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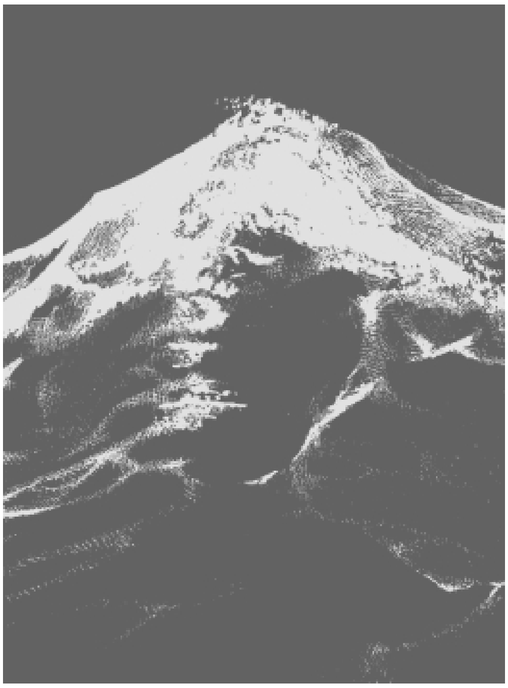
VOLUME 52, 2001



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Mar. Freshwater Res., 2001, **52**, 1125–32

Lobster trap video: *in situ* video surveillance of the behaviour of *Homarus americanus* in and around traps

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Abstract. A lobster-trap video (LTV) system was developed to determine how lobster traps fish for *Homarus americanus* and how behavioural interactions in and around traps influence catch. LTV consists of a low-light camera and time-lapse video cassette recorder (VCR) mounted to a standard trap with optional red LED arrays for night observations. This self-contained system is deployed like a standard lobster trap and can collect continuous video recordings for >24 h. Data are presented for 13 daytime deployments of LTV (114 h of observation) and 4 day and night deployments (89 h of observation) in a sandy habitat off the coast of New Hampshire, USA. Analyses of videotapes revealed that traps caught only 6% of the lobsters that entered while allowing 94% to escape. Of those that escaped, 72% left through the entrance and 28% through the escape vent. Lobsters entered the trap at similar rates during the day and night and in sandy and rocky habitats. Lobsters generally began to approach the trap very shortly after deployment, and many appeared to approach several times before entering. These data confirm the results of previous laboratory-based studies in demonstrating that behavioural interactions in and around traps strongly influence the ultimate catch.

Extra keywords: saturation, catch, crustacean

Introduction

All crustacean traps, regardless of their materials and configuration, selectively sample the target population. Although some of this selectivity is intentional (e.g., escape vents minimize retention of small lobsters), much of it is not, and the factors that influence trap selectivity are not fully understood (Krouse 1989; Miller 1990; Addison and Bell 1997; Fogarty and Addison 1997; Addison and Bannister 1998). Most studies of how lobsters interact with traps have been carried out either in semi-natural settings in the laboratory (Richards *et al*. 1983; Karnofsky and Price 1989; Miller and Addison 1995) or by divers in the field (Auster 1985; Miller 1989, 1995). Laboratory studies are very effective because long-term observations are feasible, but the degree to which lobsters exhibit normal behaviour is uncertain. Diver observations are very enlightening, but they are expensive, bottom time is limited, and dives are generally restricted to daylight hours.

Laboratory studies of the behaviour of *Homarus americanus* around traps indicate that only a small proportion (11%) of the lobsters that encounter a trap actually enter it, and of those only 2% are subsequently caught (Karnofsky and Price 1989). Field studies of *Nephrops norvegicus* (Bjordal 1986) confirm these data, and the prestocking studies of Richards *et al*. (1983) suggest one of the main factors limiting catch of *H. americanus* is the interaction between lobsters inside and outside the trap. As a result of these findings, and others, many recent studies of catchability have concluded that catch per unit effort is not necessarily a good indicator of the density of lobsters (Addison 1995; Addison 1997; Fogarty and Addison 1997) and that '... considerably more research is needed on behavioural and ecological factors affecting trap encounter and entry before traps can be a truly effective device for measuring lobster abundance' (Cobb 1995). To address this need, we developed an *in situ* video surveillance technique to observe the behaviour of lobsters in and around traps in the field.

