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September 20, 2006

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Magalie Roman Salas, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: *Broadwater Energy LLC*, Docket No. CP06-54-000
Broadwater Pipeline LLC, Docket Nos. CP06-55-000 & CP06-56-000

Dear Ms. Salas:

Broadwater Energy LLC and Broadwater Pipeline LLC (collectively, "Broadwater") enclose for filing in the referenced proceedings the following:

- Report summarizing the results of American lobster larvae sampling in the vicinity of the proposed Broadwater FSRU, 16 June-28 July, 2006.

Please contact the undersigned with any questions regarding this submission.

Respectfully submitted

/s/ Brett A. Snyder

Brett A. Snyder

Enclosures

cc: James Martin, FERC
Cooperating Agencies
ENTRIX, Inc.
Roger Stebbing and Associates

August 25, 2006
Ref No. 20546.000

Mike Donnelly
Ecology and Environment, Inc.
Buffalo Corporate Center
368 Pleasant View Dr.
Lancaster, NY 14086

RE: Report summarizing the results of American lobster larvae sampling in the vicinity of the proposed Broadwater FSRU, 16 June-28 July, 2006.

FIELD METHODS

Normandeau Associates, Inc. conducted neuston samples for American lobster (*Homarus americanus*) larvae in the vicinity of the proposed Broadwater Energy floating storage and regasification unit (FSRU) on six sampling (16 June, 23 June, 30 June, 14 July, 18 July, 28 July 2006). Three replicate samples were collected within a one by one nautical mile square block centered on the location of the proposed FSRU facility (Figure 1) on each of the six sampling dates (18 total samples). The start location for each tow was randomly selected from coordinates along the 4 sides of the one by one nautical mile square block; the direction of each tow was toward the center of the block at the proposed FSRU location. The neuston net was 1 m deep x 2 m wide x 8 m long with 1.0 mm mesh. The mouth of the net was mounted on a 1x2 m aluminum frame deployed from a boom off the side of the boat in water clear of the vessel's wake and propeller turbulence. The mouth of the net was fished to a depth of approximately 0.5 m with 0.5 above the water's surface to ensure the surface layer was sampled. Tow duration was 30 minutes at approximately 0.6 meters/second. Tow distance was recorded with a flume-calibrated digital flow meter (GO Model 2030R) and ranged from 847-1409 m. Concentrations of neustonic lobster larvae are reported as number per 1000m^2 within 0.5 m depth (Incze and Wahle 1991, Wahle and Incze 1997). All tows were conducted during daylight hours from 0715-1000 h with an observer from the Long Island Sound Lobsterman's Association on board. After each tow, net contents were washed into the cod end with a deck mounted hose, rinsed through a 0.500 mm sieve, and preserved in 10% buffered formalin in seawater. A salinity, temperature, and dissolved oxygen profile was made at 5 foot intervals from one foot below the surface to one foot above the bottom at the proposed FSRU location prior to the first trawl on each sampling date with a YSI Model 85 meter.

LABORATORY METHODS

In the laboratory, all lobster larvae were sorted and enumerated by stage (I-IV) as described by Herrick (1895). The first three stages are zoeal. Newly hatched stage I larvae lack swimmerets and are only 8 mm or so in total length, the shell of the larvae is transparent and many internal organs are readily visible. Stage II larvae are only slightly larger, approximately 9 mm long, and resemble the first stage. The main distinguishing feature is the presence of four pairs of rudimentary swimmerets. Stage III larvae are 11 mm or so in length, have more developed swimmerets with setae as well as a developed tail fan and larger claws. During the molt to the next stage (IV), larval lobsters undergo a metamorphosis in which anatomical characteristics of the zoeal stages are replaced by those of a juvenile and the animal resembles an adult lobster. Stage IV is the megalops or post-larval stage of American lobster. Stage IV post-larvae are approximately 15 mm in total length and have well developed claws that extend forward, larger antennules and antennae and larger swimmerets with well developed setae.

STUDY OBJECTIVE

The first three larval instars (stage I, II, and III) are observed throughout the water column above the thermocline while stage IV post-larvae are largely confined to surface layers (Harding et al. 1987, Annis 2005). The accuracy of abundance estimates derived from plankton samples relies on knowing what proportion of the population of the population resides in the neuston, this is unknown for stage I, III and III lobster larvae. Therefore, abundance estimates for stage I, II and III lobster larvae based solely on neuston sampling in the upper 0.5 m are likely underestimates. Entrainment estimates for stage I, II, and III lobster larvae based on the 2002 Poletti Ichthyoplankton Program (Normandeau 2006a) are therefore, likely to be more representative of the seawater intake zone of the proposed FSRU facility which is located 35-45 feet below surface than neuston tows collected in the upper 0.5 m. The 2002 Poletti data represents collections taken from specific depths throughout the water column from 1 meter below surface to 3 m above the bottom in Long Island Sound (Normandeau 2006a). Stage IV post-larvae were not collected during the 2002 Poletti Program which is not surprising because most estimates place 78-96% of the stage IV lobster larvae population in the upper 0.8 m of the water column (Harding et al. 1982, 1987, Hudon et al. 1986). The Poletti Program sampling design was inadequate to collect stage IV post-larvae and their absence in the collections does not demonstrate that they are absent from surface waters in the project area. The objective of Broadwater's site specific, June-July 2006 neuston sampling program was to sample the upper surface layer (0.5 m) of the water column where the majority of stage IV lobsters occur in order to provide entrainment estimates for this stage which are lacking from the 2002 Poletti Program data.

RESULTS

Physical Profiles of Water Column

Surface temperatures at the proposed FSRU location ranged from 17.1 °C on 16 June to 25.0 °C on 18 July, 2006. A weak (3-7 °C) thermal gradient was present between the surface and 40 feet on the six sampling dates in June and July, 2006 (Figure 2). The water was isothermal from 40 feet to the bottom. Surface dissolved oxygen concentrations ranged from 7.1 mg/L on 28 July to 8.8 mg/L on 23 June (Figure 3). There was no evidence of bottom hypoxia (D.O < 3.0 mg/L, LISS 1994, Anderson and Taylor 2001) during sampling in June and July, however, D.O concentration in the bottom waters dropped as low as 4.8 mg/L on the last sampling date on July 28, 2006. Hypoxia occurs primarily during late summer in the deeper waters of the more urbanized western basin of Long Island Sound, although hypoxic conditions sometimes exist in the central basin (LISS 1994). Surface salinity ranged from 23.5 to 25.3 $^{o}/_{oo}$ and the water column was isohaline from 60 feet to the bottom (Figure 4).

Neustonic Lobster Larvae Density in the Study Area

A total of 56 American lobster larvae were collected in the 18 neuston tows. This catch included 7 stage I larvae, 11 stage II larvae, 26 stage III larvae, and 12 stage IV post-larvae. Average density of larvae in the three replicate tows on each sampling date was highest during the first sampling date on 16 June, 2006 when all four neustonic stages were collected (Table 1, Figure 5).

Average density of lobster larvae (all four stages combined) was 4.4/1000 m^2 within 0.5 m depth on 16 June (Figure 5). Density declined to about 2/1000m^2 on 23 and 30 June and to 0.6/1000m^2 on 14 July. No lobster larvae were collected during the last two sampling dates on 18 and 28 July. Stage I larvae were most abundant on 23 June (0.8/1000m^2) and were not collected after this date. Stage II larvae were most abundant in the first collection on 16 June (1.4/1000m^2) and were collected in lower densities (0.1 and 0.2/1000m^2) on 30 June and 14 July respectively. Stage III larvae were most abundant during the first collection on 16 June (1.9/1000m^2) and were collected in declining density through 14 July (0.3/1000m^2). Stage IV post-larvae had an average density of 0.9/1000m^2 on 16 June and 1.0/1000m^2 on 30 June. Average stage IV density declined during collections on 14 July to 0.2/1000m^2 and they were not collected after this date.

The presence of stage IV post-larvae on 16 June clearly indicates that hatching occurred prior to the first sample. Using the development rates of MacKenzie (1988) and daily average temperature recorded by the University of Connecticut Department of Marine Science's weather buoy in the Central Basin of Long Island Sound located near the proposed FSRU facility (Station 44039: http://www.ndbc.noaa.gov/station_page.php?station=44039) it is estimated that the stage IV post-larvae collected on 16 June may have hatched around May 20-24. The timing of first appearance of Stage I larvae in the plankton tends to coincide with a narrow range of surface temperatures averaging around 12.5 °C (Harding et al. 1983). May 24 was the first day in 2006 where the daily average temperature (measured once per hour) exceeded 12.5 °C.

