerably in 2004 as the availability of crab was reduced.

This project led DMR and key industry EFP participants in to collaborate on a Maine coast video survey for Jonah crab that was funded by NEC in 2003. This survey developed new techniques to video crabs in complex habitats inaccessible by trawls. Industry participants designed the video drop camera system and contributed their specific knowledge of their fishing area to help facilitate this project.

NEC funding provided support for several meetings between industry participants and DMR staff regarding the status of the EFP and future management directions. The future management of Jonah crab is unclear given concerns about the potential crab effort that exists in the lobster fishery and interactions with protected resources. There were significant advances in the understanding on all sides for the need to implement biological limits on crabs and the DMR plans to move forward with complete protection for female crab and a minimum size for male crab

## **9. Collaboration with other projects:**

There has been limited collaboration with other projects as many of the sampling tasks are unique to crab traps. We found with most observer trips it was rare that EFP

participants set the full amount of experimental gear and would often complement the experimental gear by hauling standard lobster traps. In these cases observers recorded information from the traps using standard lobster sampling methodologies. The lobster trap data was then directly incorporated into the MEDMR biological databases for lobster.

#### **10. Impact on end-users:**

This project has had a direct impact on end users as information collected has contributed to biological recommendations on crabs in Maine. At this time EFP participants have designed a trap that effectively minimizes lobster by-catch, but it is unclear what role this gear will have in the future.

#### **11. Presentations:**

Over the course of this project four industry meetings (February/July 2003 and March/July 2004) were held to discuss initial results, participant concerns and future directions of the EFP. Meetings were centrally located and an average of 50 participants attended on each date.

*Specific presentations to scientific audiences were as follows:*

Development of a trap to exclusively target Jonah crab (*Cancer borealis*) in near shore Gulf of Maine. Reardon, K and C. Wilson. presented by Kathleen Reardon. Canadian Conference for Fisheries Research. St. Johns, Newfoundland, Canada. 1/8/04.

Development, assessment, and management of a potential targeted Jonah crab (*Cancer borealis*) fishery in Maine. presented by Kathleen Reardon. School of Marine Science, University of Maine Graduate Mini-Symposium. 5/10/04.

Estimation of key fishery parameters for managing Jonah crab (*Cancer borealis*) fishery in Maine. Reardon, K, C. Wilson, and Y. Chen. presented by Kathleen Reardon. American Fisheries Society Annual Meeting, Madison, WI. 8/23/04.  
(not directly talking about the trap project, but using some of the sea sampling data)

#### **12. Student participation:**

There has been one student directly involved with this project. Under the supervision of Dr. Yong Chen, University of Maine, Kathleen Reardon has worked toward a dual-masters degree in Marine Policy and Biology. Kathleen is scheduled to graduate in December 2005.

#### **13. Published report and papers:**

There will be several published reports stemming from this project. As part of K. Reardon's degree program we will likely submit one article on the selectivity of Jonah crab traps. An additional final report will be generated for NMFS at the completion of the final year of the EFP (September 2005).

#### **14. Images:**

Please see attached files. Please do not use images with out the written consent of the author.

#### **15. Future Research:**

This project has highlighted the need for collecting more information on the status of the Jonah crab population in the Gulf of Maine. Regional differences in growth, maturity and movement are needed to better understand stock identification. The largest obstacle to management of crabs is the largely unregulated bycatch fishery for crabs by the existing lobster fishery.

#### **16. References**

- Moriyasu, M., K. Benhalima, D. Duggan, P. Lawton and D. Robichaud, 2002. Reproductive biology of male Jonah crab, *C. borealis*, Stimpsom, 1859 (Decapoda, Cancridae) on the Scotian Shelf, Northwestern Atlantic. *Crustaceana* 75 (7): 891-913.
- National Marine Fisheries Service. 2001. Endangered Species Act Section 7 consultation, biological opinion and conference. Consultation in accordance with Section 7(a) of the Endangered Species Act Regarding the Jonah Crab Experimental Fishery. National Marine Fisheries Service, Northeast Regional Office, Gloucester, MA. June 14, 2001.
- Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. *Mar. Fish. Rev. Special Edition*. 61(1): 59-74.