Underwater video monitoring has been used in marine research to observe the behaviour, distribution, and abundance of fish and invertebrates since the 1950s (Barnes 1955; Myrberg 1973). Video techniques used to study lobsters in the past have included towed video sleds (Chapman 1979; Chapman 1985), hand-held video cameras (Potts *et al*. 1987; Lawton and Lavalli 1995), remotely

10.1071/MF01096 1323-1650/01/081125

operated vehicles (ROVs) (Spanier *et al.* 1994), drop cameras (Mayfield *et al.* 1999), and submersibles (Anonymous 1997; Steneck pers. comm.). *In situ* video systems are advantageous because they (1) increase observation time (2) reduce many types of diver-related disturbances (3) obtain continuous permanent records of behaviours that can be viewed repeatedly and thus analysed more thoroughly, and (4) provide access to habitats in areas (e.g., deep ocean) or times (e.g., night) that would be difficult or impossible for divers to observe. These many advantages, along with improvements in technology, have led to an increased use of mounted video systems to study the behaviours of marine animals *in situ* (Witman and Sebens 1992; Burrows *et al.* 1994; Ramsay *et al.* 1997; Gibson 1998; Burrows *et al.* 1999; Willis and Babcock 2000). These video surveillance systems, when connected to a time-lapse recording device, allow for long-term continuous monitoring of behaviour in the natural environment while minimizing disturbance.

The data obtained in the present study, from an *in situ* video system used to study the behaviour of lobsters in and around traps, support previous reports that lobster traps are selective in sampling natural populations and provide additional evidence suggesting that aggressive interactions between lobsters play a key role in limiting catch.

Methods

The lobster-trap video (LTV) system is a modular, low-cost, underwater video system designed to be easily used by lobster biologists and fishery managers. The approach we have taken, and advocate, for underwater video surveillance is to use the most economical solution that will address the hypotheses at hand, but to keep the system modular so that it can be upgraded if the hypotheses change or new ones are explored.

LTV System

LTV consists of a traditional double-parlour wire-mesh lobster trap (122 × 61 × 34 cm) with equipment in a waterproof housing in one parlour so that the trap essentially fishes like a single parlour trap (Fig. 1). The wire-mesh top has been replaced with Plexiglas, which facilitates observation of the interior of the trap. Lobsters enter the kitchen of the trap, which contains a bait bag filled with approximately 1–2 kg of frozen herring, through two standard circular heads 6 inches (15.3 cm) in diameter (Fig. 1). The parlour has one standard escape vent (15.9 × 4.5 cm). A low-light, black-and-white, CCD video camera (0.05 lux, 3.6-mm lens, Model RHP-320WP, Rock House Products, Middletown, New York) mounted 100 cm above the trap allows for observation of the interior of the trap, as well as a field of view of an area 0.5 m larger than the perimeter of the trap (Fig. 1). A custom-made PVC underwater housing holds a 12-VDC time-lapse VCR (Panasonic AG-1070DC), six 12-VDC sealed rechargeable gel cell batteries, and a timer that switches the electronics on and off to conserve power. The system is capable of collecting data for at least 24 h, so it can continuously record all lobster approaches within the field of view, as well as entries, exits, and intra- and interspecific behavioural interactions. When collecting data at night we used an array of 36 near-red LED lights (650 nm) because lobsters seem to have limited light detection capability at wavelengths >600 nm (Wald and Hubbard 1957). Using this lighting, we were able to observe entries, exits, and behavioural interactions inside the trap at night, but not approaches. Because LTV is self-contained, it can be deployed by two people in a small boat in remote locations, interspersed with traditional traps. Although the modifications necessary to fit the trap with electronics may have altered the way it fishes, control traps fished with LTV showed similar catch rates (see results).