Entrainment Estimates Based on the 2002 Poletti Ichthyoplankton Data

Entrainment estimates for larval lobsters in water withdrawal operations at the proposed FSRU facility were calculated using the 2002 Poletti Ichthyoplankton Program (PBS&J/LMS Joint Venture, 2003) data subset to represent the FSRU intake (Normandeau 2006). Poletti regions 7-9 (Figure 6) were selected to represent the Central Basin of Long Island Sound because the proposed FSRU facility is located near the intersection of the three regions. The water column depth strata for the Broadwater subset was restricted to deep (total depth of the water column > 30 m or 98 ft) and intermediate (total depth of the water column 6-30 m or 20-98 ft) because the total depth of the water column at the proposed FSRU location is approximately 95 feet. Sampling gear was restricted to the 1x1 m^2 tucker trawl (0.500 mm mesh) to represent water column collections (from 1 m below surface to 3 m above bottom) because water withdrawal from the proposed FSRU facility will occur from 35-45 feet below surface. Because all samples within a given biweekly period/water column total depth strata/region/gear type were combined in the laboratory to form composite samples prior to enumeration, it is not possible to analyze samples from specific depths or locations proximate to the proposed FSRU location. Therefore, tucker trawl collections represent a composite of samples taken from specific depths 1 meter below surface to 3 m above the bottom (Normandeau 2006). The average larval lobster density in regions 7-9 during each biweekly survey in the subset Poletti data was multiplied by the daily water intake (28.2 MGD, 106,750 m^3/day) of the proposed FSRU facility to estimate number entrained per day. The daily entrainment estimate was multiplied by fourteen to estimate the number entrained in each of the eleven biweekly surveys. The entrainment estimates for each of the four planktonic life stages of American lobster were summed for the eleven biweekly surveys to estimate the number entrained based on the March 4-August 5 sampling period of the 2002 Poletti Ichthyoplankton Program presented in Table 2. Further details regarding the Poletti Ichthyoplankton Program and assumptions made to apply that data to represent the ichthyoplankton and larval lobster community in the proposed Broadwater FSRU area are provided in Normandeau (2006a) (*see* Broadwater's Resource Report 3, Fish, Vegetation and Wildlife, Appendix E for this report).

The 2002 Poletti Ichthyoplankton Program data subset to represent the proposed FSRU location (Normandeau 2006) collected lobster larvae during biweekly surveys 6 through 10 (May 13-26 through July 8-July 21, 2002). Annual entrainment estimates of stage I-III larvae was about 48,000 in the intermediate (total water depth 6-98 ft) depth strata and 44,000 in the deep (total water depth > 98ft) depth strata (Table 2). Stage I larvae were numerically dominant with lower abundance of stage II and III; stage IV post-larvae were not collected. For a basis of comparison, annual entrainment of larval lobsters at Millstone Power Station in Waterford, Connecticut from 1984-2005 has ranged from 9,600 to about 660,000 with an average of about 330,000 and are predominantly stage I (NUSCO 2006).

DISCUSSION

Stage I-III Lobster larvae

The vertical distribution of American lobster larvae has been difficult to resolve because of their natural low density and patchy distribution (Fogarty and Lawton 1983, Harding et al. 1987). Early studies suggested that American lobster larvae were neustonic and largely confined to the upper meter of the water column (Templeman 1937, Sherman and Lewis 1967, Scarratt 1964, 1973, Stasko and Gordon 1983). However, studies by Harding et al. (1987) demonstrated that stage I-III larvae were distributed throughout the upper 30 m mixed layer (above the thermocline) of the water column in Browns Bank off the coast of Nova Scotia. In particular, stage I larvae were most abundant at the 15-30 m depths with few at the surface during the day; although almost all stage I larvae remained above the thermocline. At night, most stage I larvae were at the surface and from 5 to 10 m and few were deeper than 10 m. Integrated throughout the water column, on average < 1% of stage I larvae occurred above 2.5 m depth during daylight, compared to 28 % after dark. Stage II and III larvae were taken over a broad depth range above the thermocline as well; most were taken in the upper 20 m, but some stage II larvae were taken as deep as 30 m (Harding et al. 1987). There was no indication of diel vertical migration by stage II and III larvae, although these stages were relatively rare thus hindering statistical analysis (Harding et al. 1987).

The vertical distribution of stage I-III larvae throughout the upper 30 m of the mixed zone observed by Harding et al. (1987) is consistent with early behavioral observations noted by Hadley (1905, 1908). Hadley noted that the larval response to light intensity varied with ontogeny. In the first hours after hatching, experimental larvae were positively phototactic, but this response reversed by the second day into a negative reaction to bright light, although they were still attracted to reduced light. These results explain a vertical migration cued to light intensity and the presence of some stage I larvae at the surface throughout the day (Harding et al. 1987). Hours before molting into stage II, III or IV larvae, lobsters were strongly attracted to bright light again. This response could also explain the presence of some stage II and III larvae in the surface waters during daylight. Lobster larvae had a negative response to bright light after molting into stage II and III and actively sought regions of reduced light.

Although it appears that the first three larval instars may be more broadly distributed throughout the mixed water column than previously believed, field (Harding et al. 1987) and laboratory (Boudreau et al. 1991) evidence suggests they remain above the thermocline. However, the artificial thermal gradient used in Boudreau et al.'s (1991) laboratory experiments was considerably stronger and more compressed (~ 10°C/m) than typically observed in natural conditions. A temperature gradient, regardless of its depth, is generally believed to restrict lobster larvae to the warmer-water layer above (Ennis 1995). Residence in the warmer water of the upper mixed zone increases growth and development rates (Templeman 1936, MacKenzie 1988) which enhances survival by reducing the duration of exposure to predators in the plankton (Hudon and Fradette 1988). Thus, there is a strong incentive for larvae to remain in warmer waters above a thermal gradient. In the study area, a weak (3-7°C) thermal gradient was present between the surface and 40 feet in June and July, 2006 (Figure 2). The seawater intake of the FSRU facility is located 35-45 below surface which is the approximate depth where the summertime thermal gradient at the proposed site occurs. Unfortunately, it is not possible to determine if the relatively weak thermal gradient observed in this study poses a barrier to the vertical distribution of lobster larvae in Long Island Sound using the Poletti data because all samples within a biweekly survey/region/total water column depth strata/and gear type were combined into a laboratory composite for enumeration.

Although lobster larvae were more abundant in the tucker trawl collections (sampled depths from approximately 1 meter below surface to 3 m above the bottom) than the epibenthic sled (sampled the bottom 1 meter of the water column), the occurrence of stage I-III lobster larvae in the epibenthic sled collections (Figure 7) demonstrates that they were not restricted to the surface layers and can occur within 1 m of the bottom in central Long Island Sound. Therefore, abundance estimates for stage I-III larvae based solely on neuston sampling are likely underestimates. Density of stage I-III lobster larvae collected from tucker trawl samples in Central Long Island Sound during the 2002 Poletti Ichthyoplankton Program (Figure 7, Table 2) are likely more representative of the seawater intake zone of the proposed FSRU facility which is located 35-45 feet below surface than neuston tows collected in the upper 0.5 m.

Stage IV post-larvae

Although the first three larval instars were observed throughout the water column above the thermocline by Harding et al. (1987), stage IV post-larvae were largely confined to surface layers with 90% of stage IV lobsters collected in the upper meter. Stage IV lobsters are believed to be primarily neustonic and they have been sampled at the surface in most studies quantifying distribution (reviewed by Ennis 1995). Most estimates from plankton net samples place 78-96% of the stage IV population in the top 0.8 m of the water column with no diel differences in vertical distribution (Scarratt 1973, Harding et al. 1982, 1987, Hudon et al. 1986). Annis (2005) found on average, stage IV post-larvae spent 65% of the time in the top 0.5 m and 95% of the time in the top 4.5 m during in situ diver observations of wild caught post-larvae in Boothbay, Maine. Annis (2005) suggests that estimating total abundance of lobster post-larvae throughout the entire water column based on surface samples likely results in greater underestimations than previously believed, however his results still support the efficacy of surface sampling for stage IV lobsters as they spent more time at the surface than any other depth. Therefore, it is not surprising that stage IV post-larvae were not collected during the 2002 Poletti Program because neither the tucker trawls or epibenthic sleds sample the surface film (upper 0.5 m) of the water column where planktonic stage IV lobsters primarily occur. The Poletti Ichthyoplankton Program sampling design was inadequate to collect stage IV lobster post-larvae and their absence in the collections does not demonstrate that they are absent from the area. Therefore, density estimates of stage IV lobsters derived from the 2002 Poletti Ichthyoplankton Program are not representative of surface waters near the proposed FSRU location, although they do suggest that if stage IV lobsters are present, they likely do not occur at depths liable to be entrained (35-45 feet) for considerable periods of time. The objective of Broadwater's site specific, June-July 2006 neuston sampling program was to target the upper surface layer of the water column where the majority of stage IV lobsters occur.