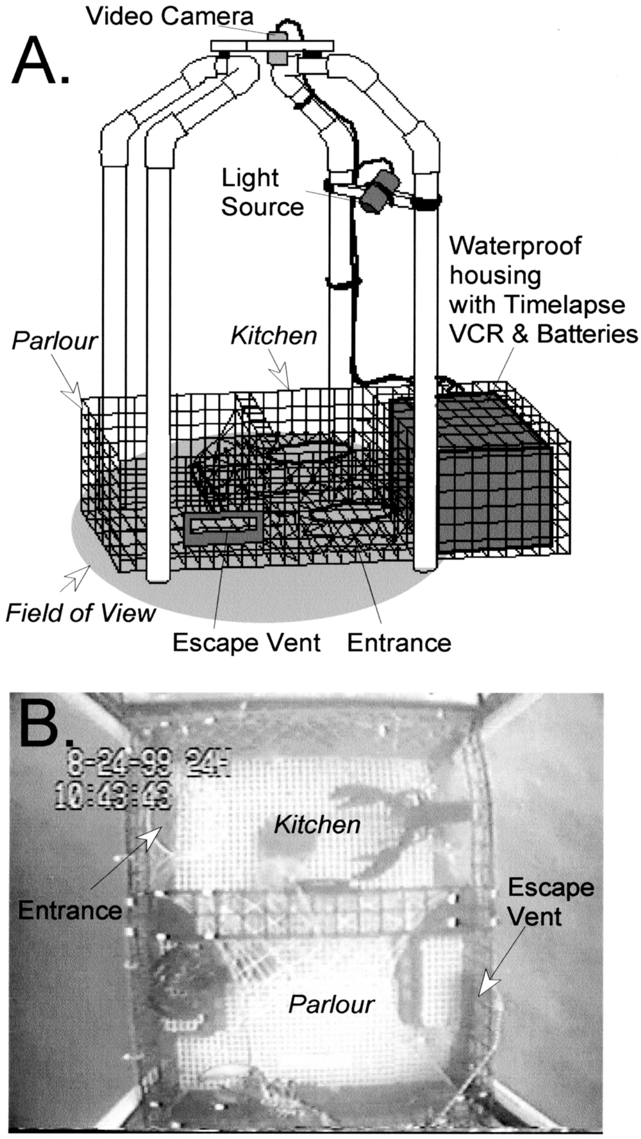

Fig. 1. Lobster trap video (LTV) system. A. LTV is an *in situ* time-lapse video-recording system attached to a standard lobster trap. Optional lights and recording equipment can be turned on and off by a timer in the waterproof case that contains all electronics. Movement of lobsters around the trap (within the field of view) and inside the trap can be continuously recorded. B. A single frame from an LTV time-lapse video with the time and date in the upper left of the image. Three lobsters are in the trap, one clearly visible entering the kitchen section of the trap and two retained in the parlour (for video, see Watson 2001).

A single frame from a section of video obtained during the summer of 1999 is shown in Fig. 1, and short sections of actual video are available at our web site (Watson 2001) or as an Accessory Publication to the present paper at (http://www.publish.csiro.au/journals/mfr).

Field Experiments

Most deployments of LTV (n = 13) were conducted in a 10 000–m^2 study area marked with buoys off Wallis Sands Beach, New Hampshire (43°01′15″ N, 70°43′40″ W). This site is 4–6 m in depth and dominated by a sandy substrate that facilitates visualizing lobsters around LTV and obtaining accurate estimates of lobster abundance by means of SCUBA surveys. Densities of lobsters in the area determined by transects conducted by SCUBA divers generally ranged from 0.001 to 0.06 lobsters/m^2 (unpublished data). No other fisherman used this site, presumably because catch of lobsters is assumed to be generally low in sand habitats. This type of habitat is not typical lobster habitat, so comparative LTV deployments were made on five occasions in a rocky habitat approximately 0.5 km south of the sandy habitat. Each deployment in the rocky habitat was made within 1 week of a paired sandy-habitat deployment. Densities determined by SCUBA surveys at the rocky-habitat site (0.01–0.06 lobsters/m^2) were similar to those obtained at the sandy-habitat site (unpublished data).

LTV (n = 13), and 3–5 single parlour (control) traps (n = 56), were deployed between 0900 hours and 1400 hours, June–October in 1997–2000. During each deployment, time-lapse video was obtained for an average of 19 h (range 10–25 h). A timer was used to turn off the electronics at night to save batteries except for the four deployments when lights were used to observe night-time entries. Thus, depending upon ambient visibility, observable video was obtained from deployment to dusk and then from dawn to retrieval on the following day. Typically, all traps were hauled on the day after deployment, and all lobsters caught in the LTV trap and the control traps were measured and released back at the study site.