Lobster larvae are naturally low in abundance and stage IV larvae are typically collected in densities < 20/1000 m^2 in the upper 0.5-1.0 m in neuston collections or < 20/1000m^3 in samples where volume was quantified (Harding et al. 1982, 1987, Incze and Wahle 1991, Wahle and Incze 1997, Incze et al. 1997, Incze et al. 2000). However, most studies quantifying larval lobster abundance has taken place in Canadian and northern New England waters with comparatively little work south of Cape Cod or in Long Island Sound. Lund and Stewart (1970) sampled areas offshore in southern New England and in Long Island Sound over a four year period from 1966-1969 with a 1.52 m diameter plankton net towed at the surface. The 1966 and 1967 samples in Long Island Sound were primarily restricted to the eastern end of the Sound with few tows taken in the central and western Sound. The 1968 program was expanded to 50 stations throughout the Sound where they observed an average density of about 1.2 lobster larvae/1000m^3 during June-July in 1968 (Harding et al. 1982). Sampling began each year in May and continued on a biweekly schedule until hatching was first evident when weekly sampling was to be conducted. However, sampling was terminated in late July and early August due to clogging of the nets by ctenophores. Stage I lobster larvae first appeared in Long Island Sound collections on 14 June, 1966, 26 June 1967, 4 June 1968 and 19 June 1969, the minimum surface water temperature when larvae were first collected was 12.5 °C. The peak of the hatching season in Long Island Sound generally occurred during the later part of June and the first half of July when surface water temperatures were approximately 20 °C (Lund and Stewart 1970). Stage IV lobster were first collected in the central Sound during the week of 16-23 June and peaked during the week of 8-15 July in 1968.

The period of occurrence of stage IV lobsters observed in the central Sound by Lund and Stewart (1970) in 1968 (June 16-23 through July 24-31) corresponds with the sampling period of the site specific samples in 2006 (June 16-July 28). The timing of first appearance of stage I larvae in plankton collections tends to coincide with a narrow range of surface temperatures averaging around 12.5 °C (Harding et al. 1983). Over a ten year period at the Massachusetts State Lobster hatchery and Research Station, the lowest temperature at which hatching occurred was 12.2 °C, but hatching usually began at 15.0 °C and peaked at approximately 20 °C (Hughes and Matthiessen 1962). The first date in which daily average surface temperature was • •12.5 °C at the Central Basin Buoy (Station 44039) was May 24 in 2006. Using the temperature specific development rates of MacKenzie (1988) and a first hatch date of May 24, it is not likely that stage IV lobsters were present in significant numbers prior to around June 10, 2006. No lobster larvae were collected during site specific day and night ichthyoplankton sampling near the proposed FSRU facility on May 24, 2006 with a 1m^2 tucker trawl (Normandeau, 2006b).

Because stage IV lobsters primarily occur in the upper meter of the water column (Harding et al. 1982, 1987, Hudon et al. 1986, Annis 2005) their probability of being entrained in the proposed FSRU's seawater intake 35-45 feet below surface is likely minimal. However, settling behavior (diving and bottom testing) may begin 2-6 days after molting to stage IV (Cobb et al. 1989) and stage IV lobsters could be exposed to entrainment in the FSRU facility while testing the bottom and settling. The presence of a thermal gradient in the study area above the intake depth of the proposed FSRU facility may serve as a physical barrier to diving stage IV larvae. Boudreau et al. (1991, 1992) proposed that thermocline strength and depth were important variables influencing the vertical distribution of stage IV lobsters. In laboratory studies they found that stage IV post-larvae stayed above the thermocline (Boudreau et al. 1991) and that settlement was greatly reduced in the presence of a thermocline compared to unstratified controls (Boudreau et al. 1992). In particular, thermal gradients from 18.5 to 13.5 °C and from 16.5 to 12 °C were sufficient to significantly reduce the proportion of settled post-larvae, suggesting that the thermocline could be perceived as a negative physical cue by settling post-larvae. However, these laboratory induced gradients were steeper than those observed in the study area and it is unknown if the substantially weaker thermal gradient observed in the study area at ~ 40 feet and warmer overall temperatures observed in Long Island Sound compared to northern New England and Canadian waters would serve as a barrier for settling stage IV post-larvae before they were exposed to the intake depths of the FSRU facilities. Results of Boudreau et al.'s (1992) laboratory experiments indicate that the proportion of post-larvae crossing the thermocline increases with a decrease in the intensity of the stratification. Although the thermal gradient could be perceived as a negative physical barrier by settling lobsters, physiology and ultimately survival of post-larvae is also influenced by absolute temperature and it is suspected that the behavioral response of post-larvae to thermal gradients would be different under different thermal conditions (Boudreuau et al. 1992). MacKenzie (1988) demonstrated elevated mortality of post-larvae below 12 °C. Because bottom temperatures in study area in mid-June-August are considerably warmer than 12 °C it does not appear that temperature conditions on the bottom in the study area are likely to be detrimental to settling lobster as has been suggested for areas with stronger thermal gradients and colder bottom temperatures in Maine (Annis 2005).

Boudreau (1992) hypothesized that post-larvae avoid crossing a thermocline while testing the bottom and settling in order to conserve energy and enhance their chances of settling in nearshore areas which are more likely to contain cobble and substrate with perforated crevices and macroalgal cover where juvenile lobsters prefer to settle (Botero and Atema 1982, Johns and Mann 1987). Stage IV post-larvae are found more frequently closer to shore (Rogers et al. 1968, Katz et al. 1994) and the water column in nearshore shallow waters is typically warmer and unstratified. Remaining above the thermocline could reduce energy costs associated with repeated descents because it would only be when settling post-larvae are close to shore that their search for suitable microhabitats would be unhindered in a homogeneous water column.

Preferred areas for lobster settlement in Long Island Sound are poorly understood. Studies in other areas suggest that lobster prefer to settle in shallow (< 10 m) cobble habitat (Incze and Wahle 1991, Wahle and Steneck 1991, Cobb and Wahle 1994). However, the Central Basin of Long Island Sound has relatively little cobble (Poppe et al. 2000). While newly settled lobsters are capable of using a variety of habitats such as peat beds in salt marshes and eelgrass, environments comprised of rocks and boulders represent the "safest" habitat against predation (Lavalli and Barshaw, 1986; Barshaw and Lavalli, 1988, Wahle and Steneck 1992). Featureless habitats (those lacking in significant relief or vegetation) represent the "worst" habitats (Lavalli and Krupp 1998). The bottom type in the proposed FSRU location is primarily sandy silt and it is unknown if lobsters settle to this area in Long Island Sound. For the basis of calculating an entrainment estimate for settling stage IV post-larvae found in the Broadwater survey it was assumed that the thermal gradient present does not pose a barrier to vertical distribution and that the stage IV larvae collected in the neuston in the project area are settling the bottom in the sampling area rather than settling inshore and are therefore exposed to possible entrainment in the FSRU's seawater intakes. Because the neuston net was towed with the mouth approximately only half (0.5 m) submerged to ensure the surface waters were skimmed, precise volume estimates for each sample are not possible due to wave action constantly altering the proportion of the net mouth that was submerged. However, for the most part, sampling was conducted in relatively calm sea conditions and on average the net mouth was fished at a depth of 0.5 m. Volume of each tow can then be estimated based on the distance of the tow determined from the flowmeter counts multiplied by the area of the mouth of the net underwater (2 m wide net* 0.5 m submerged depth). Mean density (#/1000 m^3) of stage IV lobsters from samples during their period of occurrence in our twelve samples from 16 June-14 July is 0.99/1000m^3 ± 0.36 standard error. The validity of abundance estimates derived from neuston samples relies on knowing the proportion of the population represented in the sample. It is assumed that 65 % of stage IV lobsters present in the study area were present in the upper 0.5 m based on the recently published in situ observations by Annis (2005). Although caution is warranted in using a correction factor developed off the coast of Maine to Long Island Sound based on differing hydrography and potential differences in vertical distribution of lobster larvae, this value is considerably more conservative than previous estimates of abundance reporting 78-96% (Harding et al. 1982, 1987, Hudon et al. 1986) of the stage IV population in surface samples. This 65% correction factor may also be conservative because it represents an average throughout the course of the day, however Annis (2005) noted that the proportion in the top 0.5 m was higher when light levels were lower in the morning prior to 1000 h which is when our samples were collected. Although it is not possible to determine the first occurrence of stage IV larvae in the project area because they were present in our first sample, using surface temperature data from the Central Basin Buoy (Station 44039), the temperature specific development rates of MacKenzie (1988) and assuming first hatch date of May 24, it is not likely that stage IV lobsters were present in significant numbers prior to around June 10, 2006. The average density of 0.99 stage IV lobsters/1000m^3 is multiplied by 1.54 to account for the 65 % adjustment from Annis (2005) which is then multiplied by average daily water intake (28.2 MGD, 106,750 m^3/day) of the proposed FSRU facility to estimate number entrained per day (163 stage IV lobsters) during the period in which post-larvae (June 16-July 14) were collected. However, because stage IV post-larvae primarily occur in surface waters well above the seawater intake depth of the FSRU facility, they would likely only be exposed to entrainment risk during periods of settling behavior and these entrainment values are likely conservative estimates. The conservative nature of these estimates is supported by the absence of stage IV lobsters in the 232 samples collected in the Intermediate depth strata and 118 samples collected in the deep sampling strata of the 2002 Poletti data subset to represent the Broadwater FSRU location (Normandeau 2006).

REFERENCES

Anderson, T.H., and G.T. Taylor. 2001. Nutrient Pulses, Plankton Blooms, and Seasonal Hypoxia in Western Long Island Sound. Estuaries 24: 228-243.

Annis, E.R. 2005. Temperature effects on the vertical distribution of lobster postlarvae (*Homarus americanus*). Limnol. Oceangr. 50(6):1972-1982.

Barshaw, D.E, and K.L. Lavalli. 1988. Predation upon postlarval lobsters *Homarus americanus* by cunners *Tautogolabrus adspersus* and mud crabs *Neopanope sayi* on three different substrates: eelgrass, mud and rocks. Marine Ecology Progress Series 48:119-123.

Botero, L. and Atema, J. (1982). Behavior and substrate selection during larval settling in the lobster *Homarus americanus*. J. Crust. Biol. 2(1): 59-69.

Boudreau B., Simard Y., Bourget E. 1991. Behavioural response of planktonic stages of the American lobster *Homarus americanus* to thermal gradients, and ecological implications. Mar. Ecol. Prog. Ser. 76:13-23.

Boudreau B., Simard Y., Bourget E. 1992. Influence of a thermocline on vertical distribution and settlement of post-larvae of the American lobster *Homarus americanus.* Journal of Experimental Marine Biology and Ecology 162:35-49.

Cobb JS, Wang D, and D.B. Campbell. 1989. Timing of settlement by postlarval lobsters (*Homarus americanus*): field and laboratory evidence. Journal of Crustacean Biology 9:60-66.

Cobb, J.S. and R.A. Wahle. (1994). Early life history and recruitment processes of clawed lobsters. Crustaceana 67 (1): 1-25.

Ennis, G.P. (1995). Larval and postlarval ecology. *In* Biology of the Lobster *Homarus americanus* (edited by J.R.Factor,) Academic Press, NY. pp. 23-46.

Fogarty, M.J., and R. Lawton. 1983. An overview of larval American lobster, *Homarus americanus* sampling programs in New England during 1974-79. Natl. Mar. Fish. Serv., SSRF-75: 9-14.

Hadley, P.B. 1905. Phototropism in the larval and early adolescent stages of *Homarus americanus*. Science 22:675-678.

Hadley, P.B. 1908. The behavior of the larval and adolescent stages of the American lobster (*Homarus americanus*). J. Comp. Neurol. Psychol. 18:199-301.

Harding, G.C., Vass, W.P., and K.F. Drinkwater. 1982. Aspects of larval American lobster (*Homarus americanus*) ecology in St. Georges Bay, Nova Scotia. Can. J. Fish. Aquat. Sci. 39:1117-1129.

Harding, G.C., K.F. Drinkwater, and W.P. Vass. 1983. Factors influencing the size of American lobster (*Homarus americanus*) stocks along the Atlantic coast of Nova Scotia, Gulf of St. Lawrence, and Gulf of Maine: A new synthesis. Can. J. Fish. Aquat. Sci. 40:168-184.

Harding G.C, Pringle J.D, Vass W.P, Pearce S, Jr., and S.J. Smith. 1987. Vertical distribution and daily movements of larval lobsters *Homarus americanus* over Browns Bank, Nova Scotia. Marine Ecology Progress Series 41:29-41.

Herrick, F.H. 1895. The American lobster: a study of its habits and development. Bulletin of the U.S. Fish Commission. 15:1-252.

Hudon C, Fradette P, Legendre P. 1986. La répartition horizontale et verticale des larvae de homard (*Homarus americanus*) autour des îles de la Madeleine, golfe du Saint-Laurent. Canadian Journal of Fisheries and Aquatic Sciences 43:2164-2176.

Hudon, C. and P. Fradette. 1988. Planktonic growth of larval lobster (*Homarus americanus*) of Iles de la Madeleine (Quebec), Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci. 45:868-878.

Hughes, J.T., and G.C. Matthiessen. 1962. Observations on the biology of the American lobster, *Homarus americanus*. Limnol. Oceanogr. 7:314-321.

Incze, L.S. and R.A. Wahle. (1991). Recruitment from pelagic to early benthic phase in lobsters *Homarus americanus*. Mar. Ecol. Progr. Ser., 79: 77-87.

Incze, L.S., Wahle, R.A., and J.S. Cobb. 1997. Quantitative relationships between postlarval production and benthic recruitment in lobsters, *Homarus americanus.* Mar. Freshwater Res. 48:729-743.

Incze, L.S., P. Aas, T. Ainaire and M. Bowen. 2000. Abundance and development of planktonic Stage IV lobsters in the western Gulf of Maine Can. J. Fish. Aquat. Sci. 57: 1-11.

Johns, P.M. and K.H. Mann. 1987. An experimental investigation of juvenile lobster habitat preference and mortality among habitats of varying structural complexity. J. Exp. Mar. Biol. Ecol. 109:275-285.

Katz, C.H., J.S. Cobb, and M. Spaulding. 1994. Larval behavior, hydrodynamic transport, and potential offshore to inshore recruitment in the American lobster *Homarus americanus*. Mar. Ecol. Prog. Ser. 103:265-273.

Lavalli, K.L., and D.E. Barshaw. 1986. Burrows protect postlarval lobsters *Homarus americanus* from predation from the non-burrowing cunner *Tautogolabrus adspersus,* but not from the burrowing mud crab *Neopanope texani*. Marine Ecology Progress Series 32(1):13-16.

Lavalli, K.L. and R.K. Krupp. 1998. Abundance of juvenile lobsters at the new outfall site: comparisons with inshore abundances and discussion of potential impacts on lobster populations. Massachusetts Water Resources Authority. Report ENQUAD 1998-14. 26p. http://www.mwra.state.ma.us/harbor/enquad/pdf/1998-14.pdf#search=%22hudon%20et%20al.%201986%20references%20verticale%22

Long Island Sound Study (LISS). 1994. Comprehensive Conservation and Management Plan for Long Island Sound. http://www.longislandsoundstudy.net/mgmtplan.htm

Lund, W.A., Jr. and L.L Stewart. 1970. Abundance and distribution of larval lobsters, *Homarus americanus*, off southern New England. Proc. Natl. Shellfish. Assoc. 60:40-49.

MacKenzie, B.R. 1988. Assessment of temperature effects on interrelationships between stage durations, mortality, and growth in laboratory-reared *Homarus americanus* larvae. J. Exp. Mar. Biol. Ecol. 116:87-98.

Normandeau Associates Inc. 2006a. Ichthyoplankton entrainment estimates at the Broadwater FSRU facility based on data collected during the 2002 Poletti Ichthyoplankton Program. Prepared for Ecology and Environment Inc., Lancaster, NY.

Normandeau Associates Inc. 2006b. Letter Report summarizing the results of ichthyoplankton sampling in the vicinity of the proposed Broadwater FSRU. Sampling event No. 6, May, 2006. Prepared for Ecology and Environment Inc., Lancaster, NY.

NUSCO. 2006. Lobster Studies. Pages 195-226 *In* Monitoring the marine environment of Long Island Sound at Millstone Nuclear Power Station, Waterford, CT. Annual Report 2005.

PBS& J/LMS Joint Venture. 2003. Charles Poletti Power Project, Studies to Determine the Effects of Entrainment and Impingement, Vol. 1 and 2. Prepared for New York Power Authority.

Poppe, L.J. et al. (2000). Distribution of surficial sediment in Long Island Sound and adjacent waters: texture and total organic carbon. Journal of Coastal Research 16 (3): 567-574.

Rogers, B.A., Cobb, J.S., and N. Marshall. 1968. Size comparisons of inshore and offshore larvae of the lobster, *Homarus americanus*, off southern New England. Proc. Natl. Shellfish. Assoc. 58:78-81.