Video Analysis

Videotapes were viewed at the University of New Hampshire Image Analysis Laboratory, and counts were made of all the lobsters viewed in the following behavioural categories: (1) approach, any individual entering the field of view of the camera (because most lobsters were not individually identifiable, we assume that many lobsters were counted multiple times as they left the field of view and then returned); (2) entry, lobsters fully entering a trap; (3) half-entry, lobsters entering more than half a body-length into a trap (this category included individuals that entered just enough to feed but never left the entrance; see Karnofsky and Price 1989 or Auster 1985 for a detailed description of this behaviour); (4) exit, lobsters leaving the trap through either an entrance (kitchen) or the escape vent (parlour) and; (5) catch, the number of lobsters in the trap at the end of each hour (see Fig. 2 for a sample of the relationship of these behaviours over time). We determined sizes of lobsters that entered the trap by digitizing individual frames and then measuring lobsters with NIH Image software calibrated to a ruler on the bottom of the trap (Fig. 1). Lobsters ≥80 mm carapace length (CL) were considered ‘large’ lobsters, whereas those <80 mm CL were categorized as ‘small’. Size data are presented for the deployment on 6 August 1997. Finally, times spent in the kitchen and in the parlour were recorded for all individuals that entered the trap.

Results

LTV has provided a unique method for collecting information about the behavioural factors that influence catch in lobster traps (Fig. 1, see Watson 2001). LTV appears to fish in the same way as standard traps because catch per unit effort in control traps (2.66 ± 0.29, n = 56) was similar to that in LTV (2.38 ± 0.50, n = 13; $p > 0.10$, Mann Whitney U-test). The average size of lobsters caught by LTV (76.3 ± 1.2 mm CL) was also similar to that of lobsters caught in control traps (75.2 ± 0.7 mm CL). (All variation is reported as standard error (SE) throughout the results.)

Although the behaviour and ecology of lobsters may be different in rocky and sandy habitats, we found that between June and September they differed little in catch per unit effort (2.5 ± 0.65 on sand; 2.2 ± 0.82 on rock) or entries per hour (2.0 ± 0.86 on sand; 2.4 ± 0.67 on rock). The data used for comparison were obtained from five deployments of LTV at the rocky site paired with five deployments of LTV at the sandy site (a subset of the 13 deployments presented below) made within the same one-week period. Although these data are not definitive because of low sample sizes, they do suggest that traps in the sandy habitat at Wallis Sands fished similarly to those in more typical rocky habitats. All data presented below are from LTV deployments at the Wallis Sands location because the analyses of approaches and behavioural interactions were more reliable at the sandy site, where the visual contrast between lobsters and the substrate was much greater.

Trap dynamics

Approaches, entries, exits, and catch per hour from deployment to dusk on the first day were determined (n = 13) (Table 1, Figs 2 and 3). Analyses of these videotapes showed that a large number of lobsters approached the trap, but of these only 4% entered (n = 331). Of those entering the trap, only 6% were captured, whereas 94% escaped. Of those escaping (n = 310), 72% escaped from the kitchen, and 28% escaped from the parlour. Lobsters can escape from the parlour back into the kitchen and then out of the trap, but they did so infrequently. Although most of the lobsters observed were estimated to be of sublegal size (<83 mm CL) and could readily escape from the parlour through the entrances and escape vents, even larger, legal-sized lobsters often escaped from the traps through the entrances. For example on 6 August 1997, 5 of the 7 large lobsters observed entering the trap (mean size 86.9 ± 3.9 mm CL, range 80–93) escaped. Of the small lobsters observed entering the trap (mean size 62.8 ± 1.6 mm CL, range 34–79, n = 38) all but three escaped before the end of the observation period (12 h). (See also Watson 2001).

Immediately after entering the trap, most lobsters began feeding and spent an average of 9 min 50 s (± 4 min 8 s) in the kitchen (Fig. 3). Lobsters that did not escape through the entrances but entered the parlour section of the trap spent an average of 18 min 8 s (± 13 min 11 s) in the parlour (this group does not include large lobsters that were ultimately captured when the trap was hauled because these individuals were in the trap for several hours) (Fig. 3*B*).

One of the most striking and consistent observations was that the number of approaches by lobsters to a trap greatly

Table 1. Lobster trap dynamics summary.

Numbers of approaches, entries, escapes, and catches were determined for the duration of a given deployment of the LTV. Only data taken between deployment and dusk of the first day are included ($n = 13$). # caught: refers to the number of lobsters present in the trap at the end of the last hour of the observation time, not necessarily when the traps were hauled. These data provide the basis for the trap dynamics diagram shown in Fig. 3

Date	Observation time (h)	# approaches	# entries	# escapes, kitchen	# escapes, parlour	# caught
6 Aug 97	12	3058	45	23	17	5
3 July 98	11	45	2	1	1	0
25 Sept 98	9	1603	43	37	5	1
21 June 99	10	11	7	6	1	0
7 July 99	10	122	10	7	2	1
15 July 99	5	253	4	2	2	0
9 Aug 99	8	503	38	25	10	3
12 Aug 99	10	256	34	21	11	2
17 Aug 99	7	246	28	21	5	2
24 Aug 99	10	705	47	32	11	4
13 Sept 99	7	237	18	8	9	1
10 July 00	8	284	3	3	0	0
25 July 00	7	699	52	35	15	2
Totals	114	8023	331	221	89	21

exceeded the number of lobsters entering it (Table 1, Figs 2 and 3). This approach behaviour began very shortly after the trap was deployed. Because of the difficulties in accurately quantifying the number of individual lobsters that approach a trap, the relationship between approach to the trap and catch remains unclear.

Temporal variability in catch

Red lights were used on four LTV deployments to illuminate the inside of the trap, making it possible to compare rate of entry during the night (56 h of videotape) and the day (33 h of video tape). Although lobsters are generally considered nocturnal (Cobb 1971; Stewart 1972; Reynolds and Casterlin 1979; Cooper and Uzman 1980; Lawton 1987; Karnofsky *et al*. 1989; Lawton and Lavalli 1995; Jury 1999), we observed no significant difference between the rate of entries during the day and that during the night ($p > 0.05$, Mann Whitney U-test). An average of 3.3 ± 1.3 entries/h occurred in the daytime and 2.5 ± 1.1 entries/h at night (Fig. 4). These data suggest that, although lobsters may be more active at night and may even approach the trap more frequently, they do not enter the trap at a higher rate at night.

Comparison of entries per hour between deployment and dusk ($n = 13$) with entries per hour between dawn and recovery ($n = 13$) revealed no statistically significant difference in rate of entry ($p > 0.5$, paired t-test) between successive periods. On average 1.8 ± 0.5 lobsters entered the trap each hour during Day 1 and 1.7 ± 0.5 lobsters/h entered during Day 2. Entry rate during both periods closely matched exit rate in any given hour, and any small difference in rates resulted in changes in ultimate catch (Fig. 2).

Behavioural interactions

Entries into, and exits out of, the trap appeared to be strongly influenced by the length of time that lobsters fed on the bait as well as antagonistic interactions between lobsters in the kitchen and lobsters attempting to enter the trap. When the lobster entering was larger, it usually chased the smaller lobster out of the kitchen. If the lobster attempting to enter the trap was smaller, the lobster in the kitchen defended the bait and prevented it from entering. Lobsters in the kitchen eventually stopped feeding spontaneously when there were no lobsters in the trap. To quantify this observation, we determined from one videotape the numbers of half-entries and full entries into the kitchen when another lobster was already in the kitchen and when the kitchen was not occupied (see Watson 2001). The results show that, when the kitchen was occupied ($n = 222$ observations), 89% of lobsters displayed half-entries (i.e., began to enter and then retreated); while only 11% fully entered. When the kitchen was not occupied ($n = 39$ observations), 64% fully entered without hesitation, and only 36% displayed half-entries. The difference was statistically significant (Fisher's Exact Test, $p < 0.001$) and demonstrates the strong influence of conspecifics on entry rate.