Scarratt, D.J. 1964. Abundance and distribution of lobster larvae (*Homarus americanus)* in Northumberland Strait. J. Fish. Res. Board Can. 21:661-680.

Scarratt, D.J. 1973. Abundance, survival, and vertical and diurnal distribution of lobster larvae in Northumberland Strait 1962-63, and their relationships with commercial stocks. J. Fish. Res. Board Can. 30:1819-1824.

Sherman K, and R.D. Lewis. 1967. Seasonal occurrence of larval lobsters in coastal waters of central Maine. Proceedings of the National Shellfisheries Association 57:27-30.

Stasko, A.B. and D.J. Gordon. 1983. Distribution and relative abundance of lobster larvae off southwestern Nova Scotia 1977-1978. Can. Tech. Rep. Fish. Aquat. Sci. 1175: 23p.

Templeman, W. 1936. The influence of temperature, salinity, light and food conditions on the survival and growth of the larvae of the lobster (*Homarus americanus)*. J. Biol. Board. Can. 2:485-497.

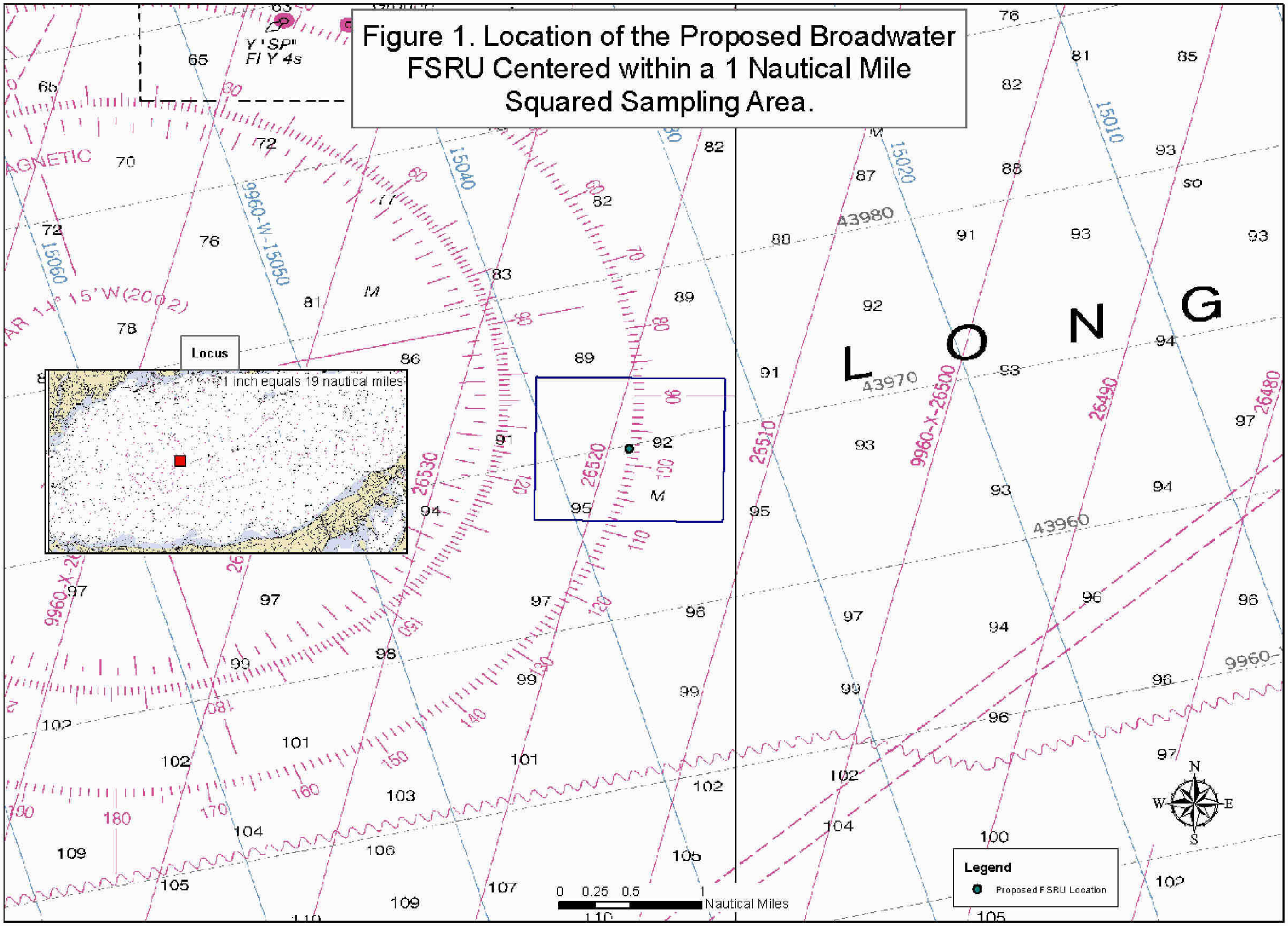
Templeman, W. 1937. Habits and distribution of larval lobsters (*Homarus americanus*). Journal of the Biological Board of Canada 3:343-347.

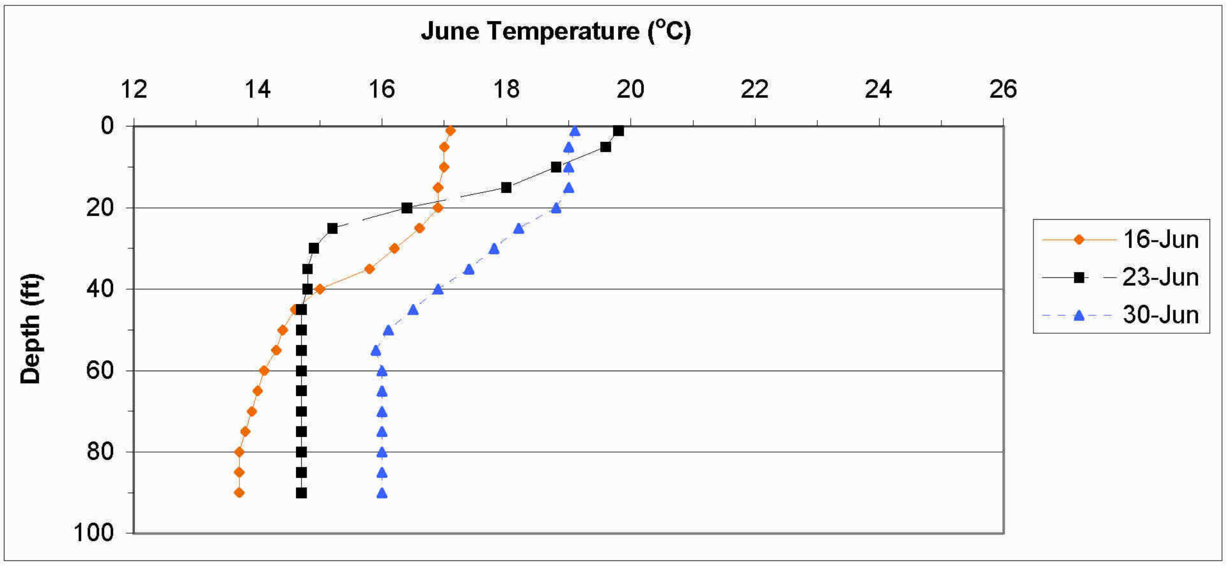
Wahle, R.A, and R.S. Steneck. 1991. Recruitment habitats and nursery grounds of the American lobster *Homarus americanus*: a demographic bottleneck? Marine Ecology Progress Series 69:231-243.

Wahle, R.A., and R.S. Steneck. 1992. Habitat restrictions in early benthic life: Experiments on habitat selection and in situ predation with the American lobster. Journal of Experimental Marine Biology and Ecology 157:91-114.

Wahle, R.A. and L.S. Incze. 1997. Pre- and post-settlement processes in recruitment of the American lobster. J. Exp. Mar. Bio. Ecol., 217:179-207.

Figure 1. Location of the Proposed Broadwater FSRU Centered within a 1 Nautical Mile Squared Sampling Area.