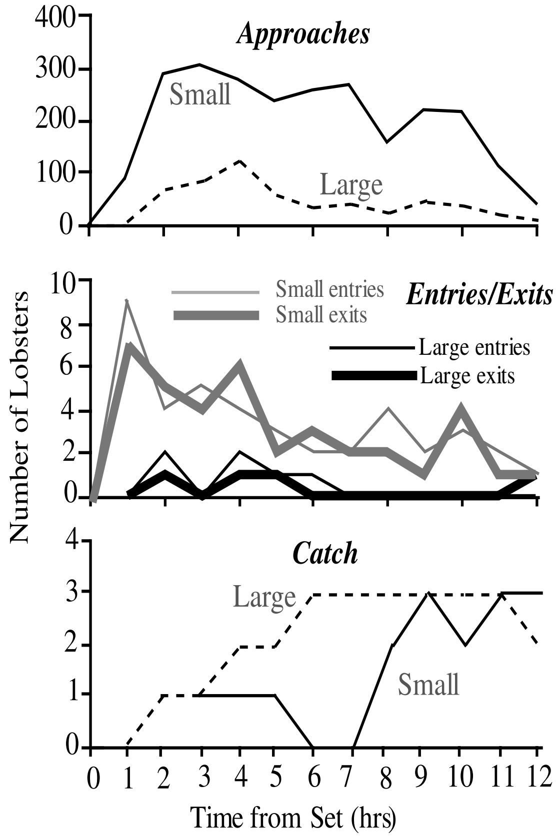

Fig. 2. Comparison of approaches, entries, exits, and total catch of large and small lobsters vs. time from one 12-h deployment of LTV on 6 August 1997. For this analysis large lobsters (≥80 mm carapace length) were considered to be 'catchable'. Small animals appeared to enter and exit the trap at approximately the same rate every hour, whereas large animals entered the trap and were usually retained. The retention of large lobsters and the differential between entries and exits each hour leads to the catch per hour seen in the bottom panel.

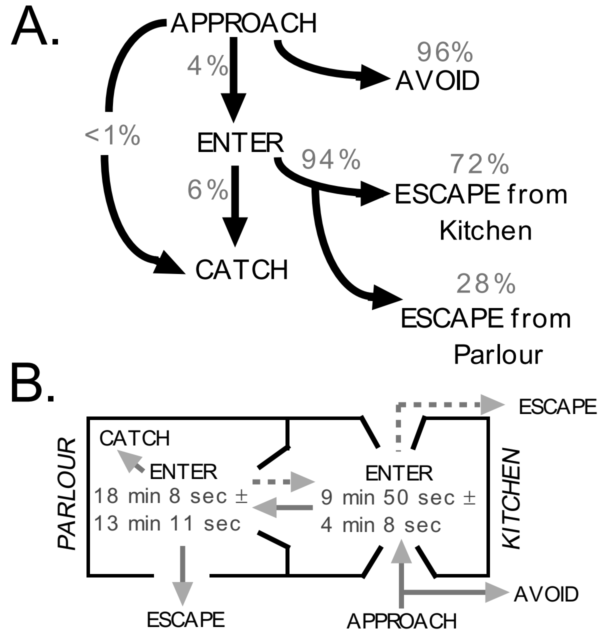

Fig. 3. Overview of LTV trap dynamics. A. Approaches, entries, escapes, and catch were determined for daytime observations with the LTV system (n = 13) (see Table 1). Many approaches were observed but were probably not unique individuals. B. Schematic of trap showing the time course of entry and escape. Lobsters generally enter the kitchen through one of two entrances, feed for a set amount of time (minutes and seconds ± SE) and then either escape or enter the parlour. They then remain in the parlour for some time (minutes and seconds ± SE) and then either escape or remain to be ultimately caught.

Discussion

We were surprised to discover that traps catch such a small percentage of the lobsters that approach and enter and how closely these data matched laboratory studies of trap dynamics (Karnofsky and Price 1989). In addition, our observations of the behavioural interactions between lobsters makes it clear that they play an extremely important role in determining the flow of lobsters through a trap and ultimately the catch. Although the present paper does not address questions of how lobster density influences these interactions and subsequent catch, it does provide the framework for further analyses (Watson and Jury in prep.).