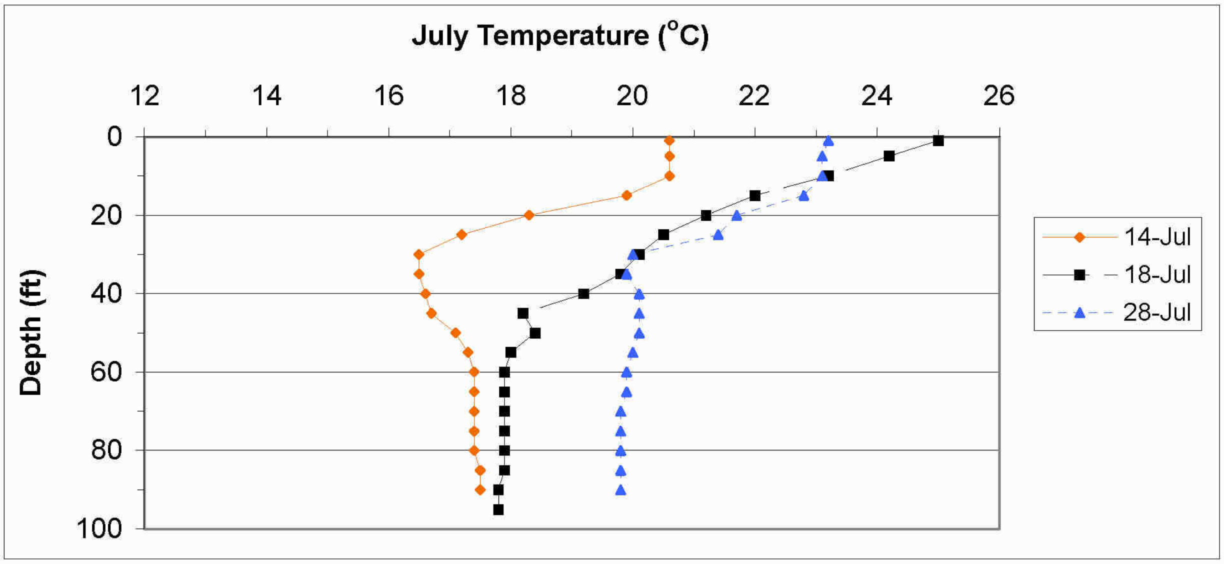
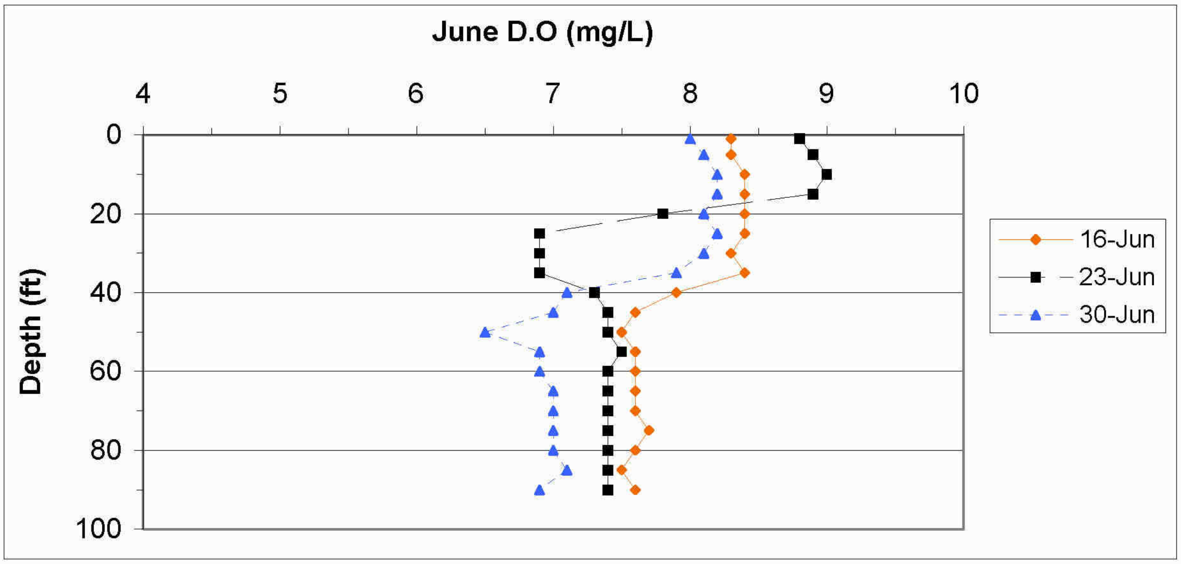


Figure 2. Temperature (°C) profile at the site of the proposed Broadwater FSRU facility in June and July, 2006. Temperature was recorded at five foot intervals from one foot below the surface to one foot above the bottom.



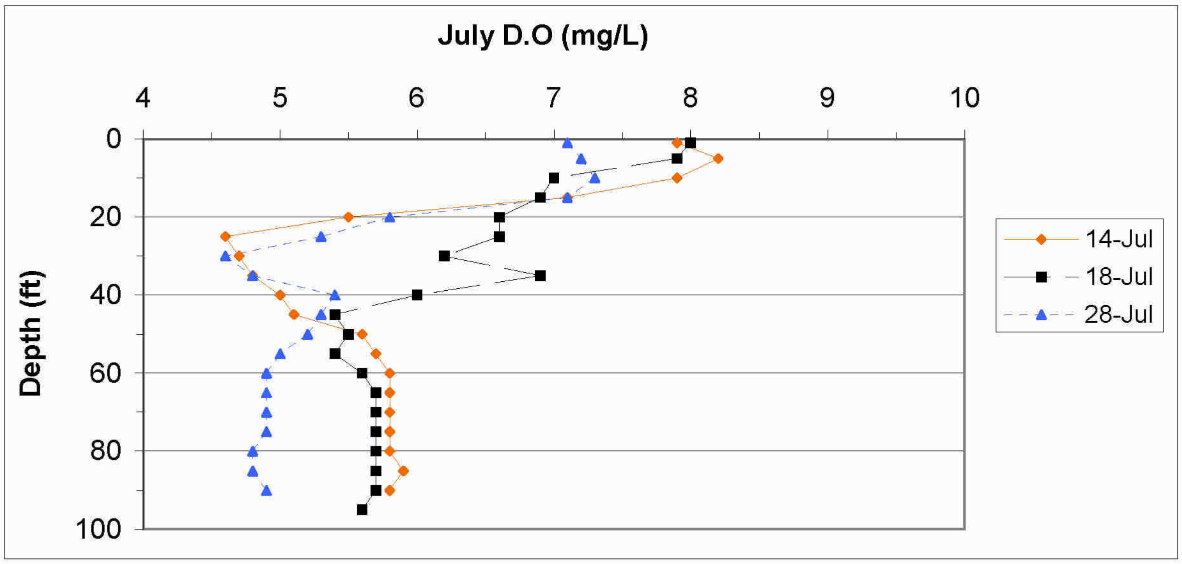
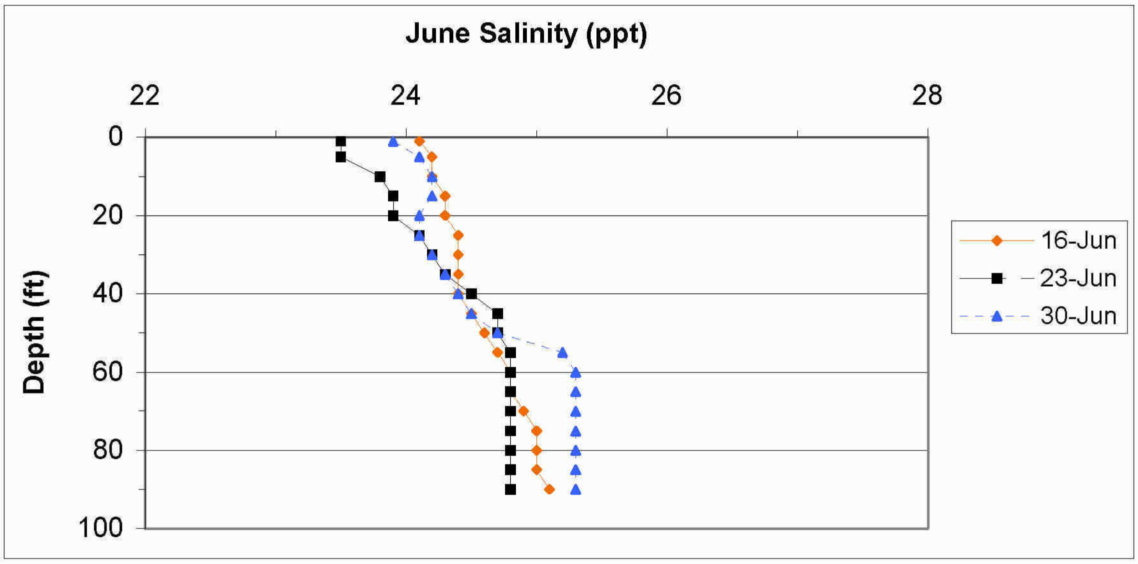


Figure 3. Dissolved oxygen (D.O, mg/L) profile at the site of the proposed Broadwater FSRU facility in June and July, 2006. Dissolved oxygen concentration was recorded at five foot intervals from one foot below the surface to one foot above the bottom.



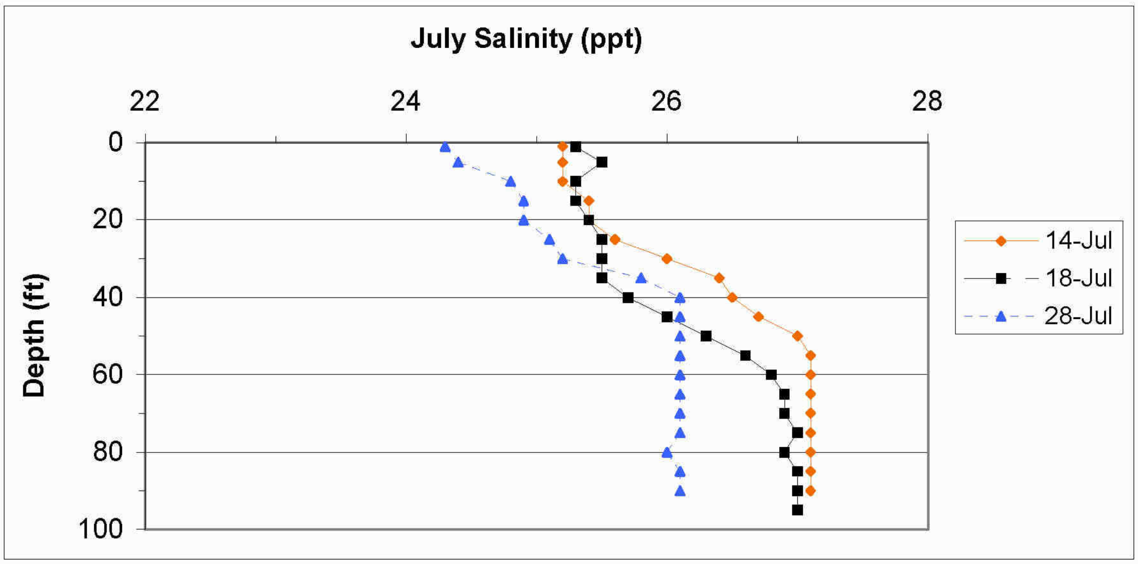


Figure 4. Salinity (parts per thousand, $^{o}/_{oo}$) profile at the site of the proposed Broadwater FSRU facility in June and July, 2006. Salinity was recorded at five foot intervals from one foot below the surface to one foot above the bottom.

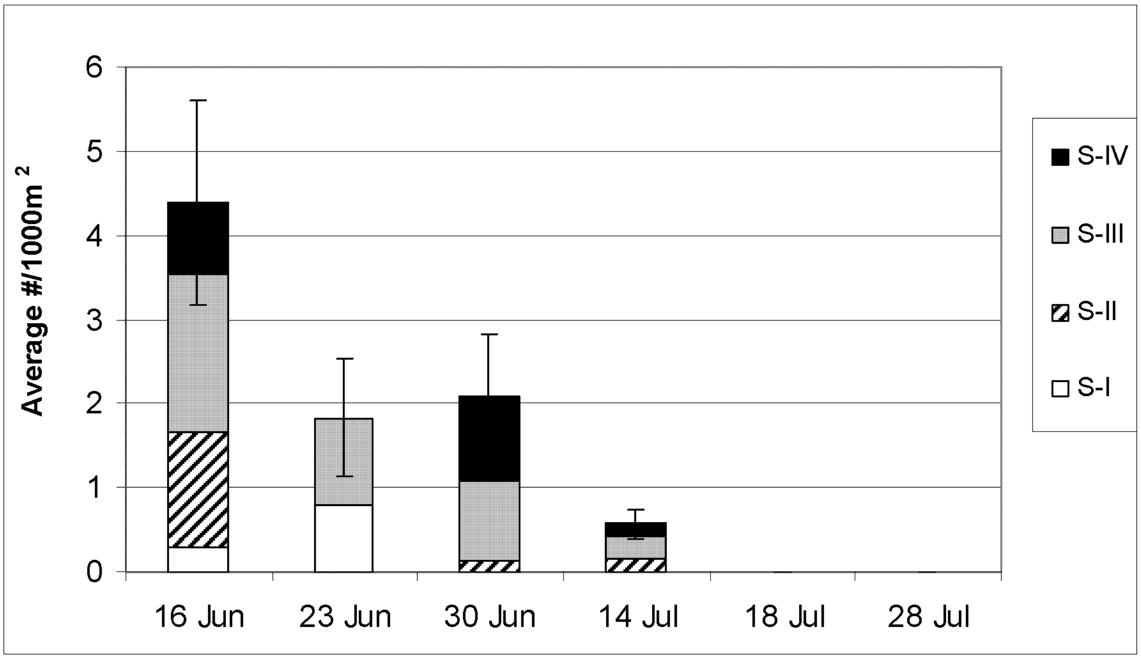


Figure 5. Average density (#/1000 m^2 within 0.5 m depth ± standard error) of lobster larvae by stage (I-IV) collected in neuston samples in the vicinity of the proposed Broadwater FSRU facility in central Long Island Sound in June and July, 2006.

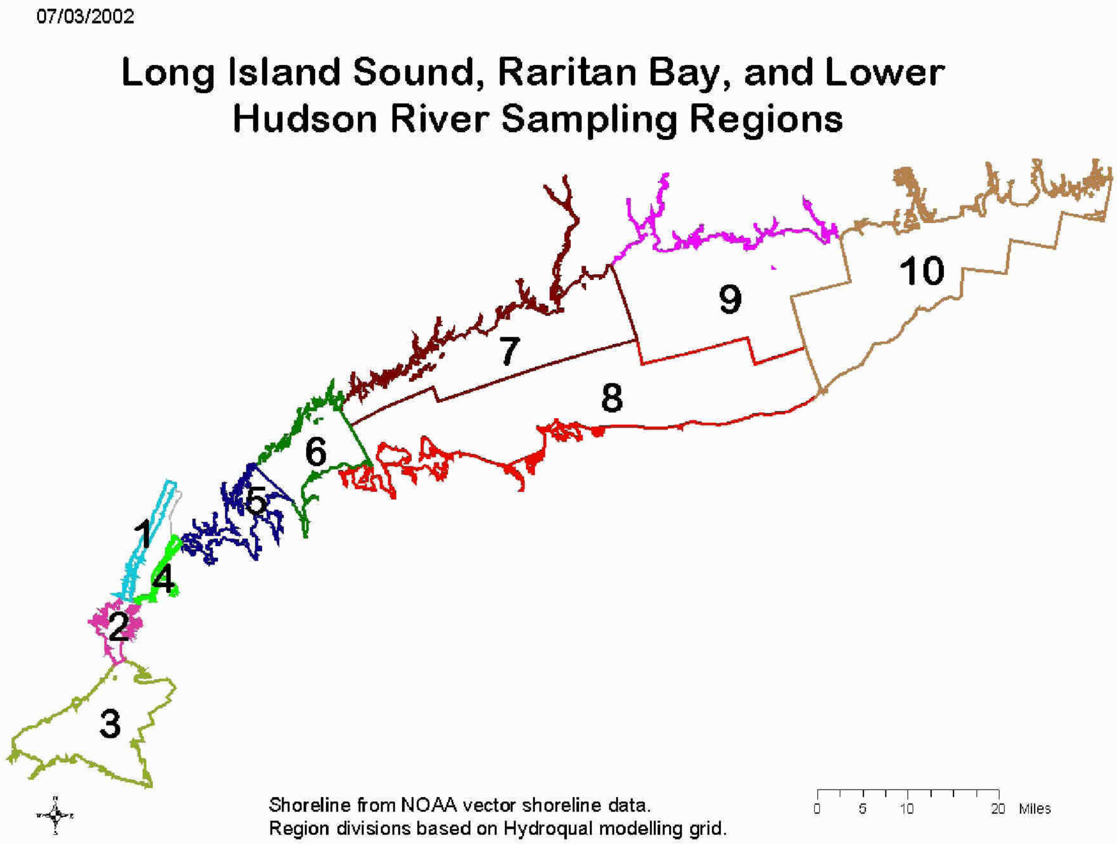


Figure 6. Sampling regions for the 2002 Poletti Ichthyoplankton Program.