Diver-held underwater video cameras, time-lapse video, and tethered ROVs have been used previously to observe lobster behaviour in the field (Auster 1985; Wahle and Steneck 1992; Barshaw and Spanier 1994; Burrows *et al.* 1994; Spanier *et al.* 1994), but few have systematically examined how lobsters interact with traps. In one study of *H. americanus*, a time-lapse camera and strobe system was used to study the effect of changing current velocities on foraging behaviour in a 0.5–m^2 area around bait staked to the bottom (Auster 1985). Frames were taken every minute for one 50-h deployment, but no lobsters or crabs were observed, and the bait was gone when the system was recovered. ROVs have been used to observe lobster behaviour in the field but the noise and possibly lights appeared to alter some lobster behaviours significantly (Spanier *et al.* 1994). Finally, a system similar to LTV was used to demonstrate that only 6% of Norway lobsters (*N. norvegicus*) observed near traps were actually caught (Bjordal 1986). The explanations put forth to explain this low catch rate included (1) temporal changes in feeding motivation (2) difficulty in locating trap entrances (3) frequent aggressive behaviours (small individuals were chased away by larger ones), and (4) failure by one third of the observed individuals to contact the trap at all. The data presented here are consistent with Bjordal's findings and provide additional insight into some of the mechanisms that may lead to low catch efficiency. In particular, aggressive interactions between lobsters appear to be one of the dominant factors limiting both rate of entry into traps and rate of exit from traps.

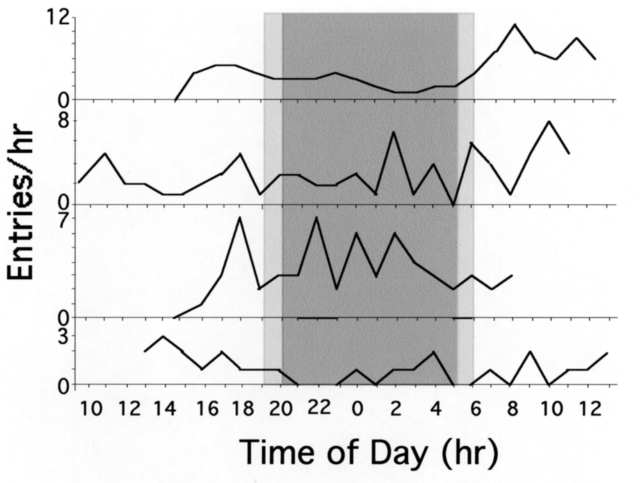

Fig. 4. Changes in the rate of entry of lobsters into a lobster trap during four deployments in August–September 1999. Entry data are presented from both daytime and night-time recordings from each deployment. The shaded area represents night-time observations. These data demonstrate that there is little diel change in entry rate.

One of the most striking and consistent observations was that the number of lobster approaches to a trap greatly exceeded the number of lobster entries into the trap (Table 1, Figs 2 and 3).). The disparity resulted, in part, because many individual lobsters appeared to stay in the vicinity of the trap and approached it many different times before entering, if they entered at all. SCUBA observations of LTV, as well as time-lapse observations of LTV by a separate camera mounted 2–3 m away, have confirmed these observations (unpublished data). Karnofsky and Price (1989), in their laboratory study, found similar results showing that individual lobsters that ultimately entered a trap approached their traps an average of 27 times (range = 0–54), whereas individuals that never entered a trap approached an average of 15 times (range = 1–50). Despite the large individual variability, Karnofsky and Price (1989) did find that 'large individuals which approached more tended to be caught more... although there were numerous exceptions'. If these numbers are also typical of field behaviours, then we can roughly estimate the number of individual lobsters approaching a trap in the present study by dividing observed approaches by a factor of 15–25. If this 'correction' factor is accurate, then the number of approaches by individual lobsters is fairly close to the number of entries (see Table 1) suggesting that a large proportion of the lobsters that are attracted to a trap will eventually enter.

Several studies have shown that lobsters are nocturnally active (Cobb 1971; Stewart 1972; Reynolds and Casterlin 1979; Cooper and Uzman 1980; Lawton 1987; Karnofsky *et al*. 1989; Lawton and Lavalli 1995; Jury 1999), and it is often suggested that they are therefore more likely to be captured at night. However, recent recordings from the feeding muscles of blue crabs (*Callinectes sapidus*), also generally considered a nocturnal forager, indicate that they feed throughout the day (Wolcott and Hines 1989). A study on the crab *Scylla serrata* also showed no evidence to support the long-standing belief that night catches are higher than day catches (Robertson 1989). The results of the present study suggest that entry rate of *H. americanus* into traps does not significantly increase at night. In a separate set of trap studies, we also found very little difference in catch per unit effort between traps deployed for 12 h during daytime and traps deployed for 12 h at night (Watson, unpublished data). Therefore, even though laboratory studies and field observations indicate that the American lobster is generally nocturnal, the relationship of catch to diurnal and nocturnal activity is unclear (Karnofsky and Price 1989). We suggest that, even though lobsters may be more active and approach traps more often at night, entry rate and subsequent catch are limited by competitive interactions. Thus differences between daytime and night-time activity are not generally reflected in catch data.

The likelihood that a lobster will enter a trap and be captured appears to depend on several factors, including the number of individuals already in the trap (saturation effect), moult stage, reproductive condition, size, sex, satiation, predator density, habitat type, water temperature, season, and time of day (Ennis 1973; McCleese 1974; Miller 1978, 1979a, 1979b, 1980, 1983, 1989, 1990, 1995; Richards *et al*. 1983; Smith and Jameison 1985; Krouse 1989; Robertson 1989; Miller and Addison 1995; Tremblay 2000). Many of these factors may influence the tendency of lobsters to approach a trap, but the likelihood that a lobster will find a given trap may also depend on the density of lobsters in the area, the area fished by the trap, the density of traps being fished, or the foraging area of individuals (Jernakoff and Phillips 1988; Skajaa *et al*. 1998; Watson and Jury in prep.). Our data suggest that, once lobsters have approached a trap, the likelihood that they will enter and be captured is strikingly low. Karnofsky and Price's (1989) laboratory study of *H. americanus* supports this finding. They found that only 2% of approaches led to capture, and of those that entered the trap only 11% were captured. In addition only 37% of the population tested (n = 30) in their study were ever captured in *any* trial (103 h total observation time), and 43% of the lobsters that approached never even entered a trap. These results suggest a high degree of individual variability in the behavioural response to traps.

On the basis of our behavioural observations we hypothesize that the agonistic interactions between conspecifics are the single most important factor influencing rate of entry and catch (see Watson 2001). In particular, interactions between lobsters in the kitchen and those attempting to enter strongly limit the rate of entry. Additional competition outside the trap may also play an important role because lobsters, and sometimes crabs, appear to compete aggressively for the opportunity to be the next individual to enter the trap. Lobsters in the parlour may influence the entry of additional individuals into the trap, but we have yet to address this question quantitatively. Richards *et al.* (1983) reached that conclusion after prestocking the parlours of single-parlour traps without escape vents with 3 to 8 large lobsters and examining subsequent catch. They found that the presence of lobsters in a trap reduced the catch of other lobsters, probably because of some type of interaction between the lobsters in the trap and those outside. The present study, taken together with the aforementioned laboratory and field data, suggests that lobster behaviour in and around traps leads to the phenomenon of trap saturation. As a result, traps are not very efficient, and the probability that catch directly reflects the true population density on the bottom is low.

Several recent papers have described models designed to predict the dynamics of how traps function to catch lobsters (Addison and Bell 1997; Fogarty and Addison 1997; Addison and Bannister 1998). These models incorporate behavioural parameters to allow prediction of catch over various deployment times and simulated densities of lobsters, but the dearth of *in situ* empirical data on these behaviours has necessitated numerous assumptions to make the models work. One goal of the LTV studies is to provide some of the necessary empirical data for models such as these and to develop a revised model to describe the various processes that dictate the dynamics of lobster movements into and out of traps. Finally we are working toward moving from the individual-trap level to the fishery level in order to determine how the density of lobsters is related to entry and escape processes and to determine how these processes are related to catch per unit effort in the field (Watson and Jury, in prep.).

Acknowledgments

We thank the University of New Hampshire Ocean Projects students who developed and tested the initial LTV prototype. Dan Eves provided all drawings, and Bob Champlain constructed many underwater housings and specialty fittings throughout the development phase of the technology. In addition, we acknowledge Noel Carlson and Liz Kintzing for diving assistance and Dave Koortis, Sue Krull, Gary Smith, Suzanne Watson, Briana Calore, Jen Wishinski, Adrienne O'Connor, and many others for analysing hours of videotapes. This study was funded by New Hampshire Sea Grant (W.W., H.H., and S.J.) and the University of New Hampshire Center for Marine Biology grants (S.J.). Support for data analysis and preparation of this manuscript was provided through a University of New Hampshire Dissertation Fellowship to S.J. This is contribution No. 372 from the Center for Marine Biology/ Jackson Estuarine Laboratory series.

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