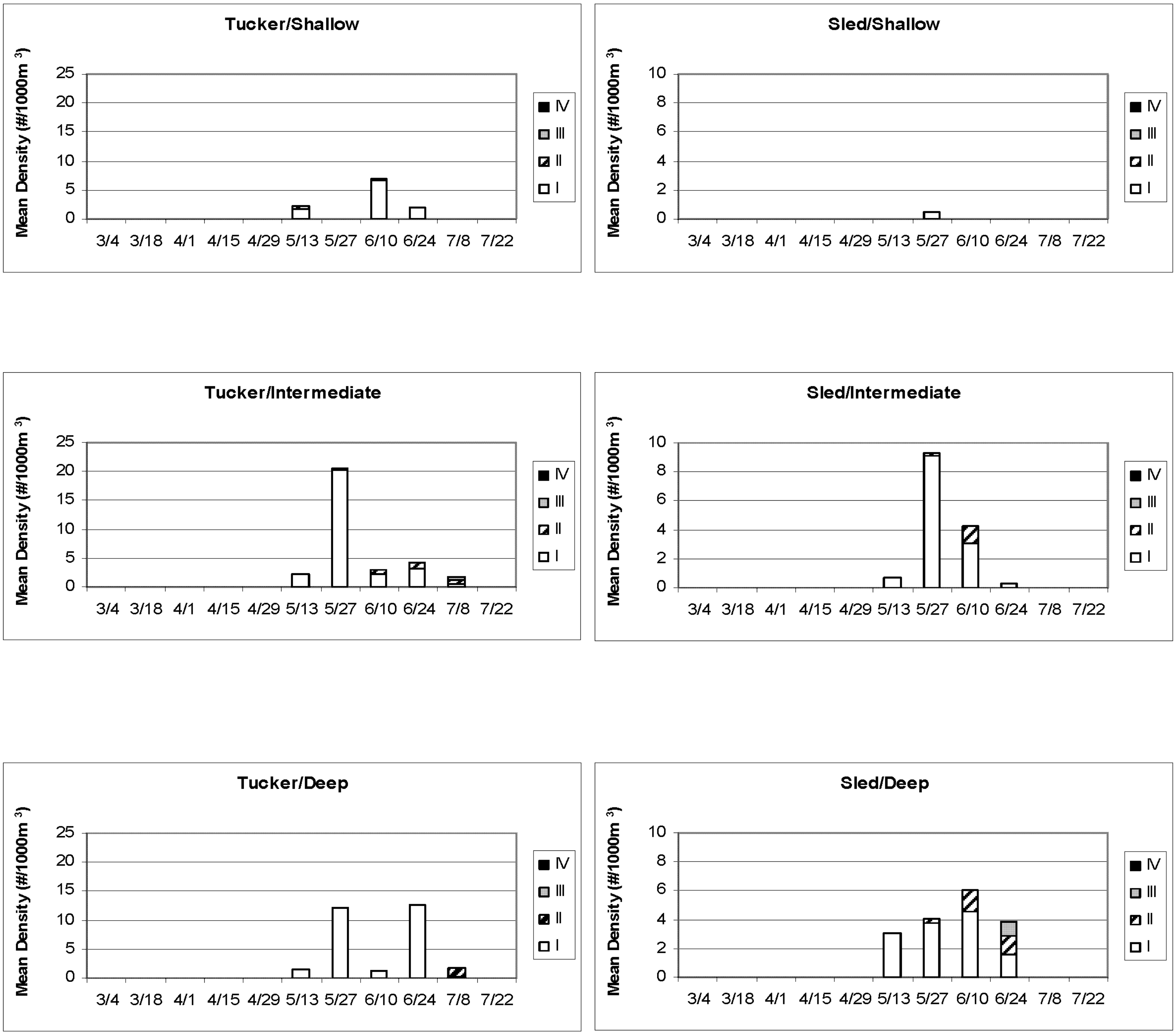


Figure 7. Average density (#/1000m^3) of lobster larvae (by stage I-IV) collected in regions 7-9 during the 2002 Poletti Ichthyoplankton Program. A separate panel is presented for each combination of gear type (tucker trawl or epibenthic sled) and total water column depth strata (Intermediate = total water depth 6-30 m; Deep = total water depth > 30 m, see Normandeau 2006 for details). Note the different scale on the Y axis for tucker trawl and epibenthic sled.

Table 1. Lobster larvae density (#/1000m^2 within 0.5 m depth) by stage in each neuston sample conducted in the vicinity of the proposed Broadwater FSRU, June 16-July18, 2006.

Sample #	Date	Stage	#/1000m^2	Sample #	Date	Stage	#/1000m^2
1	16-Jun-06	I	0.85	10	14-Jul-06	I	0.00
		II	2.56			II	0.00
		III	2.99			III	0.40
		IV	0.43			IV	0.00
		SUM	6.82			SUM	0.40
2		I	0.00	11		I	0.00
		II	1.57			II	0.00
		III	0.52			III	0.39
		IV	1.05			IV	0.00
		SUM	3.14			SUM	0.39
3		I	0.00	12		I	0.00
		II	0.00			II	0.46
		III	2.13			III	0.00
		IV	1.06			IV	0.46
		SUM	3.19			SUM	0.91
4	23-Jun-06	I	0.00	13	18-Jul-06	I	0.00
		II	0.00			II	0.00
		III	0.41			III	0.00
		IV	0.00			IV	0.00
		SUM	0.41			SUM	0.00
5		I	0.85	14		I	0.00
		II	0.00			II	0.00
		III	1.71			III	0.00
		IV	0.00			IV	0.00
		SUM	2.56			SUM	0.00
6		I	1.52	15		I	0.00
		II	0.00			II	0.00
		III	1.01			III	0.00
		IV	0.00			IV	0.00
		SUM	2.53			SUM	0.00
7	30-Jun-06	I	0.00	16	28-Jul-06	I	0.00
		II	0.00			II	0.00
		III	1.77			III	0.00
		IV	1.77			IV	0.00
		SUM	3.54			SUM	0.00
8		I	0.00	17		I	0.00
		II	0.00			II	0.00
		III	1.11			III	0.00
		IV	0.00			IV	0.00
		SUM	1.11			SUM	0.00
9		I	0.00	18		I	0.00
		II	0.40			II	0.00
		III	0.00			III	0.00
		IV	1.19			IV	0.00
		SUM	1.59			SUM	0.00

Table 2. Stage specific density, daily entrainment estimates, and biweekly entrainment estimates for lobster larvae derived from the Poletti Ichthyoplankton Program (March 4-August 5, 2002) subset to represent the proposed Broadwater FSRU location*.

	Intermediate Depth Strata (total depth 6-30 m)											
	Stage I			Stage II			Stage III			Stage IV		
Biweekly Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey
1 (March 4 - 27)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
2 (March 18-31)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
3 (April 1-14)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
4 (April 15-28)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
5 (April 29-May 12)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
6 (May 13-26)	2.3	249	3,487	0.0	0	0	0.0	0	0	0.0	0	0
7 (May 27-June 9)	20.3	2,163	30,289	0.3	28	399	0.0	0	0	0.0	0	0
8 (June 10-23)	2.2	235	3,288	0.8	85	1,196	0.0	0	0	0.0	0	0
9 (June 24-July 7)	3.1	331	4,633	1.1	121	1,694	0.0	0	0	0.0	0	0
10 (July 8-July 21)	0.5	53	747	0.8	85	1,196	0.5	57	797	0.0	0	0
11 (July 22-August 5)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
March 4-August 5 Sum			42,444			4,484			797			0

	Deep Depth Strata (total depth > 30 m)											
	Stage I			Stage II			Stage III			Stage IV		
Biweekly Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey	#/ 1000m^3	# Entrained/ Day	# Entrained/ Survey
1 (March 4 - 27)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
2 (March 18-31)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
3 (April 1-14)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
4 (April 15-28)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
5 (April 29-May 12)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
6 (May 13-26)	1.4	153	2,142	0.0	0	0	0.0	0	0	0.0	0	0
7 (May 27-June 9)	12.2	1,302	18,233	0.0	0	0	0.0	0	0	0.0	0	0
8 (June 10-23)	1.2	132	1,843	0.0	0	0	0.0	0	0	0.0	0	0
9 (June 24-July 7)	12.5	1,338	18,731	0.0	0	0	0.0	0	0	0.0	0	0
10 (July 8-July 21)	0.4	39	548	1.4	153	2,142	0.0	0	0	0.0	0	0
11 (July 22-August 5)	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0
March 4-August 5 Sum			41,497			2,142			0			0

*Lobster density represents the average from Poletti regions 7,8,9 collected with Tucker Trawls. Density was multiplied by the maximum estimated daily seawater intake of the proposed FSRU facility and associated LNG carriers (106,750 m^3/day) to yield the estimated number entrained per day and per survey (14 days).

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the service list compiled by the Secretary in this proceeding in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure.

Dated at Washington, D.C. this 20th day of September 2006.

/s/ Brett A. Snyder
Brett A. Snyder

Submission Contents